ABSTRACT

ALLEN, RONALD MAURICE. Performance Measurement of Textile and Apparel Supply Chains in Developing Countries. (Under the direction of William Oxenham and George Hodge).

This research examined performance measurement of textile and apparel supply chains in developing countries. The research utilized a two-phase, mixed methods research design. The first phase consisted of field research on the Sri Lankan textile and apparel industry. The second phase collected quantitative data using online surveys and qualitative data using phone interviews.

Results indicate that developed and developing countries differ with respect to performance measurement of textile and apparel supply chains. Companies in developed countries are more likely to have a performance measurement system, whereas companies in developing countries are more likely to not have such a system. In addition, results indicate differences between smaller and larger companies.

This research defines companies as developing or developed based on location, size, company function, level of sophistication, value-adding activities, and performance measurement. Results from both phases of the research have been utilized to develop a model of performance measurement specific to the textile and apparel industry.

Performance Measurement of Textile and Apparel Supply Chains in Developing Countries

by
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BIOGRAPHY

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ACKNOWLEDGEMENTS

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1   INTRODUCTION

Trade agreements and the phase out of quotas due to the WTO have caused a dramatic increase in global sourcing over the past decade. Textile and apparel products are being produced in developing countries, sometimes thousands of miles away from the point of consumption – developed countries. During this same period, the concept of supply chain management has gained wide acceptance. Companies are cooperatively working to increase competitiveness, and gauging the performance of supply chains has become increasingly more important. In order for a supply chain to succeed, companies should measure the performance of the chain and identify areas of improvement for increased competitiveness.

The main research question for this study was "How can textile and apparel companies increase economic competitiveness?" One way that companies are achieving this is through supply chain management. In order to gauge the effectiveness of supply chain management efforts, companies utilize performance measurement systems. When looking at the textile and apparel supply chain, more of the upstream portion (closer to raw materials) is located in developing countries. Efforts to improve supply chain performance by these upstream companies should be based on the expectations of their downstream supply chain members – apparel marketers and retailers. As an example, the Sri Lankan textile and apparel industry is currently trying to improve productivity (Joint Apparel, 2007). However, are their customers interested in performance in this area? Or are they more interested in improved innovation, quality, or cycle time? The visual depiction of the research question is shown as Figure 1.1.

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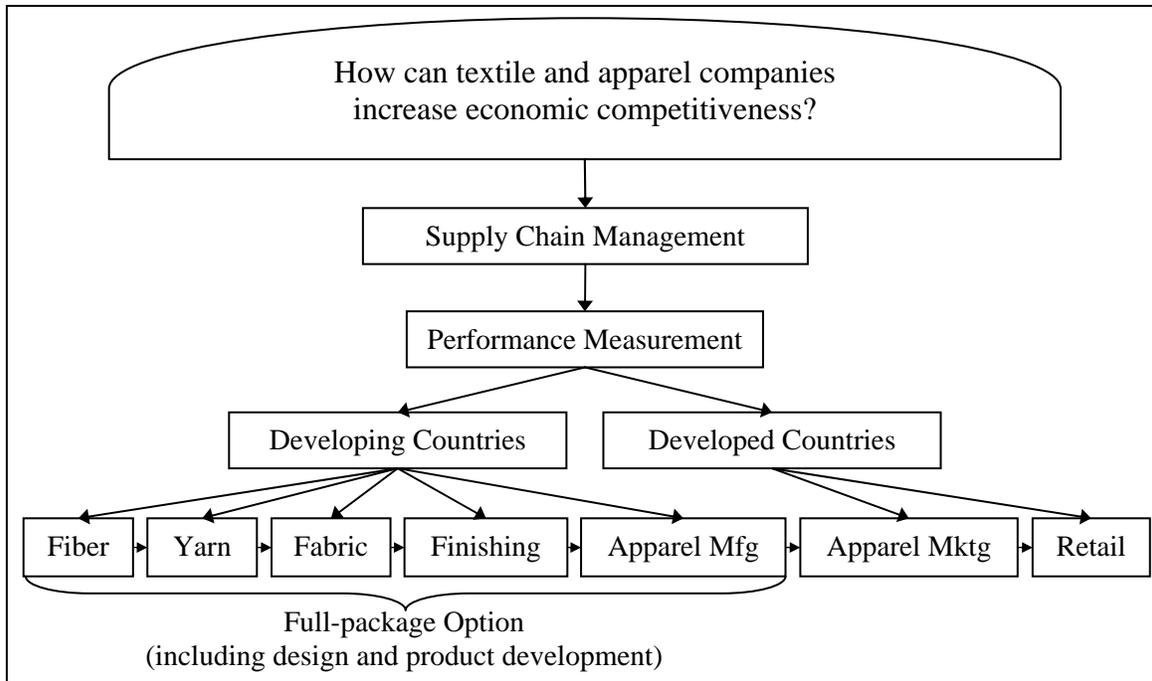
Figure 1.1: Visual depiction of the research question

1.1   Objectives of the Research

The objectives of this research were to:

RO1: Identify the measures used by textile and apparel companies to gauge the

performance of their supply chains in:

RO1A: Developing countries;

RO1B: Developed countries.

RO2: Develop a practical definition of supply chain management in developing and

developed countries.

RO3: Evaluate the efforts of companies in developing countries to improve performance.

RO4: Construct a model of performance measurement specific to textiles and apparel.

1.2   Purpose of the Research

This research investigated performance measurement for supply chains in developing and developed countries. It identified specific measures that textile and apparel companies use to gauge the performance of their supply chains. The research developed a practical definition of supply chain management in developing countries. In addition, downstream companies in developed countries were interviewed to discover metrics used to measure supply chain performance. Also, this research evaluated performance improvement efforts of textile and apparel manufacturers in developing countries.

1.3   Significance of Study

This research was significant for several reasons. First, it examined performance measurement specific to textiles and apparel for companies in developed and developing countries. Secondly, the sample for the research was global in nature, and contained respondents from Asia, Latin America, the United States, and Europe.

Thirdly, this research contributed to the field of knowledge by developing a model of performance measurement in developed and developing countries specific to the textile and apparel industry. The model includes specific supplier, internal, and supply chain performance measures by country type. Companies are able to use this model as a basis for benchmarking. The model will also aid future textile and apparel researchers as a framework for studying performance improvement and supply chain management in developing

countries. Lastly, this research utilized a mixed methods research design, with field research, internet surveys, and phone interviews. This mixing of different methods allowed for broad results with depth in certain areas.

2   REVIEW OF LITERATURE

2.1   Supply Chain Management

According to Beamon (1999), "a supply chain is an integrated process wherein raw materials are manufactured into final products, then delivered to customers (via distribution, retail, or both)." The supply chain includes all activities in the flow and conversion of goods from raw material to final consumer (Handfield & Nichols, 1999). A typical supply chain is shown in Figure 2.1.
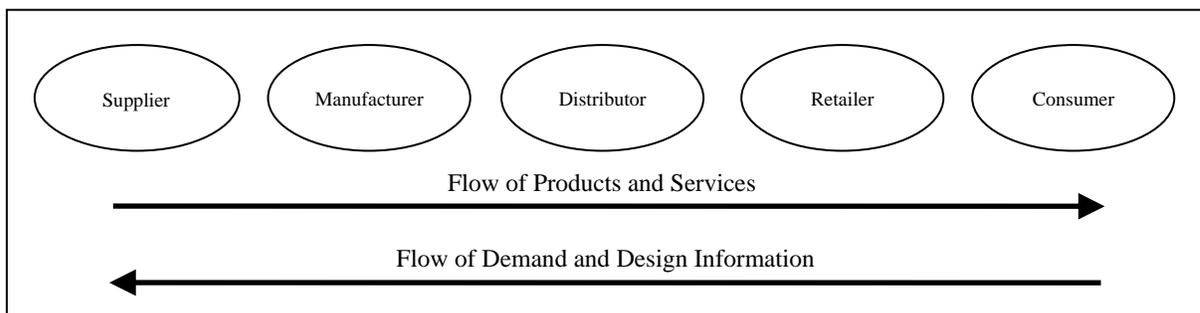
Figure 2.1: Typical supply chain

Source: Midha, V.K., Mathur, G. & Sharma, C. (2007). Supply chain management in the textile industry. *Textile Asia*, September 2007, 65-66.

Some supply chain models omit the customer, arguing that the customer does not add value. However, customers do add value by providing feedback to the supply chain about quality, cost, delivery, and other measures. It is important for supply chain members to understand the needs of their customers in order to provide value-added features.

The concept of supply chain management is defined as "the systemic, strategic coordination or the traditional business functions within a particular company or across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Mentzer et al., 2001; Mentzer, Myers, & Stank, 2007). It includes all activities from concept to consumer. According to Handfield and Nichols (1999), supply chain management – the integration of all the activities in producing a product – is used to create a competitive advantage by strengthening relationships among supply chain members.

A theoretical framework for research in supply chain management is shown in Figure 2.2 (Chen & Paulraj, 2004). Chen and Paulraj (2004) reviewed more than 400 articles dealing with supply chain management in terms of purchasing and supply, logistics and transportation, marketing, organizational behavior, network, strategic management, management information system, and operations management. From the literature, the theoretical framework was developed.
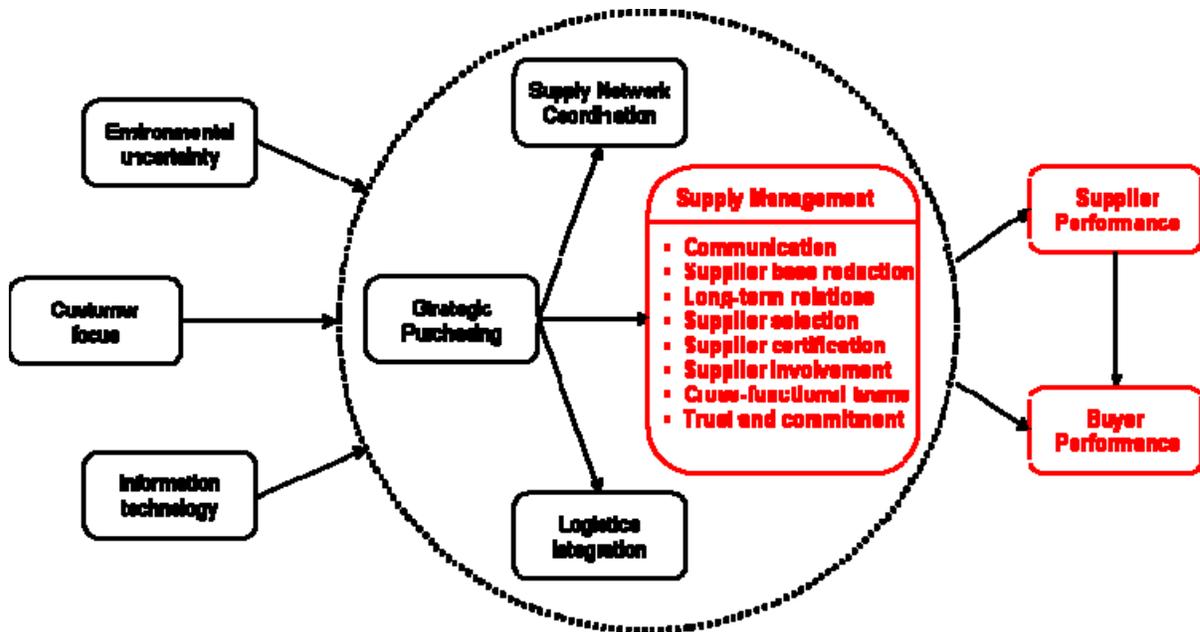
Figure 2.2: Theoretical framework for supply chain management research

Source: Adapted from Chen, I.J. & Paulraj, A. (2004). Understanding supply chain management: Critical research and a theoretical framework. *International Journal of Production Research, 42*(1), 131-163.

Since this research concerns performance measurement in supply chain management, Figure 2.2 has been adapted to show the components of the model that are affected by performance measurement. The obvious components, supplier performance and buyer performance, deal directly with the upstream and downstream portions of the supply chain. The middle portion, supply management, addresses concerns of a company (internally) that are affected by performance of the entire supply chain (See Chen & Paulraj, 2004, section 4.3, p. 150 for a description of the relation of supply management and performance).

2.2   Performance Measurement

As noted in Beamon (1999), cost was the basis of performance measures in many supply chain models from the mid-1980's to the mid-1990's. According to a KSA report (1996; 1998), performance measurement in SMEs was focused on benchmarks of financial measures (As cited in Cooper, Rayson, Botchway, & McCafferty, 2005). Though cost is an important measure in determining performance, it should not be the sole performance measure. For example, a company could be operating at minimum cost; however, material utilization, productivity, lead time, or customer satisfaction could be lacking.

By the early 1990's, it was recognized that traditional financial measures such as return on investment (ROI) could misinform continuous improvement and innovation efforts (Kaplan & Norton, 1992). Also, financial performance measures have been criticized because of "their backward looking focus and their inability to reflect contemporary value-creating actions" (Kaplan & Norton, 1992). As a result, researchers in the 1990's began investigating performance measurement systems utilizing cost and customer responsiveness (Beamon, 1999). Researchers have since acknowledged problems with purely financial performance measurement and developed measurement systems that account for non-financial measures, such as time and capacity utilization, in addition to incorporating qualitative measures, such as customer satisfaction, information flow, supplier performance, and risk management (Beamon, 1999).

Performance measurement systems involve the methods used to gauge the performance of a supply chain. Beamon (1996 as cited in Beamon, 1999) states characteristics of performance measurement systems: inclusiveness (all relevant information is measured), universality (differing conditions can be compared), measurability (data can be measured), and consistency (measures are consistent with organizational goals). These characteristics can be used as a starting point for analyzing performance measurement systems. Research in performance measurement systems involves identifying performance measures, grouping these measures, and developing frameworks for performance measurement systems.

Alfaro, Ortiz, and Poler (2007) have identified the requirements of performance measurement systems (Table 2.1). The authors (Alfaro et al., 2007) considered various systems, including the balanced scorecard of Kaplan and Norton (discussed in detail later in this paper). From this table, we can observe that the requirements of measurement systems are many, and include fulfillment of stakeholders concerns, facilitation of strategy concerns, and mixing quantitative and qualitative measures.

Table 2.1: Performance measurement systems requirements analysis

PMS requirement	BSC	PRISM	IDPMS	DPMSM	PMS IE-GIP
Reflects stakeholders requirements	**	***	*	*	***
Reflects external/competitive position	*	*	*	**	*
Reflects competitive criteria	***	***	**	***	***
Differentiates between control and improvement measures	*	*	**	***	**
Facilitates strategy development	*	**	**	*	***
Deploys strategic objectives	***	**	**	**	***
Objective deployed to business processes and activities	**	***	*	***	***
Focuses of critical areas of the business	*	***	***	**	***
Facilitates resource bargaining	*	***	***	**	***
Facilitates performance planning	***	***	***	***	***
Focuses of leading measures as well as lagging measures	***	***	***	***	**
Accommodates both quantitative and qualitative measures	***	***	***	***	***
Measures organizational capability and learning where appropriate	***	***	**	**	***
Uses measures at correct levels	*	**	*	***	***
Promotes understanding of the relationships between measures	*	*	*	**	***
Facilitates simple reporting-demonstrating trends	***	**	**	**	***

*** High fulfillment of the requirements; ** medium; * low
BSC, balanced scorecard (Kaplan et al., 1996); PRISM, The performance prism (Neely et al., 2001); IDPMS, integrated dynamic performance measurement systems (Ghalayini et al., 1997); DPMSM, dynamic performance measurement system model (Bititci et al., 1999); PMS IE-GIP, performance measurement system IE-GIP (Alfaro et al., 2003).

In certain developing countries, such as India, performance improvement efforts are being concentrated on improving productivity (Bheda, 2002; Bheda, 2003). Also, the Joint Apparel Association Forum (JAAF), an industrial association in Sri Lanka, has undertaken a productivity improvement program to increase process efficiency (Joint Apparel Association Forum, 2007). However, instead of simply improving productivity, companies should understand the basis of performance measurement in their supply chain and improve their operations to meet the terms of performance of their suppliers and customers. This idea is illustrated by the Triple P-model (Figure 2.3). Here one can see that performance is constructed of profitability and productivity, and includes attributes of quality, delivery, speed, flexibility, and price recovery.
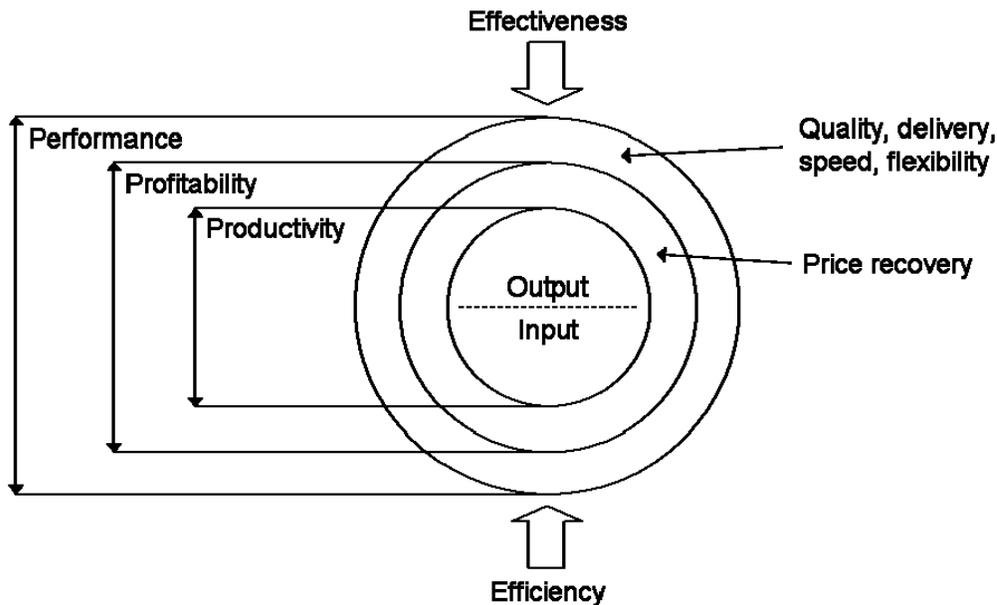
Figure 2.3: Triple P-model

Source: Tangen, S. (2002). Understanding the concept of productivity. Proceedings of the Asia Pacific Industrial Engineering and Management Systems Conference (APIEMS 2002), Taipei.

Gunasekaran and Kobu (2007) have performed an excellent review of performance measurement. Table 2.2 provides an overview of the key literature in performance measurement. From this list one can see that there have been varied attempts at identifying and categorizing performance measures. Researchers have identified measures as financial or non-financial, quantitative or qualitative, and function-based or value-based. Other researchers have attempted to categorize measures according to different perspectives, both internal and external. Attempts have been made to classify measures according by process, by metric required, or by planning level. Table 2.2 also serves as a starting point for the organization of the initial discussion herein on performance measurement. Following is a

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discussion of various perspectives of performance measurement systems (balanced scorecard, component, planning level, and supply chain process), efforts to combine these perspectives, and efforts to classify vast amounts of performance measures. Lastly, performance measurement specific to textile and apparel supply chains is discussed.

Table 2.2: Categories of performance measurement in logistics and SC systems

Source: Adapted from Gunasekaran, A. & Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: A review of recent literature (1995-2004) for research and applications. *International Journal of Production Research, 45*(12), 2819-2840.

Key references	Criteria	Details
Kaplan & Norton (1997)[a]	Balanced score card perspective	• Financial • Internal process • Innovation and improvement • Customers
Beamon (1999)	Components of performance measures	• Time[b] • Resource Utilization • Output • Flexibility
Gunasekaran et al. (2001)	Location of measure in supply chain links	• Planning and Product Design • Supplier • Production • Delivery • Customer
Gunasekaran et al. (2001)	Decision-making levels	• Strategic • Tactical • Operational
Financial base (De Toni & Tonchia 2001)	Nature of measures	• Financial • Non-financial
Gunasekaran et al. (2001)	Measurement base	• Quantitative • Non-quantitative
Bagchi (1996)	Traditional vs. modern measures	• Function-based • Value-based

Notes: [a] Gunasekaran & Kobu, 2007 (secondary source) cited Kaplan & Norton, 1997. The citation should read Kaplan & Norton, 1996a. [b] Beamon, 1999 (primary source) did not list time as one of the three main components of performance measurement systems.

2.2.1 Balanced Scorecard

Since financial measures alone are not indicators of performance, some researchers have proposed measurement models that contain measures from a variety of sources. Kaplan and Norton (1992) proposed a balanced scorecard (BSC) as a way to evaluate performance from four perspectives: financial, internal business process, customer, and learning and growth. A BSC, Figure 2.4, is used to answer key questions about a business: 1) How do customers see us? (customer perspective), 2) What must we excel at? (internal perspective), 3) Can we continue to improve and create value (innovation and learning perspective), and 4) How do we look to shareholders? (financial perspective) (Kaplan & Norton, 1992).
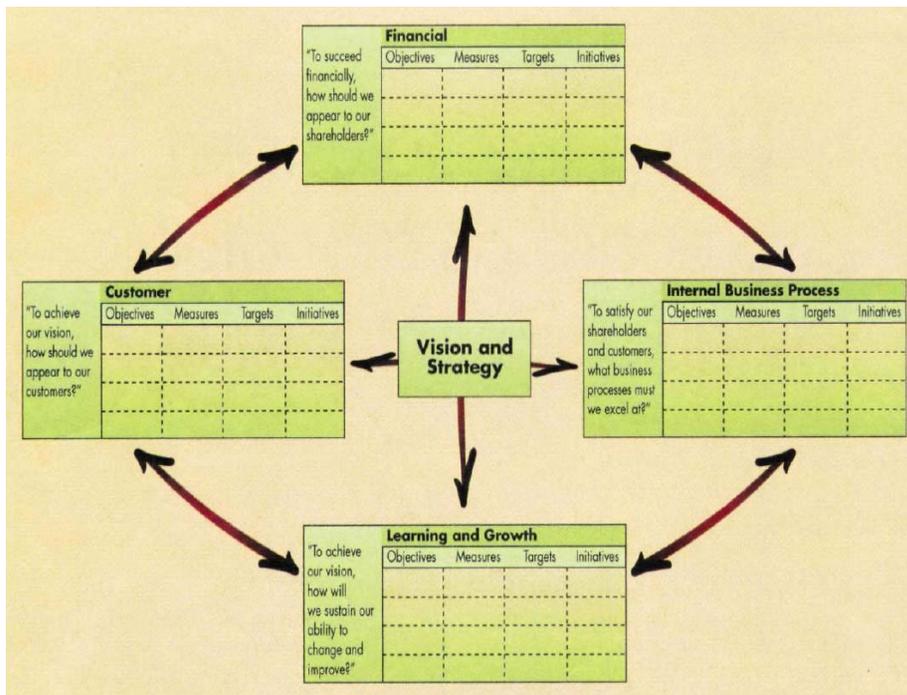
Figure 2.4: Balanced scorecard

Source: Kaplan, R.S. & Norton, D.P. (1996b). Using the balanced scorecard as a strategic management system. *Harvard Business Review, 74*(1), 75-87.

Since the initial publication of the balanced scorecard (Kaplan & Norton, 1992), the researchers released an updated version of the scorecard in 1996 (Figure 2.4). The scorecard (Kaplan & Norton, 1996) was updated to relate long-term strategy with short-term actions. In this way, the view of financial performance is balanced with performance in other areas (e.g., customers, innovation and learning), and performance is linked to strategy. Kaplan and Norton (1996) claim that balanced scorecards can be used to communicate strategic vision across an organization.

One important feature of the BSC is the combining of several company goals such as improving customer relations, shortening lead times, and improving quality. Another feature is that the BSC aids in avoiding suboptimization; that is, the BSC can be used to see the effect of improvement in one area on the performance of another area. Kaplan and Norton (1996) claim that the BSC focuses on strategy and vision, not control, and is therefore suited to dynamic business environments. The BSC provides goals for employees to improve performance; however, it is up to the individual to determine actions to meet the goals.

2.2.1.1 Components of the Balanced Scorecard

The customer perspective focuses on time, quality, performance and service, and cost. Lead time is critical in ensuring that customers have products at the right time. Lead time for new products takes into account the time from product development to shipment of products; for new products, the lead time is a measure of order taking, scheduling, and manufacturing.

Quality measures focus on customer-accepted defect levels. It is critical to consider the requirements of a customer in terms of quality. If a company delivers a quality level that is far above what their customers expect, then resources are being misused. Performance and service measures are used in conjunction to create value for the consumer. Cost has to be carefully considered, and companies should fully understand their customers. Price of products is only one component of cost; others include cost of returns, reworks, and lost time from quality/delivery issues.

The expectations of customers should be used to determine what companies should do internally to satisfy customers. Measures for the internal business perspective should therefore be developed from business processes that affect customer satisfaction, such as cycle time, quality, employee skills, and productivity (Kaplan & Norton, 1992). In addition, companies should identify and measure core competencies. Overall measures should be deconstructed to measures that can be applied at the factory and individual level in order to meet corporate objectives.

The innovation and learning perspective is used to measure a company's ability to innovate, improve, and learn. With business paradigms shifting due to increases in competition and technology, trade dynamics, and environmental concerns, companies should continually improve products and processes to remain economically competitive. At Milliken & Co, managers were required, under the "ten-four" improvement program, to reduce measures of

process defects, missed deliveries, and scrap by a factor of ten over four years (Kaplan & Norton, 1992).

Typical financial performance measures concern profitability, growth, and shareholder value (Kaplan & Norton, 1992). In the balanced scorecard approach, financial measures are used as a check for corporate strategy. For example, quality improvement efforts may not necessarily result in increased sales and market share, and strategic goals may need to be refined in order to focus on improvement in other areas in order to realize financial gains.

2.2.2   Component Perspective

Beamon (1999) is often cited in the performance measurement literature. She (1999) argues that any performance measurement system should consist of at least one measure in each of three categories: 1) resources, 2) output, and 3) flexibility (Figure 2.5). These three types of measures work in conjunction to provide a picture of performance in terms of efficiency, customer service, and adaptability.
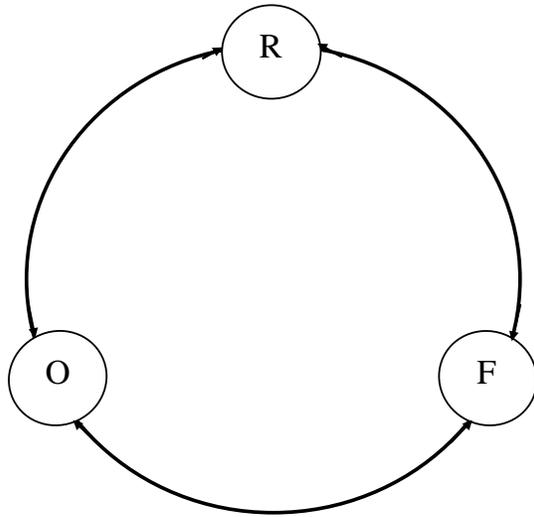
Figure 2.5: The supply chain measurement system

Resources are measured based on minimum quantities required or an efficiency measure and include inventory levels, personnel requirements, equipment utilization, energy usage, and cost (Beamon, 1999). Output measures are specified in terms on minimum outputs and include lead time, quality, customer satisfaction, and number of products produced. Flexibility is the ability to adapt to changes in demand volume or scheduling, and it differs from output or resource measures because it is a "measure of potential" (Beamon, 1999, p. 285). Flexibility includes volume flexibility, delivery flexibility, mix flexibility, and new product flexibility. The goals and purposes of performance measure types are shown in Table 2.3.

Table 2.3: Goals of performance measure types

Performance measure type	Goal	Purpose
Resources	High level of efficiency	Efficient resource management is critical to profitability
Output	High level of customer service	Without acceptable output, customers will turn to other supply chains
Flexibility	Ability to respond to a changing environment	In an uncertain environment, supply chains must be able to respond to change

A performance measurement system based on a single performance measure is limited because it ignores interactions that could influence performance. Beamon (1999) provides examples of each type of performance measures (Table 2.4).

Table 2.4: Examples performance measures

Source: Adapted from Beamon, B.M. (1999). Measuring supply chain performance. *International Journal of Operations and Production Management, 19*(3), 275-292.

Resources	Output	Flexibility
Total cost	Sales	Volume flexibility
Distribution costs	Profits	Delivery flexibility
Manufacturing cost	Fill rate	Mix flexibility
	• Target fill rate achievement	
	• Average item fill rate	
Inventory	On-time deliveries	New product flexibility
• Inventory investment	• Product lateness	
• Inventory obsolescence	• Average lateness of orders	
• Work in-process	• Average earliness of orders	
• Finished goods	• Percent on-time deliveries	
Return on investment	Backorder/stockout	
	• Stockout probability	
	• Number of backorders	
	• Number of stockouts	
	• Average backorder level	
	Customer response time	
	Manufacturing lead time	
	Shipping errors	
	Customer complaints	

In terms of resources, total cost shows the total cost of resources used. Distribution costs include transportation and handling costs. Manufacturing cost reflects the total cost to produce a product, including labor, maintenance, and re-work costs. Inventory costs include the investment values of inventory, costs of obsolete inventories, work-in-process inventories, and holding costs for finished goods inventory. The return on investment (ROI) is the ratio of net profit to total assets.

When looking at output measures, sales show the total revenue, while profits are sales less expenses. Fill rate includes the proportion of orders filled immediately, measured in terms of

meeting target fill rates or in terms of an average fill rate, based on the number of items. On-time deliveries measure item, order, or product delivery performance. Product lateness is the delivery date minus the due date, average lateness/earliness is determined by dividing total lateness/earliness divided by total number of orders, and percent on-time deliveries shows the percentage of orders delivered on or before the due date. The backorder/stockout metrics concern the probability that an item is out of stock, the number of backorders due to a stockout, the number of stockouts, and the number of backorders divided by the total number of items. Customer response time is the amount of time between ordering and delivery. Manufacturing lead time is simply the amount of time required to product a product. Shipping errors are concerned with the number of incorrect shipments. Customer complaints simply measure the number of complaints. Flexibility measures concern the ability to adapt to changes in output level (volume flexibility), planned delivery dates (delivery flexibility), and variety of products produced (mix flexibility). Also, new product flexibility measures "the ability to introduce and produce new products" and modify existing products (Beamon, 1999, p. 285).

2.2.3 Planning Level Perspective

Angerhofer and Angelides (2006) discuss levels of collaboration that could be undertaken in a supply chain: strategic, managerial, and operational (Figure 2.6). An example of collaboration at the operational level is transportation scheduling. By working with retailers, suppliers could improve delivery performance through sharing of stock levels. Collaboration

at the managerial level could result in better planning and increased forecast accuracy. At the strategic level, collaboration could result in capital investment to improve the supply chain.
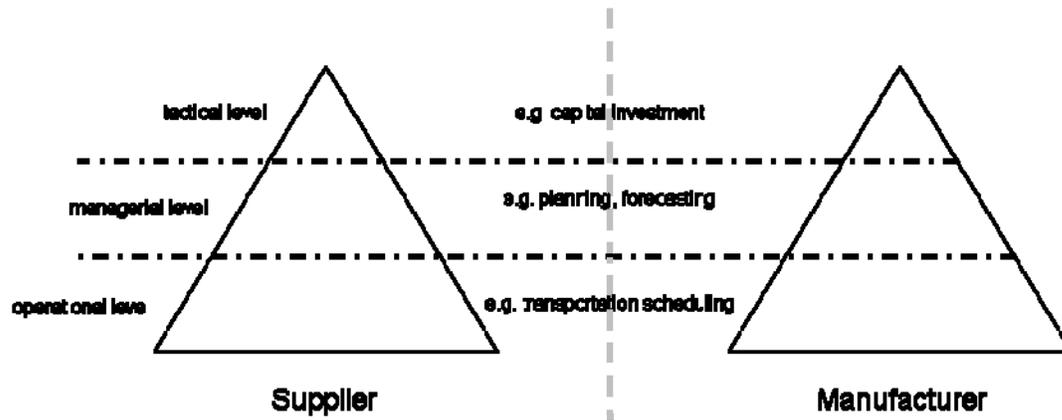
Figure 2.6: Levels of collaboration

Source: Angerhofer, B.J. & Angelides, M.C. (2006). A model and a performance measurement system for collaborative supply chains. *Decision Support Systems, 42*(1), 283-301.

Metrics for measuring performance support decision making at each of these levels. According to Gunasekaran, Patel, and Tirtiroglu (2001), there is not a clear distinction between tactical, operational, and strategic levels of metrics. Therefore, a performance measurement system should contain metrics from these three levels, referred to as planning levels (Gunasekaran et al., 2001). In addition, performance measures and metrics should be studied in the context of a balanced framework that contains an appropriate number of financial and non-financial measures (Gunasekaran et al., 2001). As a result, Gunasekaran et al. (2001) propose a performance measurement system, Table 2.5, which includes financial and non-financial metrics grouped by the three planning levels.

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Table 2.5: A framework for performance metrics for supply chain evaluation

Source: Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management, 21*(1/2), 71-87, cited in Bhagwat, R. & Sharma, M.K. (2007). Performance measurement of supply chain management: A balanced scorecard approach. *Computers & Industrial Engineering, 53*(1), 43-62.

Level	Performance metric	Financial	Non-financial
Strategic	Total supply chain cycle time		✓
	Total cash flow time	a*	✓
	Customer query time	✓	✓
	Level of customer perceived value of product		✓
	Net profit vs. productivity ratio	✓	
	Rate of return on investment	✓	
	Range of products and services		✓
	Variations against budget	✓	
	Order lead time		✓
	Flexibility of service systems to meet particular customer needs		✓
	Buyer-supplier partnership level	✓	✓
	Supplier lead time against industry norms		✓
	Level of supplier's defect free deliveries		✓
	Delivery lead time		✓
	Delivery performance	✓	✓
Tactical	Accuracy of forecasting techniques		✓
	Product development cycle time		✓
	Order entry methods		✓
	Effectiveness of delivery invoice methods		✓
	Purchase order cycle time		✓
	Planned process cycle time		✓
	Effectiveness of master production schedule		✓
	Supplier assistance in solving technical problems		✓
	Supplier ability to respond to quality problems		✓
	Supplier cost saving initiatives	✓	
	Supplier's booking in procedures		✓
	Delivery reliability	✓	a*
	Responsiveness to urgent deliveries		✓
	Effectiveness of distribution planning schedule		✓
Operational	Cost per operation hour	✓	
	Information carrying cost	✓	✓
	Capacity utilization		✓
	Total inventory costs as:	a*	b*
	Incoming stock level		
	Work-in-progress		
	Scrap value		
	Finished goods in transit		
	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 goods		✓

* Notes: a) Included in Gunasekaran et al., 2001 (primary source) but not in Bhagwat & Sharma, 2007 (secondary source); b) Included in Bhagwat & Sharma, 2007 but not in Gunasekaran et al., 2001

Gunasekaran et al. (2001) also reviewed literature in the area of performance measurement systems and identified measures that were used as bases of research. These key measures, shown in Table 2.6, have been divided by planning level (strategic, operational, and tactical) and identified as financial or non-financial.

Table 2.6: A list of key SCM performance metrics

Source: Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management, 21*(1/2), 71-87, cited in Bhagwat, R. & Sharma, M.K. (2007). Performance measurement of supply chain management: A balanced scorecard approach. *Computers & Industrial Engineering, 53*(1), 43-62.

Level	Performance metric	Financial	Non-financial	References
Strategic	Total cash flow time		✓	Stewart (1995)
	Rate of return on investment	✓		Christopher (1992); Dobler & Burt (1996)
	Flexibility to meet particular customer needs		✓	Bower & Hout (1988); Christopher (1992)
	Delivery lead time		✓	Rushton & Oxley (1991); Christopher (1992)
	Total cycle time		✓	Christopher (1992); Stewart (1995)
	Buyer-supplier partnership level	✓	✓	Toni et al. (1994)
	Customer query time		✓	Mason-Jones & Towill (1997)
Tactical	Extent of cooperation to improve quality		✓	Graham et al. (1994)
	Total transportation costs		✓	Rushton & Oxley (1991)
	Truthfulness of demand predictability/forecasting methods		✓	Fisher (1997); Harrington (1996)
	Product development cycle time		✓	Bower & Hout (1988)
Operational	Manufacturing cost	✓		Wild (1995)
	Capacity utilization		✓	Stewart (1995)
	Information carrying cost	✓		Levy (1997); Lee & Billington (1992)
	Inventory carrying cost	✓		Stewart (1995); Dobler & Burt (1996); Slack et al. (1998); Pyke & Cohen (1994)

2.2.4   Supply Chain Sector Perspective

The Supply-Chain Operations Reference-model (SCOR), developed by the Supply-Chain Council, is a process reference model that serves as a diagnostic tool for supply chain management. In 1997, the Supply-Chain Council released the first version of the SCOR model. It included Plan, Make, Source, and Deliver as the stages of the supply chain in addition to metrics, best practices, and technology (Phelps, 2006). Version 4 was the first to include the Return stage of the supply chain. Currently, the SCOR model stretches from a company's supplier's supplier to a company's customer's customer, thereby encompassing all steps from concept of products to their final consumption (Figure 2.7).
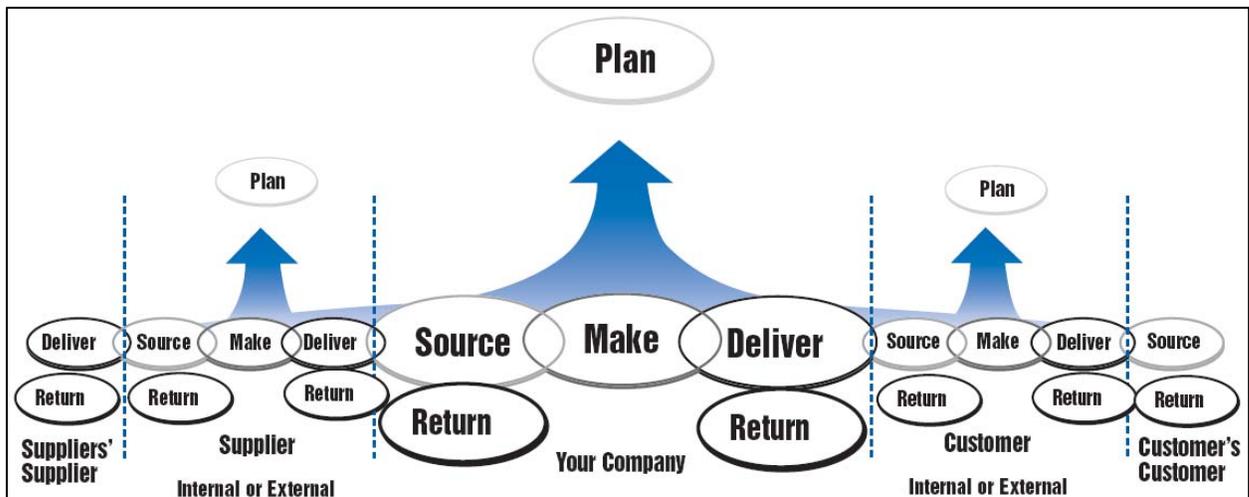
Figure 2.7: Interrelation of five key management processes of the SCOR model

Source: Supply-Chain Council (2006). Supply-chain operations reference-model. Retrieved from
http://www.supply-chain.org

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The SCOR model has been through several revisions. Phelps (2006) provides a timeline of revisions to the model, shown as Figure 2.7. The latest release of the SCOR model, version 8.0, was in 2006. The SCOR model provides a framework for business processes, metrics, best practices, and technology. The SCOR model covers four levels: top level (process types), configuration level (process categories), process element level (decompose processes), and implementation level (decompose process elements).
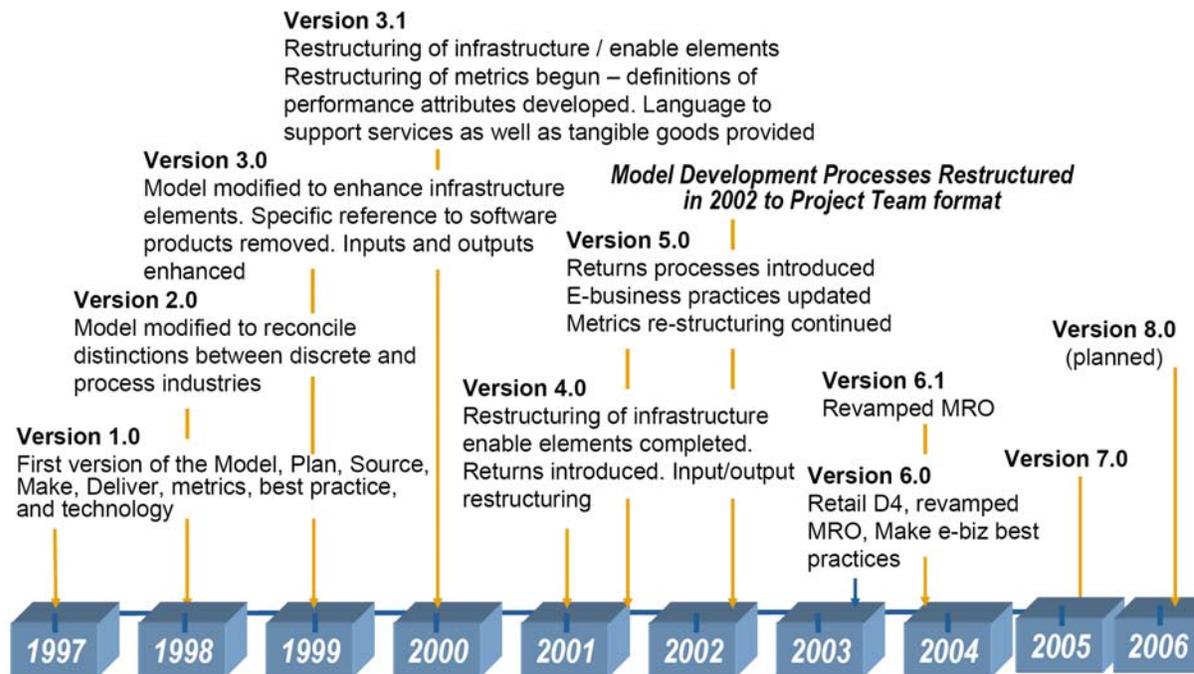
Figure 2.8: SCOR release timeline

Source: Phelps, T. (2006). SCOR and benefits of using process reference models. *Proceedings of the 2006 Supply Chain International Conference*, Taipei, Taiwan.

Performance metrics for the SCOR model, called Level 1 Metrics, are top level measures (Table 2.7). They can cross multiple SCOR top level processes (Plan, Source, Make, Deliver, and Return), though they "do not necessarily relate" to a top level process (Supply-Chain Council, 2006). The metrics as either customer-facing or internal-facing. Customer-facing metrics relate to reliability, responsiveness, or flexibility. Internal-facing metrics relate to either cost or assets. This system of cross-classification allows for visibility of the type of attribute and the metric that it affects.

Table 2.7: SCOR performance metrics

Source: Supply-Chain Council (2006). Supply-chain operations reference-model. Retrieved from http://www.supply-chain.org

Level 1 Metrics	Performance Attributes				
	Customer-Facing			Internal-Facing	
	Reliabilty	Responsiveness	Flexibility	Cost	Assets
Perfect Order Fulfillment	✔				
Order Fulfillment Cycle Time		✔			
Upside Supply Chain Flexibility			✔		
Upside Supply Chain Adaptability			✔		
Downside Supply Chain Adaptability			✔		
Supply Chain Management Cost				✔	
Cost of Goods Sold				✔	
Cash-to-Cash Cycle Time					✔
Return on Supply Chain Fixed Assets					✔
Return on Working Capital					✔

2.2.5 Combination Perspectives

Some researchers have addressed the issues of performance measurement by combining aspects of previous measurement systems. While most of these models have been developed

simply by combining various measurement systems and are therefore rearrangements of secondary data, a few researchers have validated their models through primary data.

2.2.5.1 Gunasekaran et al., 2001

In a similar fashion to the SCOR model, the performance measurement system developed by Gunasekaran et al. (2001) was depicted along all four sectors of an integrated supply chain: 1) plan, 2) source, 3) make/assemble, and 4) delivery/customer (Stewart, 1995). Figure 2.9 is a basic supply chain, with measures and metrics for each stage of the supply chain. Note that the last stage (delivery/customer) has been depicted graphically as two nodes – one for delivery performance and one for customer service and satisfaction.
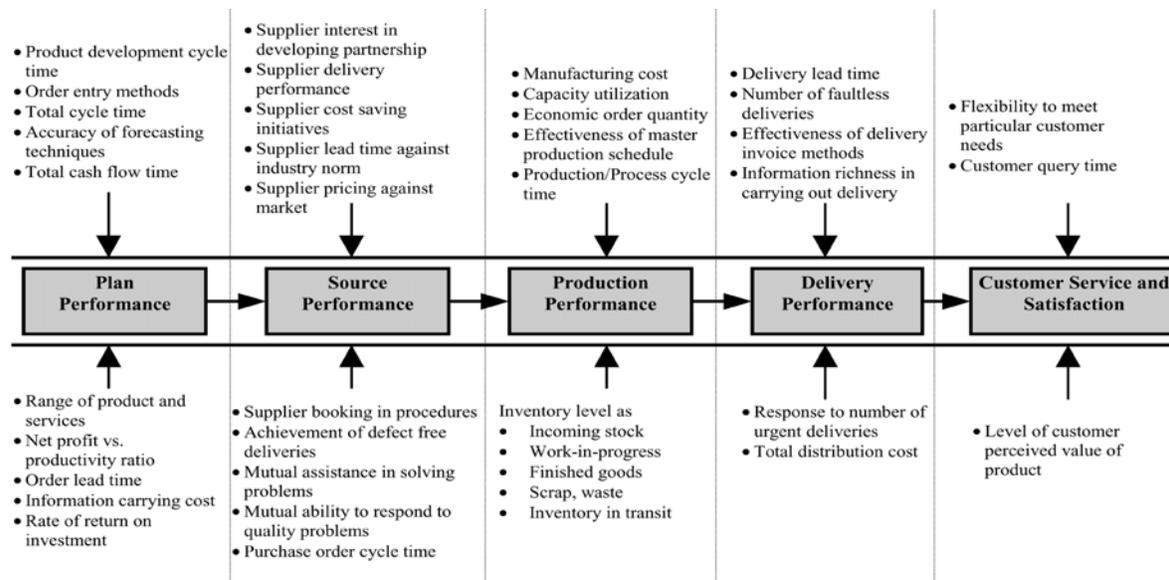
Figure 2.9: Measures and metrics for basic sections of a supply chain

Source: Gunasekaran, A., Patel, C., & Tirtiroglu, E. (2001). Performance measures and metrics in a supply chain environment. *International Journal of Operations & Production Management, 21*(1/2), 71-87.

2.2.5.2 Gunasekaran et al., 2004

Expanding on the work of Gunasekaran et al. (2001), Gunasekaran, Patel, and McGaughey (2004) surveyed 150 companies in various industries to assess the framework for performance metrics. Of these 150 companies, 21 surveys were returned – a 12% response rate. By validating secondary data with primary data, the resulting measurement system is strengthened.

Gunasekaran et al. (2004) adapted the framework of Gunasekaran et al. (2001), grouping metrics by planning area (tactical, strategic, and operational) and supply chain function (plan, source, make/assemble, and deliver). It has been adapted to show the importance level of each metric (Table 2.8). These importance levels are shown and discussed by planning level and supply chain sector in Gunasekaran et al. (2004).

The resulting framework, Table 2.8, allows for easy identification and classification of metrics. These metrics are shown at the intersection of planning level and supply chain process; for example, the metric *percentage of defects* applies to the make/assemble supply chain activity at the tactical planning level, and has been found to be a highly important metric. *Percentage of defects* also applies to the make/assemble supply chain activity at the operational planning level, and has also been found to be highly important in this context.

Table 2.8: Supply chain performance metrics framework

Source: Adapted from Gunasekaran, Patel, & McGaughey, R.E. (2004). A framework for supply chain performance measurement. *International Journal of Production Economics, 87*(3), 333-347.

Supply chain activity/ process	Strategic	Tactical	Operational
Plan	**Level of customer perceived value of product**, *Variances against budget, Order lead time, Information processing cost, Net profit vs. productivity ratio, Total cycle time, Total cash flow time, Product development cycle time*	**Customer query time**, *Product development cycle time,* Accuracy of forecasting techniques, Planning process cycle time, Order entry methods, Human resource productivity	Order entry methods, Human resource productivity
Source		**Supplier delivery performance**, *supplier leadtime against industry norm, supplier pricing against market, Efficiency or purchase order cycle time,* Efficiency of cash flow method, Supplier booking in procedures	*Efficiency of purchase order cycle time, Supplier pricing against market*
Make/ Assemble	*Range of product and services*	**Percentage of defects, Cost per operation hour, Capacity utilization,** Utilization of economic order quantity	**Percentage of defects, Cost per operation hour**, Human resource productivity index
Deliver	**Flexibility of service system to meet customer needs,** *Effectiveness of enterprise distribution planning schedule*	**Flexibility of service system to meet customer needs,** *Effectiveness of enterprise distribution planning schedule, Effectiveness of delivery invoice methods,* Percentage of finished goods in transit, Delivery reliability performance	**Quality of delivered goods, On time delivery of goods,** *Effectiveness of delivery invoice methods, Number of faultless delivery notes invoiced, Percentage of urgent deliveries, Information richness in carrying out delivery,* Delivery reliability performance

Note: Adapted to show importance level of metrics: (**Highly important**, *Moderately important*, Less important)

2.2.5.3 Bullinger et al., 2002

Another study that has combined aspects of two perspectives – Supply Chain Sector and Balanced Scorecard – was conducted by Bullinger, Kühner, and Van Hoof (2002). This focused on creating an integrated measurement system by integrating the SCOR metrics into the balanced scorecard. The resulting system is shown as Table 9.

Table 2.9: Supply chain performance indicators

	Financial Perspective	Customer Perspective	Organisational Perspective	Innovation Perspective
Supply Chain Perspective	• Total Supply Chain Costs • Total Supply Chain Inventories • Total Supply Chain Revenues	• Point of consumption product availability • Point of consumption product quality	• Supply Chain Relationship quality • Productivity Loss • Perfect order fulfillment	• Market share • New product time-to-market • New product time-to-first-make
Process-Perspective	• Return on investment • Return on capital employed • Cash-to-cash cycle • Revenues	• Customer satisfaction • Customer loyalty • Customer complaints	• Forecast accuracy • Planning process cycle • Schedule changes	• Percent sales from new product • Percent employees in cross-functional teams
Function Perspective	• Material acquisition cost • Inventory costs • Work in progress • Costs per unit produced • Freight costs • Picking costs • Transportation costs • Cash Flow	• In-time delivery • Order fill rate • Order cycle time • Invoice accuracy • Number of Back Orders • Percent resolution on first customer call • Order track and trace Performance	• Incoming material quality • Inventory count accuracy • Out of stocks • Line item fill • Inventory turns • EDI transactions	• Number of employee suggestions

2.2.5.4 Bhagwat and Sharma, 2007

Bhagwat and Sharma (2007) applied the performance metrics framework of Gunasekaran et al. (2001) to the balanced scorecard (Kaplan & Norton, 1996). The results, grouped by the four perspectives of the balanced scorecard, have been combined and are shown as Table 2.10. Bhagwat and Sharma (2007) interviewed three firms to assess their balanced scorecards. The three companies had four perspectives in the scorecards; however, two of these companies indicated plans to add an employee perspective to the scorecards in the future (Bhagwat & Sharma, 2007).

Table 2.10: Balanced scorecard for supply chain evaluation

Source: Adapted from Bhagwat, R. & Sharma, M.K. (2007). Performance measurement of supply chain management: A balanced scorecard approach. *Computers & Industrial Engineering, 53*(1), 43-62.

Financial Perspective	Innovation and Learning Perspective
Net profit vs. productivity ratio	Supplier assistance in solving technical problems
Rate of return on investment	Supplier ability to respond to quality problems
Variations against budget	Supplier cost saving initiatives
Buyer-supplier partnership level	Supplier's booking in procedure
Delivery performance	Capacity utilization
Supplier cost saving initiatives	Order entry methods
Delivery reliability	Accuracy of forecasting techniques
Cost per operation hour	Product development cycle time
Information carrying cost	Flexibility of service systems to meet particular customer needs
Supplier rejection rate	Buyer-supplier partnership level
	Range of products and services
	Level of customer perceived value of product
Customer Perspective	**Internal Business Perspective**
Customer query time	Total supply chain cycle time
Level of customer perceived value of product	Total cash flow time
Range of products and services	Flexibility of service systems to meet particular customer needs
Order lead time	Supplier lead time against industry norms
Flexibility of service systems to meet particular customer needs	Level of supplier's defect free deliveries
Buyer-supplier partnership level	Accuracy of forecasting techniques
Delivery lead time	Product development cycle time
Delivery performance	Purchase order cycle time
Effectiveness of delivery invoice methods	Planned process cycle time
Delivery reliability	Effectiveness of master production schedule
Responsiveness to urgent deliveries	Capacity utilization
Effectiveness of distribution planning schedule	Total inventory cost as:
Information carrying cost	Incoming stock level
Quality of delivery documentation	Work-in-process
Driver reliability for performance	Scrap value
Quality of delivered goods	Finished goods in transit
Achievement of defect free deliveries	Supplier rejection rate
	Efficiency of purchase order cycle time
	Frequency of delivery

In order to build a firm-specific balanced scorecard for supply chain evaluation, Bhagwat and

Sharma (2007) recommend a seven stage process:

1. Create awareness for the concept of balanced SCM scorecard in the organization;
2. Collect and analyze data on the following items:
a. Corporate strategy, business strategy, and SCM strategy;
b. Specific objectives and goals related to corporate strategy, business strategy, and SCM strategy;
c. Traditional metrics already in use for SCM evaluation;
d. Potential metrics related to four perspectives of balanced scorecard;
3. Clearly define the company specific objectives and goals of the SCM function for each of the four perspectives;
4. Develop a preliminary balanced SCM scorecard based on the defined objectives and goals of the enterprise;
5. Receive comments and feedback on the balanced SCM scorecard from the management, and revise it accordingly;
6. Achieve a consensus on the balanced SCM scorecard that will be used by the organization; and
7. Communicate both the balanced SCM scorecard and its underlying rationale to all stakeholders. (p. 55)

2.2.6   Exhaustive Perspectives

There have been attempts to categorize the entirety of performance measures. Two

approaches are illustrated with Table 2.11 and Table 2.12. One approach involves collecting

all published performance measures and listing this information. Table 2.11 contains metrics

from sixteen sources and is grouped by SCOR top level process (Plan, Source, Make,

Deliver, and Return). It identifies the topic of measurement (cost, time, etc.) and whether the

metric is quantitative or qualitative. This type of system provides myriad measures from

which a company can choose in order to align corporate goals and strategy with performance.

A disadvantage of this type of classification system is that is can be overwhelming, leading to difficulty in understanding or implementation.

Table 2.11: Taxonomy of supply chain performance measures

Source: Shepard, C. & Günter, H. (2006). Measuring supply chain performance: Current research and future directions. *International Journal of Productivity and Performance Management, 55*(3/4), 242-258.

Stages in supply chain	Measure	Cost (C) Time (T) Quality (Q) Flexibility (F) Innovativeness (I)	Quantitative (QN) or qualitative (QL)
Plan	Sales [b]	C	QN
	Profit [b]	C	QN
	Return on investment (ratio of net profits to total assets [b]	C	QN
	Rate of return on investment [a]	C	QN
	Net profit vs. productivity ratio [a]	C	QN
	Information carrying cost [a]	C	QN
	Variations against budget [a]	C	QN
	Total supply chain management costs [d]	C	QN
	Cost of goods sold [d]	C	QN
	Asset turns [d]	C	QN
	Value added productivity [d]	C	QN
	Overhead cost [n]	C	QN
	Intangible cost [n]	C	QN
	Incentive cost and subsides [n]	C	QN
	Sensitivity to long-term costs [n]	C	QN
	Percentage sales of new product compared with whole sales for a period [n]	C	QN
	Expansion capability [n]	C	QN
	Capital tie-up costs [o]	C	QN
	Total supply chain response time [c]	T	QN
	Total supply chain cycle time [a]	T	QN
	Order lead time [a, o]	T	QN
	Order fulfillment lead time [d]	T	QN
	Customer response time [b]	T	QN
	Product development cycle time [a]	T	QN
	Total cash flow time [a]	T	QN
	Cash-to-cash cycle time [d]	T	QN
	Horizon of business relationship [e]	T	QL
	Percentage decrease in time to produce a product [n]	T	QN
	Fill rate (target fill rate achievement & average item fill rate) [b, c, m, n]	Q	QN
	Order entry methods [a]	Q	QN
	Accuracy of forecasting techniques [a]	Q	QN

Table 2.11 continued

Plan (cont.)	Autonomy of planning [e]	Q	QL
	Perceived effectiveness of departmental relations [f]	Q	QL
	Order flexibility [m]	Q	QN
	Perfect order fulfillment*	Q	QN
	Mix flexibility [b, n]	F	QN
	New product flexibility [b]	F	QN
	Number of new products launched [n]	I	QN
	Use of new technology [n]	I	QN
Source	Supplier cost-serving initiatives [a]	C	QN
	Percentage of late or wrong supplier delivery*	C	QN
	Supplier lead time against industry norm [a]	T	QN
	Supplier's booking-in procedures [a]	T	QN
	Purchase order cycle time [a]	T	QN
	Efficiency of purchase order cycle time [a]	T	QN
	Buyer-supplier partnership level [a]	Q	QL
	Level of supplier's defect-free deliveries [a]	Q	QN
	Supplier rejection rate [a]	Q	QN
	Mutual trust [e]	Q	QL
	Satisfaction with knowledge transfer [g]	Q	QL
	Satisfaction with supplier relationship [h]	Q	QL
	Supplier assistance in solving technical problems [a]	Q	QL
	Extent of mutual planning cooperation leading to improved quality [J]	Q	QL
	Extent of mutual assistance leading in problem-solving efforts [k]	Q	QL
	Distribution of decision competences between supplier and customer [i]	Q	QL
	Quality and frequency of exchange of logistics information between supplier and customer [i]	Q	QL
	Quality of perspective taking in supply networks [l]	Q	QL
	Information accuracy [p]	Q	QL
	Information timeliness [p]	Q	QL
	Information availability [p]	Q	QL
	Supplier ability to respond to quality problems [a]	F	QL
Make	Total cost of resources [b]	C	QN
	Manufacturing cost [b, n]	C	QN
	Inventory investment [b]	C	QN
	Inventory obsolescence [b]	C	QN
	Work in process [b]	C	QN
	Cost per operation hour [a]	C	QN
	Capacity utilization as incoming stock level, work-in-process, scrap level, finished foods in transit [a, c]	C	QN
	Inventory cost [n]	C	QN
	Inventory turnover ratio [c]	C	QN
	Inventory flow rate [m]	C	QN
	Inventory days of supply [d]	C	QN
	Economic order quantity [a]	C	QN
	Effectiveness of master production schedule [a]	C	QN
	Number of items produced [b]	C	QN
	Warehouse costs [m, n]	C	QN

Table 2.11 continued

Make (cont.)	Stock capacity [m]	C	QN
	Inventory utilization [m]	C	QN
	Stockout probability [b, n]	C	QN
	Number of backorders [b]	C	QN
	Number of stockouts [b]	C	QN
	Average backorder level [b]	C	QN
	Percentage of excess/lack of resource within a period [n]	C	QN
	Storage costs per unit of volume [o]	C	QN
	Disposal costs [o]	C	QN
	Planned process cycle time [a]	T	QN
	Manufacturing lead time [b]	T	QN
	Time required to produce a particular item or set of items [b]	T	QN
	Time required to produce new product mix [n]	T	QN
	Inventory accuracy [m]	Q	QN
	Inventory range [o]	F	QN
	Percentage of wrong products manufactured [n]	Q	QN
	Production flexibility [d]	F	QN
	Capacity flexibility [c]	F	QN
	Volume flexibility [b, n]	F	QN
	Number of tasks worker can perform [n]	F	QN
Deliver	Total logistics costs [o]	C	QN
	Distribution costs [b, n]	C	QN
	Delivery costs [m]	C	QN
	Transport costs [m]	C	QN
	Transport costs per unit of volume [o]	C	QN
	Personnel costs per unit of volume moved [o]	C	QN
	Transport productivity [m]	C	QN
	Shipping errors [b]	C	QN
	Delivery efficiency [o]	C	QN
	Percentage accuracy of delivery [n]	C	QN
	Delivery lead time [a]	T	QN
	Frequency of delivery [a]	T	QN
	Product lateness [b]	T	QN
	Average lateness of orders [b]	T	QN
	Average earliness of orders [b]	T	QN
	Percent of on-time deliveries [b, n]	T	QN
	Delivery performance [a, d]	Q	QN
	Delivery reliability [a, c, d, m]	Q	QN
	Number of on-time deliveries [b]	Q	QN
	Effectiveness of distribution planning schedule [a]	Q	QL
	Effectiveness of delivery invoice methods [a]	Q	QN
	Driver reliability for performance [a]	Q	QN
	Quality of delivered foods [a]	Q	QL
	Achievement of defect-free deliveries [a]	Q	QN
	Quality of delivery documentation [a]	Q	QL
	Delivery flexibility [b, m]	F	QN

Table 2.11 continued

Deliver (cont.)	Responsiveness to urgent deliveries [a, m]	F	QN
	Transport flexibility [m]	F	QN
Return (customer satisfaction)	Warranty/returns processing costs [d]	C	QN
	Customer query time [a]	T	QN
	Customer satisfaction (or dissatisfaction) [b, n]	Q	QL
	Level of customer perceived value of product [a]	Q	QL
	Customer complaints [b]	Q	QN
	Rate of complaint [c]	Q	QN
	Product quality [b, m]	Q	QL
	Flexibility of service systems to meet particular customer needs [a]	F	QL

Notes: [a] = Gunasekaran et al. (2001); [b] = Beamon (1999); [c] = Schonsleben (2004); [d] = SCOR level I metrics; [e] = Hieber (2002); [f] = Ellinger; [g] = Sperka (1997); [h] = Artz (1999); [i] = Windischer & Grote (2003); [j] = Graham et al. (1994); [k] = Maloni & Benton (1997); [l] = Parker & Axtell (2001); [m] = Chan & Qi (2003); [n] = Chan (2003); [o] = VDI guidelines (association of engineers); [p] = Van der Vorst & Beulens (2001); Note by Allen (2008): * = no source provided

Another approach to identifying performance measures has been utilized by Gunasekaran and Kobu (2007). They collected metrics from performance measurement literature spanning 1995-2004. This process resulted in "about 80-90" metrics (Gunasekaran & Kobu, 2007, p. 2832). After removing duplications and overlaps, 27 "Key Performance Indicators (KPI)" remained (Gunasekaran & Kobu, 2007). These are shown in Table 2.12.

Table 2.12: Supply chain performance metrics and relation to categories and factors

Source: Gunasekaran, A. & Kobu, B. (2007). Performance measures and metrics in logistics and supply chain management: A review of recent literature (1995-2004) for research and applications. *International Journal of Production Research, 45*(12), 2819-2840.

Metrics	A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	F1	F2	G1	G2	Total	Percentage
01 Accuracy of scheduling		X			X				X							X	X	X	X				7	32
05 Bid management cycle time		X			X				X					X			X	X	X				7	32
06 Capacity utilization		X	X			X					X				X	X	X	X	X				9	41
07 Compliance to regulations		X	X				X		X	X					X		X	X		X		X	10	45
08 Conformance to specifications		X		X			X			X	X					X	X	X				X	9	41
18 Delivery reliability		X	X	X			X						X			X	X	X				X	9	41
24 Forecasting accuracy			X	X	X				X						X	X	X	X				X	9	41
29 Inventory costs	X	X				X		X	X	X	X	X	X		X	X	X				X	X	14	63
33 Labor efficiency			X			X					X				X	X	X	X	X				8	36
35 Lead time for procurement				X	X						X				X		X	X	X				7	32
36 Lead time manufacturing		X		X	X						X				X	X	X	X	X				9	41
39 Obsolescence cost	X			X	X		X		X					X			X					X	8	32
44 Overhead cost	X	X			X	X			X		X				X	X	X					X	10	42
46 Perceived quality			X				X	X				X					X			X		X	7	32
47 Perceived value of product			X				X					X					X			X		X	6	27
50 Process cycle time		X			X			X	X	X	X				X	X	X	X	X				11	50
51 Product development time		X	X		X				X					X			X	X	X				8	36
54 Product/service variety	X		X	X		X	X	X						X			X			X		X	10	45
55 Production flexibility		X	X		X	X	X	X			X					X	X			X	X		11	50
62 Return on investment	X				X				X					X			X		X			X	7	32
63 Selling price	X		X			X	X						X	X			X		X			X	9	41
68 Stock out cost	X		X			X	X						X				X		X			X	8	32
71 Supply chain response time		X	X		X							X	X	X	X	X	X	X	X				11	50
76 Transportation cost	X					X						X		X	X	X	X					X	8	32
77 Value added	X		X			X					X		X	X	X	X	X					X	10	45
81 Warranty cost	X		X				X		X						X		X					X	7	32
Total	10	13	7	13	12	9	12	7	13	4	9	3	7	7	9	14	9	17	22	5	11	16		
Percentage	38	50	27	50	46	35	46	27	50	15	35	12	27	27	35	54	35	65	85	19	42	61		

A. Balance score perspectives: 1. Financial, 2. Internal process, 3. Innovation and improvement, 4. Customers. B. Components of performance measures: 1. Time, 2. Resource utilization, 3. Output, 4. Flexibility. C. Location of measures in supply chain links: 1. Planning and product design, 2. Supplier, 3. Production, 4. Delivery, 5. Customer. D. Decision level: 1. Strategic, 2. Tactical, 3. Operational. E. Financial base: 1. Financial, 2. Nonfinancial. F. Measurement base: 1. Quantitative, 2. Nonquantitative. G. Traditional vs. Modern: 1. Function based, 2. Value based.

2.3   Textile and Apparel Applications

Though there has been much research in terms of performance measures for supply chains, textile and apparel specific research in the area is lacking. There have been a limited number of studies related to textiles and apparel (Lohman et al., 2004; McMullen, 1996; Nowell, 2005; Sauls, 2007).

A study performed by McMullen (1996) examined supply chain management processes in the Asia Pacific region. A survey methodology was used, and included respondents from a variety of industries performing various supply chain functions (manufacture, service, resource, and retail). The sample included two apparel firms. Results indicate that 85% of those companies surveyed used financial performance measures, among them budget to actual, savings, return on investment (ROI), return on equity (ROE), and other measures (McMullen, 1996). In addition to financial performance measures, companies were utilizing customer service performance measures such as on-time deliveries, customer complaints, back orders, stock-outs, inventory accuracy, ship errors, total order cycle time, and fill rates. Ten percent of those surveyed had no customer service performance measures in place (McMullen, 1996).

In terms of warehousing and transportation performance measures, costs calculated by 49% of the respondents include standard order processing, stock-outs, order expediting, back orders, or other costs. Fifty-one percent of those surveyed did not calculate any of the costs

specified by the researcher (McMullen, 1996). When looking at warehouse performance, twelve percent of respondents had no measures in place. The performance measures utilized by the remaining 88% included inventory accuracy, in-time shipments, shipping errors, customer complaints, back orders, warehouse cycle time, number of kilos/units shipped, number of dollars shipped, or other measures (McMullen, 1996).

Kurt Salmon Associates conducted a study on sourcing of textiles and apparel (Sauls, 2007). The respondents for the study were apparel retailers (35%); apparel manufacturers, brand marketers and contractors (58%); and "other" firms, including home furnishing manufacturers and sporting good retailers (7%). One area of the study focused on vendor selection criteria. The top four criteria as shown in Figure 2.10 are 1) cost, 2) quality program, 3) product development/execution capabilities, and 4) lead time. These criteria are related to performance measurement, as they should be an extension of a company's performance measurement system (Sauls, 2007). Half of the respondents of the study indicated their companies utilized some form of a scorecard for performance measurement (Sauls, 2007). Also, Nowell (2005) determined that performance measures are being utilized in the textile and apparel industry as both selection criteria and metrics for gauging performance.
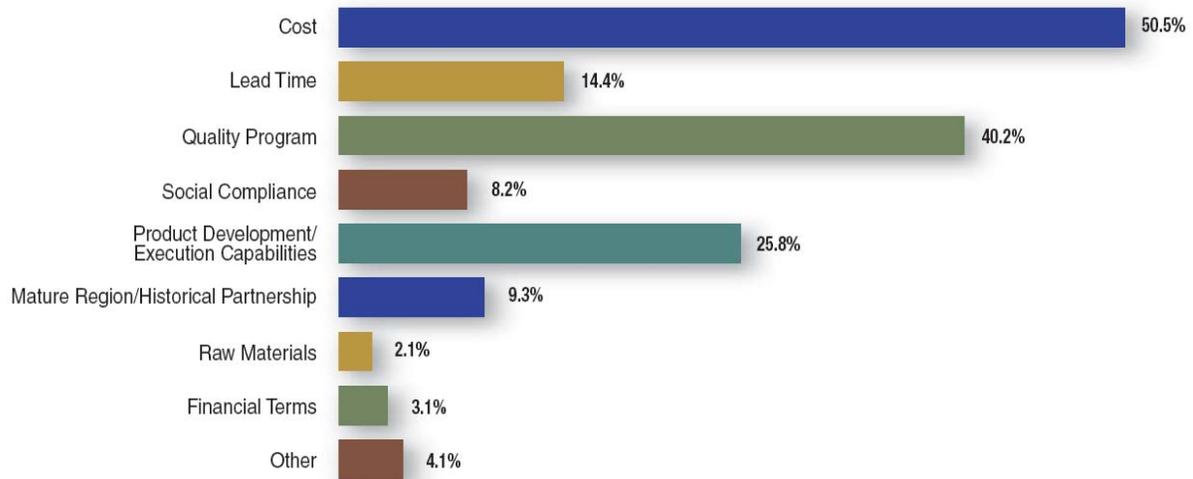
Figure 2.10: Most important factors in choosing a sourcing region/partner

Source: Sauls, J. (2007). Excellence in sourcing. *Apparel Magazine, 48*(12), Suppl., 2-9.

Nowell (2005) identified performance measures through a secondary literature search in preparation for primary data collection related specifically to textiles and apparel. Several non-textile and apparel specific sources were reviewed (Beamon, 1999; Cooke, 2001; Gunasekaran et al., 2004; Handfield & Nichols, 1999 (cited by Nowell, 2005 as Handfield, 1999); Keebler et al., 1999 (cited by Nowell, 2005 as Durtsche, 1999)), and a list of performance measures was developed, including cost, quality, on-time delivery, lead time, responsiveness, customer service, order fill rate, order accuracy, stock outs, damages, flexibility, technical expertise, product range, and capacity (Nowell, 2005). The frequency of performance measures found by Nowell (2005) is shown in Figure 2.11. Cost and customer service were the two most important performance metrics. Capacity, flexibility, lead time, on-time delivery, and damages were identified as important with supply chains lengthening due to global sourcing (Nowell, 2005).
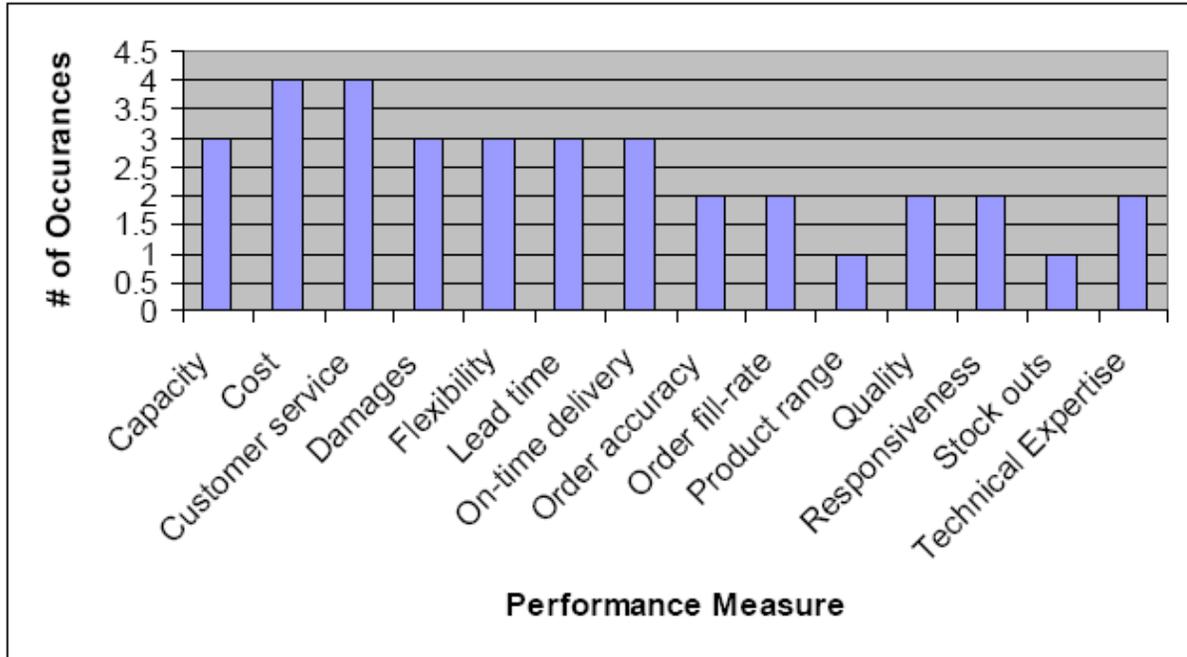
Figure 2.11: Performance measure frequency – secondary data

Source: Nowell, C.H. (2005). *Market competitiveness in the global textile supply chain: Examination of supply chain configurations* (Master's thesis, North Carolina State University, 2005). Retrieved from http://www.lib.ncsu.edu/theses/available/etd-04182005-105951/unrestricted/etd.pdf

For primary data collection, Nowell (2005) interviewed thirty-four (34) respondents from eighteen companies, representing a mixture of domestic and global, bed-bath and bottomweight manufacturers and retailers. Respondent were asked to identify performance measures and vendor selection criteria. As can be seen in Figure 2.12, cost, quality, and on-time delivery were the most common metrics cited, and were identified by respondents in each sector studied. In terms of vendor selection criteria, common metrics include speed, compliance, flexibility, and product innovation (Nowell, 2005).
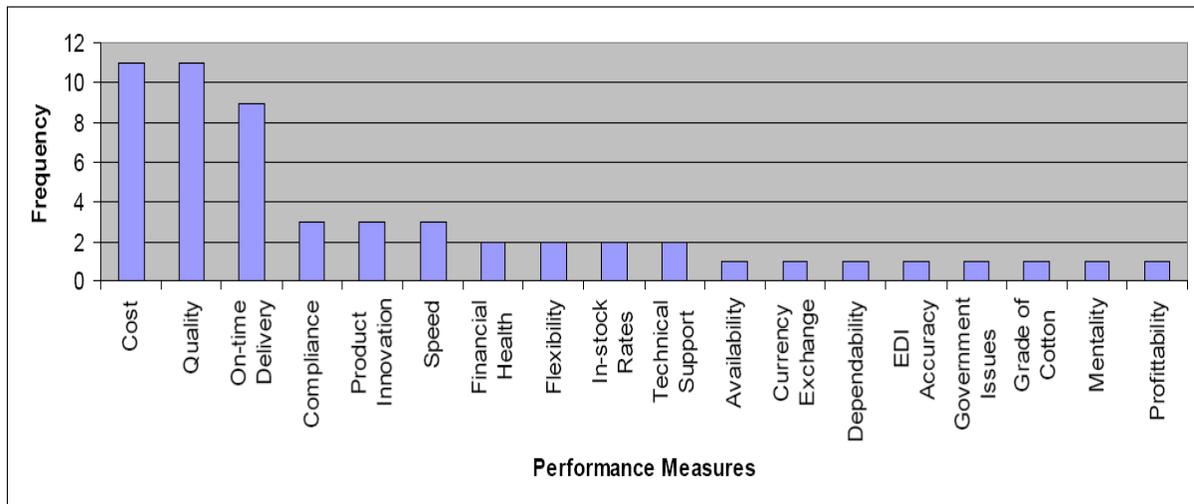
Figure 2.12: Performance measure frequency – primary data (Nowell, 2005)

A study conducted by Lohman, Fortuin, and Wouters (2004) focused on performance measurement at Nike's European operations center in Belgium. This center serves Europe, the Middle East, and Africa. It is important to note that the study did not cover the entirety of the Nike supply chain; rather, only the European market was investigated and only in terms of operations (transportation, warehousing, and customer service). The researchers developed a scorecard, based on the work of Kaplan and Norton (1992, 1996), for performance measurement, and also developed a list of performance measures for each category of the balanced scorecard.

The scorecard, Figure 2.13, shows six scorecard areas (Lohman et al., 2004). It is similar to the scorecard proposed by Kaplan and Norton (1992, 1996) with the addition of a

sustainability section (relating to environmental stewardship) and people (relating to organizational health and employee satisfaction). This scorecard was developed by Lohman et al. (2004) while working at Nike Europe's operations center, and the scorecard format has evolved since the research ended. This highlights the fact "that the format is a fluid element for the development and implementation of [performance measurement systems]" (Lohman et al., 2004, p. 281). That is, performance measurement systems should evolve as business dynamics and requirements shift.
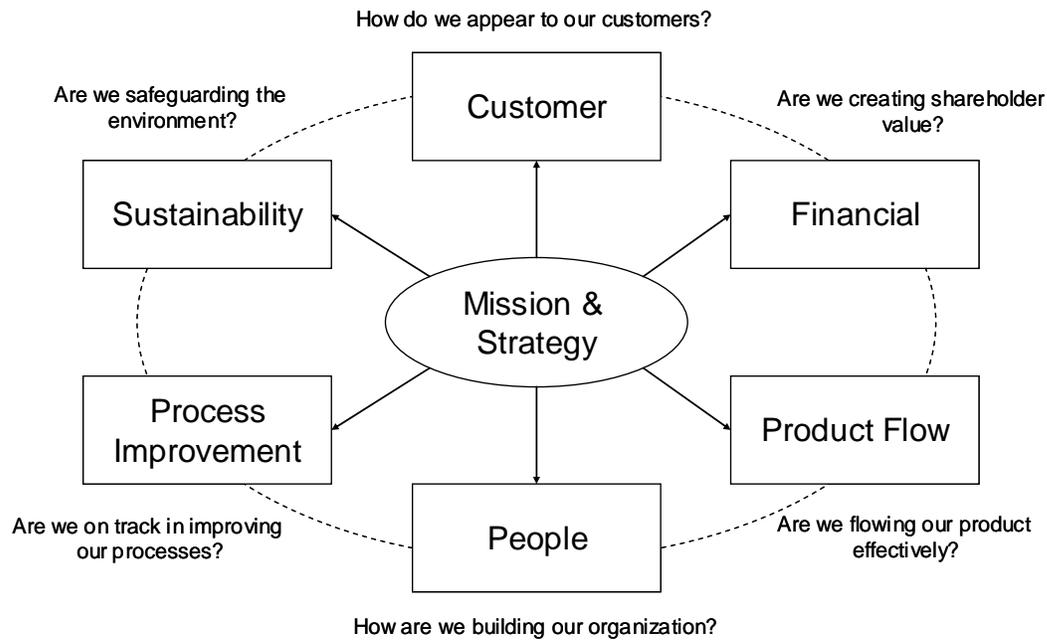
Figure 2.13: Balanced scorecard for Nike European Operations

Source: Lohmen, C., Fortuin, L., & Wouters, M. (2004). Designing a performance measurement system: A case study. *European Journal of Operations Research, 156*(2), 267-286.

2.4   Conclusion

There have been many efforts in the recent past to determine metrics to gauge the performance of supply chains. It is interesting to note that most of the performance measurement systems published in the literature are based on a limited number of studies. Figure 2.14 was developed to illustrate how studies on performance measures relate over time. The four main streams of research (Beamon, 1999; Gunasekaran et al., 2001; Kaplan & Norton, 1992; Kaplan & Norton, 1996; Supply-Chain Council, 1997-2006) have each been assigned a different color for ease of reading. From this, one can see how each of these four performance measurement systems has been used as the basis for the other studies.

Previous efforts of developing performance measurement systems have identified an extensive number of metrics (Gunasekaran & Kobu, 2007; Shepherd & Günter, 2006). These studies have not been specific to textiles and apparel. As shown, there have been a limited number of studies concerning textile and apparel-specific performance measurement. This presents an opportunity to enrich the both the supply chain and the textile and apparel management literature with a study of industry-specific performance measures. By identifying the metrics that are being used by textile and apparel companies, research can support industry – Only through understanding the needs of companies can academic research aid industry improvement.
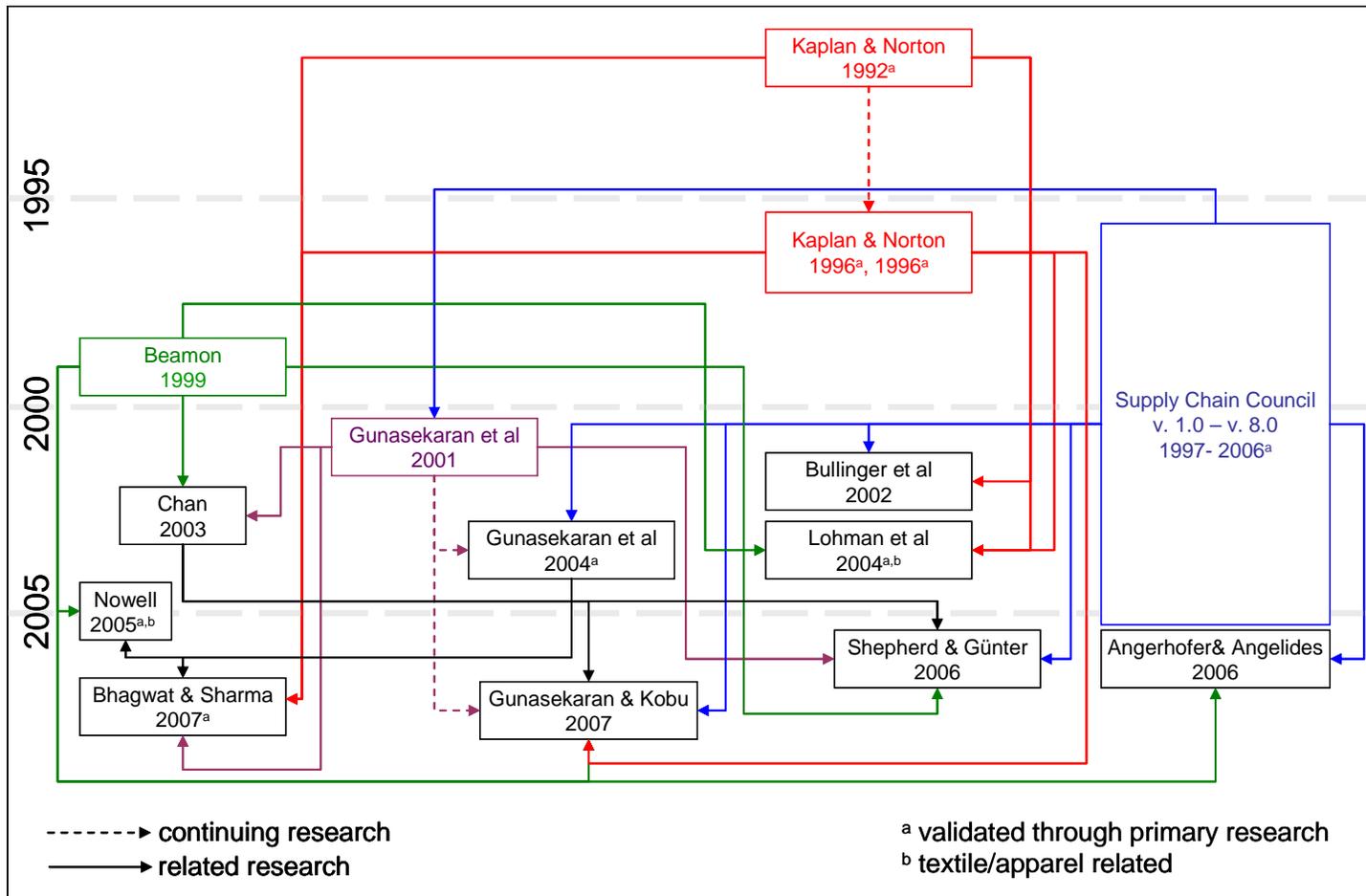
Figure 2.14: Relation of performance measurement research over time

Source: Allen (2008)

3 METHODOLOGY

3.1 Purpose of the Research

This research investigated performance measurement for supply chains in both developing and developed countries. It identified the specific measures that textile and apparel companies use to gauge the performance of their supply chains. The research developed a practical definition of supply chain management used in developing countries. Also, this research evaluated performance improvement efforts of textile and apparel manufacturers in developing countries.

3.2 Research Objectives

The objectives of this research were to:

RO1: Identify the measures used by textile and apparel companies to gauge the performance of their supply chains in:

RO1A: Developing countries;

RO1B: Developed countries.

RO2: Develop a practical definition of supply chain management in developing and developed countries.

RO3: Evaluate the efforts of companies in developing countries to improve performance.

RO4: Construct a model of performance measurement specific to textiles and apparel.

3.3   Research Design

This research used a two-phase mixed methods approach; both quantitative and qualitative data were collected and analyzed. The first phase of this methodology was exploratory in nature and consisted of field research – plant visits and interviews – on the Sri Lankan textile and apparel industry. This first phase of the research was conducted from May-August 2007.

The second phase of the research was exploratory as well and consisted of an internet survey and phone interviews on a global sample of textile and apparel companies in both developed and developing countries. This phase was conducted from June-September 2008. The second phase of the research used a concurrent triangulation strategy, shown in Figure 3.1, which involves collecting quantitative (QUAN) and qualitative (QUAL) data simultaneously and comparing results from analysis of each type of data. This strategy was selected because it offers the ability to confirm, cross-validate, or corroborate findings within a single study (Creswell, 2003).

Mixed research methods, in which quantitative and qualitative methods are used, was developed by Campbell and Fiske in 1959 (Creswell, 2003). By using a mixed methods approach, biases associated with quantitative or qualitative methods alone can be offset or cancelled (Creswell, 2003). With mixed methods research, both open- and closed-ended questions can be utilized. Also, multiple forms of data are collected and statistical and text analyses can be performed. By using multiple methods of data collection and analyses, a more comprehensive analysis of the research problem can be performed.

```
┌──────────────┐       ┌──────────────┐
│     QUAN     │   +   │     QUAL     │
│              │       │              │
└──────────────┘       └──────────────┘

      QUAN                        QUAL

  *Data Collection*          *Data Collection*
        │                          │
        ▼                          ▼
      Quan                        Qual
                 ◄──────────►
  *Data Analysis*    *Data Results Compared*    *Data Analysis*
```
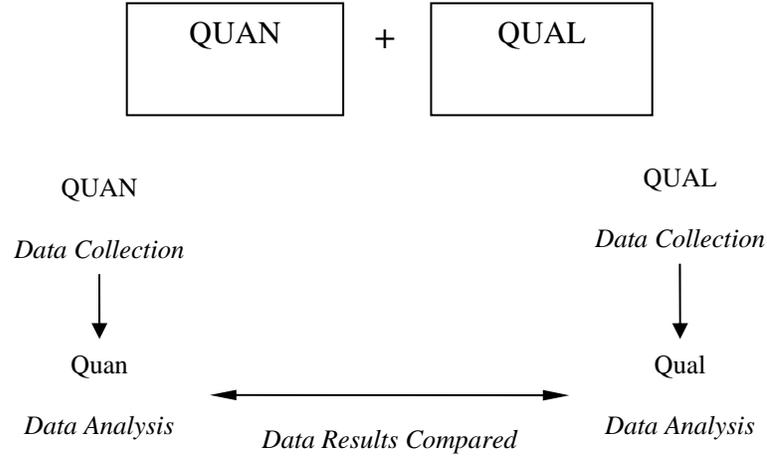
Figure 3.1: Concurrent triangulation strategy.

Source: Creswell, J. (2003). *Research design: Quantitative, qualitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications.

3.3.1   Phase I (Field Research – Sri Lanka)

Phase I of the research involved field research in Sri Lanka. The objectives of Phase I were to 1) understand the current state of the Sri Lankan textile and apparel industry and 2) identify the needs of the industry. This phase of the research was critical to understanding the textile and apparel industry in developing countries.

3.3.1.1 Phase I (Field Research – Sri Lanka): Sample Selection

The factories visited and respondents interviewed were a convenience sample chosen based on availability of contacts. In total, four factories were visited and twenty-one respondents

were interviewed. In addition, two textile and apparel industry training institutes were toured and their training programs studied. A government sponsored training institute for textiles and apparel that works closely with industry arranged for the meetings and factory visits.

3.3.1.2 Phase I (Field Research – Sri Lanka): Data Collection

Industry institutes and manufacturing facilities were toured, and respondents from government, industry, and academe were interviewed. These interviews and visits aided in assessing the current state of the industry in Sri Lanka, as well as the needs of the Sri Lankan textile and apparel industry. Data collection for interviews was structured, though data collection for factory visits was unstructured.

3.3.2   Phase II (Survey and Interview)

This second phase of the research used two forms of data collection: surveys and interviews. Surveys were used to identify performance measures being utilized by companies. Also, the survey aided in identifying performance improvement efforts. Interviews were used to operationalize a practical definition of supply chain management being utilized in industry in both developed and developing countries. Interviews also added depth to results in terms of performance measurement and improvement in developing countries.

3.3.2.1 Phase II (Survey): Sample Selection

The survey sample was chosen from the population of domestic and international textile and apparel companies. International companies for this study were chosen through country-specific textile and apparel trade associations. The companies chosen represent a convenience sample, and companies were identified through the online rosters of textile and apparel trade associations. The following developing countries were targeted for study:

1. Asia: Sri Lanka, Bangladesh, Thailand

2. Latin America: El Salvador, Guatemala, Honduras, Costa Rica, Dominican Republic, and Peru.

Domestic companies for this study were chosen through the alumni roster of a leading domestic textile institution.

Companies identified for this study competed in the sectors of textile and apparel supply chain: 1) fiber/yarn producers, 2) fabric manufacturers, 3) fabric finishers, 4) apparel manufacturers, 5) apparel brand managers and marketers, and 6) retailers. The goal was to study domestic apparel marketers and retailers and to study international apparel manufacturers. Upstream companies such as fiber, yarn, and fabric manufacturers were studied in developing countries as well as in the United States.

Two separate email lists were created: one for Asian Countries and one for Latin American countries. Domestic companies were contacted using an email list of alumni of a leading domestic textile and apparel institute. Table 3.1 shows details related to each of the email

lists utilized. It is important to note that the country-specific lists did have duplicates present. When adding addresses to the email lists, a listserv program used to create the lists automatically removed duplicates. In total, 5724 possible respondents were contacted for participation in the study.

Table 3.1: Listserv descriptors

Email List	Number of Email Addresses
List 1	**4059**
Bangladesh	3364
Sri Lanka	460
Thailand	1969
List 2	**1302**
El Salvador	86
Guatemala	257
Dominican Republic	136
Honduras	225
Costa Rica	30
Peru	643
Alumni Email List	**363**

3.3.2.2 Phase II (Survey): Data Collection

An email cover letter was sent to each of the lists which contained a link to the online survey (cover letter shown in Appendix A). Two reminder emails were sent to each of the lists. Once the respondent clicked the link in the email cover letter, they were directed to the survey home page (Appendix B), which served as the informed consent form for the surveys. After agreeing to the terms of the study, the respondent clicked a link that directed them to the

survey (Appendix C). Upon completion of the survey, respondents were directed to a thank you page (Appendix D).

3.3.2.3 Phase II (Survey): Research Questions

From the research objectives, specific survey-related research questions were developed. Table 3.2 shows the independent and dependent variables studied and how these variables relate to the research objectives (RO). In addition, Table 3.2 lists the corresponding coded variable, shown in parentheses, for analyzing data in the Statistical Package for the Social Sciences (SPSS), discussed in Section 3.3.2.4.

Table 3.2: Dependent and independent variables for study

Independent Variables	Dependent Variables	RO
a) Country (V3) b) Country type (V3alt) c) Region (V3alt1) d) Type of company (Q5) e) Products produced (Q7) f) Manufacturing region (Q8) g) Size of company, sales (V11alt)	1) Presence of performance measurement system (V14) 2) Basis of performance measurement system (Q15) 3) Components of performance measurement system (Q16) 4) Specific performance metrics for suppliers (Q17) 5) Specific performance metrics for customers (Q18) 6) Specific performance metrics for company (Q19) 7) Specific performance metrics for supply chain (Q20)	RO1
h) Size of company, emps (V12) i) End market (Q13)	8) Presence of performance improvement program (V21alt) 9) Type of performance improvement program (Q21) 10) Focus of performance improvement (Q22) 11) Strategies to improve competitiveness (Q23)	RO3

The specific research questions developed were:

RQ1: How does the presence of a performance measurement system differ?
    RQ1a: Does the presence of a performance measurement system differ by country?

RQ1b: Does the presence of a performance measurement system differ by country type?

RQ1c: Does the presence of a performance measurement system differ by region?

RQ1d: Does the presence of a performance measurement system differ by type of company?

RQ1e: Does the presence of a performance measurement system differ by products produced?

RQ1f: Does the presence of a performance measurement system differ by manufacturing region?

RQ1g: Does the presence of a performance measurement system differ by company size in terms of sales?

RQ1h: Does the presence of a performance measurement system differ by company size in terms of number of employees?

RQ1i: Does the presence of a performance measurement system differ by end market?

RQ2: How does the basis of a performance measurement system differ?

RQ2a: Does the basis of a performance measurement system differ by country?

RQ2b: Does the basis of a performance measurement system differ by country type?

RQ2c: Does the basis of a performance measurement system differ by region?

RQ2d: Does the basis of a performance measurement system differ by type of company?

RQ2e: Does the basis of a performance measurement system differ by products produced?

RQ2f: Does the basis of a performance measurement system differ by manufacturing region?

RQ2g: Does the basis of a performance measurement system differ by company size, in terms of sales?

RQ2h: Does the basis of a performance measurement system differ by company size, in terms of number of employees?

RQ2i: Does the basis of a performance measurement system differ by end market?

RQ3: How do the components of a performance measurement system differ?

RQ3a: Do the components of a performance measurement system differ by country?

RQ3b: Do the components of a performance measurement system differ by country type?

RQ3c: Do the components of a performance measurement system differ by region?

RQ3d: Do the components of a performance measurement system differ by type of company?

RQ3e: Do the components of a performance measurement system differ by products produced?

RQ3f: Do the components of a performance measurement system differ by manufacturing region?

RQ3g: Do the components of a performance measurement system differ by company size in terms of sales?

RQ3h: Do the components of a performance measurement system differ by company size in terms of number of employees?

RQ3i: Do the components of a performance measurement system differ by end market?

RQ4: How do supplier performance metrics differ?

RQ4a: Do supplier performance metrics differ by country?

RQ4b: Do supplier performance metrics differ by country type?

RQ4c: Do supplier performance metrics differ by region?

RQ4d: Do supplier performance metrics differ by type of company?

RQ4e: Do supplier performance metrics differ by products produced?

RQ4f: Do supplier performance metrics differ by manufacturing region?

RQ4g: Do supplier performance metrics differ by company size in terms of sales?

RQ4h: Do supplier performance metrics differ by company size in terms of number of employees?

RQ4i: Do supplier performance metrics differ by end market?

RQ5: How do customer performance metrics differ?

RQ5a: Do customer performance metrics differ by country?

RQ5b: Do customer performance metrics differ by country type?

RQ5c: Do customer performance metrics differ by region?

RQ5d: Do customer performance metrics differ by type of company?

RQ5e: Do customer performance metrics differ by products produced?

RQ5f: Do customer performance metrics differ by manufacturing region?

RQ5g: Do customer performance metrics differ by company size in terms of sales?

RQ5h: Do customer performance metrics differ by company size in terms of number of employees?

RQ5i: Do customer performance metrics differ by end market?

RQ6: How do internal performance metrics differ?

RQ6a: Do internal performance metrics differ by country?

RQ6b: Do internal performance metrics differ by country type?

RQ6c: Do internal performance metrics differ by region?

RQ6d: Do internal performance metrics differ by type of company?

RQ6e: Do internal performance metrics differ by products produced?

RQ6f: Do internal performance metrics differ by manufacturing region?

RQ6g: Do internal performance metrics differ by company size in terms of sales?

RQ6h: Do internal performance metrics differ by company size in terms of number of employees?

RQ6i: Do internal performance metrics differ by end market?

RQ7: How do supply chain performance metrics differ?

RQ7a: Do supply chain performance metrics differ by country?

RQ7b: Do supply chain performance metrics differ by country type?

RQ7c: Do supply chain performance metrics differ by region?

RQ7d: Do supply chain performance metrics differ by type of company?

RQ7e: Do supply chain performance metrics differ by products produced?

RQ7f: Do supply chain performance metrics differ by manufacturing region?

RQ7g: Do supply chain performance metrics differ by company size in terms of sales?

RQ7h: Do supply chain performance metrics differ by company size in terms of number of employees?

RQ7i: Do supply chain performance metrics differ by end market?

RQ8: How does the presence of a performance improvement program differ?

RQ8a: Does the presence of a performance improvement program differ by country?

RQ8b: Does the presence of a performance improvement program differ by country type?

RQ8c: Does the presence of a performance improvement program differ by region?

RQ8d: Does the presence of a performance improvement program differ by type of company?

RQ8e: Does the presence of a performance improvement program differ by products produced?

RQ8f: Does the presence of a performance improvement program differ by manufacturing region?

RQ8g: Does the presence of a performance improvement program differ by company size in terms of sales?

RQ8h: Does the presence of a performance improvement program differ by company size in terms of number of employees?

RQ8i: Does the presence of a performance improvement program differ by end market?

RQ9: How does the type of performance improvement program differ?

RQ9a: Does the type of performance improvement program differ by country?

RQ9b: Does the type of performance improvement program differ by country type?

RQ9c: Does the type of performance improvement program differ by region?

RQ9d: Does the type of performance improvement program differ by type of company?

RQ9e: Does the type of performance improvement program differ by products produced?

RQ9f: Does the type of performance improvement program differ by manufacturing region?

RQ9g: Does the type of performance improvement program differ by company size, in terms of sales?

RQ9h: Does the type of performance improvement program differ by company size, in terms of number of employees?

RQ9i: Does the type of performance improvement program differ by end market?

RQ10: How does the focus of performance improvement differ?

RQ10a: Does the focus of performance improvement differ by country?

RQ10b: Does the focus of performance improvement differ by country type?

RQ10c: Does the focus of performance improvement differ by region?

RQ10d: Does the focus of performance improvement differ by type of company?

RQ10e: Does the focus of performance improvement differ by products produced?
RQ10f: Does the focus of performance improvement differ by manufacturing region?
RQ10g: Does the focus of performance improvement differ by company size, in terms of sales?
RQ10h: Does the focus of performance improvement differ by company size, in terms of number of employees?
RQ10i: Does the focus of performance improvement differ by end market?
RQ11: How do strategies for improved competitiveness differ?
RQ11a: Do strategies for improved competitiveness differ by country?
RQ11b: Do strategies for improved competitiveness differ by country type?
RQ11c: Do strategies for improved competitiveness differ by region?
RQ11d: Do strategies for improved competitiveness differ by type of company?
RQ11e: Do strategies for improved competitiveness differ by products produced?
RQ11f: Do strategies for improved competitiveness differ by manufacturing region?
RQ11g: Do strategies for improved competitiveness differ by company size, in terms of sales?
RQ11h: Do strategies for improved competitiveness differ by company size, in terms of number of employees?
RQ11i: Do strategies for improved competitiveness differ by end market?

3.3.2.3.1 Additional Analyses

In addition to performing chi-square analyses for the research questions, several variables were investigated to determine if significant relationships existed. For ease of reference, these have been labeled as alternative research questions (RQalt):

RQalt1: Size in terms of number of employees vs. size in terms of sales;
RQalt2: Size in terms of number of employees vs. country type;
RQalt3: Products produced vs. country type;
RQalt4: Type of company vs. country type.

3.3.2.4 Phase II (Survey): Data Analysis

Survey data were first coded in order to be analyzed using the Statistical Package for the Social Sciences (SPSS) 16.0 for Windows (SPSS is a registered trademark of SPSS, Inc.).

After the survey data were coded, descriptive statistics were calculated. Then, chi-square analyses were performed. In a few cases, the data had to be modified in order to analyze the results. This modification meant placing data from the "other" category into one of the predefined answer choices. Relevant data that were modified are described in Chapter 4.

3.3.2.5 Phase II (Interview): Sample Selection

Interviews were used to provide depth to the survey results and were conducted via phone. Upon completion of the online survey, respondents were offered the chance to provide contact information for the researcher (Appendix E). After providing contact information, respondents were directed to a second, thank you screen (

Appendix F). After providing contact information, appointments for interviews were arranged via email.

3.3.2.6 Phase II (Interview): Data Collection

Interviews were conducted via phone. In a few cases, the connection was unclear and respondents chose to complete the questionnaire through email. The informed consent form for interviews is shown in Appendix G, and the questionnaire used for data collection is shown in Appendix H.

3.3.2.7 Phase II (Interview): Data Analysis

Qualitative data from interviews was first transcribed. Next, the data were grouped by topic. Finally, the data were analyzed to identify trends and special-case scenarios.

3.3.3   Institutional Review Board

This research was granted administrative approval by the Institutional Review Board for the Protection of Human Subjects in Research (IRB). The exemption from federal regulation 45CFR46 is shown in Appendix I.

4   RESULTS AND DISCUSSION

4.1   Phase I Results (Field Research – Sri Lanka)

4.1.1   Phase I (Field Research – Sri Lanka) Results: Respondent Summary Statistics

Field research in Sri Lanka was conducted from May-August, 2007. Twenty-one respondents were interviewed face-to-face. These interviews were conducted at manufacturing facilities, company and institute offices, and educational institutions.

In total, five factories were visited, and consisted of 1) a central receiving, cutting, washing, and warehouse facility for a denim manufacturing company; 2) a central receiving, cutting, washing, embroidery, and warehouse facility for a childrenswear manufacturing company; 3) a cutting and sewing facility for an intimate apparel manufacturing company; 4) a fabric production and finishing facility for a knit fabric company; and 5) a cutting and sewing facility for an apparel manufacturing company. Additionally, two industry-specific training institutes were toured and one university was visited.

The position of respondents varied from technical consultant and department head to CEO and human resource manager. In fact, many of the respondents represented human resource and training functions A listing of job titles for the respondents is shown in Table 4.1.

Table 4.1: Job titles of interview respondents (Phase I Field Research – Sri Lanka)

Title	
Country Manager	Director, Human Resources & Administration
CEO	Group Compliance, Systems, & Training Manager
Chairman	Manager, Human Resources & Administration
Executive Director	Human Resource Manager
General Manager	Manager, Strategic Enterprise & Industry Solutions
Director (2)	Human Resources Development Manager
Department Head	Assistant General Manager
Division Manager (2)	Assistant Human Resource Manager
Chief People Officer	Technical Consultant
Training Manager	

4.1.2   Phase I (Field Research – Sri Lanka) Results: Sri Lankan Textile and Apparel Industry

The apparel industry of Sri Lanka is prominent in Asia and a large and important sector in the country, with a history of over 40 years. The industry began as a result of the tourism industry. Tourists on cruise ships would shop in the capital of Colombo. Since the ships were docked for only a short amount of time, there were a number of tailors who would quickly make custom suits to order.

The work force employs over 300,000 people. It was described by many as a well-trained and trainable work force. The country has a high Singhalese literacy rate (over 90%). English is spoken well by corporate-level employees and production managers in larger companies. The managers of small and medium companies are also proficient in English, though production employees in all sectors have less of a grasp of English.

The apparel industry consists of roughly 300 manufacturing companies with 750-800 factories. Interestingly, 20% of factories do 85% of the country's business, which has 3 billion USD annually in sales. The products produced are "quality garments," meaning that they are not mass quality. For lower quality (mass market) items and because of the quota system, customers have gone to the Maldives and Bangladesh. In addition, Sri Lanka is the largest supplier to Marks & Spencer.

4.1.2.1 Reasons for Sourcing from Sri Lanka

Respondents indicated that there were, historically, several reasons for sourcing from Sri Lanka. Sri Lanka has had efficiency in manufacturing and a good level of corporate compliance. In terms of the size of the production base, it is not so large as to be unmanageable. Because portions of the industry have a collaboration with U.S. and European brands, the country has had a high level of expertise in manufacturing, particularly with respect to certain product categories, such as lingerie. Also, respondents stated that Sri Lanka's industry was more organized than other countries. The apparel industry has been comparatively stable in terms of compliance and reliable in terms of deliveries. One respondent indicated that there had been an issue with terrorist attacks at Sri Lanka's main port that had delayed shipment, and in response, apparel manufacturers began air-freighting goods to customers.

Respondents indicated that brands are currently sourcing from Sri Lanka for several reasons. First, the industry was built on a model of collaboration and works together. The Joint Apparel Association Forum (JAAF), a government-sponsored industry group, has developed a plan for the future and growth of the industry. There have also been investments in supply chain management and vertical integration, and the industry is attempting to add fabric and trim suppliers to the production base. Further, employees have required skill sets in production management, and there is good garment merchandising in Sri Lanka. It was also indicated that the country has better supply chain management than other South Asian countries.

4.1.2.2 Small and Medium Companies (SME's)

The sector of small and medium companies or enterprises (SME's) in Sri Lanka is very fragmented. The sector is shrinking, but respondents indicated that it is the backbone of the industry. There were 800 SME's, but that figure has dwindled to 350. Various definitions exist for SME's, and they are classified by the amount of investment (in Rs.), the amount of exports (in Rs.), the number of machines, and/or the number of employees. One respondent stated that there was a need for a cohesive definition of companies in this sector.

The SME's have indirect access to buyers. Since they are small, they are good at smaller orders in the range of 5,000-10,000 pieces. This has led to large companies, with connections to brands, subcontracting to SME's. The large companies will either use smaller companies

as overflow capacity for large orders or will contract out work for smaller jobs. For example, when Asia was affected by the bird flu, buyers placed a lot of orders with Sri Lanka. In order to meet the increased demand, large companies subcontracted orders out to smaller companies.

A few of the SME's have product development and design, but not many. One respondent who is a trainer for pattern design / CAD classes and frequently works with SME's indicated that the SME's were interested in design and willing to make investments for CAD systems. Also, these small and medium companies are attending apparel and fabric trade shows to promote their products.

Companies in the SME sector normally consist of an owner-manager along with production employees. These owner-managers are reluctant to hire university graduates, as they cannot pay the salaries that large companies can. In addition, the SME's are performing a lot of in-house training and would rather not employ university graduates that they will have to train. That is, they expect the universities to train the graduates so that they will not have to train them.

It was claimed that the SME's had a low cost of production; however, one academic interviewed stated that the cost of production was not as low as claimed due to 1) low efficiency, 2) low productivity, and 3) high waste. This same academic did claim that there was a strength possibility in the SME's, as they do produce a good portion of apparel goods.

4.1.2.3 Large Companies

The large textile and apparel companies in Sri Lanka are highly sophisticated, with design and product development functions. These large companies also have direct access to buyers; in some cases, buyers have offices in the same buildings as large apparel manufacturing companies. See the company profiles, Section 4.1.3, for an in-depth look at several large apparel companies.

4.1.2.4 Upstream Manufacturing

4.1.2.4.2 Fabric

The domestic fabric industry in Sri Lanka is limited in terms of production. There is production for school uniform and army fabrics, and these appeared to be the only two apparel items that were both produced and consumed domestically. It was stated that 30% of fabrics were produced domestically; however, this could mean that 30% of fabrics were finished domestically. When inquiring about production of fabrics, it was discovered that Sri Lanka has no woven fabric production, but does have dyeing and finishing facilities for woven fabrics.

Sri Lanka does have knitted fabric production – both warp and weft knits – and produces about 40% of needed knit fabric domestically. In addition, there are dyeing and finishing facilities for knitted fabrics. In order to qualify for GSP+, a preferential duty-free program to promote growth in developing countries, the Sri Lankan industry needs to produce 350

million kilograms of fabric. At the time of the research, the country produced about 70 million kilograms of fabric. One respondent indicated that China had good innovation in fabrics, but before Sri Lanka could innovate, capacity should be built.

4.1.2.4.3 Yarn

China and India are two major sources of yarn for the Sri Lankan industry. It was found that there used to be yarn spinning in the country, through the company has now closed. A responded indicated that there were efforts by the government to privatize the yarn and fabric industry, though attempts were unsuccessful. The reason stated was that the Korean investors who were working on the projects "cheated the government."

4.1.2.4.4 Dyeing/Finishing

Fabrics are often dyed and finished in China. The government of Sri Lanka was investigating the feasibility of a new dyeing and finishing plant to increase the competitiveness of the industry. The main issue for this factory, aside from cost, is color matching.

4.1.2.5 Product Improvement Program

Respondents indicated a need to increase productivity. Because of this, many resources were being devoted to a new productivity improvement program (PIP). This program was instituted and fostered by the new director at a government-sponsored textile and apparel

training center. The program involves 23 university graduates from math, probability, process improvement, and is outside the paradigm of the training center, as the center does not usually educate university graduates. These students were being trained in productivity issues and are the future staff for the training center.

According to one respondent, there have been several other PIP programs at great expense, though they have not been successful. One reason given by the respondent was that the focus has been on productivity in sewing. Instead, the focus should be the productivity of the total supply chain, including cutting and finishing. From plant tours, it was evident that there is a lot of emphasis on decreasing time in sewing. It did not seem as though the same amount of emphasis was being placed on optimizing pre-production operations such as receiving, inspecting, and cutting.

4.1.2.6 Joint Apparel Association Forum (JAAF)

Large companies, SME's, and free trade groups are united in Sri Lanka under the Joint Apparel Association Forum (JAAF). JAAF serves as one voice for the industry, and its strength comes from coordination. It was formed as part of a Five Year Strategic Plan to strengthen the competitiveness of the industry. There are eight subcommittees in JAAF:

1. Backward Integration Committee
2. Finance Committee
3. Homan Resources and Technology Advancement Committee

4. Labor Initiatives Committee

5. Logistics and Infrastructure Committee

6. Marketing and Image Building Committee

7. SME Initiatives Committee

8. Trade Initiatives Committee (Joint Apparel Association Forum, 2008).

The Five Year Strategic Plan was developed in 2002 and was updated in 2006. The subcommittees work to implement the goals of the Five Year Strategic Plan.

4.1.2.7 Design and Product Development

One goal of the industry was to move from simple assembly processes to more value-added functions. A focus of value addition is design. A need for design was highlighted by the respondents. Traditionally, designs have been dictated by buyers. Now, buyers are looking for apparel manufacturers to design and develop new products. Customers of the industry are also asking for increased fashion in intimates.

A relatively new fashion degree program has been added to the curricula of the University of Moratuwa. This program was started in conjunction with the London College of Fashion. The program focuses on products, category, and price point. Interestingly, students have to design collections in their final year which utilize the next seasons fabrics. In order to accomplish this, many students travel to India because it is the cheapest and closest source of

fabrics. Though it is the SME's that need fashion employees to increase competitiveness, the fashion design students want to work with large companies.

Respondents indicated that JAAF was investigating the building a design center at the airport to facilitate quick response and just-in-time manufacturing. The Sri Lankan government would provide the land for the design center, and JAAF and other associations would contributing funds for the building. A design center at the airport would allow buyers to fly in, assess designs and products, and depart in a short amount of time.

4.1.2.8 Advantages of Sri Lanka

There were many advantages mentioned by respondents. In the past, buyers sourced from Sri Lanka because of availability of category specific quota. After 2005, products were sourced from Sri Lanka because of value addition through supply chain management, execution, compliance, product development, reliability (on-time delivery), and quality. In addition, communication is good with Sri Lankan manufacturers, as English is widely spoken in industry. It stated that manufacturers are satisfying the needs of brands. Soft advantages of Sri Lanka were mentioned as well, such as the presence of good beaches and a fun atmosphere.

Other advantages cited by respondents were that Sri Lankan manufacturers have no major quality issues. One respondent mentioned that Sri Lanka's ports are better than Bangladesh's.

There is also good product specialization in Sri Lanka, particularly with lingerie. The manufacturing base is competitive, though the advantage is being eroded by increases in labor and utility costs.

For lingerie companies, Sri Lanka has good local sources of fabrics, including elastics and lace. Having a proximal fabric source allows for reductions in raw materials inventory. The lead time for a basic fabric from Sri Lanka was quoted by one respondent as 3-4 weeks, with a lead time of 8-10 weeks for a non-basic fabric.

Sri Lankan manufacturers were cited as being easy to work with, with reasonably good quality compared to the region. Sri Lanka also has a reputation as an ethical clothing manufacturer. There is no child labor, and all the factories visited were clean and air-conditioned. Many apparel factories supply meals, health care, and lodging for production workers. In the cases where lodging is not provided, transportation is offered to ferry workers from residence to workplace. One HR manager spoke of providing counseling services to employees.

Geographically, Sri Lanka is well placed. Shipping time to Europe by boat was quoted as 13 days. Another geographic advantage is the proximity to India, which represents a potential consumer market for Sri Lankan manufacturers. Respondent indicated that they were 40-50 million consumers with spending power in India.

4.1.2.9 Disadvantages of Sri Lanka

Sri Lanka also has many disadvantages. The largest problems stem from the civil war between the government and the Tamil Tigers, an ethnic separatist group. Because of this conflict, buyers have been reluctant to visit Sri Lanka and the government has been limited in the amount of funding available for the industry's development. The cost of the war, in terms of both lost sales and lost government funding, has been detrimental to the industry.

Other rising costs have also become a problem with the industry. Utility costs and port charges have been increasing, and electricity is often unreliable. Much of the apparel industry relies on generators for constant electricity. In addition to utility costs, production costs are high due to low efficiency and high waste. Also, prices that manufacturers charge are decreasing, while wage rates are increasing. Further, interest rates are increasing, leading to an increased financial burden on manufacturers.

There are some infrastructure issues in Sri Lanka. Roughly 20 years ago, the apparel industry was moved to the villages. In order to reach these villages, one must travel on small, congested roads. This infrastructure is not good for quick delivery. These roads are being developed, and a north-south highway has been under construction for 6-7 years. Once the roads are improved, accessing remote factories will be easier and faster, and therefore, less expensive.

Another large issue in Sri Lanka is labor turnover. In speaking with human resource managers, turnover rates were identified from 2-5% per month and up to 30% per year. Because of this, companies are continuously spending time and money training employees. In addition, absenteeism is a large problem in the country. Respondents indicated that it is a habit of Sri Lankans to miss work – it is part of the "laid-back" attitude of the country.

One respondent spoke about "cheap" training in terms of both cost and quality. In the Sri Lankan culture, there is a lot of value placed on training programs and certifications. Workers like to tout that they have attended a short course, but there was discussion of the *real* value of a short course. The respondent said that attending several day-long short courses was not as valuable as attending one week-long course. In addition, there was little product-specific training being done, and one respondent spoke of the need for lingerie training.

Another disadvantage is a shortage of basic labor in sewing. There is a social stigma that is attached to the industry, as respondents indicated that the country looks down on the apparel industry. People that work in apparel factories live in dormitories, and it is thought that when the female apparel workers live together, they begin to socialize with men after the workday is over. As a result, it is thought that these women will not be able to marry because they are "loose."

The lack of marketing and supply chain management was also cited as a disadvantage. Merchandisers in the industry, at all size companies, are merely coordinators. Another disadvantage was the proximity of the manufacturing base to the consumption base. Sri Lanka is distant from the U.S. and Europe, which represent two significant markets for the industry. This can lead to difficulties in product development and design, as Sri Lankans do not understand their consumers.

Further, the lack of verticality in the industry is a disadvantage. However, increases in fabric manufacturing have led to continued confidence in Sri Lankan. As an example, a respondent indicated that 5 years ago, there were no domestic sources of elastic in the country; now there is. A buyer indicated that his company is comfortable sourcing from Company SL1 because of their level of verticality.

4.1.2.10 Needs

There were many needs that were mentioned when interviewing respondents. A few respondents indicated a need for a new airport and a new port on the southern tip of the island. The need for increased product development and design was also highlighted by respondents. In order to increase competitiveness, one respondent claimed that the industry needed to access niche markets. This would allow for increased margins and increased profitability. However, the respondent cautioned against relying solely on niche markets, and instead recommended serving a mix of niche and mass markets.

The Sri Lankan industry also needs innovation in finishing and environmental issues. In terms of finishing, increased competencies are needed with specialty finishes, such as nanotechnology or antimicrobial finishes. In response to environmental issues, one UK brand has opened a "green" factory in Sri Lanka with Company SL2. This is part of the UK brand's environmental policy to have a "green" supply chain.

In addition to a need to increased the number of value-added products, respondents indicated that Sri Lanka needed to capture new markets. They felt that U.S. and European markets are becoming stagnant in terms of growth, and cited Japan, India, New Zealand, and Australia as possible new markets. In addition, respondents indicated that Sri Lankan manufacturers, in the future, could not compete with China, India, and Bangladesh on price. Therefore, some respondents indicated that Sri Lanka could "piggyback" on India, as Hong Kong did with China. This would involve India serving as a raw material base for Sri Lankan apparel manufacturers.

Respondents also spoke of a need to minimize waste. Lean Management was offered as one way that could minimize waste. Sampling was an issue that was mentioned when speaking about waste. Many companies are making 3-4 samples, but such a sampling process yields waste in terms of time, materials, and money. By optimizing the sampling process, companies would be able to minimize the amount of waste generated.

As an example, one U.S. lingerie brand had a product development time, from concept to consumer, of 52 weeks. The company instituted an initiative to decrease lead time to 16 weeks. As summer 2007, the lead time was 26 weeks; this reduction in lead time was due to removal of non-value adding operations and duplication of work. This includes decreasing sample approval time through regional (Asian) approval of samples instead of the traditional U.S. sample approval.

Respondents indicated a need for a mindset change in the industry in terms of trust. Sri Lanka has a habit of policing people because of a lack of trust and a thought that employees cannot do their jobs. This has let to inspections being performed at every production stage in the apparel process. In a few cases, statistical process control is being performed to standard acceptable quality level, or AQL. In most cases, apparel manufacturers are inspecting 10% of each incoming order of fabric, though workers then check 100% of garments after *each step* in the assembly and finishing process.

Many of the companies visited were finishing final garments. Some of the treatments observed were stonewashing, hand sanding, sand blasting, chemical finishing with potassium permanganate, and curing with resin. Another way to add value was screen printing and embroidering. These post-production finishing techniques allow companies to add value without the capital needed to build a yarn or fabric mill. Industry respondents expressed an interest to develop specific training for washing and other post-production finishing techniques in order to access value.

4.1.3 Phase I (Field Research – Sri Lanka) Results: Company Profiles

4.1.3.1 Company SL1

Company SL1 is one of the premier textile and apparel manufacturing firms in Sri Lanka, with 700 million USD annual turnover. They are performing design functions, and have a supply chain with stretches from design to delivery and from concept to consumer. The company has 28 factories divided among three clusters: 1) intimates (7 factories), 2) activewear, and 3) fabrics.

The fabrics cluster produces elastics, lace, and warp and weft knits for internal and external customers, strengthening the supply chain capabilities of the overall company. The fabrics cluster is also producing molded bra cups, underwire, and hook and eye closures. There was an indication that a new printing facility would be operational by the end of 2007. In order to further facilitate supply chain management, Company SL1 is developing a fabric park with yarn spinning, weaving, knitting, and finishing.

4.1.3.2 Company SL2

Sri Lanka's largest exporter is Company SL2, with sales in excess of 320 million USD. The company has 20 plants in Sri Lanka, Bangladesh, and India. Plants in the Maldives and Madagascar were previously operated in order to take advantage of quota, but have been closed. Company SL2 is starting fabric plant in India to take advantage of India's economies

of scale. In addition, cost of production in India is lower than Sri Lanka. Company SL2 uses local sources for about 40-50% of raw materials from Sri Lanka.

Company SL2 caters to fashion brands, such as a lifestyle brand management and retailing company, an American clothing and accessories retailer, a major American denim brand, and a youth-oriented, lifestyle-branded retailer. The company produces sleepwear, lingerie, and casualwear (bottoms and denim). The company had produced denim for a major American denim brand in Spain, but moved production to Sri Lanka.

A competitive advantage of Company SL2 is backwards integration. The company has woven and knit fabric production and a dyeing and finishing plant. Company SL2 is also developing a new apparel park in India, using the Luen Thai Supply Chain City in China as a model. There, customers can visit factories, select products, and get samples in 2-3 days. The company does have design and development capabilities, and employs designers from Sri Lanka, India, and the UK.

Company SL2 also has a corporate training facility. One strategy utilized is customer-specific training. If the company decides to be the top supplier with a certain customer, Company SL2 will bring in a current or former employees with the customer that will educate employees on the culture of the customer. This helps Company SL2 in identifying and filling gaps in order to best meet the needs of the desired customer.

In terms of process improvement, Company SL2 will divide each process into sub-processes. Each of these sub-processes have metrics for each sub-process (i.e., time of each purchase order). The company will establish a current state baseline and a goal based on the best in class. Performance will then be measured over time and goals will be raised as performance improves.

In terms of sampling, the company has a separate sampling room for one of it's largest customer. This is mostly due to intellectual property issues. The company will develop customer-specific products that they will not share with other customers. In fact, to avoid leakage of the product they will destroy or burn the samples; this is a requirement of the customer. The company will have to photo document the destroyed product. Company SL2 also has a brand protection team, as well as a team that checks markets for counterfeit products. Also, their customers have investigations offices.

4.1.3.3 Company SL3

Company SL3 is a UK owned lingerie company. It is a member of a group of companies that produces hosiery, socks, lingerie, underwear, and shirts. The entirety of Company SL3's production is for one large UK customer. Other products the group produces are not specifically for that customer, but the end consumer is in the UK. The company produces both men's and women's products, and manufactures a mix of high volume, low value

products, such as multi-pack underwear, as well as more high value products, such as camisoles, bras, and underwire.

The company's head office is in the UK, which is where product development, design, and customer service functions are housed. The first sample is always made in the UK to enable quick turnaround; the Sri Lankan factory receives designs at the first fit stage. Company SL3 will then make fit and final samples in Sri Lanka. It was stated that design and product development would not move to Sri Lanka because of lead time. Additionally, warehousing and distribution functions are still located in the UK.

The connection to the UK expands into training as well. Because of a lack of lingerie-specific training in Sri Lanka, employees are sent to the UK to be trained in fit, pattern making, grading, and marker making. Training for production employees is done internally using GSD specifications.

Company SL3 used 70-75% local fabrics and imported the balance from China and India, mostly, as well as Taiwan and Turkey. Local fabrics were being sourced from all four Sri Lankan knit mills. Because of this use of local fabric, the company was receiving some GSP+ benefits. A GSP+ benefit was also being realized through the used of some European fabrics. For domestic fabrics, the company holds an inventory of, roughly, one week. More inventory is kept for imported fabrics, and the company has inventory for about 2 weeks

production. The respondent from Company SL3 indicated that there have been instances where the company will get new fabrics from China and then develop them locally over time.

Company SL3's factory in Sri Lanka had a factory productivity level ~60%; however, the productivity at any one time depends on the mix of products produced. For example, higher productivity can be achieved when producing panties, but when producing bras, the productivity will be lower.

The company has manufacturing plants in Mauritius, Cambodia, Indonesia (shirts), Morocco (higher fashion lingerie – faster turnaround time), and Turkey. Company SL3 also has sourced manufacturing in Vietnam and China. At the time of the interview, India and Bangladesh were being investigated as manufacturing locations. There is no manufacturing in the UK, only sampling.

Lead time from the customer's perspective is 26-28 weeks. Development has a lead time of 10-12 weeks, and fabric/product production has a 16 week lead time. Of this 16 week lead time, apparel production has a 3 week lead time. Travel time from Sri Lanka to the UK is 2-3 weeks, with about 1 week required to clear customs.

The factory visited had a 5-6% absenteeism rate and a 20% annual turnover, so the work force is essentially replaced every 5 years. Because the company has to constantly train employees, the company tends to develop employees internally. For sewing, Company SL3's

home office provides a rough estimate of a minute value. In the Sri Lankan factory, each operation is broken down, and makeup sheets are made using General Sewing Data (GSD) standards. Cycle checks are then performed using the makeup sheets.

4.1.3.4 Company SL4

Company SL4 started as textile trading company in 1890's. In the 1950's, the company began manufacturing for the domestic market, and began exporting in the 1970's. Company SL4 has three clusters: 1) wovens, 2) knits, and 3) a UK customer-specific unit producing a mix of knits and wovens. The company produces a 50/50 mix of knit and woven products and serves a 50/50 mix of U.S. and UK markets. Company SL4 has 10 plants in Sri Lanka, 4 in Bangladesh, 1 in Vietnam, and 1 in India.

The company started product development about 2.5 years ago, and has a product development center with 2 head designers. At the time of the interview, about 50 percent of the company's orders were being designed in-house. The customer for Cluster 3 visits often, and a U.S. brand visits twice per year. More European customers are using the design center. Buyers want to be able to source fabrics from the company as well – in essence making the company a full-package source. In terms of product development, buyers come with an idea, colorways, and/or sketches. Buyers want fabrics and washes developed for a certain price point. In terms of intellectual property issues, the company will only show 'customer A' products to 'customer B' after those products have been rejected by 'customer A.'

Company SL4 is heavily involved with joint ventures and partnerships to promote supply chain management and backward integration. One joint venture of Company SL4 involves Company SL2 and a Hong Kong company. This joint venture produces greige, dyed and finished, and printed weft knit fabrics. Another joint venture resulted in a labeling factory with an international labeling firm. Also, the company manufactures packaging materials through another joint venture.

The company sources 30-40% of knits from its joint venture. It sources some wovens from a mill owned by Company SL2, some from a Sri Lankan wovens finishing plant, and the balance from Pakistan, India, and China. The respondent from Company SL4 highlighted a need for growth in woven manufacturing in Sri Lanka.

The company's lead time is 62-110 days. Orders for yarn dyed products have a longer lead time. Some buyers book capacity and approve lab dips, which results in shorter lead times. In the cases where buyers book capacity, the company will hold greige good inventory.

The customers of the company are a major British retailer, a major American fashion company, a lifestyle-branded retailer, a leading multiple-brand apparel company, a major British grocery and retail company, the children's brand of an American lifestyle-branded retailer, a leading khaki brand, a major American denim brand (12,000 units/week), an American, lifestyle denim brand (almost all non-denim and some denim), and an outdoor-

lifestyle brand retail and catalog company (using a lot of U.S. and European fabrics – some cost $19-20/yard).

Company SL4 is also washing and finishing denim as a way to add value. The respondent said that washing can turn a $50 pair of jeans into a $150 pair of jeans. One of the company's customers sends people at the beginning of each season to teach new washing and finishing techniques.

4.1.3.5 Company SL5

Company SL5 was founded in 1982. It has since been acquired by a Hong Kong company, which has since been acquired by a U.S. brand management company. Company SL5 produces knit and woven tops and bottoms, in addition to washing and dipping denim. The company has 8 factories in Sri Lanka. Company SL5 has 11,500 employees. Of those, 7,000 employees work in one town (with 3 factories). Factory 1, the company's largest, has 4,500 employees. The company had an export revenue of roughly 105 million USD.

Design was being done by the home office in Hong Kong, but the respondent indicated that design may move to Sri Lanka in the future. The home office was also dictating fabric sources to the company, although some buyers provide fabric or dictate sources of fabrics. Sri Lanka serves as the production and warehousing center for the company. The respondent from Company SL5 stated that the three important things to the organization were 1) quality,

2) cost, and 3) on-time delivery. The production department for the company focused on quantity, and the quality department focused on quality.

4.1.3.6 Company SL6

Company SL6 is a bottoms manufacturer that works mainly with denim. There are five plants in the company's group. The plant visited performs the following functions for the group: receiving and inspection of fabrics, fabric warehousing, cutting, finishing, quality control, packing, and shipping. Finishing activities at Company SL6 include sanding, whiskering, curing, oxidizing with potassium permanganate, and stone washing (Figure 4.1).

The major customer for the company is an American women's denim brand, and they are also producing some denim products for a major American denim brand. The majority of the products are composed of stretch denim. The fabrics for the group are sourced from India, Israel, and Pakistan. In the past, the group received cut parts from Israel in order to take advantage of a trade agreement.

There is some product development and design performed in-house. The company has a separate wash development section for a major American denim brand to protect intellectual property rights. Respondents were interviewed in several areas of the factory, and the product development and design team stated that they needed designers with textile knowledge, including the way that pattern is affected by drape, style, weight, and shrinkage, as well as

the ways in which fabrics interact with dyestuffs. The washing manager and washing product development manager traveled to the U.S., Italy, and Spain to receive training in finishing and washing.

Hand sanding

Whiskering

Stone washing

Spraying potassium permanganate

Figure 4.1: Value addition activities at Company SL6

Due to the remote location of the factory visited and the difficulty of the work, turnover is high. In addition, the factory had a large proportion of male workers, whereas sewing factories for the group have mostly female workers.

4.1.3.7 Company SL7

Company SL7 is a childrenswear manufacturer, with a head office in Hong Kong and a technical center in China. The technical center performs product development and sampling functions. Designers and merchandisers for the company are from Hong Kong and have an increased wage requirement compared to Sri Lankans. The company sources yarn from China and owns a knit mill in Malaysia, with sourced apparel production from China and the Philippines. Customers of the company include an American clothing and accessories retailer, a global marketer of children's apparel, a major children's brand, a leading global discount retailer, and a buying company for women's and children's brands.

The company has two sewing plants, one for wovens and one for knits. The woven sewing plant had an efficiency of ~55%, with the knit sewing plant at ~50% efficiency. The respondent from Company SL7 stated that efficiency could be as low as 35% for small orders.

The factory visited in Sri Lanka served as a central cutting location, as well as a garment washing and finishing center, with screen printing, heat transfer, embroidery, sanding, and washing (Figure 4.2). The capacity for screen printing and embroidery was a 50/50 mix of in-house and contract work. The company had 64 embroidery machines capable of traditional embroidery and sequin embroidery.

Screen printing

Heat Transfer
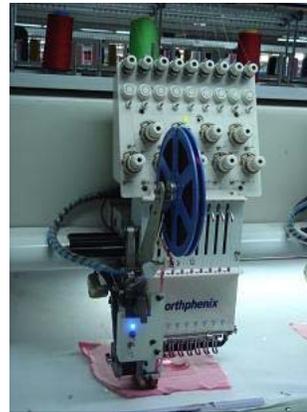
Embroidery

Sequin Embroidery

Figure 4.2: Value addition activities at Company SL7

It is noteworthy that the factory was WRAP[1] certified, and some buyers recognized the certification, through some brands have their own compliance standards/departments that do not recognize WRAP. Therefore the company had to be compliant with several codes of conduct, often simultaneously.

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[1] WRAP (Worldwide Responsible Accredited Production) is a third-party certification organization that determines factories' compliance with standards designed to ensure "lawful, humane, and ethical conditions" for workers (Worldwide Responsible Accredited Production, 2008).

4.1.3.8 Company SL8

Company SL8 is a buying company formed through a joint venture with a large, American contract manufacturer, Company SL1 and Company SL2. When the company was formed 20 years ago, labor in Sri Lanka was cheap and motivated buyers to source from the country. The company works with a leading plus-size retailer and an Italian denim brand, and formerly worked with a youth-oriented, lifestyle-branded retailer and an American, lifestyle-branded retailer.

The respondent from Company SL8 was worried about the stability of the region, as well as competition from India, which is a "vast untapped resource." According to the respondent, Sri Lanka's costs are increasing, but companies in the country have good relationships. The large, American contract manufacturer for which the company buys does $530 million in business in Sri Lanka.

4.1.3.9 Company SL9

Company SL9 is an American lifestyle branded apparel company. The respondent had only been working with Company SL9 for 3 months, but had worked with other brands and was able to speak from a general perspective. The main challenges in sourcing from Sri Lanka are rising costs and the raw material base. Fabrics for apparel production are coming from South Asia. Company SL9 sources finished fabrics for cutting and sewing in Sri Lanka. The respondent discussed multiple sourcing models:

1. Technical products – brand develops fabrics with a few mills (or one, if proprietary), and gives apparel manufacturers the choice of mill (decision made by apparel manufacturer based on relationships, cost, lead time, etc);

2. Some apparel manufacturers find new fabrics and bring to brand;

3. Some sources are 100% dictated by the brand.

The respondent from Company SL9 stated that large companies in Sri Lanka, such as Company SL1 and SL2, have great sourcing because of supply chain ownership. Because Sri Lanka is lacking in upstream manufacturing, 65-70% of lead time is from raw material, with 2-3 weeks coming just from transit. This leads to increased competitiveness for companies with backward linkages.

When discussing productivity improvement, the respondent from Company SL9 stated that brands don't want to squeeze lead time in production. The vast majority of brands buy and use capacity in monthly "buckets." Some companies, like Zara, use weekly buckets. If a brand is using monthly buckets, then it does not make sense to reduce the lead times to less than a month. Therefore, productivity improvement resulting in lead time reductions of less than a month, in most cases, does not interest brands.

In terms of compliance, the respondent for Company SL9 provided three steps. First, manufacturers have to adhere to local laws. Next, manufacturers have to consider brand-specific codes of conduct. In many cases, manufacturers are third-party certified, but they

must also comply with separate customer-specific codes of conduct. As an example, an apparel manufacturer may be WRAP certified, but the company's customer would want the manufacturer to comply with its own code of conduct. Lastly, in order to remain competitive, manufacturers must consider industry best practices. An example would be the "green" movement; Sri Lankan manufacturers are interested because it offers a competitive advantage, and not necessarily because of environmental benefits.

4.2   Phase II (Survey) Results

4.2.1   Phase II (Survey) Results: Summary Statistics

Online survey data was collected June-September, 2008. As can be seen in Table 4.2, of the 5724 textile and apparel industry members contacted, 79 respondents completed the online survey. One respondent began the survey but not finish, and the results do not include the omitted respondent. These respondents represent a wide variety of job functions. The top five job areas of the respondents were 1) supply chain management (22 respondents), 2) sourcing (13 respondents), 3) production and manufacturing (5 respondents), 4) purchasing (5 respondents), and 5) CEO (5 respondents).

Table 4.2: Job areas of respondents (Question 1)

	Frequency	Percent
supply chain management	22	27.8
sourcing	13	16.5
purchasing	5	6.3
other (CEO)	5	6.3
other (producing, production, production management, manufacturing)	5	6.3
other (managing, management, management of sales and service)	4	5.1
other (merchandising)	3	3.8
other (marketing)	2	2.5
other (apparel manufacturing)	2	2.5
other (general manager)	2	2.5
other (develop new customer and to ensure the order has been executed properly)	1	1.3
other (strategic planning)	1	1.3
other (human resources)	1	1.3
no answer	1	1.3
other (manufacturing and exporting)	1	1.3
other (compliance, training)	1	1.3
other (business solutions)	1	1.3
other (executive)	1	1.3
other (executive director of an industry trade association)	1	1.3
other (product development)	1	1.3
other (process improvement)	1	1.3
other (engineering)	1	1.3
other (operations)	1	1.3
other (export)	1	1.3
other (commercial/sales)	1	1.3
other (interior design)	1	1.3
Total	79	100.0

Respondents to the survey were asked how long they had been employed with their companies. Figure 4.3 shows that the majority of respondents have been employed for more than five years. Over a third of respondents have been employed for more than ten years.
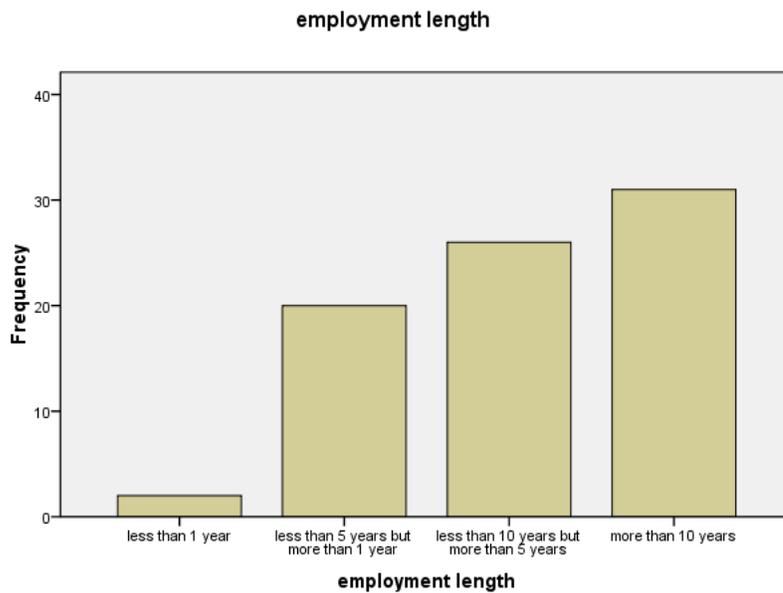
Figure 4.3: Employment lengths for respondents (Question 2)

Table 4.3 shows where companies that responded to the survey were headquartered. Companies from Bangladesh and the United States represent the highest number of responses to the survey. Two of the respondents did not provide headquarter information for their companies and are denoted as 'missing' in Table 4.3. Alternatively, 'valid' responses were those in which company headquarters were provided.

Table 4.3: Location of companies' headquarters (Question 3)

country

		Frequency	Percent	Valid Percent
Valid	Bangladesh	27	34.2	35.1
	Hong Kong	1	1.3	1.3
	Sri Lanka	5	6.3	6.5
	Thailand	5	6.3	6.5
	United States	24	30.4	31.2
	England	1	1.3	1.3
	Peru	7	8.9	9.1
	Guatemala	3	3.8	3.9
	Honduras	1	1.3	1.3
	The Netherlands	1	1.3	1.3
	Belgium	1	1.3	1.3
	El Salvador	1	1.3	1.3
	Total	77	97.5	100.0
Missing	System	2	2.5	
Total		79	100.0	

For the purpose of analysis, these countries were placed into one of two categories, developing or developed, based on classifications in the CIA World Factbook (Appendix B, 2008). Developed countries include Hong Kong, the United States, England, the Netherlands, and Belgium. Developing countries include Bangladesh, Sri Lanka, Thailand, Peru, Guatemala, Honduras, and El Salvador. Figure 4.4 illustrates the number of developing and developed countries that participated in the survey.
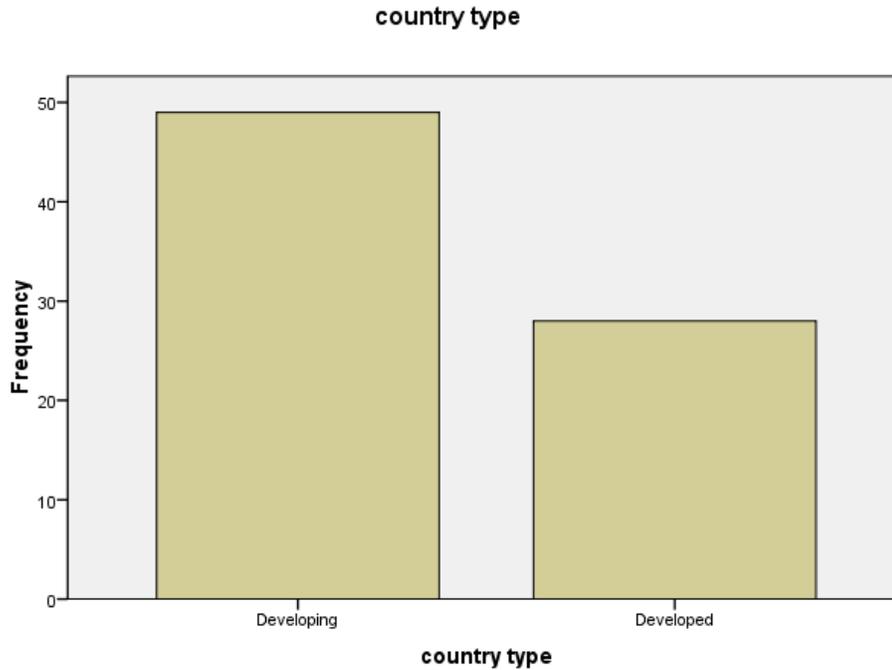
Figure 4.4: Country types (Determined from Question 3)

The countries were also grouped into regional categories to look for trends by region. The three regions were 1) Asia, 2) Latin America, and 3) US/EU. Though the U.S. and the EU are not geographic regions, they have been grouped together due to similarities in company function and structure. Since these regions are high cost in terms of labor, companies in the U.S. and the EU are most likely not manufacturing bases. Instead, companies in these regions would be more suited to marketing and brand management functions, where production is outsourced. The groupings can be seen in Figure 4.5.
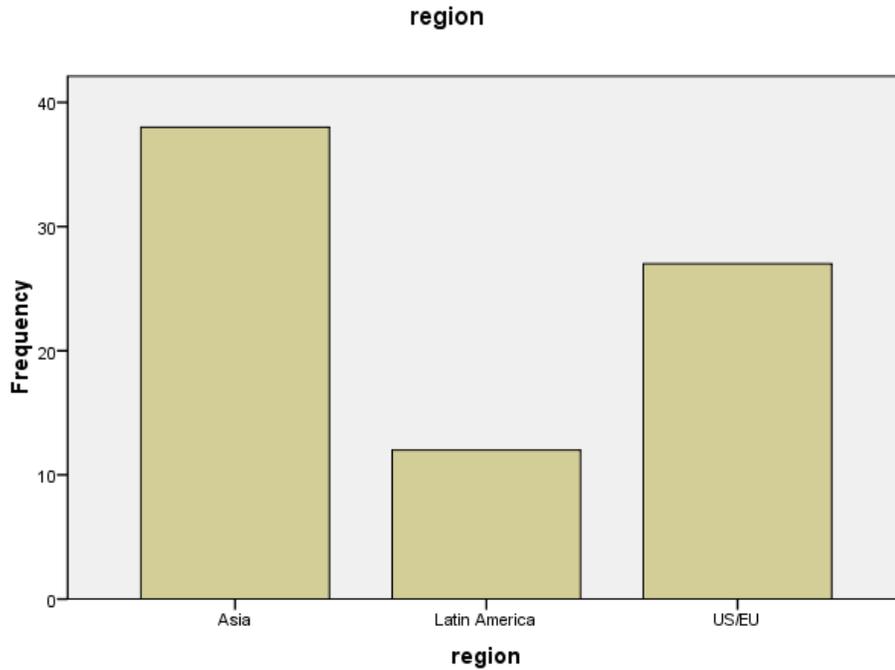
Figure 4.5: Company regions (Determined from Question 3)

Respondents were asked to select all of the product categories in which their companies compete. As seen in Table 4.4, most companies compete in the tops and bottoms markets. The total count is greater than 79 because this question was 'select all that apply.' There were several 'other' responses, most notably lingerie and sweaters. It is interesting to note that there is a variety of responses, from resin to fiber to fabric to industrial and performance textiles.

Table 4.4: Summary of product categories (Question 4)

Product Category	Count
bottoms	49
tops	40
lingerie	11
(other) sweaters	6
(other) home textiles, home fashions, home furnishings	4
(other) synthetic fibers, fibers	2
(other) apparel roll goods, fabric production	2
(other) sportswear and casualwear	1
(other) fleece and knit products	1
(other) ladieswear only	1
(other) sleepwear	1
(other) t-shirts	1
(other) jackets	1
(other) jogging sets	1
(other) mens innerwear	1
(other) knitted garments	1
(other) spinning mill	1
(other) yarn and fabric	1
(other) trim supply	1
(other) dresses for children	1
(other) logistics provider	1
(other) sewing thread	1
(other) PET resin and packaging	1
(other) industrial textiles	1
(other) performance textiles	1
(other) childrens products	1
(other) special projects	1
(other) automotive, napery, drapery, carpets, nonwovens, etc.	1
(other) hosiery	1
(other) automotive interiors	1
(other) consulting to all of above	1
(other) yarns and knitted apparel	1

Respondents were asked to classify their company according to type. These company types are shown in Table 4.5. The total count of responses is greater than 79, as this was a 'select all that apply' question. Most of the respondents characterized themselves as manufacturers. There was participation by brand managers/marketers and retailers, though those companies represent a small proportion of responses. It is interesting to note that there were responses from a consultant, a third-party logistics provider, a machinery supplier, and a trade association. Company type was one question where the responses were able to be collapsed into fewer categories in order to perform chi-square analyses. The modified category for 'other' variables and the modified counts of each response are also shown in Table 4.5.

Table 4.5: Summary of company types (Question 5)

Company Type	Count	Modified Category	Modified Count
manufacturer	66		67
agent	9		10
brand manager/marketer	8		8
retailer	3		4
auxiliary	1		11
(other) exporter	4	auxiliary	
(other) liason office	1	agent	
(other) converter	1	manufacturer	
(other) contracted manufacturer	1	duplicate – removed	
(other) distributor	1	auxiliary	
(other) 3PL	1	auxiliary	
(other) trade association	1	auxiliary	
(other) importer	1	auxiliary	
(other) machinery supplier	1	auxiliary	
(other) consulting	1	auxiliary	
(other) retail/design	1	retailer	

Products produced by the companies are listed in Table 4.6. Most of the products produced were apparel, though there was fairly good representation of the supply chain from fiber, yarn, and fabric companies.

Table 4.6: Summary of products produced (Question 7)

Products Produced	Count
fiber	5
yarn	15
woven fabric (greige)	11
knitted fabric (greige)	15
woven fabric (dyed and finished)	15
knitted fabric (dyed and finished)	13
nonwovens	7
apparel	48
other (sweater)	2
other (retail ready home textiles, home fashions)	2
other (garments manufacturer)	1
other (zipper, elastic, labels)	1
other (dresses)	1
other (sewing thread)	1
other (carpet, chemicals)	1
other (own embroidery machine for monogramming)	1
other (weaving machines, weaving and knitting yarn feeders, jacquard heads)	1

The regions in which the companies manufacture are diverse in terms of location. There is a good distribution of manufacturing region, particularly when 'other' responses are collapsed. There were comparatively few responses from Africa and the Middle East, and they were therefore removed from analysis. Both responses and modified responses with counts are

shown in Table 4.7. The total count of responses is more than 79 because this was a 'select all that apply' question.

Table 4.7: Summary of manufacturing regions (Question 8)

Manufacturing Region	Count	Modified Category	Modified Count
United States	16		16
Americas (excluding United States)	20		21
Europe	10		10
Asia Pacific	15		17
South Asia	30		31
Middle East	1	Omitted from analysis	
North Africa	3	Omitted from analysis	
Sub-Saharan Africa	0	Omitted from analysis	
other (no answer)	2	Omitted from analysis	
other (South East Asia)	2	Asia Pacific	
other (South America)	2	duplicate – omitted	
other (Bangladesh)	1	South Asia	
other (Guatemala)	1	Americas (excluding United States)	

Table 4.8 provides an overview of the products sourced by companies participating in the survey. This was a 'select all that apply' question, and therefore the total count of responses is greater than 79. Since the majority of the companies in the survey were manufacturers and the majority of products produced were apparel, it follows that the majority of the products sourced were fabric (greige fabric, n = 32; dyed and finished fabric, n=57).

Table 4.8: Summary of products sourced (Question 9)

Sourced Products	Count
fiber	18
yarn	33
woven fabric (greige)	19
knitted fabric (greige)	13
woven fabric (dyed and finished)	32
knitted fabric (dyed and finished)	25
nonwovens	10
apparel	15
other (trimmings/accessories, accessories for apparel, accessories of garments, trims)	6
other (retail ready home textiles, home fashions-finished products)	2
other (acrylonitrile)	1
other (mostly printed fabric)	1
other (no answer)	1
other (our members source PET resin from off shore)	1
other (films)	1
other (electronic components)	1
other (none, but works with all)	1
other (braided and plied)	1

Respondents indicated the regions from which their companies source. The results are shown in Table 4.9. The top responses are Asia Pacific and South Asia. Combining these into an "Asia" region, there are 85 responses. If the next three responses, United States, Americas (excluding United States), and Europe, were combined, then there would be 82 responses. This shows the dependence on Asia as a source for textile and apparel goods.

Table 4.9: Summary of sourcing regions (Question 10)

Sourcing Regions	Count	Modified Category	Modified Count
United States	35		35
Americas (excluding United States)	23		23
Europe	24		24
Asia Pacific	43		46
South Asia	35		39
Middle East	6		6
North Africa	5		5
Sub-Saharan Africa	2		2
other (China, Hong Kong, and Taiwan)	1	Asia Pacific	
other (South East Asia)	1	South Asia	
other (India, China, Pakistan, and Indonesia)	1	Asia Pacific, South Asia	
other (own country, local)	2	South Asia (2)	
other (mostly China)	1	Asia Pacific	
other (Australia)	1		1

Sales figures for 2007, in U.S. dollars, are shown in Figure 4.6. The highest number of responses were from companies making between one and five million dollars per year. In order to aid analysis of the sales data, the number of categories was decreased from ten to six. The 2007 sales data (2007 Sales) and the alternative 2007 sales data (2007 Sales alt) are shown in Table 4.10.
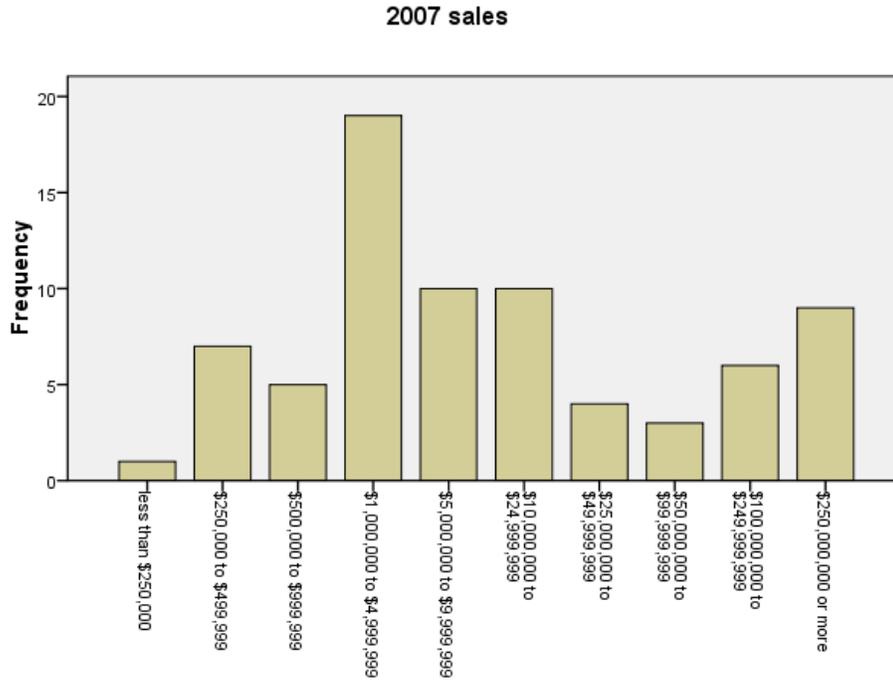
Figure 4.6: 2007 sales of companies (Question 11)

Table 4.10: Relation of 2007 sales to 2007 sales alt (Determined from Question 11)

2007 Sales	Count	2007 Sales alt	Modified Count
less than $250,000	1	less than $1,000,000	13
$250,000 to $499,999	7		
$500,000 to $999,999	5		
$1,000,000 to $4,999,999	19	$1,000,000 to $4,999,999	19
$5,000,000 to $9,999,999	10	$5,000,000 to $9,999,999	10
$10,000,000 to $24,999,999	10	$10,000,000 to $49,999,999	14
$25,000,000 to $49,999,999	4		
$50,000,000 to $99,999,999	3	$50,000,000 to $249,999,999	9
$100,000,000 to $249,999,999	6		
$250,000,000 or more	9	$250,000,000 or more	9
Total	74	Total	74

Figure 4.7 illustrates the number of employees for the respondents' companies. There were a large number of responses from both small (under 500 employees) and large (2,000 or more employees) companies. Interestingly, the same pattern seen in Figure 4.7, with a large number of responses on both ends of the spectrum, was not seen when looking at sales data. Instead, the sales data had the large number of responses concentrated in the middle ($1,000,000-$4,999,999).
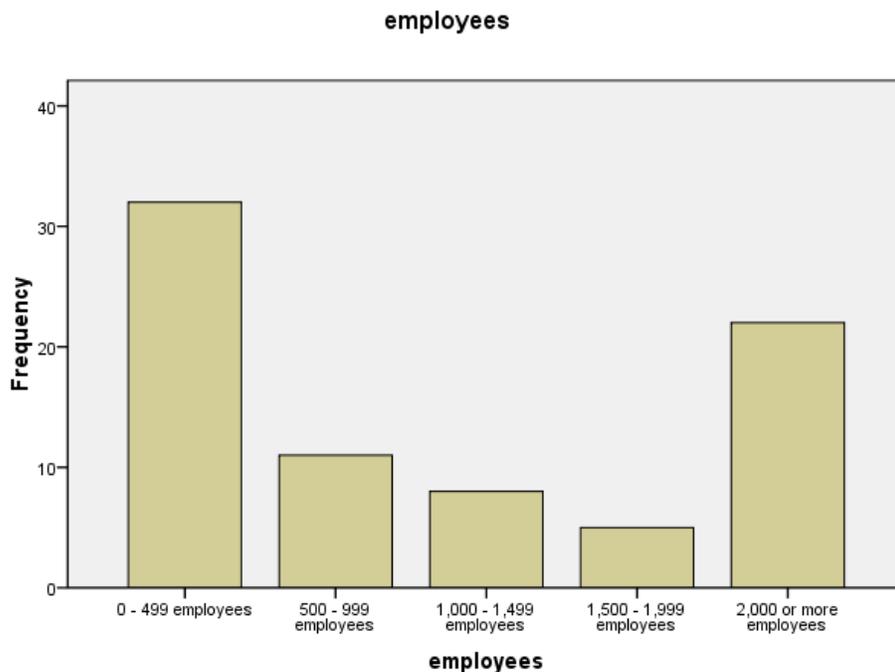
Figure 4.7: Number of employees for companies (Question 12)

Performance metrics for suppliers are shown in Figure 4.8. The top supplier performance metrics, in order, were 1) *quality*, 2) *on-time delivery*, 3) *cost*, and 4) *customer service*.

Capacity and *lead time* were tied for the fifth most important supplier performance metric. Tied for the fifth least important supplier performance metric were *financial health*, *availability*, and *product development / design capabilities*. The bottom four supplier performance metrics, in order, were *product innovation*, *damages*, *product / service variety*, and lastly, *in-stock rates / stock-outs*.
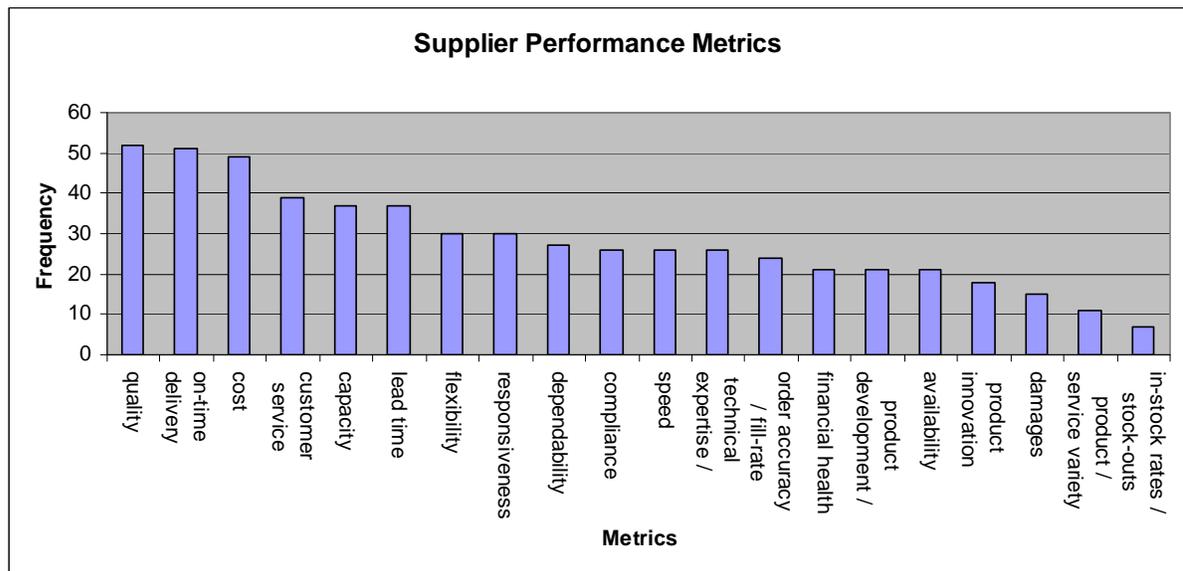
Figure 4.8: Frequency of supplier performance metrics (Question 17)

Figure 4.9 shows performance metrics for customers. The top five customer performance metrics, in order were 1) *cost*, 2) *quality*, 3) *financial*, 4) *on-time delivery*, and 5) *capacity*. The bottom customer performance metrics were *speed*, *product development / design capabilities*, *product innovation*, and *availability*. Tied for the least important customer performance metric were *damages*, *in-stock rates / stock-outs*, and *product / service variety*.
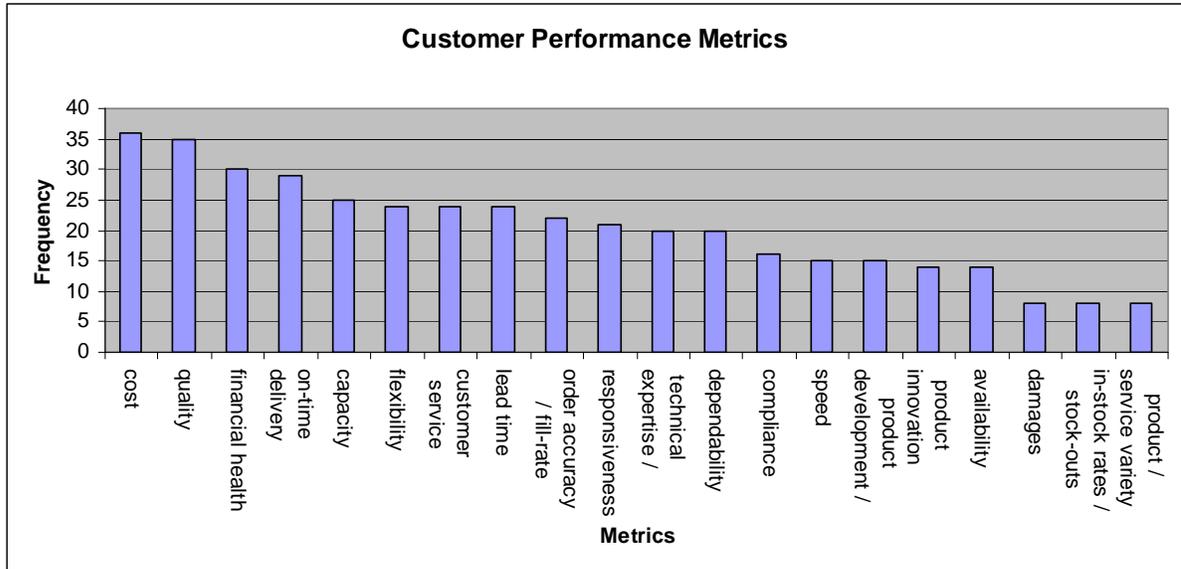
Figure 4.9: Frequency of customer performance metrics (Question 18)

Performance metrics used internally are presented in Figure 4.10. The top internal performance metrics were, in order, 1) *quality*, 2) *on-time delivery*, 3) *cost*, 4) *customer service*, and 5)*compliance*. The bottom metrics were *dependability*, *damages*, *product / service variety*, *availability*, and, lastly, *in-stock rates / stock-outs*.
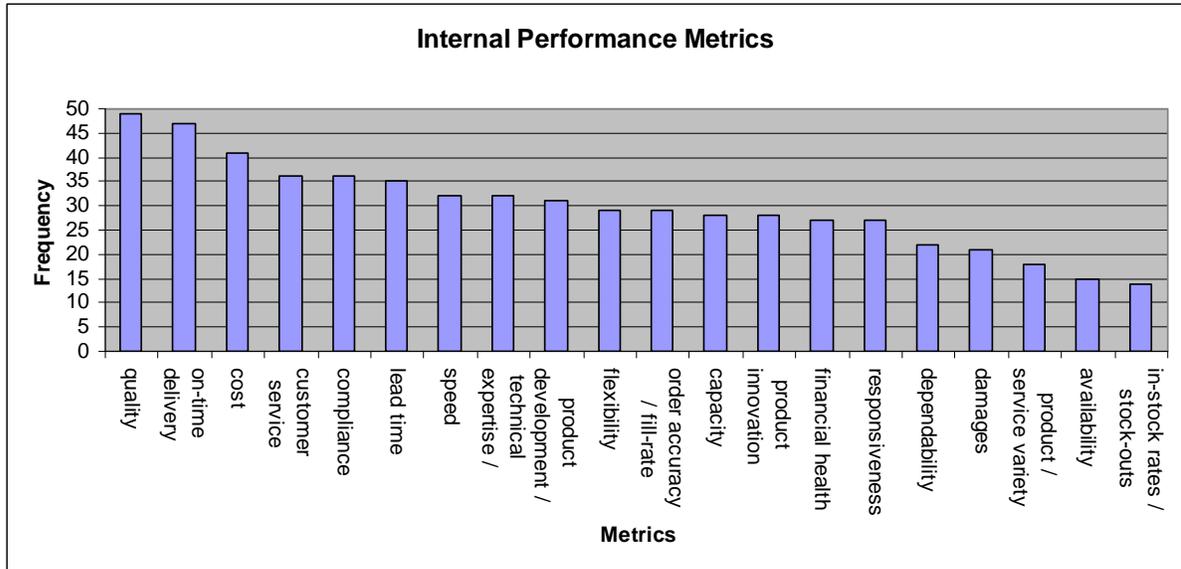
Figure 4.10: Frequency of internal performance measures (Question 19)

Figure 4.11 shows metrics to gauge the performance of supply chains. The most important metrics were 1) *cost*, 2) *on-time delivery*, 3) *quality*, 4) *lead time*, and 5) *capacity*. The least important metrics were *product innovation*, *financial health*, *product development / design capabilities*, *damages*, *in-stock rates / stock-outs*, and, lastly, *product / service variety*.
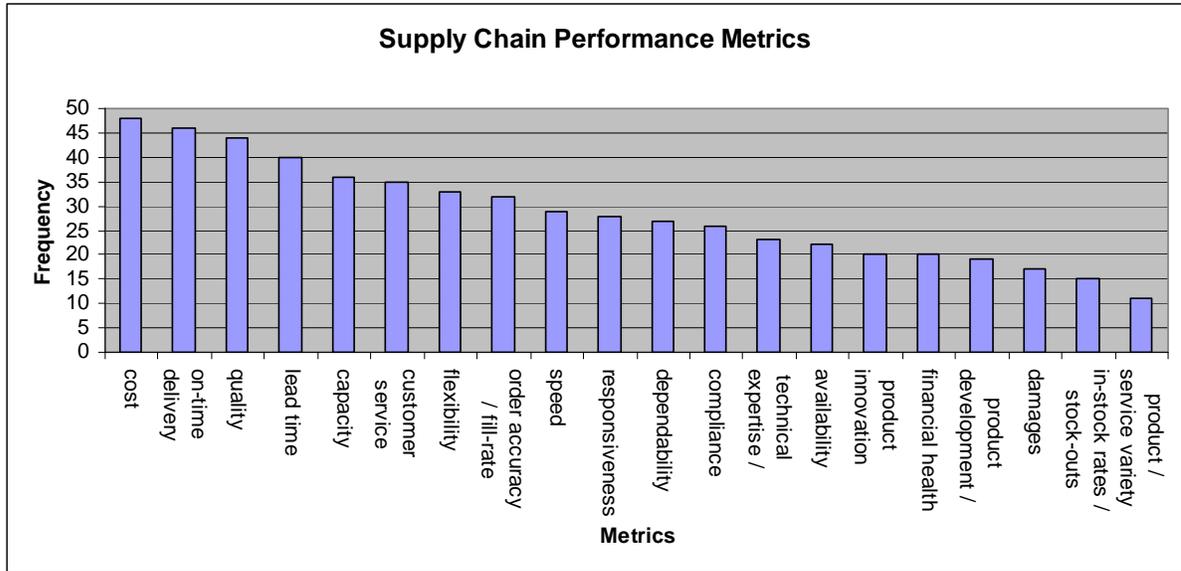
Figure 4.11: Frequency of supply chain performance metrics (Question 19)

The supplier, customer, internal, and supply chain performance metrics shown above have been combined into one graphic, Figure 4.12. Rather than showing metrics by count, Figure 4.12 shows metrics by relative percentage of responses. The top five and bottom five supplier, customer, internal, and supply chain performance metrics are shown in Table 4.11.
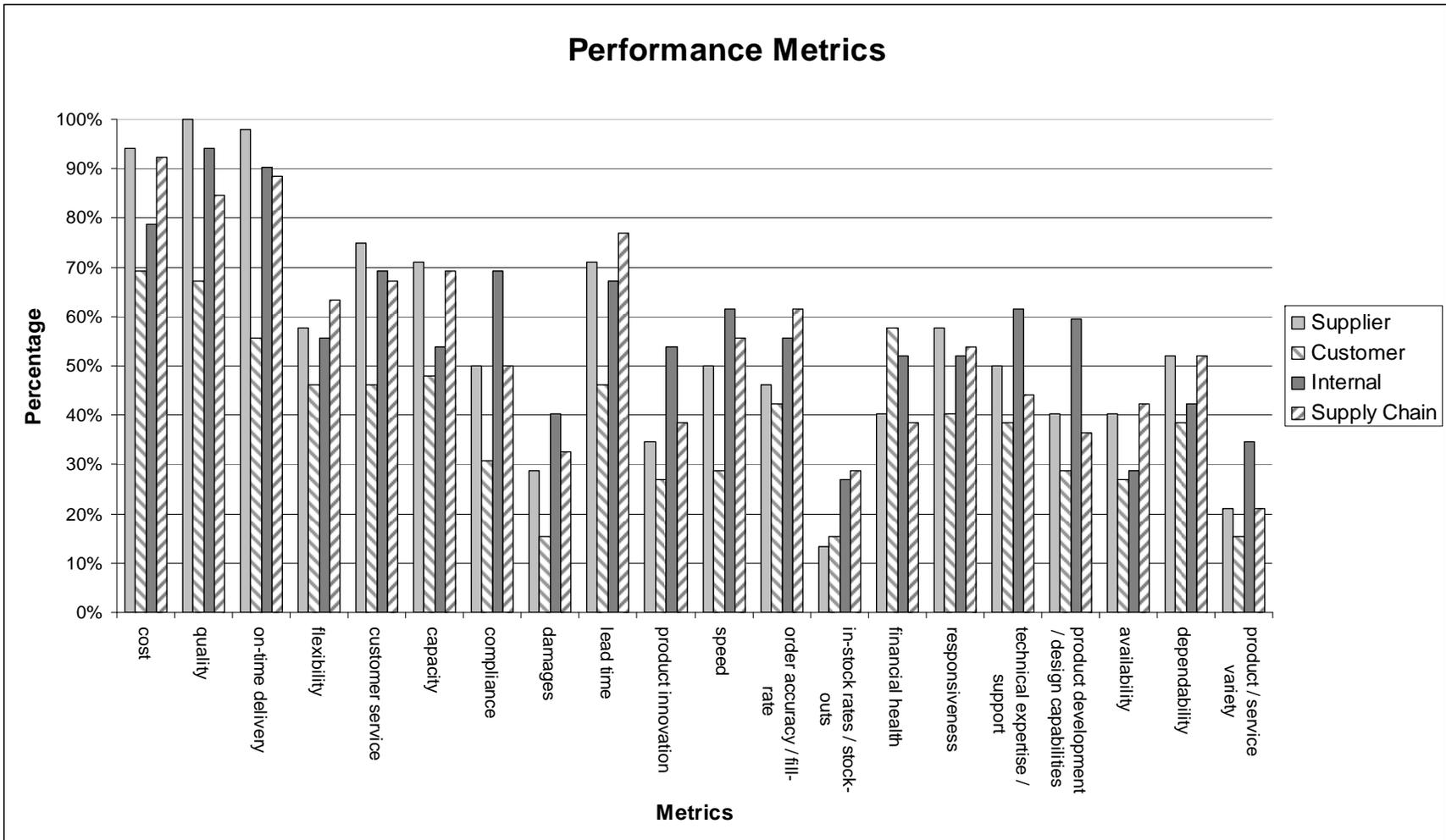
Figure 4.12: Relative percentages of supplier, customer, internal, and supply chain performance metrics

Table 4.11: Top and bottom supplier, customer, internal, and supply chain performance metrics

Supplier Performance Metrics		Customer Performance Metrics	
Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**	
quality	100.00%	cost	67.92%
on-time delivery	98.08%	quality	66.04%
cost	94.23%	financial health	56.60%
customer service	75.00%	on-time delivery	54.72%
capacity	71.15%	capacity	47.17%
Bottom 5		**Bottom 5**	
availability	40.38%	product innovation	26.42%
product innovation	34.62%	availability	26.42%
damages	28.85%	damages	15.09%
product / service variety	21.15%	in-stock rates / stock-outs	15.09%
in-stock rates / stock-outs	13.46%	product / service variety	15.09%
Internal Performance Metrics		**Supply Chain Performance Metrics**	
Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**	
quality	92.45%	cost	92.31%
on-time delivery	88.68%	on-time delivery	88.46%
cost	77.36%	quality	84.62%
customer service	67.92%	lead time	76.92%
compliance	67.92%	capacity	69.23%
Bottom 5		**Bottom 5**	
dependability	41.51%	financial health	38.46%
damages	39.62%	product development / design capabilities	36.54%
product / service variety	33.96%	damages	32.69%
availability	28.30%	in-stock rates / stock-outs	28.85%
in-stock rates / stock-outs	26.42%	product / service variety	21.15%

4.2.2   Phase II (Survey) Results: Chi-square Tests of Survey Data

Chi-square tests for independence were performed on the survey data to assess if there were statistically significant differences among variables. The statistical analyses were performed using SPSS 16.0 for Windows (SPSS is a registered trademark of SPSS, Inc.). The results of the chi-square tests are summarized by research question in the following tables. Using an alpha level of 0.055, significant p-values have been highlighted. Following each research question-specific summary table, frequency tables or bar charts have been shown for significant chi-square results. In a few cases, chi-square results were significant; however, the cell sizes were inappropriate for analysis. In these cases, results are not discussed.

4.2.2.1 RQ1: How does the presence of a performance measurement system differ?

First, chi-square tests were performed to determine how the presence of a performance measurement system differs (R1). The results are shown in Table 4.12.

Table 4.12: Chi-square values, degrees of freedom, and p-values for RQ1 – How does the presence of a performance measurement system differ?

Research Question	Variable	Chi-square	df	P-value
RQ1a	Country	17.938	11	0.083
RQ1b	**Country Type**	**3.787**	**1**	**0.052**
RQ1c	**Region**	**5.804**	**2**	**0.055**
RQ1d[*]	Type of Company	4.108	5	0.534
RQ1e[*,†]	Products Produced	15.125	17	0.587
RQ1f	**Manufacturing Region**	**13.736**	**5**	**0.017**
RQ1g	Size by Sales	6.851	5	0.232
RQ1h	**Size by Employees**	**16.855**	**4**	**0.002**
RQ1i	**End Market**	**16.151**	**5**	**0.006**

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

As seen in Table 4.12, the presence of a performance measurement system by country type is slightly significant different (p-value = 0.052). Taking a closer look at this relationship, Figure 4.13 is a bar chart showing the presence of a performance measurement system (yes or no) by the type of country (developing or developed). There is evidence that the proportion of companies in developing countries that do not have a performance measurement system is greater than the proportion that do have such a system. When looking at developed countries, it seems that a greater proportion does have a performance measurement system.

Bar Chart
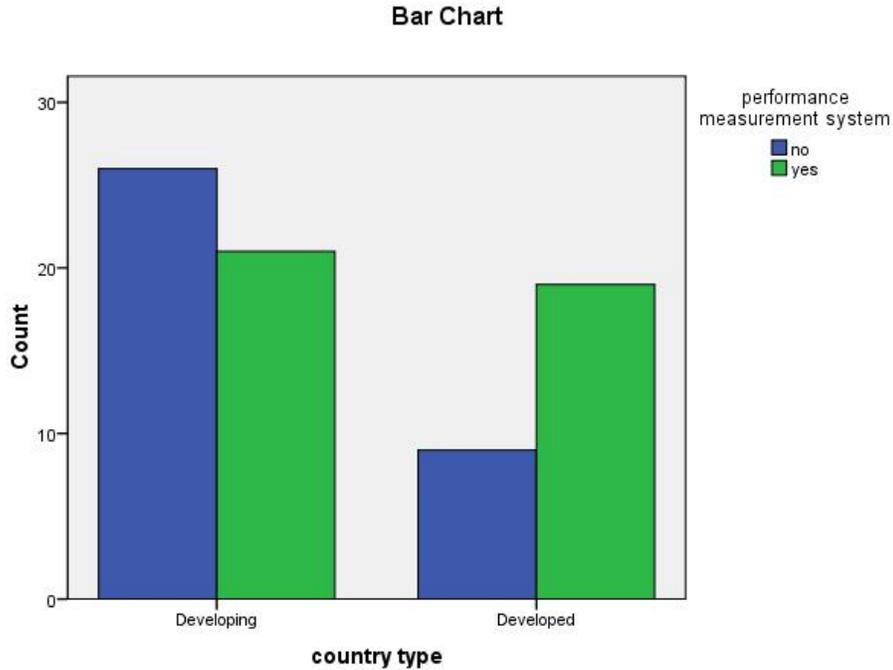
Figure 4.13: Presence of a performance measurement system by country type (RQ1b)

The presence of a performance measurement system by region is also slightly significantly different (p-value = 0.055). As shown in Figure 4.14, more companies in U.S./EU have a performance measurement system than do not. A slightly larger proportion of companies in Asia have a performance measurement system than do not. This research indicates that companies in Latin America, however, are more likely to not have a performance measurement system.
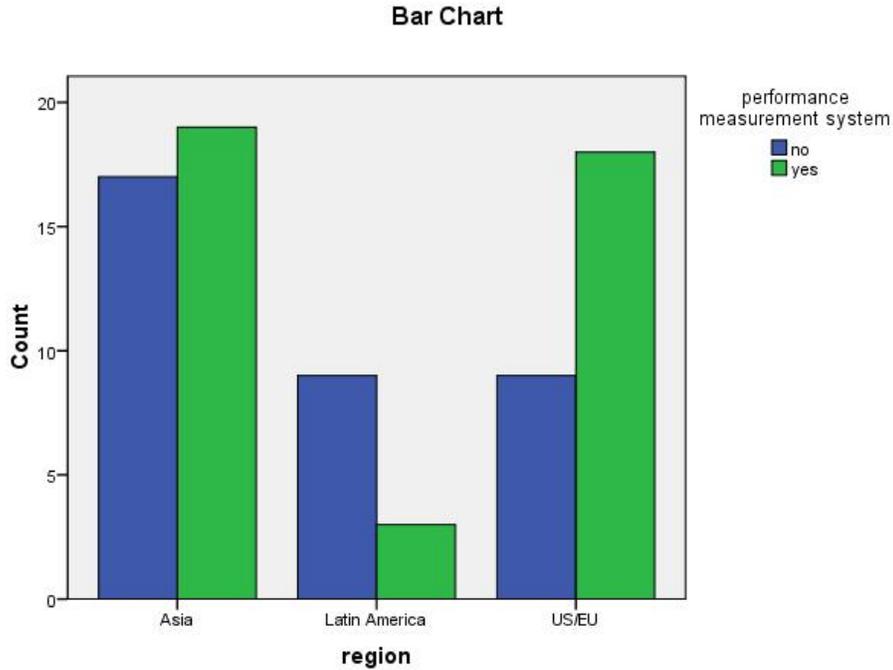
Figure 4.14: Presence of a performance measurement system by region (RQ1c)

As seen in Table 4.12, the presence of a performance measurement system by manufacturing region is significantly different (p-value = 0.017). There is evidence that a larger proportion of companies that manufacture in the United States, Europe, and South Asia have a performance measurement system.

Table 4.13: Presence of a performance measurement system by manufacturing region (RQ1f)

			performance measurement		
			no	yes	Total
manufacturing region	United States	Count	5	10	15
		Expected Count	6.4	8.6	
	Americas (excluding United States)	Count	11	9	20
		Expected Count	8.53	11.5	
	Europe	Count	1	8	9
		Expected Count	3.84	5.16	
	Asia Pacific	Count	8	8	16
		Expected Count	6.82	9.18	
	South Asia	Count	8	23	31
		Expected Count	13.2	17.8	
	Total		29	39	68

The presence of a performance measurement system by size of company in terms of number of employees was found to be significantly different (p-value = 0.002). It is very evident in Figure 4.15 that smaller companies (0-499 employees) do not have a performance measurement system, whereas larger companies (2,000 or more employees) do have a performance measurement system. Results suggest that mid-size companies (500-1,999 employees) also have a performance measurement system.
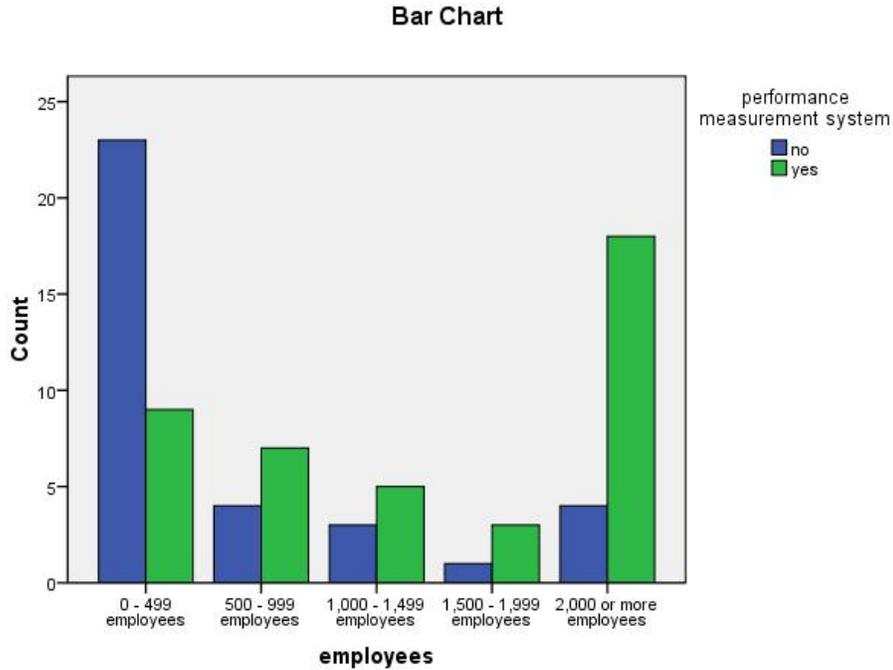
Figure 4.15: Presence of a performance measurement system by number of employees (RQ1h)

Presence of a performance measurement system by end market was found to be statistically significantly different. Companies whose end market is the United States, the United Kingdom, Europe (excluding United Kingdom), or Asia are more likely to have a performance measurement system (Table 4.14).

Table 4.14: Presence of a performance measurement system by end market (RQ1i)

			performance measurement		
			no	yes	Total
end market	United States	Count	27	37	64
		Expected Count	28.6	35.4	
	Americas (excluding United States)	Count	15	15	30
		Expected Count	13.4	16.6	
	United Kingdom	Count	18	28	46
		Expected Count	20.6	25.4	
	Europe (excluding United Kingdom)	Count	19	36	55
		Expected Count	24.6	30.4	
	Asia	Count	8	20	28
		Expected Count	12.5	15.5	
	Total		34	42	76

4.2.2.2 RQ2: How does the basis of a performance measurement system differ?

Research question two asked how the basis of a performance measurement system differed. Results of chi-square tests performed for research question two are shown in Table 4.15. As noted in Table 4.15, chi-square results could be invalid for RQ2c, as more than 20% of the cells have expected counts less than 5. Therefore, results for RQ2c are not discussed.

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Table 4.15: Chi-square values, degrees of freedom, and p-values for RQ2 – How does the basis of a performance measurement system differ?

Research Question	Variable	Chi-square	df	P-value
RQ2a[*,†]	Country	69.485	60	0.188
RQ2b	Country Type	11.807	6	0.066
RQ2c[*]	**Region**	**20.701**	**12**	**0.055**
RQ2d[*,†]	Type of Company	28.566	30	0.540
RQ2e[*,†]	Products Produced	80.382	84	0.592
RQ2f[*]	Manufacturing Region	21.617	30	0.868
RQ2g[*,†]	Size by Sales	18.74	30	0.945
RQ2h[*,†]	Size by Employees	32.036	24	0.126
RQ2i	End Market	19.513	30	0.929

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

4.2.2.3 RQ3: How do the components of a performance measurement system differ?

Next, chi-square tests were performed to analyze how the components of a performance measurement system differed. Table 4.16 shows results for chi-square tests. As seen in Table 4.16, chi-square results for RQ3e and RQ3h may be invalid due to inappropriate cell sizes, and these results are not discussed below.

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Table 4.16: Chi-square values, degrees of freedom, and p-values for RQ3 – How do the components of a performance measurement system differ?

Research Question	Variable	Chi-square	df	P-value
RQ3a[*],[†]	Country	50.935	40	0.115
RQ3b	**Country Type**	**13.531**	**4**	**0.009**
RQ3c[*]	Region	14.542	8	0.069
RQ3d[*]	Type of Company	28.179	20	0.105
RQ3e[*],[†]	**Products Produced**	**77.722**	**56**	**0.029**
RQ3f[*]	Manufacturing Region	29.125	20	0.085
RQ3g[*]	Size by Sales	19.393	20	0.496
RQ3h[*]	**Size by Employees**	**31.631**	**16**	**0.011**
RQ3i	End Market	19.372	20	0.498

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

As seen in Table 4.16, the components of a performance measurement system by type of country (developing or developed) were found to be highly significantly different (p-value = 0.009). Table 4.17 provides counts of responses and expected counts of responses for research question 3b.

Table 4.17: Components of a performance measurement system by country type (RQ3b)

			components of performance measurement system				
			financial information	planning level	supply chain functions	balanced scorecards	Total
country type	Developing	Count	18	18	18	11	32
		Expected Count	19.45	20.71	21.96	14.43	
	Developed	Count	13	15	17	12	19
		Expected Count	11.55	12.29	13.04	8.57	
	Total		31	33	35	23	51

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4.2.2.4 RQ4: How do supplier performance metrics differ?

In order to determine how performance metrics for suppliers differ, chi-square tests were performed. Table 4.18 shows each research question along with the corresponding independent variable of interest, chi-square value, degrees of freedom, and p-value. Cell sizes were not appropriate for RQ4c and RQ4d, and results for these questions are not discussed below.

Table 4.18: Chi-square values, degrees of freedom, and p-values for RQ4 – How do supplier performance metrics differ?

Research Question	Variable	Chi-square	df	P-value
RQ4a[*,†]	Country	188.502	200	0.710
RQ4b	**Country Type**	**34.95**	**20**	**0.020**
RQ4c[*,†]	**Region**	**60.015**	**40**	**0.022**
RQ4d[*,†]	**Type of Company**	**139.365**	**100**	**0.006**
RQ4e[*,†]	Products Produced	263.492	280	0.753
RQ4f[*]	Manufacturing Region	97.991	100	0.538
RQ4g[*,†]	Size by Sales	81.696	100	0.909
RQ4h[*,†]	Size by Employees	85.435	80	0.318
RQ4i	End Market	64.414	100	0.998

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

Supplier performance metrics by country type were found to be statistically significantly different (p-value = 0.020). This means that supplier performance metrics differ by country type. As seen in Figure 4.16, developed countries had a higher percentage of responses for several of the supplier performance metrics, including *lead time*, *responsiveness*, *flexibility*,

technical expertise / support, *dependability*, and *compliance*. However, only *customer service* had a higher percentage of responses when looking at developing countries. It is noteworthy that the top three supplier performance metrics for both developed and developing countries were *cost*, *quality*, and *on-time delivery*. The top five and bottom five supplier performance metrics by country type are shown in Table 4.19.

Supplier Performance Metrics by Country Type
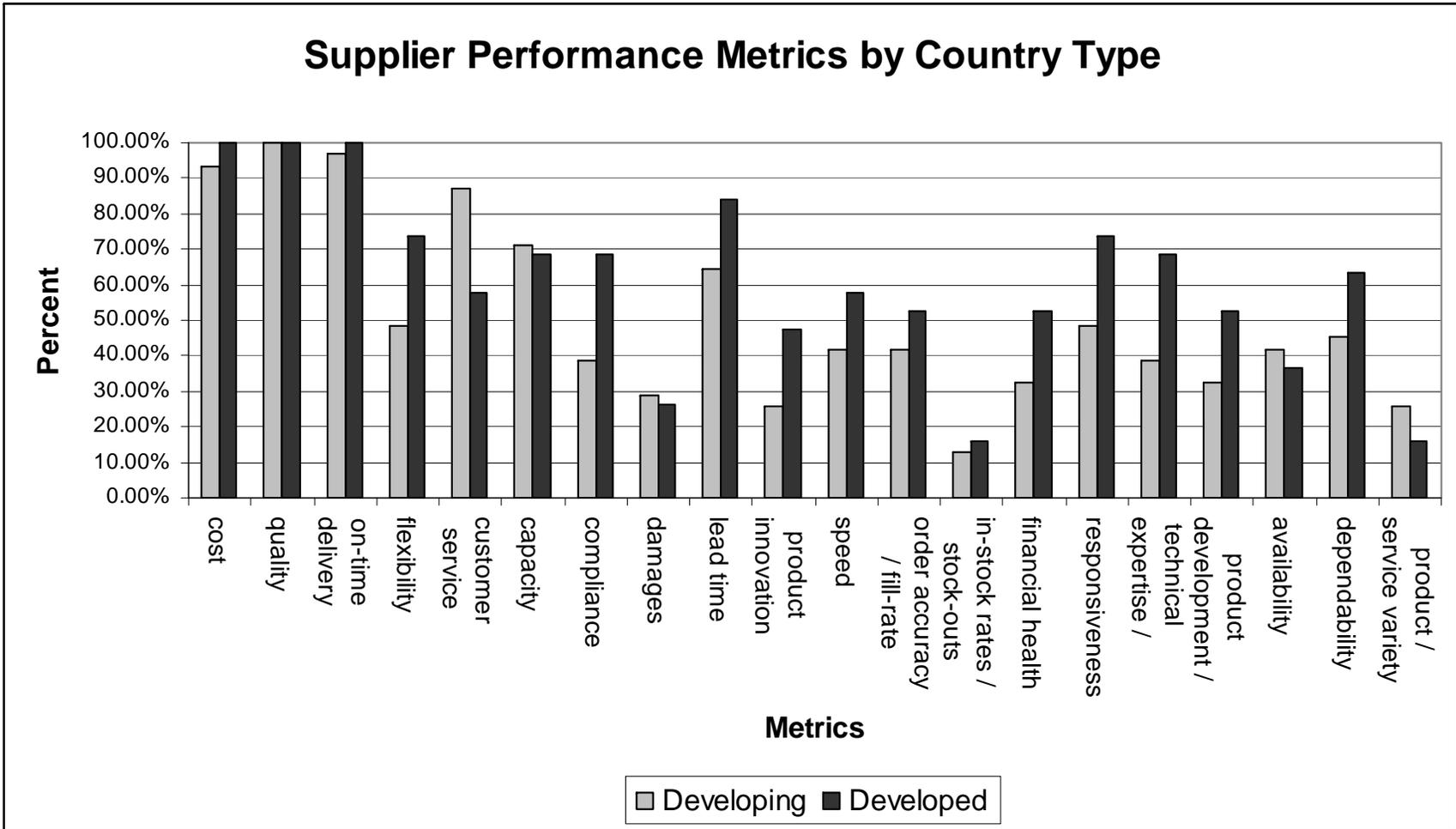
Figure 4.16: Supplier performance metrics by country type (RQ4b)

Table 4.19: Top and bottom supplier performance metrics by country type (RQ4b)

Developing Countries		Developed Countries	
Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**	
quality	100.00%	quality	100.00%
on-time delivery	96.77%	on-time delivery	100.00%
cost	93.55%	cost	100.00%
customer service	87.10%	lead time	84.21%
capacity	70.97%	flexibility	73.68%
Bottom 5		**Bottom 5**	
product development / design capabilities	32.26%	product innovation	47.37%
damages	29.03%	availability	36.84%
product innovation	25.81%	damages	26.32%
product / service variety	25.81%	product / service variety	15.79%
in-stock rates / stock-outs	12.90%	in-stock rates / stock-outs	15.79%

4.2.2.5 RQ5: How do customer performance metrics differ?

When chi-square tests were performed on customer performance metrics by various independent variables, there were no statistically significantly different results. Chi-square values, degrees of freedom, and corresponding p-values for each research question are shown in Table 4.20.

Table 4.20: Chi-square values, degrees of freedom, and p-values for RQ5 – How do customer performance metrics differ?

Research Question	Variable	Chi-square	df	P-value
RQ5a[*,†]	Country	182.187	200	0.812
RQ5b[*]	Country Type	15.081	20	0.772
RQ5c[*,†]	Region	53.99	40	0.069
RQ5d[*,†]	Type of Company	108.059	100	0.274
RQ5e[*,†]	Products Produced	234.044	260	0.875
RQ5f[*,†]	Manufacturing Region	107.956	100	0.276
RQ5g[*,†]	Size by Sales	86.442	100	0.831
RQ5h[*,†]	Size by Employees	92.315	80	0.164
RQ5i	End Market	80.69	100	0.922

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

4.2.2.6 RQ6: How do internal performance metrics differ?

Chi-square tests were also performed to discern how internal performance metrics differ, and the results are shown in Table 4.21. Significant results are discussed below. Due to insufficient cell sizes, several chi-square results may be invalid and are therefore not discussed below.

Table 4.21: Chi-square values, degrees of freedom, and p-values for RQ6 – How do internal performance metrics differ?

Research Question	Variable	Chi-square	df	P-value
RQ6a[*,†]	**Country**	**250.001**	**200**	**0.009**
RQ6b	**Country Type**	**58.69**	**20**	**0.000**
RQ6c[*]	**Region**	**89.502**	**40**	**0.000**
RQ6d[*,†]	**Type of Company**	**127.192**	**100**	**0.035**
RQ6e[*,†]	**Products Produced**	**331.231**	**280**	**0.019**
RQ6f	**Manufacturing Region**	**123.642**	**100**	**0.055**
RQ6g[*,†]	Size by Sales	86.579	100	0.828
RQ6h[*,†]	**Size by Employees**	**102.408**	**80**	**0.046**
RQ6i	End Market	111.903	100	0.196

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

Internal performance metrics were found to be statistically significantly different by country type (p-value = 0.000). Figure 4.17 shows the relative percentage of responses for each internal performance metrics by country type. The relative percentage of each internal performance metric for developed countries is higher than for developing countries. The top five internal performance metrics for developed countries were 1) *quality*, 2) *on-time delivery*, 3) *cost*, 4) *product development / design capabilities*, and 5) *speed*. The top five internal performance metrics for developing countries were 1) *quality*, 2) *on-time delivery*, 3) *cost*, 4) *compliance*, and 5) *customer service*.
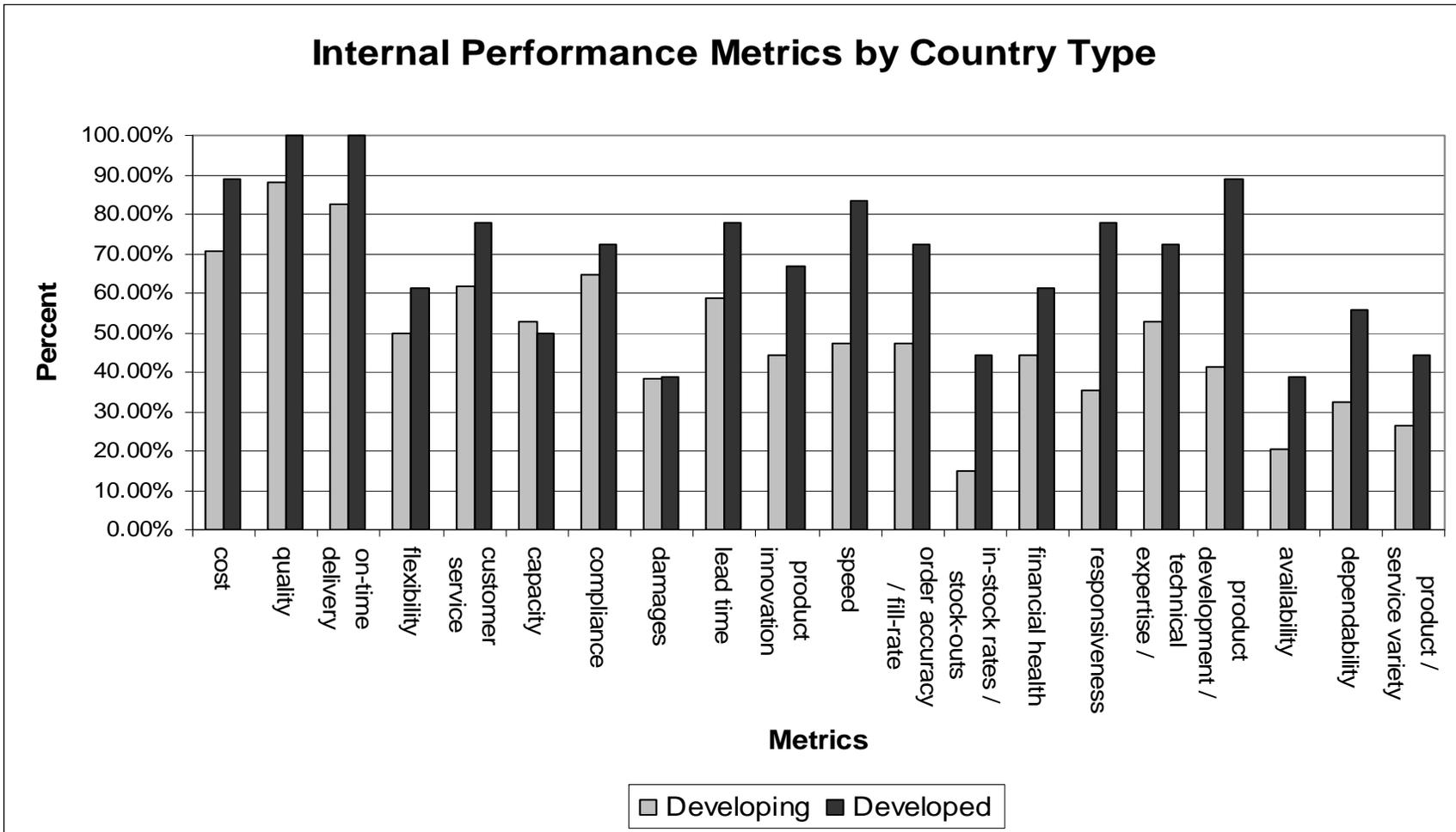
Figure 4.17: Internal performance metrics by country type (RQ6b)

Table 4.22: Top and bottom internal performance metrics by country type (RQ6b)

Developing Countries		Developed Countries	
Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**	
quality	88.24%	quality	100.00%
on-time delivery	82.35%	on-time delivery	100.00%
cost	70.59%	cost	88.89%
compliance	64.71%	product development / design capabilities	88.89%
customer service	61.76%	speed	83.33%
Bottom 5		**Bottom 5**	
responsiveness	35.29%	capacity	50.00%
dependability	32.35%	in-stock rates / stock-outs	44.44%
product / service variety	26.47%	product / service variety	44.44%
availability	20.59%	damages	38.89%
in-stock rates / stock-outs	14.71%	availability	38.89%

Internal performance metrics were also found to be slightly statistically significantly different by manufacturing region (p-value = 0.055). The relative percentage of each response is shown in Figure 4.18. The top five and bottom five internal performance metrics for each manufacturing region are shown in Table 4.23. The top internal performance metrics for companies manufacturing in the United States were *quality*, *on-time delivery*, *customer service*, *lead time*, and *order accuracy / fill rate*. The top internal performance metrics for companies manufacturing in the Americas (excluding the United States) were *quality*, *on-time delivery*, *cost*, *capacity*, and *lead time*. For companies that manufacture in Europe, the top internal performance metrics were *quality*, *order accuracy / fill-rate*, *on-time delivery*, *speed*, *technical expertise / support*, and *product development / design capabilities*. The top internal performance metrics for companies that manufacture in Asia Pacific were *quality*, *on-time delivery*, *cost*, *speed*, *customer service*, *compliance*, *product innovation*, and *order accuracy / fill-rate*. For companies manufacturing in South Asia, the top internal performance metrics were *quality*, *on-time delivery*, *cost*, *customer service*, *compliance*, and *lead time*.
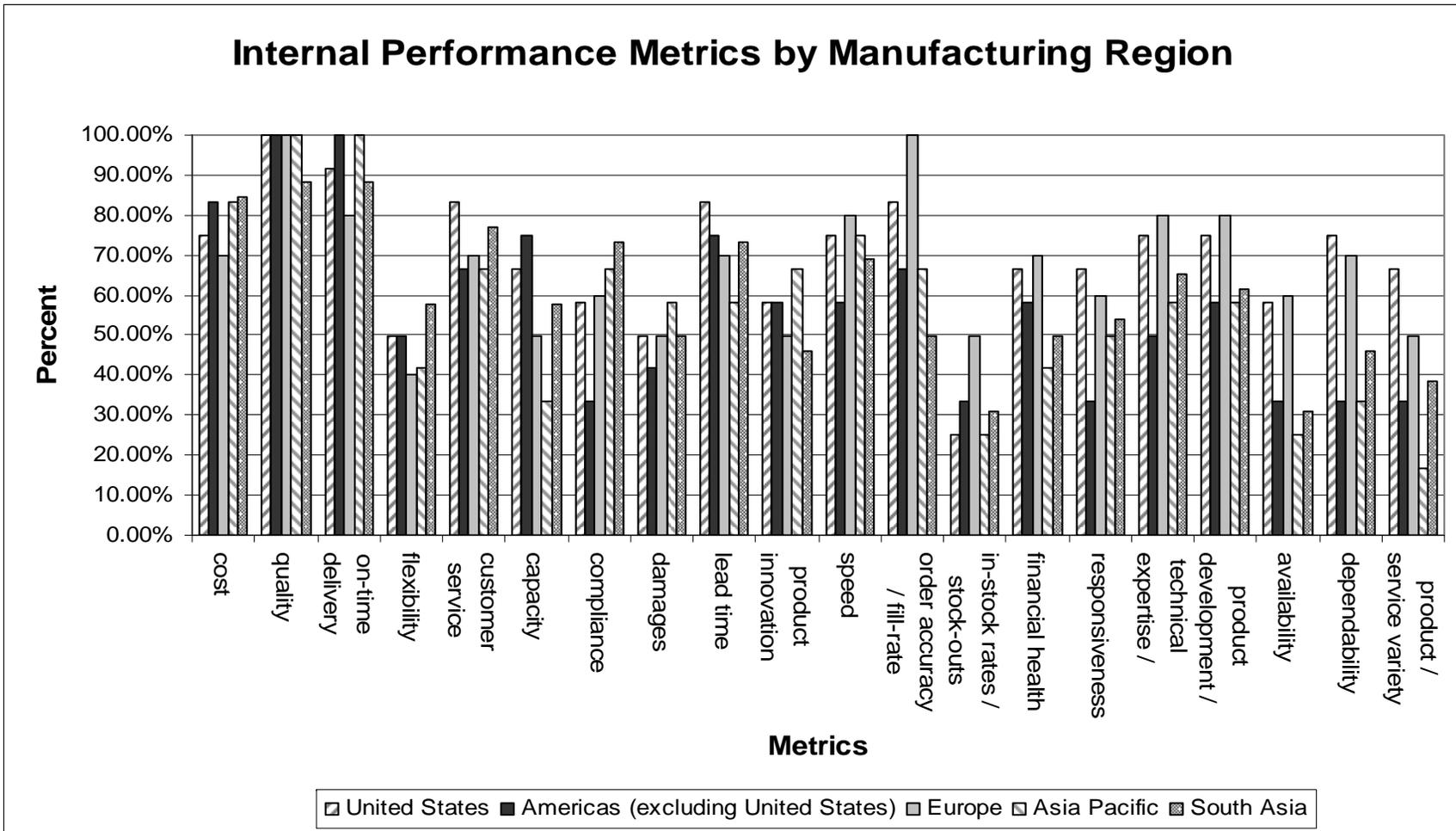
Figure 4.18: Internal performance metrics by manufacturing region (RQ6f)

Table 4.23: Top and bottom internal performance metrics by manufacturing region (RQ6f)

United States		Americas (excluding United States)		Europe	
Metric	Percent of Responses	Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**		**Top 5**	
quality	100.00%	quality	100.00%	quality	100.00%
on-time delivery	91.67%	on-time delivery	100.00%	order accuracy / fill-rate	100.00%
customer service	83.33%	cost	83.33%	on-time delivery	80.00%
lead time	83.33%	capacity	75.00%	speed	80.00%
order accuracy / fill-rate	83.33%	lead time	75.00%	technical expertise / support	80.00%
Bottom 5		**Bottom 5**		**Bottom 5**	
product innovation	58.33%	in-stock rates / stock-outs	33.33%	damages	50.00%
availability	58.33%	responsiveness	33.33%	product innovation	50.00%
flexibility	50.00%	availability	33.33%	in-stock rates / stock-outs	50.00%
damages	50.00%	dependability	33.33%	product / service variety	50.00%
in-stock rates / stock-outs	25.00%	product / service variety	33.33%	flexibility	40.00%

		Asia Pacific		South Asia	
		Metric	Percent of Responses	Metric	Percent of Responses
		Top 5		**Top 5**	
		quality	100.00%	quality	88.46%
		on-time delivery	100.00%	on-time delivery	88.46%
		cost	83.33%	cost	84.62%
		speed	75.00%	customer service	76.92%
		customer service	66.67%	compliance	73.08%
		Bottom 5		**Bottom 5**	
		capacity	33.33%	product innovation	46.15%
		dependability	33.33%	dependability	46.15%
		in-stock rates / stock-outs	25.00%	product / service variety	38.46%
		availability	25.00%	in-stock rates / stock-outs	30.77%
		product / service variety	16.67%	availability	30.77%

4.2.2.7 RQ7: How do supply chain performance metrics differ?

Chi-square tests were performed to determine the ways in which supply chain metrics differ. These results are shown in Table 4.24. Significant results are discussed below. Some relationships were found to be significant, but chi-square results may be invalid due to insufficient cell sizes. Possibly invalid results are therefore not discussed below.

Table 4.24: Chi-square values, degrees of freedom, and p-values for RQ7 – How do supply chain performance metrics differ?

Research Question	Variable	Chi-square	df	P-value
RQ7a[*,†]	**Country**	**222.885**	**180**	**0.016**
RQ7b	**Country Type**	**44.093**	**20**	**0.001**
RQ7c[*,†]	**Region**	**100.465**	**40**	**0.000**
RQ7d[*,†]	**Type of Company**	**133.968**	**100**	**0.013**
RQ7e[*,†]	**Products Produced**	**345.467**	**260**	**0.000**
RQ7f[*]	**Manufacturing Region**	**142.021**	**100**	**0.004**
RQ7g[*,†]	Size by Sales	97.366	100	0.556
RQ7h[*,†]	Size by Employees	48.374	80	0.998
RQ7i	End Market	78.448	100	0.945

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

As seen in Table 4.24, supply chain performance metrics were found to be highly statistically significantly different by country type (p-value = 0.001). Figure 4.19 shows the relative percent of responses for supply chain performance metrics by country type. The top five and bottom five supply chain performance metrics by country type are shown in Table 4.25. The top supply chain performance metrics for developing countries were 1) *cost*, 2) *quality*,

3) *on-time delivery*, 4) *customer service*, and 5) *lead time*, whereas the top supply chain performance metrics for developed countries were 1) *lead time*, 2) *cost*, 3) *on-time delivery*, 4) *order accuracy / fill-rate*, and 5) *capacity*.
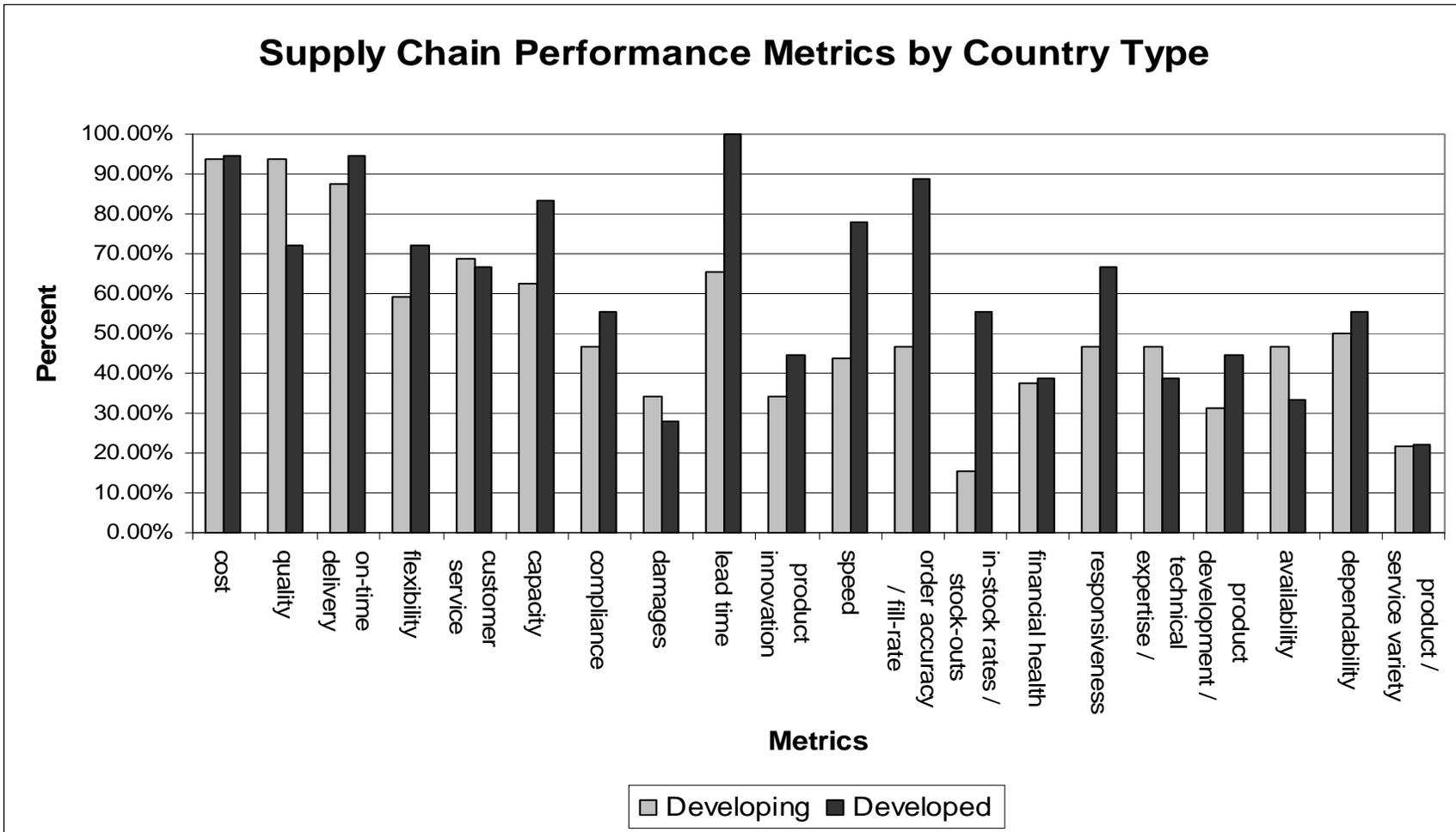
Figure 4.19: Supply chain performance metrics by country type (RQ7b)

Table 4.25: Top and bottom supply chain performance metrics by country type (RQ7b)

Developing Countries		Developed Countries	
Metric	Percent of Responses	Metric	Percent of Responses
Top 5		**Top 5**	
cost	93.75%	lead time	100.00%
quality	93.75%	cost	94.44%
on-time delivery	87.50%	on-time delivery	94.44%
customer service	68.75%	order accuracy / fill-rate	88.89%
lead time	65.63%	capacity	83.33%
Bottom 5		**Bottom 5**	
damages	34.38%	financial health	38.89%
product innovation	34.38%	technical expertise / support	38.89%
product development / design capabilities	31.25%	availability	33.33%
product / service variety	21.88%	damages	27.78%
in-stock rates / stock-outs	15.63%	product / service variety	22.22%

4.2.2.8 RQ8: How does the presence of a performance improvement program differ?

In order to determine how the presence of a performance improvement system differs, chi-square analyses were performed. The results are shown in Table 4.26. There was only one significant result, although the results may be invalid due to inappropriate cell sizes and are therefore not discussed.

Table 4.26: Chi-square values, degrees of freedom, and p-values for RQ8 – What influences the presence of a performance improvement program?

Research Question	Variable	Chi-square	df	P-value
RQ8a	Country	8.802	10	0.551
RQ8b	Country Type	0.015	1	0.903
RQ8c	Region	1.087	2	0.581
RQ8d[*,†]	Type of Company	8.168	5	0.147
RQ8e[*,†]	**Products Produced**	**37.931**	**17**	**0.003**
RQ8f[*]	Manufacturing Region	2.589	5	0.763
RQ8g	Size by Sales	2.366	5	0.797
RQ8h	Size by Employees	2.395	4	0.664
RQ8i[*]	End Market	7.697	5	0.174

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

4.2.2.9 RQ9: How does the type of performance improvement program differ?

Chi-square analyses were performed to determine how the type of performance improvement program differs. Results are shown in Table 4.27. Though there were several significant results, there were limitations in terms of cell sizes, and results for RQ9 are not discussed below.

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Table 4.27: Chi-square values, degrees of freedom, and p-values for RQ9 – How does the type of performance improvement differ?

Research Question	Variable	Chi-square	df	P-value
RQ9a[*,†]	**Country**	**92.404**	**60**	**0.005**
RQ9b[*]	**Country Type**	**20.898**	**6**	**0.002**
RQ9c[*,†]	**Region**	**45.065**	**12**	**0.000**
RQ9d[*,†]	Type of Company	24.508	30	0.749
RQ9e[*,†]	**Products Produced**	**215.06**	**102**	**0.000**
RQ9f[*,†]	**Manufacturing Region**	**76.689**	**30**	**0.000**
RQ9g[*,†]	Size by Sales	28.268	30	0.556
RQ9h[*,†]	Size by Employees	31.955	24	0.128
RQ9i[*]	**End Market**	**63.66**	**30**	**0.000**

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

4.2.2.10 RQ10: How does the focus of performance improvement differ?

Chi-square tests were also performed to determine how the focus of performance improvement differs. Results are shown in Table 4.28. RQ10d and RQ10i had significant results, but due to inappropriate cell sizes, chi-square results could be invalid; hence, significant results are not discussed below.

Table 4.28: Chi-square values, degrees of freedom, and p-values for RQ10 – How does the focus of performance improvement differ?

Research Question	Variable	Chi-square	df	P-value
RQ10a[*,†]	Country	69.383	55	0.092
RQ10b[*]	Country Type	7.07	5	0.215
RQ10c[*,†]	Region	13.157	10	0.215
RQ10d[*,†]	**Type of Company**	**50.486**	**25**	**0.002**
RQ10e[*,†]	Products Produced	97.045	85	0.175
RQ10f[*,†]	Manufacturing Region	31.516	25	0.172
RQ10g[*,†]	Size by Sales	32.209	25	0.152
RQ10h[*,†]	Size by Employees	12.546	20	0.896
RQ10i[*]	**End Market**	**39.626**	**25**	**0.032**

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

4.2.2.11 RQ11: How do strategies for improved competitiveness differ?

In order to discover how strategies for improved competitiveness differ, chi-square tests were performed on variables. The results are shown in Table 4.29. Results for RQ11b are discussed below. Note that the results for RQ11e and RQ11f may be invalid due to inappropriate cell sizes, and these results are not discussed.

Table 4.29: Chi-square values, degrees of freedom, and p-values for RQ11 – How do strategies for improved competitiveness differ?

Research Question	Variable	Chi-square	df	P-value
RQ11a[*],[†]	Country	64.699	66	0.522
RQ11b	**Country Type**	**13.61**	**6**	**0.034**
RQ11c[*]	Region	17.117	12	0.145
RQ11d[*],[†]	Type of Company	25.294	30	0.711
RQ11e[*],[†]	**Products Produced**	**154.234**	**96**	**0.000**
RQ11f[*]	**Manufacturing Region**	**63.343**	**30**	**0.000**
RQ11g[*]	Size by Sales	37.587	30	0.161
RQ11h[*],[†]	Size by Employees	16.937	24	0.851
RQ11i	End Market	32.645	30	0.338

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

Figure 4.20 shows the relative percent of responses for strategies for improved competitiveness by country type. As seen, developed countries had a higher percentage of responses for all competitiveness improvement strategies with the exception of *decreases in lead time*. The top three strategies used by developing countries to improve competitiveness were 1) *decreases in lead time*, 2) *addition of value-added services*, 3) *increases in flexibility*. The top competitiveness improvement strategies used by developed countries were 1) *addition of value-added services*, 2) *decreases in lead time*, and 3) *increases in flexibility*.
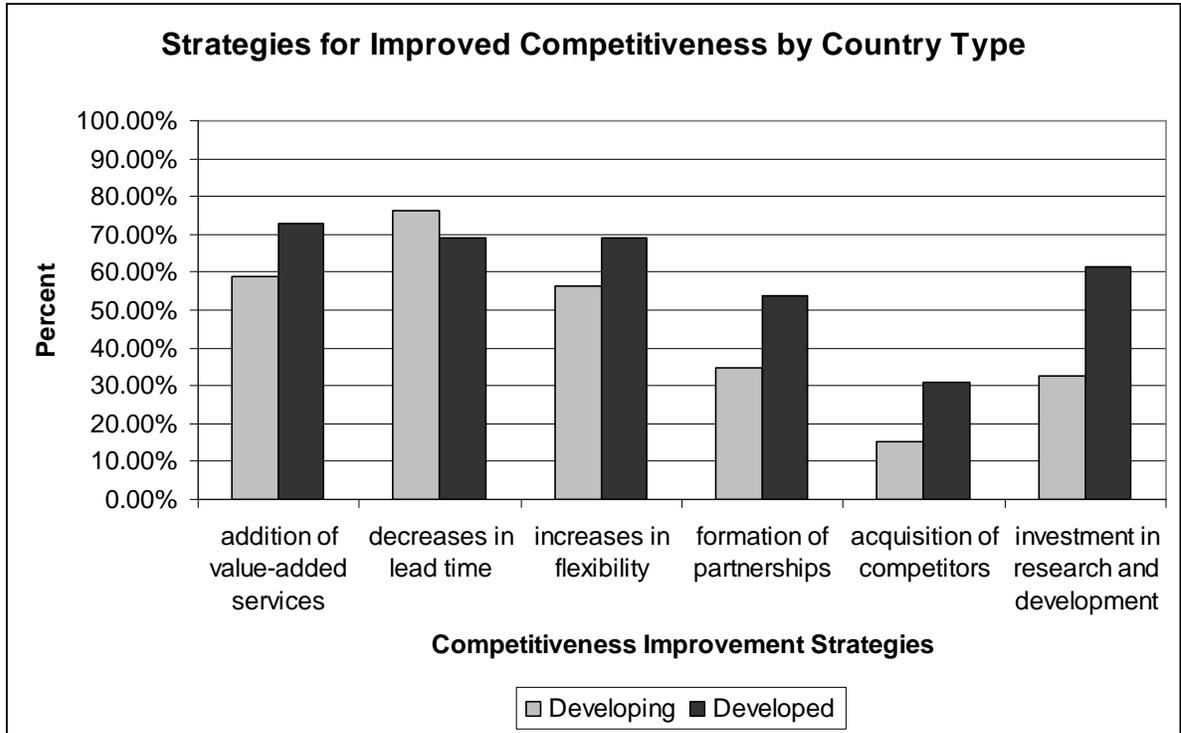
Figure 4.20: Strategies for improved competitiveness by country type (RQ11b)

4.2.2.12 RQalt: Additional analyses

Additionally, chi-square tests were performed to determine if there were statistically significant differences between independent variables. Results are shown in Table 4.30. For RQalt3 and RQalt4, cell sizes were inappropriate for chi-square analysis and results are not discussed. Results for RQalt1 are described below.

Table 4.30: Chi-square values, degrees of freedom, and p-values for RQalt – Additional analyses

Research Question	Variable	Chi-square	df	P-value
RQalt1	**size v. sales**	**39.887**	**20**	**0.005**
RQalt2	size v. cntry type	4.963	4	0.291
RQalt3[*,†]	**prods v. cntry type**	**59.088**	**17**	**0.000**
RQalt4[*]	**cmp type v. cntry type**	**24.096**	**5**	**0.000**

[*] More than 20% of the cells have expected counts less than 5, and Chi-square results may be invalid.
[†] The minimum expected cell count is less than one, and Chi-square results may be invalid.

Size of company in terms of number of employees was examined by size of company in terms of sales, and was found to be statistically significantly different (p-value = 0.005). Table 4.31 shows counts and expected counts for size in terms of number of employees and in terms of sales.

Table 4.31: Sales by number of employees (RQalt1)

			employees * 2007 sales alt Crosstabulation						
			2007 sales alt						
			less than $1,000,000	$1,000,000 to $4,999,999	$5,000,000 to $9,999,999	$10,000,000 to $49,000,000	$50,000,000 to $249,999,999	$250,000,000 or more	Total
employees	0-499 employees	Count	8	9	5	6	2	1	31
		Expected Count	5.4	8.0	4.2	5.9	3.8	3.8	
	500-999 employees	Count	2	4	2	1	2	0	11
		Expected Count	1.9	2.8	1.5	2.1	1.3	1.3	
	1,000-1,499 employees	Count	1	4	0	0	2	1	8
		Expected Count	1.4	2.1	1.1	1.5	1.0	1.0	
	1,500-1,999 employees	Count	0	0	3	1	1	0	5
		Expected Count	.9	1.3	.7	.9	.6	.6	
	2,000 or more employees	Count	2	2	0	6	2	7	19
		Expected Count	3.3	4.9	2.6	3.6	2.3	2.3	
	Total	Count	13	19	10	14	9	9	74

4.3 Phase II (Interview) Results

4.3.1 Phase II (Interview) Results: Respondent Summary Statistics

Of the 79 respondents that completed online surveys, 34 provided contact information for scheduling interviews. However, of those 34, only 19 responded to follow-up emails to schedule an interview. From August-September, 2008, nineteen interviews were then conducted via phone (14) and email (5). Email interviews were conducted only in cases where there were problems with phone interviews; the rationale being that a combination of bad connections and language differences could be overcome through email interviews. In one case, a respondent completed the interview questionnaire via email, and a phone interview followed to discuss certain responses. In another case, a phone interview was started, but due to a bad connection, the interview was finished via email. The position of respondents varied from founder, president, and CEO to project managers and sourcing specialists. The job titles of each respondent are shown in Table 4.32.

Table 4.32: Job titles of interview respondents

Title	
Founder and President (third party logistics)	Merchandising Manager
CEO	Marketing Manager
Executive Directory (trade association)	Marketing General Manager
Vice President (machinery company)	General Manager
Director of Strategic Planning	Assistant General Manager
Managing Director	Manager System Development & Audit
Director	Project Manager – Sportswear
Director	Associate Sourcing Specialist (sweaters)
Director and Plant Manager	Merchandiser – Marketing Department
Merchandising Manager Procurement	

Interview respondents were asked to provide the lengths of time they had 1) held their current position, 2) been with their company, and 3) been working in the textile and apparel industry. Table 4.33 shows the employment lengths for each respondent. Of the nineteen respondents, eleven had been working in the industry for ten or more years. In addition, ten of the nineteen respondents had held their current position for less than five years.

Table 4.33: Experience levels for respondents

Country Type	Country (n)	n	Sector Code[a]	Years in Position	Years with Company	Years in Industry
Developing	Thailand (2)	1	1	1	8	8
		1	2, 3	27	31	31
	Peru (1)	1	2	7	20	20
	Sri Lanka (1)	1	3, 4	1	15	17
	Bangladesh (10)	1	2, 3, 4	5	5	7
		3	3, 4	8	8	10
				8	8	8
				1	1	10
		6	4	5	2.5	10
				8	8	8
				3.5	4.5	10
				3	3	3
				3.5	3.5	3.5
				6	10	10
	Average for Developing			*6.2*	*9.1*	*11.1*
Developed	United States (2)	2	5, 6	1.5	1.5	4.5
				1	2	4
	Auxiliary (3)	1	7	10	10	20
		1	7	4	10	18
		1	7	3	3	30
	Average for Developed			*3.9*	*5.3*	*15.3*
Overall Average for Respondents				**5.6**	**8.1**	**12.2**

4.3.2 Phase II (Interview) Results: Company Summary Statistics

Respondents were also asked about the products that their companies produced (Table 4.34). The range of products varied from acrylic fiber, cotton and cotton blend yarns to knit and woven fabrics and apparel.

Table 4.34: Products produced, grouped by country and supply chain sector

Country Type	Country	n	Sector Code[a]	Products Produced	Details
Developing	Thailand (2)	1	1	fiber (raw)	acrylic
		1	2, 3	yarn (spin) fabric (woven)	cotton and cotton blends
	Peru (1)	1	2	yarn (spin, d/f)	ring spinning of cotton, cotton blends, polyester blends, heather yarns (no 100% cotton) outsource dyeing and texturing of heather yarns
	Sri Lanka (1)	1	3,4	tops (knit, woven) bottoms (knit, woven) lingerie fabrics (knit, d/f)	fabrics include laces and elastics
	Bangladesh (10)	1	2,3,4	yarn (d/f) tops (knit)	mix of cotton and polyester
		3	3,4	fabrics (knit, d/f) (3) tops (knit) (3) bottoms (woven, knit) bottoms (knit)	all apparel finishing in house sweaters
		6	4	bottoms (woven) (5) bottoms (knit, woven) tops (knit, woven) tops (knit)	
Developed	United States	2	5,6	tops (knit, woven) (2) bottoms (knit, woven) (2)	sweaters and other apparel school uniforms licensed accessories also

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

Respondent were asked to provide sales in U.S. dollars for 2007, as well as the number of employees. There was a wide range of sizes of companies in terms of both sales and number of employees, as shown in Table 4.35. Midstream companies from developing countries tended to be smaller in terms of both sales and number of employees, with the exception of the Sri Lankan company. Downstream brand managers/marketers and retailers in the United States were significantly larger than midstream companies.

Table 4.35: Size in terms of sales and number of employees by country and supply chain sector

Country Type	Country (n)	n	Sector Code[a]	2007 Sales (in $US)	Number of Employees
Developing	Thailand (2)	1	1	100,000 metric tons[*]	450
		1	2, 3	44,000,000	850
	Peru (1)	1	2	6,500,000	140
	Sri Lanka (1)	1	3, 4	625,000,000	40,000
	Bangladesh (10)	1	2, 3, 4	4,800,000	800
		3	3, 4	27,500,000	5,000
				500,000	125
				6,600,000	1600
		6	4	2,700,000	440
				2,500,000	2,500
				20,000,000	3,000
				3,000,000	500
				22,500,000	2,600
				5,000,000	1,500
	Average for Developing				
Developed	United States (2)	2	5, 6	1,500,000,000	xxx
				7,200,000,000	54,000
	Auxiliary (3)	1	7	--[†]	--[†]
		1	7	13,000,000	18
		1	7	--[†]	--[†]
	Average for Developed				
Overall Average for Respondents					

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer, 7) auxiliary;
[*] Data were unavailable in $US; [†] Data were unavailable

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The locations where the companies own manufacturing are shown in Table 4.36. The majority of the companies own manufacturing in Asia. One respondent from the United States stated that their company does have owned embroidery facilities for customization of final garments. Auxiliary companies are not shown in Table 4.36.

Table 4.36: Owned manufacturing locations by country and supply chain sector

Country Type	Country (n)	n	Sector Code[a]	Manufacturing Locations	Notes
Developing	Thailand (2)	1	1	Thailand and Egypt	Raw acrylic Dyed acrylic
		1	2, 3	Thailand	Spinning mill Weaving mill
	Peru (1)	1	2	Peru	Spinning mill
	Sri Lanka (1)	1	3,4	Sri Lanka, Vietnam, India, and Madagascar	Most are joint ventures
	Bangladesh (10)	1	2,3,4	Bangladesh	Spinning mill Apparel factory
		3	3,4	Bangladesh (3)	Multiple factories in group Sweater mill
		6	4	Bangladesh (6)	Apparel factories Relation with washing, printing, and embroidery
Developed	United States	2	5,6	United States, South America, and Asia	Embroidery Owned and sourced production

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

4.3.3 Phase II (Interview) Results: Supply Chain Management

The supply chain sectors in which the companies compete are shown by country in Table 4.37. The majority of respondents were midstream manufacturers, primarily cut-and-sew apparel manufacturers located in Bangladesh. Also, the entirety of the textile and apparel supply chain, from fiber to retail, was represented in the sample. Interestingly, there were only five respondents from the United States; of these, three were auxiliary companies.

Table 4.37: Supply chain sectors for companies

Country Type	Respondent Location (n)	n	Supply Chain Sector	Sector Code
Developing	Thailand (2)	1	Fiber producer	1
		1	Yarn producer and fabric (woven) producer/finisher	2, 3
	Peru (1)	1	Yarn producer	2
	Sri Lanka (1)	1	Fabric (knit) producer/finisher and apparel manufacturer	3,4
	Bangladesh (10)	1	Yarn producer/finisher, fabric (knit) producer/finisher and apparel manufacturer	2,3,4
		3	Fabric (knit) producer/finishers and apparel manufacturers	3,4
		6	Cut-and-sew apparel manufacturers	4
Developed	United States (2)	2	Apparel brand manager/marketers and retailers	5,6
	Auxiliary (3)	1	Third party logistics provider (auxiliary)	7
		1	Machinery supplier (auxiliary)	7
		1	Industry association (auxiliary)	7

Customers of the companies are shown by country, in Table 4.38. The companies serve a wide variety of customers, from spinners, knitters, weavers, and apparel manufacturers to brands and retailers of various sizes. As the world's largest retailer, it was not surprising that the most often cited customer was Wal-Mart.

Table 4.38: Customers by country

Country Type	Country (n)	Customers
Developing	Thailand (2)	Fiber: spinners in Asia (90% in Asia) Yarn: knitters, weavers (domestic & export) Fabric: importer, converter

	Peru (1)	Local Peruvian manufacturers
		    Vertically integrated garment factories producing knit garments
		    All work through agents that handle brands (Gap, Liz Claiborne, and Abercrombie & Fitch)
		    Agents work with garment factories – garment factories work with spinning mills

	Sri Lanka (1)	Victoria Secret, Nike, Gap (Old Navy, Gap, Banana Republic), Adidas, Columbia, and Ann Taylor
	Bangladesh (10)	Most companies work with customers (brands and retailers) through a buyer, though some work directly with customers Fabric: internal use Scottish companies in the UK Wal-Mart (5), JC Penney (2), Sears/K-Mart (2), Target (2), Haggar, Jones New York, The Children's Place, BHS (UK), Golden Penny (Germany), Charlie International, F&T (or S&T) Casuals, Tractor Supply Company, NEXT, Woolworth, Debenhams, Asda, DS Corporation, Jomo, X-Men (Germany), b. young (Sweden), C&S (Austria, Netherlands, Poland, Germany), H&M, TRB (France), Mervyns, Federated Stores, Shopko, Belk, Bodek and Rhodes, NES, Paradies, Meijers, Costco, Bass Pro Shops, Saks, Haband, Casual Male, Reebok, IA Industries, Omama, Jonas International, Artinse Family, Marshal Bower, Foot Locker, Bonton, Northern Gateway, Aldi, Metro-Group, Bestseller, Corona, Dunnes-Store, and Mackay
Developed	United States (2)	Internal customer (international business, store) Also have owned retail – both exclusive and stock product. Older, revamped styles for outlet Target consumer (40 and older, looking at new, younger customer) Direct to retailers (Wal-Mart, Kohl's, Macy's, Dillard's, Belk, Nieman Marcus, Nordstrom, and Saks)
	Auxiliary (3)	Every major apparel companies in Central America (Fruit of the Loom, Superior Uniform, Jockey, Delta Apparel, and Adidas) Large carpet manufacturers Weaving and knitting companies

To look at suppliers, companies were grouped by supply chain sector. Upstream companies are sourcing manmade fiber from Asia and cotton from the U.S., Peru, and Australia. Midstream companies are sourcing fabric from China, Bangladesh, Taiwan, India, Pakistan, Sri Lanka, Hong Kong, and Japan. Downstream companies are sourcing yarn, fabric, and apparel from Asia, mostly from Bangladesh, China, India, and Vietnam. Additionally, there is some sourcing of apparel from South America.

Table 4.39: Suppliers by supply chain sector

Country Type	Sector Code[a]	n	Respondent Location	Suppliers
Developing	1	1	Thailand (1)	Japan, Taiwan, & U.S. (acrylonitrile)
	2	1	Peru (1)	Peru & U.S. (cotton), Australia & Africa (cotton), and China (polyester & viscose)
	2, 3	1	Thailand (1)	U.S. & Australia (cotton) and Thailand & other Asia (manmade fiber)
	2, 3, 4	1	Bangladesh (1)	Bangladesh (cotton), China (polyester), Bangladesh (fabrics)
	3, 4	4	Sri Lanka (1) Bangladesh (3)	China (3), Bangladesh (2), Sri Lanka, India, Taiwan, and Japan
	4	6	Bangladesh (6)	Bangladesh (5), China (5), Taiwan (2), India (2), Pakistan (2), and Hong Kong
Developed	5, 6	2	United States (2)	China (2), Bangladesh (2), Vietnam, India, and Central & South America

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

Respondents were asked about the configurations of their company's supply chains, shown in Table 4.40. The functions performed by the companies are shown in brackets. It is important to note that there are multiple supply chain configurations for each sector.

Table 4.40: Supply chain configurations by supply chain sector

Country Type	Sector Code[a]	n	Respondent Location	Supply Chain Configuration[b]
Developing	1	1	Thailand (1)	acrylonitrile → [spin → dye] → yarn
	2	1	Peru (1)	fiber → [spin] → dye[c] → fabric fiber → [spin → dye] → fabric
	2, 3	1	Thailand (1)	fiber → [spin → dye] → fabric fiber → [spin → dye → fabric] → importer/converter
	2, 3, 4	1	Bangladesh (1)	fiber → [spin → dye → knit → cut/sew] → finish[c] → retailer/agent fabric → [cut/sew] → finish[c] → retailer/agent
	3, 4	4	Sri Lanka (1) Bangladesh (3)	yarn → [fabric] → importer/converter yarn → [fabric → dye/finish] → importer/converter yarn → [fabric → dye/finish → cut/sew → finish] → retailer/agent (3) yarn → [sweaters] → retailer/agent fabric → [dye/finish → cut/sew → finish] → retailer/agent fabric → [cut/sew → finish] → retailer/agent
	4	6	Bangladesh (6)	fabric → [cut/sew] → retailer/agent fabric → [cut/sew] → finish[c] → retailer/agent (2) fabric → [cut/sew → finish] → retailer/agent (3)
Developed	5, 6	2	United States (2)	yarn[c] → sweaters[c] → brand marketer/manger garments → [embroidery] → customers double/triple outsourcing to South/Central America and Asia

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer; [b] Functions in brackets denote company function; [c] Outsourced function

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Respondents were asked to define 'supply chain management.' A summary of responses is shown in Table 4.41. From the interviews, it was determined that respondents working at small companies in developing countries, particularly with respect to Bangladesh, could not provide a definition for supply chain management. Some of these respondents stated that they did not know about supply chain management and could therefore not provide a definition. It is not known whether the inability to provide a definition was due to communication difficulties or a lack of knowledge about supply chain management.

The larger companies in developing countries, i.e., the fiber producer in Thailand and the vertically integrated apparel manufacturer in Sri Lanka, discussed supply chain management as relationship management. These respondents talked about developing and maintaining relationships with suppliers and customers, and also discussed the formation of partnerships through joint ventures. These partnerships increase competitiveness by expanding the level of verticality of the companies' supply chains.

The respondents from the United States discussed supply chain management as a consolidation of the vendor base, which allows companies to foster relationships with their suppliers. One U.S. respondent worked in sourcing for sweaters, and talked about the differences between sweater (fully-fashioned apparel) manufacturing and traditional cut-and-sew apparel manufacturing. In the case of sweaters, the fabric formation step is skipped, and the company must source yarn; this results in the U.S. company having a relationship with yarn mills. When speaking with the other U.S. respondent, a project manager for sportswear,

it was discovered that the company does not communicate with yarn mills. The vendors for the company are cut-and-sew manufacturers and source fabrics. Because the U.S. company does not own the yarn used to make the fabric, they cannot meet with yarn producers and inspect the yarn mills.

Table 4.41: Definition of supply chain management by supply chain sector

Country Type	Sector Code[a]	n	Respondent Location	Definition of Supply Chain Management
Developing	1	1	Thailand (1)	Long-term relationships with suppliers
	2	1	Peru (1)	Guaranteed capacity through strategic alliance.
	2, 3	1	Thailand (1)	A way for a corporation with buying power to maintain quality and reduce costs, but it is not good for suppliers.
	2, 3, 4	1	Bangladesh (1)	Planning raw material supply in time and at maximum efficiency.
	3, 4	4	Sri Lanka (1) Bangladesh (3)	No definition (3) Consolidating customer base, building relationships and partnerships, and using ERP systems for better planning, coordination, and control.
	4	6	Bangladesh (6)	No definition (4) The process of connecting with buyers, getting orders, sampling, and pricing. Choosing the best supplier based on price, quality, and delivery.
Developed	5, 6	2	United States (2)	Optimizing the supply chain to get product when you need it, with little commitment, at the right time. Consolidating vendor base and developing relationships. Costing and scheduling, from concept to cash, using 3PL's and owned distribution.

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

4.3.3.1 Phase II (Interview) Results: Performance Measurement and Improvement

When asked about how their companies add value to products, yarn spinners indicated they offer niche products, such as imitation cotton. Three of the twelve companies that manufacture apparel cited design and product development as a way to add value. Four of the twelve apparel manufacturing companies discussed quality as their value addition strategy. For the two U.S. companies, value was added through branding.

Table 4.42: Value addition

Country Type	Sector Code[a]	n	Respondent Location	How Company Adds Value
Developing	1	1	Thailand (1)	Niche products (imitation silk and cotton)
	2	1	Peru (1)	Niche products (blends and heather yarns)
	2, 3	1	Thailand (1)	Consistent production of high quality products
	2, 3, 4	1	Bangladesh (1)	Garment production
	3, 4	4	Sri Lanka (1) Bangladesh (3)	Product competencies, reliability, ethical manufacturing, and design/development capabilities Finishing of final garments Offering the best price Designing to the latest trends
	4	6	Bangladesh (6)	Using good quality raw materials and suppliers Relationship building and quality Design capabilities, good quality materials, and marketing event Quality, price, and productivity Some design capabilities Finishing of final garments
Developed	5, 6	2	United States (2)	Branding and customer service Branding and promotions

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

Respondents were also asked about the system that they use to evaluate the performance of suppliers. A summary of their responses is shown in Table 4.43. From the responses, it seems that larger companies, i.e., the vertically integrated apparel manufacturer from Sri Lanka and the U.S. apparel companies, have a formal system in place to evaluate the performance of their suppliers.

The Sri Lankan company uses a balanced scorecard with information from ERP systems to evaluate suppliers. One of the U.S. respondents discussed the use of a sourcing supplier database, which contains information of each of the company's vendors, in order to evaluate performance. The other U.S. respondent spoke of the use of "key performance indicators" (KPI's), such as the number of correct fit samples.

When speaking with smaller companies, there was more of a focus on price as a measure of supplier performance. These small companies in developing countries seemed to be pressed to deliver products to their customers at increasingly lower costs. This resulted in the companies seeking out suppliers based on price, with some considerations of quality and on-time delivery.

Table 4.43: Performance measurement of suppliers

Country Type	Sector Code[a]	n	Respondent Location	Performance Measurement of Suppliers
Developing	1	1	Thailand (1)	Shipment dates, quantities, and quality
	2	1	Peru (1)	Reliability, price, and quality
	2, 3	1	Thailand (1)	Acceptable quality for price, delivery, and reliability
	2, 3, 4	1	Bangladesh (1)	ISO standards, relationships, and price
	3, 4	4	Sri Lanka (1) Bangladesh (3)	Quality, price competitiveness, on-time delivery, and ease of working together are used to determine a rating for suppliers using a balanced scorecard Price and quality (no formal system) Price (no formal system)
	4	6	Bangladesh (6)	No formal system (2) Price (no formal system) Price, quality, delivery date, lead time, and commitment Price, quality, and on-time delivery Quality and delivery (no formal system)
Developed	5, 6	2	United States (2)	On-time delivery, flexibility, design/development capabilities, and key performance indicators (list of different cross-functions) Sourcing supplier database (from ERP systems), quantities, on-time delivery, and quality

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

In addition to supplier performance, respondents were asked about measuring the performance of their customers. Summaries of responses are shown in Table 4.44. While many of the respondents did not measure the performance of their customers, a few respondents indicated that they measured such things as the frequency and quantity of purchase, as well as the financial health and market share of their customers. This customer analysis aided companies in determining where to direct resources in order to stay competitive.

For example, the respondent from the vertically integrated apparel manufacturer in Sri Lanka discussed two kinds of customers: "maintenance customers" and "key development accounts." "Maintenance customers" are those whose needs can be met by the Sri Lankan company with limited resources, whereas "key development accounts" are attractive customers, in terms of profitability, where the Sri Lankan company must invest resources to meet needs and develop relationships. The Sri Lankan respondent cautioned against having too many "key development accounts."

Table 4.44: Performance measurement of customers

Country Type	Sector Code[a]	n	Respondent Location	Performance Measurement of Customers
Developing	1	1	Thailand (1)	Quantity and frequency of purchase
	2	1	Peru (1)	No evaluation of customers
	2, 3	1	Thailand (1)	Reliability in terms of payment
	2, 3, 4	1	Bangladesh (1)	No evaluation of customers
	3, 4	4	Sri Lanka (1) Bangladesh (3)	No evaluation of customers (3) Revenue growth, profitability of orders, and market share of customers
	4	6	Bangladesh (6)	No evaluation of customers (4) Price
Developed	5, 6	2	United States (2)	Record 'touch points' for website traffic to determine what products were viewed and purchased and in what combination No evaluation of customers

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

In addition to supplier and customer performance measurement, respondents were asked about internal performance measures. A summary of respondents' comments is shown in Table 4.45. Quality was a metric mentioned by companies in all sectors of the supply chain. The larger companies in the sample, i.e., the Sri Lankan company and the U.S. companies, seemed sophisticated in terms of internal performance measurement. The smaller companies in developing countries discussed internal performance more in terms of survival, by ensuring a quality and price level that will maintain the business.

Table 4.45: Internal performance measurement

Country Type	Sector Code[a]	n	Respondent Location	Internal Performance Measures
Developing	1	1	Thailand (1)	Quality of marketing and product
	2	1	Peru (1)	Sales and rank of customers (want to serve 7 of the top 15 garment manufacturers)
	2, 3	1	Thailand (1)	Reliability
	2, 3, 4	1	Bangladesh (1)	Volume, number complete, and percent of good quality
	3, 4	4	Sri Lanka (1) Bangladesh (3)	Partnerships, product quality, competencies, level of training, profit, and level of compliance Sales, lead time, and quality 'Just make it' – 80-85% good quality is OK Customer complaints
	4	6	Bangladesh (6)	Price, quality, and delivery Professionalism, proactive, strong technical skills, quick response, honesty in payment Quality throughout manufacturing process Productivity levels, run time in days and pieces, and volume
Developed	5, 6	2	United States (2)	Reduction of lead times and basis point improvement goals (exe: improve COGS while maintaining quality) Margin and chargeback analysis and quality levels

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

Since quality seemed to be the most important measure of internal performance, it is not surprising that internal performance improvement was focused on quality, as shown in Table 4.46. Midstream manufacturers discussed implementing ISO and Six Sigma, in addition to other quality improvement efforts, such as a bonus program for incremental quality improvement. Two of the large companies, the Sri Lankan company and one U.S. company, discussed Lean Manufacturing as a way to improve internal performance. The respondents from the U.S. companies also talked about working to improve the performance and compliance of vendors and mills, leading to improvement for their supply chains.

Table 4.46: Internal performance improvement efforts

Country Type	Sector Code[a]	n	Respondent Location	Internal Performance Improvement Efforts
Developing	1	1	Thailand (1)	Six Sigma and ISO
	2	1	Peru (1)	Renewed machinery and monitoring of efficiency
	2, 3	1	Thailand (1)	Quality improvement
	2, 3, 4	1	Bangladesh (1)	ISO 9001 2000
	3, 4	4	Sri Lanka (1) Bangladesh (3)	Lean Manufacturing and ERP implementation Productivity improvement program and software implementation to supervise bottlenecks Attempted productivity improvement program Determining operations and specifying jobs
	4	6	Bangladesh (6)	Bonus system for good quality Incremental improvement over last year Establishing an independent work environment Productivity improvement program Decreasing stops during production Shortening operation times through time studies
Developed	5, 6	2	United States (2)	Auditing factories for compliance Lean inventories Work with vendors on performance

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer

Respondents were asked about performance measurement of their complete supply chains. Largely, respondents stated that there had been no efforts to measure the performance of the supply chain. Apparel manufacturers and brand managers/marketers discussed the issue of compliance and inspection. Apparel manufacturers discussed buyers and brands performing site visits to ensure compliance. One of the U.S. respondents spoke about having a relationship with their apparel manufacturers, as well as their yarn suppliers. This is due to the fact that this respondent works with sweaters, which are fully-fashioned garments; this means that the company must source yarn, instead of fabric, for production of apparel. The other U.S. respondent stated that their company cannot meet with yarn producers because of a lack of ownership of the yarn. Because the company sources apparel from cut-and-sew manufacturers, the inputs for the apparel process are fabrics; the company only has ownership at the fabric level.

Table 4.47: Efforts to evaluate complete supply chain

Country Type	Sector Code[a]	n	Respondent Location	Efforts to Evaluate Complete Supply Chain
Developing	1	1	Thailand (1)	None, but trying to help customers improve performance
	2	1	Peru (1)	Retailers are inspecting garment manufacturers but not yarn producers
	2, 3	1	Thailand (1)	None
	2, 3, 4	1	Bangladesh (1)	Follow compliance manual – Random visits to check quality, machines, and fabrics
	3, 4	4	Sri Lanka (1) Bangladesh (3)	None (3) Most customers want to control the supply chain in terms of price, capacity, and time. Difficulty in measuring chain performance because of the need for large ERP systems. Customer and supplier are looking for profit only
	4	6	Bangladesh (6)	None (4) Buyers check compliance for brands (2)
Developed	5, 6	2	United States (2)	Constant communication with mills and vendors. Full-package sourcing is out of date. Care about the source for specialty fibers (like cashmere). Expect vendors to work with mills on a case-by-case basis. Cannot inspect yarn mills because of a lack of ownership at the yarn level.

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer, 7) auxiliary

Lastly, respondents were asked about the competitive challenges that their companies face and their reaction in overcoming these challenges. A summary of responses is shown in Table 4.48.

Table 4.48: Competitive challenges

Country Type	Sector Code[a]	n	Respondent Location	Competitive Challenges	How Overcome Challenges
Developing	1	1	Thailand (1)	Price of raw materials	Cut costs and find new raw materials
	2	1	Peru (1)	China and the elimination of quotas in 2009	Focus on efficiencies
	2, 3	1	Thailand (1)	--[b]	--[b]
	2, 3, 4	1	Bangladesh (1)	Sourcing fabric on time	Follow up with suppliers more often
	3, 4	4	Sri Lanka (1) Bangladesh (3)	Economic slowdown in the U.S. Sorting out supply chain Increasing wages and reduction of prices No permanent customers Competitiveness	Increasing exports to Europe Developing relationships and getting suppliers to move closer Increasing quantity of product Looking to increase marketing expertise Quality, quicker delivery, and pricing
	4	6	Bangladesh (6)	Getting the price from buyers Worker health and safety Marketing, order processing, worker management, and financing Keeping quality/productivity high Controlling labor Managing supply and production	Fight with buyers over price Train managers Determine solutions on a case-by-case basis Train employees through the quality department, which also checks productivity Maintain order of labor Use a time action plan for each order
Developed	5, 6	2	United States (2)	Cost challenges (devaluation of the dollar, wage increases in China)	Sell the right product and find different countries in which to manufacture

[a] 1) fiber producer, 2) yarn producer/finisher, 3) fabric producer/finisher, 4) apparel manufacturer, 5) apparel brand manager/marketer, 6) retailer; [b] No response provided

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5   SUMMARY AND CONCLUSIONS

5.1   Summary of Results

Results are herein summarized according to research objective. Additional, relevant information in also presented where applicable.

5.1.1   RO1: Identify the measures used by textile and apparel companies to gauge the performance of their supply chains in developing and developed countries.

5.1.1.1 Differences by Country Type

This research aimed to discern the differences between textile and apparel companies in developing and developed countries regarding performance measurement of their supply chains. Survey results indicate statistically significant differences by country type: a larger proportion of textile and apparel companies in developed countries have a performance measurement system.

Following this trend, survey results indicate that companies in the U.S./EU are more likely to have a performance measurement system, while companies in Latin America are more likely to not have a performance measurement system. Further, the survey results show that companies manufacturing in the U.S., Europe, and South Asia are more likely to have a performance measurement system.

5.1.1.2 Differences by Company Size

Results from field research highlights the differences between SME's and large companies. Small and medium enterprises in Sri Lanka tend to be owner or family managed. They have indirect access to buyers and, at times, serve as subcontractors for large companies. These small and medium companies tend to have few product development and design capabilities, and are therefore limited in value-adding ability. These companies tend to promote from within, training employees internally; this culture of internal development and a lack of resources leads to a reluctance in hiring university graduates. The resulting company is ill equipped to implement evolving competitive strategies to remain competitive in dynamic global markets.

In Sri Lanka, the large companies are highly sophisticated. These large companies were formed through partnerships and joint ventures. They have direct access to buyers, and in some cases have offices agent to buying offices for major brands.

Survey results also indicate significant differences in the existence of a performance measurement system by company size, by number of employees (0-499, 500-999, 1,000-1,499, 1,500-1,999, and 2,000 or more). Larger companies were found to be more likely to have a performance measurement system when compared to smaller companies.

Phone interview results indicate companies in developing countries tend to be midstream supply chain members (fabric finishing, apparel manufacturing, and apparel finishing). The

companies tend to be smaller in terms of sales and number of employees. They are likely to be less sophisticated in terms of performance measurement. Cost/price was the most important metric used to gauge supplier performance, and quality was the most important metric these companies used to measure internal performance. Some companies in developing countries measure the performance of their customers in terms of financial health and market share. These companies improve internal performance through increases in quality.

It is important to note that company size did seem to influence the results of the phone interviews. Large companies in developing countries resembled companies in developed counties. These large companies were sophisticated in terms of level of understanding of supply chain management, performance measurement, and value addition.

Phone interviews with companies in developed countries show that these companies tend to be downstream manufacturers, and are larger in terms of sales and number of employees. These companies have sophisticated performance measurement systems utilizing databases and data from ERP systems, which allow for a combination of metrics to be used to evaluate suppliers, as well as performance of the companies themselves. These companies measure internal performance by reductions in lead times and improvement of margins, with maintained quality. Due to their large size, these companies have resources to invest in performance improvement initiatives, such as lean manufacturing, and work cooperatively with mills and vendors to improve performance.

5.1.1.3 Performance Metrics: Supplier, Internal, and Supply Chain

Survey results allowed for identification of specific performance metrics. Metrics for gauging the performance of suppliers were found to be significantly different by country type (developed and developing). The top 5 supplier performance metrics for developed countries were found to be *quality, on-time delivery, cost, lead time*, and *flexibility*, while the top 5 supplier performance metrics for developing countries were *quality, on-time delivery, cost, customer service*, and *capacity.*

Metrics used by companies to measure internal performance were also found to be significantly different by country type (developed and developing). The top 5 internal performance metrics for developed countries were *quality, on-time delivery, cost, product development / design capabilities,* and *speed*. The top 5 internal performance metrics for developing countries were found to be *quality, on-time delivery, cost, compliance*, and *customer service*.

Results indicated that metrics used to measure the performance of supply chains were also significantly different by country type (developed and developing). For developed countries, the top 5 supply chain performance metrics were identified as *lead time, cost, on-time delivery, order accuracy / fill-rate*, and *capacity*. When looking at developing countries, the top 5 supply chain performance metrics were *cost*, *quality, on-time delivery, customer service*, and *lead time*.

5.1.2 RO2: Develop a practical definition of supply chain management in developing and developed countries.

Another objective of this research was to define supply chain management for developing and developed countries. Phone interview results indicate that companies in developing countries lack concrete knowledge of the concept of supply chain management. Respondents indicated that they had heard of supply chain management, but when asked to define the concept, many could not offer a definition. Those respondents that did offer a definition spoke of it more as the buying process or a form of relationship management through joint ventures and partnerships.

When respondents from developed countries were queried, they discussed supply chain management as of managing global supply in order to get the right product at the right quality level at the right time. In order to facilitate supply chain management, these companies were using sophisticated ERP and database systems; as these were large companies, information systems were needed to manage large, complex, global supply bases.

Regardless country type, no instances of complete supply chain performance measurement were found during phone interviews. Companies are only measuring performance one supply chain function forward/backward. Some of the companies were concerned with the performance of their customers. However, all companies were concerned, on some level, with the performance of their suppliers. Apparel brand marketing and management

companies are measuring the performance of apparel suppliers through compliance to codes of conduct, because they can really only measure performance to the point of ownership.

5.1.3   RO3: Evaluate the efforts of companies in developing countries to improve performance.

From survey results, strategies for improved competitiveness were found to differ by country type (developed and developing). The top 3 competitiveness improvement strategies for developed countries were *addition of value-added services*, *decreases in lead time*, and *increases in flexibility.* The top 3 competitiveness improvement strategies for developing countries were *decreases in lead time*, *addition of value-added services*, and *increases in flexibility.*

When looking at value addition, phone interview results indicate that companies in developing countries are adding value through design/development capabilities and production of quality products. Results indicate that larger companies are focused on increasing design and development capabilities, while smaller companies are focused on producing quality items.

Field research found that buyers in Sri Lanka are looking to apparel manufacturers for design and product development capabilities. In addition, the Sri Lankan apparel association (JAAF) was investigating a design center at the airport for quick response. Large companies in Sri

Lanka have increased product development and design capabilities in order to add value. Because of the barriers to entry to backward integration (i.e., yarn and fabric manufacturing), these companies have formed joint ventures and partnerships to vertically or "virtually" vertically integrate. In an effort to add value, large companies utilize post-production finishing and washing techniques.

Companies in developed countries are adding value through branding, according to phone interview results. The companies interviewed were apparel brand marketing and management organizations, so it follows that their value-adding tool is branding.

5.1.4   RO4: Construct a model of performance measurement specific to textiles and apparel.

Using the information from Phases I (Field Research – Sri Lanka) and II (Survey and Interview), a model was developed to illustrate performance measurement of textile and apparel companies, and is shown as Figure 5.1. The model contains a gradient from dark to light in order to represent the presence of a performance measurement system for developing and developed companies, with specific supplier, internal, and supply chain metrics. In addition, the model contains information regarding developed and developing companies. Further, a textile and apparel supply chain is shown in the model, and companies in the supply chain have been identified as developing or developed companies.

5.1.4.1 Company Types

Results indicate that there are differences in companies when looking at country type, as well as when looking at company size. There is a trend for large companies in developing countries to be similar to companies in developed countries. These large companies in developing countries have therefore been grouped with companies in developed countries and have been labeled as developed companies. Small companies in developing countries have been labeled as developing companies.

5.1.4.1.1 Developing Companies

Developing companies are mostly located in developing countries in Latin America and Asia. Theses tend to be smaller companies with relatively simple supply bases. Developing companies are less likely to have formal performance measurement system, and they are concerned, basically, with survival. These are less sophisticated companies, with little automation and few design/development capabilities. These companies add value by producing quality products, offering competitive pricing, and finishing fabric and apparel. Developing companies perform supply chain functions with low barriers to entry, such as fabric finishing, apparel manufacturing, and apparel finishing.

5.1.4.1.2 Developed Companies

Developed companies are mostly located in developed countries, such as the United States and those in Europe. These developed companies tend to be larger and have complex supply

bases. Due to the complex nature of their supply bases, these companies are more likely to have a formal performance measurement system. The formal measurement systems are highly sophisticated, and utilize database and ERP systems to manage complex information. Developed companies will often employ more automation in manufacturing processes.

In order to add value, developed companies have increased design/development expertise. In addition, these companies will be marketing niche products, and will have increased supply chain control through partnerships, joint ventures, and relationships. Most often, developed companies will be members of supply chain sectors with high barriers to entry, such as fiber and yarn manufacturing, fabric manufacturing, apparel brand marketing and management, and retail.

5.1.4.2 Existence of a Performance Measurement System

The top left portion of the model contains a gradient to illustrate the existence of a performance measurement system – dark indicates that there is likely not a performance measurement system present, while light indicates that a performance measurement system is likely to exist. Developing companies are shown to the left of the shaded area, and the dark background on the left-hand side of the figure indicates that these developing companies are likely to not have a performance measurement system. However, there is some lighter space on the left-hand side to denote that there will be developing companies that do have a performance measurement system. There lighter area on the right-hand side of the model

shows that developed companies are more likely to have a performance measurement system. There is some darker space on the right side of the model to denote developed companies that do not have a system for measuring performance.

In addition to illustrating the presence of a performance measurement system by company type, the model shows specific performance measures. These are shown by company type (developing or developed) in a similar fashion to the SCOR model discussed in Section 2.2.4. Since results indicate that most companies examine the performance of suppliers, as well as their own internal performance, the suppliers of developing companies are then shown to the far left of the model. The middle of the shaded area shows the internal performance of developing companies. These developing companies are the suppliers for developed companies, which is why internal performance of developing companies is shown on top the supplier performance of developed companies.

5.1.4.3 Specific Performance Metrics

The supplier performance metrics and internal performance metrics for developing and developed companies have been located in proximity to each other for ease of comparison. Supply chain performance metrics were found to differ by country type (developing or developed) and are also shown in the model by company type (developing or developed). Note that the top supply chain performance metric for developing companies is *cost*, while the top supply chain performance metric for developed companies is *lead time*.
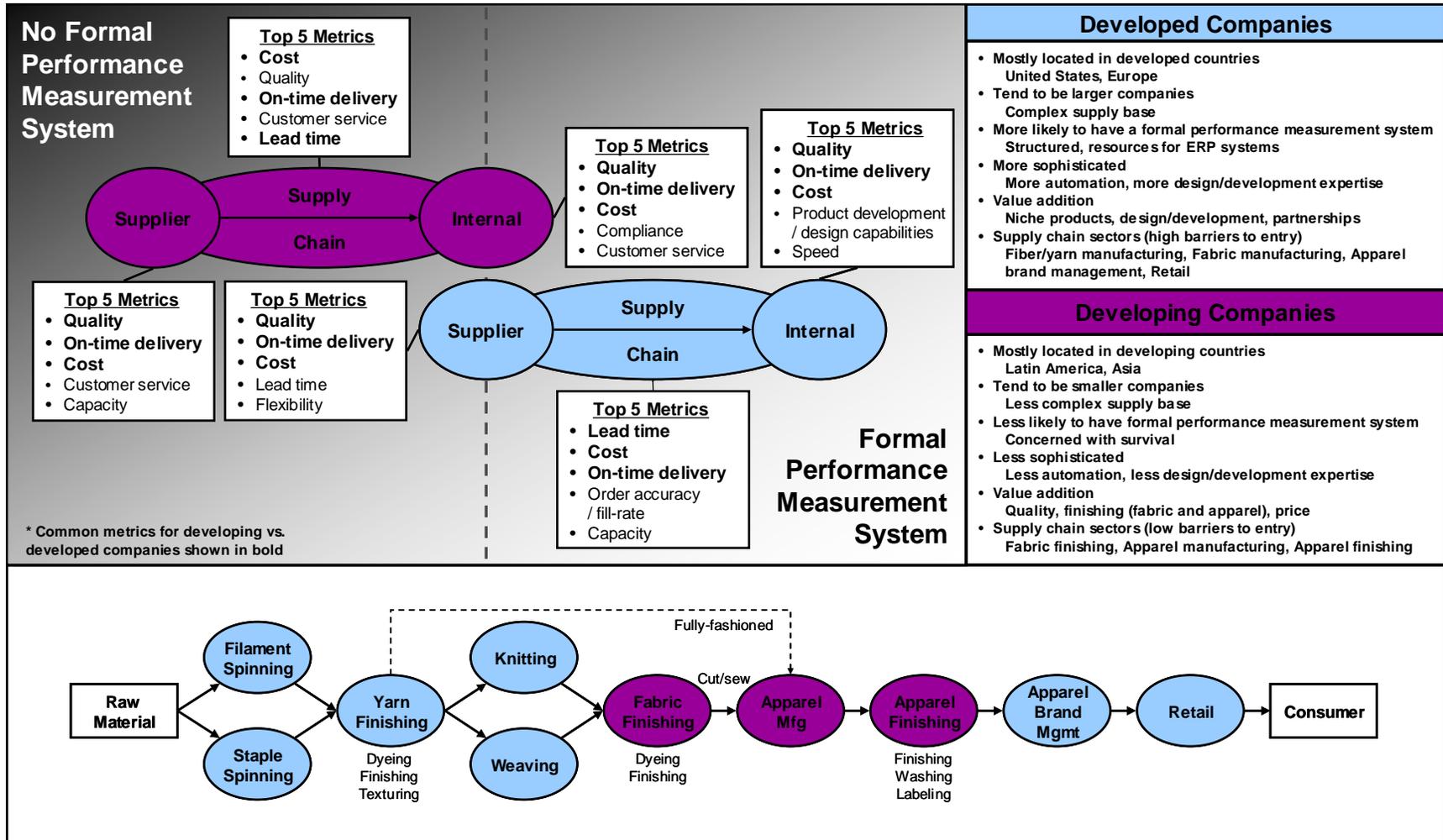
Figure 5.1: Textile and apparel performance measurement model

5.2   Conclusions

This research focused on developing an understanding of the textile and apparel industry in developing countries and how they compared to the industry of developed countries. The main conclusion is that companies in developed and developing countries differ with respect to understanding supply chain management and measuring the performance of supply chains. Differing supplier measures, internal measures, and supply chain measures were found for companies in developed and developing countries.

Though there were differences by country type, there were also differences found by company size. Larger companies were more sophisticated in terms of value addition, through product development / design capabilities and formation of partnerships to increase control of the supply chain. Larger companies are also more likely to have a system for measuring performance of their customers and suppliers. This could be attributed to 1) large companies have a more complex supply chain and therefore require a more structured system for performance evaluation and 2) large companies have the resources to invest in sophisticated ERP systems to manage supply. These large companies in both developing and developed countries have been defined as developed companies.

Smaller companies seemed to be more focused on simple survival, and these companies tend to the lowest-cost manufacturer of products. Apparel manufacturing has low barriers to entry in terms of investment and expertise, allowing smaller companies to enter the market. These

smaller companies lack the resources to 1) hire university graduates, 2) integrate vertically, 3) develop and design products, and 4) invest in software systems to measure performance. These smaller companies have been defined as developing companies.

A competitive disadvantage exists for developing companies. As trade advantages shift due to quotas and costs, these developing companies could be forced out of the market. Since the competitive advantage of a developing company is cost, customers are not motivated to continue purchasing from these companies after costs have risen.

There are several strategies that developing companies can utilized to evolve to developed companies. Developing companies can partner with other companies, either developing or developed, in order to increase value addition through verticality or "virtual" verticality. Developing companies can also invest in design and product development capabilities in order to add value. Further, the addition of design/development functions will shift the competitive advantage of developing companies away from cost, and therefore insulate these companies against shifting market forces. Following the same logic, a niche strategy will increase the competitiveness of these developing companies. As developing companies become developed companies, size will increase, hopefully resulting in increased sales. This increase in sales will afford developing companies the resources to hire university graduates and invest in sophisticated database and ERP systems.

5.3 Limitations of the Research

There were several limitations for this research:

1. Results for Phase I are based on the Sri Lankan textile and apparel industry and may therefore not be applicable to other countries.

2. The internet survey of Phase II utilized a convenience sample of companies in country-specific textile and apparel associations and results may contain bias; therefore, caution should be used when applying these results to different populations.

3. Telephone interviews of Phase II were problematic and the results may be biased as a result:

   a. The phone system utilized VOIP (voice over IP) and the calls were often difficult to hear/understand.

   b. The majority of the interview respondents were from Asia, and difficulties due to language barriers existed, both in respondents' understanding of the researcher and the researcher's understanding of respondents.

5.4 Recommendations for Future Studies

Several future studies could be performed based on the results of this study:

1. Research indicated differences in fully-fashioned and cut-and-sew manufacturing. Because the fabric formation step of the supply chain is omitted from fully-fashioned apparel production, differences could be present for lead times, performance measurement, materials flow, and logistics. A future study could focus on identifying

specific differences between fully-fashioned and cut-and-sew apparel manufacturing and the effect of these differences on supply chain management and performance measurement activities for companies in these supply chains.

2. Results indicated differences between small and large companies in terms of level of sophistication regarding knowledge of supply chain management, value addition, product development / design capabilities, and performance measurement. Future studies could focus on defining "small" and "large" in terms of specific measures, such as sales and number of employees.

3. In order to align internal performance with the expectations of customers, the perceptions of companies in developed and developing countries regarding performance expectations for customers and suppliers could be studied. In other words, what does an apparel manufacturer think is important to a brand manager/marketer compared with what is actually important to the brand manager/marketer.

4. The concept of developing and developed companies could be explored further in future research. A study could focus on defining the continuum, from the least developed to the most developed company. Specifically, research could examine how a developing company becomes a developed company, including influences of trade legislation, market dynamics, value addition, performance measurement, supply chain management, and customers and suppliers.

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APPENDIX A: SURVEY COVER LETTER

Dear textile/apparel industry professional,

I am inviting you to participate in a research project to study performance measurement of textile and apparel supply chains in developing countries. The link below will take you to the survey with a few questions relating to performance measurement. I would ask that you look over the survey and complete it (or pass on to a more appropriate person, as you deem fit). It should take 10-15 minutes of your time to complete.

The goal of this research is to develop a supply chain performance measurement model specific to the textile and apparel industry. It will span the textile and apparel supply chain, and include manufacturers in developing countries. This will help apparel manufacturing companies in these developing countries better align their process improvement processes with the performance goals of their suppliers and customers. It will also aid in benchmarking efforts by textile and apparel companies.

There are no risks to you or your privacy if you complete the survey. Results will be kept confidential, and no information will personally link you with your answers. Results will be reported in aggregate form.

I hope that you will choose to complete the survey. However, your participation is voluntary. Even if you decide not to participate, I will gladly provide you with a summary of results. Please e-mail me at rmallen@ncsu.edu for a copy of the results summary.

If you have questions or concerns about participating in this study, please contact me, Ronald M. "Reece"Allen, at 2401 Research Drive, Box 8301, Raleigh, NC 27695, rmallen@ncsu.edu, or 919-515-6449. This study has approval from the North Carolina State University Institutional Review Board for the Protection of Human Subjects in Research. You may contact Dr. David Kaber, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/515-3086) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148) if you have questions about your rights as a research participant.

To review and complete the survey, please go to http://ceres.cals.ncsu.edu/supply_chain_survey

Sincerely,
Reece Allen
Doctoral Candidate
Department of Textile and Apparel, Technology and Management
College of Textiles
North Carolina State University
rmallen@ncsu.edu

William Oxenham, Ph.D.   George L. Hodge, Ph.D.
Professor – NCSU   Professor – NCSU
william_oxenham@ncsu.edu   george_hodge@ncsu.edu

APPENDIX B: WELCOME PAGE AND INFORMED CONSENT FORM FOR

SURVEYS

Performance Measurement of Textile and Apparel Supply Chains
Principle Investigator: Reece Allen, Doctoral Candidate
Faculty Sponsors: William Oxenham, Ph.D. and George Hodge, Ph.D.
Department of Textile and Apparel, Technology and Management
Department of Textile Engineering, Chemistry, and Science
College of Textiles
North Carolina State University

What are some general things you should know about research studies?
You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. If at any time you have questions about your participation, do not hesitate to contact the researcher(s) named above.

What is the purpose of this study?
This research will investigate performance measurement for supply chains in developing countries. It will identify the specific measures that textile and apparel companies use to gauge the performance of their supply chains. Also, this research will evaluate performance improvement efforts of textile and apparel manufacturers in developing countries.

What will happen if you take part in the study?
If you agree to participate in this study, you will be asked to complete a survey. This survey should take approximately 10-15 minutes of your time to complete.

Risks
There are no risks to you or your privacy if you complete the survey. Individual results will be kept confidential, and no information will link you with your response. Survey results will be reported in aggregate form.

Benefits
The benefit of this research is that it will provide a model of performance measurement for textile and apparel supply chains. This could be used as a basis for benchmarking performance in developing countries.

Confidentiality
The information in the study records will be kept strictly confidential. Data will be stored securely in on the researcher's laptop (password protected and firewalled). No reference will be made in oral or written reports which could link you to the study.

Compensation
You will not receive anything for participating.

What if you have questions about this study?
If you have questions at any time about the study or the procedures, you may contact the researcher, Ronald M. "Reece" Allen, at 2401 Research Drive, Box 8301, Raleigh, NC 27695, rmallen@ncsu.edu, or 919-515-6449.

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. David Kaber, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/515-3086) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148).

Consent To Participate
"I have read and understand the above information. I agree to participate in this study with the understanding that I may withdraw at any time."

Click here if you agree to participate in the study and take the survey

APPENDIX C: SURVEY QUESTIONNAIRE

Performance Measurement of Textile and Apparel Supply Chains
Owner: Reece Allen, Ph.D. Candidate, College of Textiles

1. In what area of your company do you work?

☐ Supply chain management

☐ Purchasing

☐ Sourcing

☐ Other (please specify) ⬚

2. How long have you been employed with your company?

☐ Less than 1 year

☐ More than 1 year but less than 5 years

☐ More than 5 years but less than 10 years

☐ More than 10 years

3. In which country is your company headquartered?

⬚

4. In which product category does your company compete? (select all that apply)

☐ Bottoms

☐ Tops

☐ Lingerie

☐ Other (please specify) ⬚

5. How would you categorize your company? (select all that apply)

☐ Manufacturer

☐ Agent

☐ Brand manager/marketer

☐ Retailer

☐ Auxiliary

☐ Other (please specify) [＿＿＿＿]

6. Does your company own manufacturing facilities?

○ Yes

○ No (skip to question 9)

7. What product(s) does your company produce? (select all that apply)

☐ Fiber

☐ Yarn

☐ Woven fabric (greige)

☐ Knitted fabric (greige)

☐ Woven fabric (dyed and finished)

☐ Knitted fabric (dyed and finished)

☐ Nonwovens

☐ Apparel

☐ Other (please specify) [＿＿＿＿]

8. In which regions does your company manufacture? (select all that apply)

- ☐ United States
- ☐ Americas (excluding United States)
- ☐ Europe
- ☐ Asia Pacific
- ☐ South Asia
- ☐ Middle East
- ☐ North Africa
- ☐ Sub-Saharan Africa
- ☐ Other (please specify) [＿＿＿＿＿]

9. What product(s) does your company source, including raw materials? (select all that apply)

- ☐ Fiber
- ☐ Yarn
- ☐ Woven fabric (greige)
- ☐ Knitted fabric (greige)
- ☐ Woven fabric (dyed and finished)
- ☐ Knitted fabric (dyed and finished)
- ☐ Nonwovens
- ☐ Apparel
- ☐ Other (please specify) [＿＿＿＿＿]

10. From which regions does your company source? (select all that apply)

- ☐ United States
- ☐ Americas (excluding United States)
- ☐ Europe
- ☐ Asia Pacific
- ☐ South Asia
- ☐ Middle East
- ☐ North Africa
- ☐ Sub-Saharan Africa
- ☐ Other (please specify) [_____]

11. What were your company's annual sales for 2007 (in $U.S.)

- ☐ Less than $250,000
- ☐ $250,000 to $499,999
- ☐ $500,000 to $999,999
- ☐ $1,000,000 to $4,999,999
- ☐ $5,000,000 to $9,999,999
- ☐ $10,000,000 to $24,999,999
- ☐ $25,000,000 to $49,999,999
- ☐ $50,000,000 to $99,999,999
- ☐ $100,000,000 to $249,999,999
- ☐ $250,000,000 or more

12. How many employees does your company have?

- ☐ 0-499 employees
- ☐ 500-999 employees
- ☐ 1,000-1,499 employees
- ☐ 1,500-1,999 employees
- ☐ 2,000 or more employees

13. Where are your products sold? (select all that apply)

- ☐ United States
- ☐ Americas (excluding United States)
- ☐ United Kingdom
- ☐ Europe (excluding United Kingdom)
- ☐ Asia
- ☐ Other (please specify) _____

14. Does your company use a system to measure the performance of supply chain members (suppliers and customers)?

- ☐ Yes
- ☐ No (skip to question 21)

15. What is the basis of your company's performance measurement system? (select all that apply)

- [ ] Financials
- [ ] Quality
- [ ] Delivery
- [ ] Lead time
- [ ] Flexibility
- [ ] Sustainability
- [ ] Other (please specify) [ ]

16. What are the components of your company's performance measurement system? (select all that apply)

- [ ] Financial information
- [ ] Planning level (strategic, tactical, operational)
- [ ] Supply chain functions (plan/do/make/deliver/return or fiber/textile/apparel/retail)
- [ ] Balanced scorecards (financial, customer, internal, innovation, output, flexibility, etc.)
- [ ] Other (please specify) [ ]

17. How does your company measure the performance of SUPPLIERS? (select all that apply)

- ☐ Cost
- ☐ Quality
- ☐ On-time delivery
- ☐ Flexibility
- ☐ Customer service
- ☐ Capacity
- ☐ Compliance
- ☐ Damages
- ☐ Lead time
- ☐ Product innovation
- ☐ Speed
- ☐ Order accuracy / fill-rate
- ☐ In-stock rates / stock-outs
- ☐ Financial health
- ☐ Responsiveness
- ☐ Technical expertise / support
- ☐ Product development / design capabilities
- ☐ Availability
- ☐ Dependability
- ☐ Product / service variety
- ☐ Other (please specify) [   ]

18. How does your company measure the performance of CUSTOMERS? (select all that apply)

- ☐ Cost
- ☐ Quality
- ☐ On-time delivery
- ☐ Flexibility
- ☐ Customer service
- ☐ Capacity
- ☐ Compliance
- ☐ Damages
- ☐ Lead time
- ☐ Product innovation
- ☐ Speed
- ☐ Order accuracy / fill-rate
- ☐ In-stock rates / stock-outs
- ☐ Financial health
- ☐ Responsiveness
- ☐ Technical expertise / support
- ☐ Product development / design capabilities
- ☐ Availability
- ☐ Dependability
- ☐ Product / service variety
- ☐ Other (please specify) [   ]

19. How does your company measure the internal performance of YOUR COMPANY? (select all that apply)

- ☐ Cost
- ☐ Quality
- ☐ On-time delivery
- ☐ Flexibility
- ☐ Customer service
- ☐ Capacity
- ☐ Compliance
- ☐ Damages
- ☐ Lead time
- ☐ Product innovation
- ☐ Speed
- ☐ Order accuracy / fill-rate
- ☐ In-stock rates / stock-outs
- ☐ Financial health
- ☐ Responsiveness
- ☐ Technical expertise / support
- ☐ Product development / design capabilities
- ☐ Availability
- ☐ Dependability
- ☐ Product / service variety
- ☐ Other (please specify) [   ]

20. How does your company measure the performance of its SUPPLY CHAIN? (select all that apply)

- ☐ Cost
- ☐ Quality
- ☐ On-time delivery
- ☐ Flexibility
- ☐ Customer service
- ☐ Capacity
- ☐ Compliance
- ☐ Damages
- ☐ Lead time
- ☐ Product innovation
- ☐ Speed
- ☐ Order accuracy / fill-rate
- ☐ In-stock rates / stock-outs
- ☐ Financial health
- ☐ Responsiveness
- ☐ Technical expertise / support
- ☐ Product development / design capabilities
- ☐ Availability
- ☐ Dependability
- ☐ Product / service variety
- ☐ Other (please specify) [   ]

21. What improvement program(s) has your company adopted? (select all that apply)

☐ None

☐ Six Sigma

☐ Lean Manufacturing

☐ Total Quality Management (TQM)

☐ Just-In-Time (JIT)

☐ Other (please specify) _____

22. What has been the focus of internal performance improvement efforts? (select all that supply)

☐ No improvement efforts

☐ Productivity improvement

☐ Quality improvement

☐ Lead time improvement

☐ Flexibility improvement

☐ Other (please specify) _____

23. How has your company improved competitiveness? (select all that apply)

☐ Addition of value added services (i.e., design, product development, finishing, etc.)

☐ Decreases in lead time

☐ Increases in flexibility

☐ Formation of partnerships

☐ Acquisition of competitors

☐ Investment in research and development

☐ Other (please specify) _____

[Submit]

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APPENDIX D: THANK YOU PAGE

Performance Measurement of Textile and Apparel Supply Chains

Thank you for your input! If you are willing to participate in a short interview (approximately 30 minutes), please click the link below to provide contact information.

Click here to provide contact information for interviews.

APPENDIX E: INTERVIEW INFORMATION PAGE

SurveyTool

Interview Contact Information
Owner: Reece Allen, Ph.D. Candidate, College of Textiles

If you are willing and able to participate in a short interview, please enter your contact information below and I will contact you to schedule the interview.

1. Please enter your contact information below (Name, Address, Phone, Fax, and E-mail).

Submit
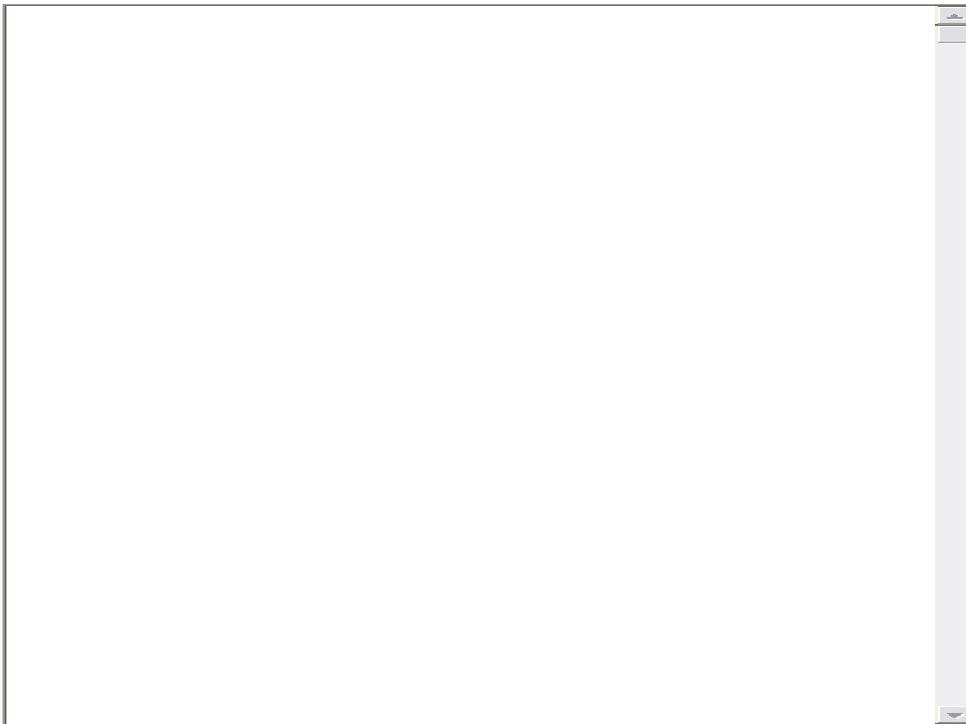
APPENDIX F: SECOND THANK YOU PAGE

Interview Contact Information

Thank you for your willingness to participate in an interview. You will be contacted to schedule a time convenient for you to participate.

APPENDIX G: INFORMED CONSENT FORMS FOR INTERVIEWS

North Carolina State University
INFORMED CONSENT FORM for RESEARCH
(For phone interviews)

Performance Measures and Metrics for Textile and Apparel Supply Chains in Developing Countries
Principal Investigator: Ronald M. "Reece" Allen   Faculty Sponsor: William Oxenham

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What are some general things you should know about research studies?

You are being asked to take part in a research study. Your participation in this study is voluntary. You have the right to be a part of this study, to choose not to participate or to stop participating at any time. The purpose of research studies is to gain a better understanding of a certain topic or issue. You are not guaranteed any personal benefits from being in a study. Research studies also may pose risks to those that participate. In this consent form you will find specific details about the research in which you are being asked to participate. If you do not understand something in this form it is your right to ask the researcher for clarification or more information. A copy of this consent form will be provided to you. If at any time you have questions about your participation, do not hesitate to contact the researcher(s) named above.

What is the purpose of this study?

This research will investigate performance measurement for supply chains in developing countries. It will identify the specific measures that textile and apparel companies use to gauge the performance of their supply chains. Also, this research will evaluate performance improvement efforts of textile and apparel manufacturers in developing countries.

What will happen if you take part in the study?

If you agree to participate in this study, you will be asked to interview with the researcher. More than one person may be interviewed at a time. This interview should take 30 minutes to one hour, depending on the length of your responses and the intensity of discussion.

Risks

Possible legal risks exist due to disclosure of confidential information; however, subject and company names will be coded. These code numbers will be stored with the data, and the master list of names and codes will be kept in a separate location. In addition, any information that could identify subjects will be removed in the reporting of information. Please do not divulge any information that you are uncomfortable sharing.

Benefits

The benefit of this research is that it will provide a model of performance measurement for textile and apparel supply chains. This could be used as a basis for benchmarking performance in developing countries.

Confidentiality

The information in the study records will be kept strictly confidential. Data will be stored securely in on the researcher's laptop (password protected and firewalled). Code numbers will be created for your name and company name; these code numbers will be the only identifiers stored with the data. The master list linking codes to subject and company names will be kept in a separate location than the data in order to minimize the potential of linking the data to you and your company. In addition, any identifying information, such as product brand names, will be removed when reporting the data. No reference will be made in oral or written reports which could link you to the study.

Compensation

You will not receive anything for participating.

What if you have questions about this study?

If you have questions at any time about the study or the procedures, you may contact the researcher, Ronald M. "Reece" Allen, at 2401 Research Drive, Box 8301, Raleigh, NC 27695, rmallen@ncsu.edu, or 919-515-6449.

What if you have questions about your rights as a research participant?
If you feel you have not been treated according to the descriptions in this form, or your rights as a participant in research have been violated during the course of this project, you may contact Dr. David Kaber, Chair of the NCSU IRB for the Use of Human Subjects in Research Committee, Box 7514, NCSU Campus (919/515-3086) or Mr. Matthew Ronning, Assistant Vice Chancellor, Research Administration, Box 7514, NCSU Campus (919/513-2148).

Consent To Participate
"The above information was read to the subject and any questions were answered. The subject verbally agreed to participate in the study with the understanding that he/she may withdraw from the study at any time."

Investigator's signature_____   **Date** _____

APPENDIX H: INTERVIEW QUESTIONNAIRE

Respondent Information
Title:
Years in position:
Years with company:
Years in industry:

Company Information
1. What type(s) of products does your company produce?

2. What were your company's annual sales for 2007 (in $U.S.)?

3. How many employees does your company have?

4. Where does your company own manufacturing locations?

Supply Chain Management
5. Who are your customers?

6. Where are your products sold?

7. Who are your suppliers?

8. Where are your suppliers located?

9. What does your supply chain look like?

10. How does your company define supply chain management?

Performance Improvement
11. How does your company add value to products?

12. What sort of performance measurement system does your company use to evaluate suppliers and customers?

13. What are the most important measures of performance that your company uses?

14. What has been the focus of performance improvement within your company?

15. Have there been efforts by your company (or another company in your supply chain) to measure performance along your complete supply chain? If so, please describe.

16. What challenges does your company face and how does it overcome these challenges?

APPENDIX I: IRB EXEMPTION

North Carolina State University is a land-grant university and a constituent institution of The University of North Carolina

Office of Research and Graduate Studies

NC STATE UNIVERSITY

Sponsored Programs and
Regulatory Compliance
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919.515.2444
919.515.7721 (fax)

From: Joseph Rabiega, IRB Coordinator
              North Carolina State University
              Institutional Review Board

Date: March 31, 2008

Project Title: Performance Measures and Metrics for Textile and Apparel Supply Chains in
                 Developing Countries

IRB#:   144-08-3

Dear Reece -

The research proposal named above has received administrative review and has been approved as exempt from the policy as outlined in the Code of Federal Regulations (Exemption: 46.101. b.2). Provided that the only participation of the subjects is as described in the proposal narrative, this project is exempt from further review.

NOTE:
1.   This committee complies with requirements found in Title 45 part 46 of The Code of Federal Regulations. For NCSU projects, the Assurance Number is: FWA00003429.

2.   Any changes to the research must be submitted and approved by the IRB prior to implementation.

3.   If any unanticipated problems occur, they must be reported to the IRB office within 5 business days.

Please provide your faculty sponsor with a copy of this letter.

Sincerely,

Joe Rabiega
NCSU IRB