CHAPTER IV

Findings and Discussion

This study examined the selected independent variables that were expected to have relationships to inventory performance in the apparel industry. The stratified random sample of U. S. apparel manufacturers was asked about supply chain management (SCM), company characteristics, and inventory performance through a mail survey. The findings and discussion of this study are presented under the following headings: (1) return rate for the survey, (2) demographic profile of the respondents, (3) SCM activity level, (4) SCM activity level and company characteristics, (5) company characteristics and inventory performance, and (6) SCM activity level and inventory performance. In each section the relevant hypotheses test results were discussed.

Return Rate for the Survey

A self-administered questionnaire was mailed to a stratified random sample of 1,195 apparel manufacturers nationwide in October 1999 and was followed by the second mailing two weeks from the initial mailing. The third mailing and the fourth mailing were done in January 2000 and February 2000 respectively and were followed with follow-up postcards and follow-up calls. In the third mailing, to boost the return rate, one dollar of incentive was included in the envelope and a potential to be included in a drawing.

The response rates for mail questionnaires are shown in Table IV-1. The first mailing brought 22 surveys returned, the second mailing 22, the third mailing 45, the fourth mailing 8. A total of 97 questionnaires were returned by mail, which included four incomplete questionnaires unable to be analyzed in this study. Out of the 1,195 initial companies mailed the survey, 215 companies were identified as non-deliverables due to business closeout or address change, and 44 companies returned the courtesy postcard enclosed with the questionnaire refusing to participate in the survey.

Four weeks from the third mailing, follow-up calls were made to a random selection (n=46) of the remaining non-responses. Of these 46 companies, four were disconnected phones three were not the right type of business eight had answering machines four said to send fax of the survey, but those plant managers did not return the faxed survey and thirteen gave a few demographics, said too busy, and then hung up, and the remaining refused to talk and just hung up. The non-respondents' profile was based on the few demographic questions that were answered over the telephone. The follow-up call interview results are displayed in Table IV-2.

Table IV-1

Response Rates

Questionnaire Response	Frequency (n)	Percent (%)
Total Mailing	1,195	100
Total Non-deliverables	215	18.0
Total Refused to participate	44	3.68
First Mailing Response	20[a]	2.04 [b]
Second Mailing Response	21[a]	2.14 [b]
Third Mailing Response	44	4.49 [b]
Fourth Mailing Response	8	0.82 [b]
Total Response Mailed	93	9.49[b]

[a]: Incomplete surveys were excluded.

[b]: Percentage is based on the 980 adjusted sample size without non-delivered.

Table IV-2

Demographics of Non-respondents

Product Category	Frequency	Percentage (%)
Women's	6	46.2
Men's	1	7.7
Men's/ women's	3	23.1
Children's	1	7.7
Other	2	15.4
Total	13	100
Production System	**Frequency**	**Percentage (%)**
Bundle	2	15.4
UPS	4	30.8
Modular	1	7.7
will not say	1	7.7
Other	1	7.7
Don't know	4	30.8
Total	13	100
Retail Customer type	**Frequency**	**Percentage (%)**
All retail	2	15.4
Specialty	1	7.7
Dept	3	23.1
Dept/specialty	2	15.4
Small independent store	1	7.7
Other	2	15.4
Don't know	2	15.4
Total	13	100

Only thirteen companies, in the follow-up calls, gave information about their product category (i.e., men's wear, women's wear, children's wear), their production system and their retail customers (see Table IV-2). Six companies said their major product category is women's wear. Regarding production system, bundle system is used in two companies, Unit Production System in four companies. Five companies said they did not know the type of the production system or would not say. Two companies said their major retail customer covers all type retailers presented in the survey. Two companies said they did not know the type of their retail customers and the remaining two said nothing was applicable to their retail customers' type.

After four mailings, the adjusted response rate, based on the exclusion of the non-deliverable subjects, is 9.49% (93/980) based on the exclusion of the non-deliverable subjects, which is far behind the anticipated return rate of 35%. Part of the low return rate might be attributed to the considerable number of small apparel companies included in the sample and the considerable number of companies out of business. Because small companies (i.e., 1 to 20 employees) are usually operated by the owner, they do not have time or staff to answer. In addition, small companies often do not keep records, which would be needed to answer the questionnaire (Jones, 1999). This is supported by the fact that small companies was the largest category among those who said the questionnaire was not appropriate for them. Concerns about privacy might be related to the low return rate. Some companies told on the returned courtesy card that they would not participate in the survey because their policy prevents them from revealing their proprietary information. Sending a questionnaire during the holiday season (i.e., Thanksgiving break, Christmas) might be an additional deterrent in collecting data.

In terms of the number of companies, the sample explains 0.8% of the population (i.e., 93/11,791). However, a total number of employees of the sample is 26,105. Considering the estimated number of employees of the population in 1997, which is 543,100 (U. S. Census Bureau, 1998), the sample explains about 4.8% of the population.

In order to examine normalcy of distribution of the three mailing batches from first to third mailing, one-way ANOVA for all 80 continuous variables and chi-square analysis for all three nominal variables were done on all the variables in the survey. The fourth mailing batch was excluded in this distribution analysis because of its small batch size (n=8). One-way ANOVA revealed that three batches have similar mean and variance distributions in almost all variables, except for five variables. Chi-square results revealed no abnormal frequency were found in the three nominal variables across the three mailing batches. From this result, a lack of bias from the three mailing with different methods is assumed, and the variation in time and method of data collection should not distort the statistical results in this study.

Demographic Profile of the Respondents

This section uses tables of frequency distributions for measured company characteristics. Sample size (n) may vary with each analysis, because some respondents did not answer certain questions. Company profiles of the respondents is presented in Table IV-3 according to the company size and product category. Company size is indicated by the number of employees and production volume and product category is indicated by SIC code (i.e., SIC 231-232 for men's wear, SIC 233-234 for women's wear).

Table IV-3

Profile of Respondents by number of employees and SIC code

	Frequency	Percent (%)[a]
Number of Employee		
1-20	31	33.3
21-100	17	18.3
100+	36	38.7
No response	9	9.7
SIC Code 231-232	35	37.6
233-234	48	51.6
No response	10	10.8
Total	93	100

Note. Percentage is based on 93 respondents

Size of the Companies

The size of the companies in the sample varied both in terms of the number of employees and the total production volume in pieces. The original sample of 1,195 companies consisted of 59.7% of small companies who hire employees less than twenty-one. Among the 93 respondents, 33.3% (n=31) of the companies have one to nineteen

employees, 18.3% (n=17) have employees between 21 to 100, 38.7% (n=36) have employees over 100 to 4300, and the remaining 9.7% (n=9) did not reveal their number of employees. More than half respondents (n=52) refused to reveal their production volume. Several respondents stated it is their policy not to make public their proprietary information, such as the number of employees and production volume. This variable was eliminated for further analysis. To summarize, small companies' adjusted response rate is considered to be low, compared to relatively bigger companies' response. The respondents represented fewer small companies than found in the sample. Too small of a company (employees =1 or 2) was one reason that was given for refusal to participate in the survey.

SIC Code

The sample for this study was selected, based on product categories, from the SIC classification of manufactured products. The categories selected were 20.5% of men's (SIC 231-232) and 79.5% of women's (SIC 233-234). The returned sample of 93 respondents indicated production of men's wear (37.6%, n=35), women's wear (51.6%, n=48), and no response (10.8%, n=10). The proportion of women's wear manufacturers to men's wear manufacturers in the sample was greater than the proportion of women's wear manufacturers to men's wear manufacturers in the manufacturers who returned the survey; however, women's wear companies were the majority of the companies in both the sample, respondents, and the non-respondents. This change, in proportion, could be attributed to the low response rate of small companies. Women's wear companies are frequently small companies that can be flexible with style change (Jones, 1999). This size company was the most frequent size among companies that refused to participate and among those that were closed. In the stratified sample, the stratum of small companies under SIC code 233-234 (i.e., women's wear) accounted for the biggest part of the sample in this study (51.4%). Low participation level of this stratum in the survey contributed to the low response rate.

SCM Activity Level

$H1_0$. Levels of SCM activity implementation among apparel manufacturers are not different.

The focus of this research was the relationship between SCM activities and other apparel manufacturing activities. SCM activities are defined into six dimensions. Those six dimensions are partnership, information technology, operation flexibility, performance measurement, management commitment and leadership, and demand characterization. Each dimension consists of four to six activity items identified through literature analysis. Respondents were assessed for their level of agreement with 26 items that characterize the SCM activities in the six dimensions. Each item was rated on a six-point scale with 0 = *not at all* to 6 = *very high*. Table IV-4 displays the mean scores and standard deviation of the 26 scales.

Based on the mean scores, respondents seem to be well aware of importance of product demand patterns (e.g., trend, seasonality, randomness) in purchasing raw materials and setting production capacity with mean scores of 3.97 and 3.88 respectively, while information technology such as EDI and POS were not generally used. The mean scores of the two technology activities are 2.22 and 1.62 respectively, lower than the average score of the scale (2.50). The scale has 0 and 5 for the extreme points.

Table IV-4

Mean Scores of 26 SCM Activity Scales

Dimension	Activity	N	Mean
Partnership	Information sharing	91	3.08
	Technology sharing	91	2.78
	Forecasting	91	3.14
	Product development	91	3.32
Information Technology	Computer –to–computer communication	93	2.84
	EDI	93	2.22
	POS	93	1.62
	Special hangers, bags, etc.	93	3.45
Operation Flexibility	Small lot delivery	93	3.24
	Small lot order	93	3.25
	Volume flexibility	93	3.66
	Customized design	93	3.33
Performance Measurement	Fill rate	93	3.01
	Order lead-time	93	3.14
	On-time delivery rate	93	3.35
	Product quality	93	3.75
Management Commitment	Production system	93	3.15
	Educational training	93	2.58
	Employee empowerment	93	2.81
	Customer relations	93	3.81
	Vendor relations	93	3.73
Demand Characterization	Production capacity	93	3.88
	Production run cycles	93	3.75
	Batch sizes	93	3.16
	Raw material purchasing	93	3.97
	Information flow	93	3.16

Note. six-point scale from 0 to 5

First, agglomerative hierarchical cluster analysis with Ward's method was used to cluster respondents into k number of relatively homogenous groups based on levels of SCM activities. As a result of the cluster analysis, three homogenous groups were identified. Each group has 33, 35, and 23 members respectively (Table IV-5). Two respondents were excluded from the analysis because of their no-responses on Partnership dimension questions. As one way to ensure the validity of clustering, the same cluster analysis was done with a reduced size of the sample that was randomly

selected (Malhotra, 1993). As a result of the cluster analysis, 89.6% of respondents were assigned the same cluster as the one originally assigned.

Table IV-5

Results of Cluster Analysis

		Frequency	Percent (%)	Cumulative Percent (%)
Valid	**Cluster 1**	33	36.3	36.3
	Cluster 2	35	38.4	74.7
	Cluster 3	23	25.3	100.0
	Total	91	100.0	

To explain significant characteristics of each classified cluster in terms of SCM activity dimensions, factor analysis was used to verify the six dimensions that were identified through the literature review. To run factor analysis, it is recommend to use as many observations (sample size) as four or five times variables (Malhotra, 1996). Due to the small sample size (n=93) in this study, Cronbach alpha scores were calculated to eliminate the items which are less correlated with the other items in the same SCM dimension. Out of 26 items identified through literature review, nine items that reduced the alpha score of the dimension were excluded in this study before factor analysis. Factor analysis was done with the 17 items remaining, and the items are displayed in Table IV-6. The number of factors was specified to be six when running factor analysis instead of extracting the factors based on Eigen value. This extraction method is called 'A Priori Determination', which is used when the researcher knows how many factors to expect because of prior knowledge (Malhotra, 1996). In factor analysis, Varimax rotation method was used to achieve simplicity and enhance interpretability of the results. After the factor analysis was done, to test the reliability of the factors, Cronbach alpha values were calculated (See Table IV-6). The items with factor loading value higher than .60 on one factor and lower than.45 on the other factors at the same time were retained for next analyses. In Table IV-6, the Varimax-rotated loadings, variance explained by each factor (i.e., SCM activity dimension), Eigen value of the factor, and Cronbach alpha values are reported.

Table IV-6

Factor Analysis Result for SCM Activity Dimension and Cronbach Alpha

SCM Activity Dimension	Item (Detailed activity)	Factor Loading	Variance Explained (%)	Eigen Value	Cronbach Alpha
Partnership	Information sharing with suppliers/retailers	.911	15.2	2.58	.8894
	Information sharing with suppliers/retailers	.850			
	Forecasting with suppliers/retailers	.896			
Information Technology	Computer-to-computer communication	.702	6.1	1.044	.7102
	Electronic data exchange (EDI)	.926			
Operation Flexibility	Small lot delivery on a daily basis	.954	8.1	1.381	.9177
	Small lot order on a daily basis	.937			
Performance Measurement	Fill rate	.823	25.0	4.250	.8661
	Order lead-time	.838			
	On-time delivery rate	.919			
	Product quality	.758			
Management Commitment	Improvements in production systems	.805	11.1	1.882	.7587
	Improvements in education training	.783			
	Improvements in employee empowerment	.774			
Demand Characterization	Setting production capacity	.878	12.2	2.078	.7874
	Setting production run cycles	.842			
	Raw material purchasing	.725			
Total variance explained by six dimensions			77.8		

Note. six-point scale from 0 to 5

Factor analysis verified the underlying six dimensions of SCM activities (see Table IV-6). Six factors were identified and could be labeled according to the *a priori* labels from the literature, and SCM activities were assigned with the factor analysis to

each dimension. As a result of factor analysis, 17 items were finally selected for the next analyses. Each SCM dimension that had been specified through literature review had two to four items loaded on the factor from the items originally assigned to the dimension. Cronbach alpha values range from 0.7102 of Information Technology dimension to 0.9177 of Operation Flexibility dimension, which implies reasonable reliability of the scales. Variance explained by the combination of the six dimensions is 78.5%. The Performance Measurement dimension explained the biggest part of the variance (variance = 25.3%). All the six factors of SCM dimensions have Eigen values over 1.0 lending more credibility to the factor analysis results.

ANOVA and post hoc test (i.e., Tukey test) was used to identify the mean differences of the six SCM activity dimensions across the clusters (see Table IV-7). Each SCM activity dimension score was obtained by dividing the summation of the scores assigned to each activity question by the number of the activity items under the corresponding dimension. In addition, to profile the cluster in terms of company size, the frequency of the number of employees were examined. ANOVA and post hoc test for the six SCM activity dimension scores were run to further test the hypothesis.

Based on the mean of all the respondents, overall level of Information Technology dimension score is lowest, with the mean score of 2.56 below the average score (2.50). Apparel industry still has more room to improve in this dimension, implying that this industry is still labor intensive rather than capital intensive. Meanwhile, Demand Characterization dimension score is the highest score, which implies that for apparel industry, understanding demand pattern such as seasonality and trend is critical factor in running business. The finding is consistent with industry characteristics (Glock & Kunz, 1995) and is appropriate for the high percentage of women's wear companies among the respondents. Respondents assessed their level of Management Commitment and Leadership dimension relatively low compared to other dimensions, but slightly over the average, which implies that investment in production system or educational training is rather insufficient and employees are not fully empowered.

Table IV-7

Results of ANOVA for the six SCM Activity Dimensions and Post Hoc Test

SCM activity dimension	Mean by Cluster			Mean Total	F-value	Df	Signif icant
	Cluster1	Cluster 2	Cluster 3				
Partnership	3.80 [a]	3.18 [b]	1.57 [c]	3.00	36.8**	90	.000
Information Technology	3.95 [a]	1.44 [c]	2.26 [b]	2.56	39.3**	90	.000
Operation Flexibility	3.48	3.50	2.59	3.26	2.87	90	.062
Performance Measurement	3.68 [a]	3.24 [ab]	3.00 [b]	3.33	2.94	90	.058
Management Commitment	3.53 [a]	2.68 [b]	2.13 [b]	2.85	16.0**	90	.000
Demand Characterization	4.11 [a]	4.09 [a]	3.26 [b]	3.89	8.67**	90	.000

Note. six-point scale from 0 to 5

[a, b, c:] shares same letter when the mean difference is not statistically significant

**p<.01

In detail, the results showed that respondents in three SCM activity clusters displayed significantly different means in four dimensions (i.e., partnership, information technology, management commitment & leadership, demand characterization) (see Table IV-7). No significant difference was found in Operation Flexibility and Performance Measurement dimensions though the significance level is close to 0.05. Yet the mean numbers of three clusters imply that every cluster's operation flexibility is greater than average (2.5) when assessed on six-point scales. The levels of the operation flexibility among apparel manufacturers seem to be similar regardless of their SCM activity level. This result might be attributed to the fact that it is hard to increase operation flexibility salient in the apparel industry. Although the F-value was not statistically significant here for Performance Measurement dimension, post hoc test showed there is potential of mean differences in this dimension. The company sizes were different among three SCM

activity clusters. Cluster 1 is significantly larger than the other two clusters. Cluster 2 has more small companies than the other clusters (Table IV-8).

Table IV-8

Results of ANOVA and Tukey Test for Number of Employees by SCM Activity Cluster

SCM activity cluster	No. of employees			Total	Mean	F-value
	1-20	21-100	+100			
Cluster 1	3	4	21	28	750[a]	11.7**
Cluster 2	19	8	7	34	69.8[b]	
Cluster 3	9	4	8	21	114.3[b]	
Total	31	16	36	83	310.5	

[a, b]: shares same letter when the mean difference is not statistically significant.

**p<.01

Cluster 1 is characterized by its high level of SCM activities (see Table IV-7), and the company size is the largest compared to the other two clusters (see Table IV-8). Partnership with its business partner (i.e., fabric supplier, retail customer) is more favorable than the other clusters. Implementation of information technology such as computer-to-computer communication and electronic data exchange (EDI) is greater than the other clusters. This cluster is likely to use performance measurement such as fill rate, order lead-time, on-time delivery rate, and product quality to monitor suppliers' performance than the other clusters do. Management's leadership and commitment to SCM is greater than the other clusters, making improvements in production systems, educational training, and employee empowerment. This cluster has a higher score on the demand dimension than Cluster 3 and recognizes the importance of understanding product demand patterns (e.g., trend, seasonality, randomness) in setting production capacity, setting production run cycles, and purchasing raw materials. In brief, this cluster is considered to be a leader group who is actively implementing every dimension of SCM activities.

Cluster 2 is also implementing every dimension of SCM activities at an average or above average score, except for one dimension, Information Technology (see Table IV-7). Its usage level of information technology such as computer-to-computer communication and EDI is lower than the other groups and is well below the average (1.44<2.5). For this group, understanding product demand pattern for their operation is important compared to the other groups (4.09).

Cluster 3 is characterized by its relatively low level of SCM activities (see Table IV-7). Except for Demand Characterization dimension, its SCM dimension scores are around the average score or below. The scores for the partnership dimension, which includes partnership with suppliers and retailers in information sharing, technology sharing, and forecasting is the lowest favorable compared to the other groups with the score of 1.57 below the average scores of 2.5. The level of management's commitment to SCM activities and leadership is lowest of the scores for the three clusters. The usage level of performance measurements is also the lowest score. In addition, though the mean difference is not statistically different, the level of Operation Flexibility is again the lowest. In brief, Cluster 3 is least active of apparel manufacturers in implementing SCM activities.

The findings from cluster analysis, factor analysis, one-way ANOVA, and post hoc test revealed that specific SCM activities could be grouped into underlying dimensions, and these dimensions could be used to assess the apparel manufacturers' level of SCM activity. In other words, apparel manufacturers could be classified into subgroups based on their level of SCM activities. This result is consistent with the findings in previous studies where apparel manufacturers could be classified into subgroups based on their QR technology adoption level (Kincade, 1988; Ko, 1995; Sullivan & Kang, 1999). Based on the findings, Hypothesis $H1_0$, which stated no difference in levels of SCM activities among apparel manufacturers, was rejected.

SCM Activity Level and Company Characteristics

In this section, the relationships with SCM activity level and company characteristics were examined. Company characteristics were measured on four selected features (i.e., product characteristics, production system, fabric supplier, retail customer).

SCM Activity Level and Product Characteristics

Product characteristics are considered a major company characteristic and an important aspect of the production management environment. The product variable has been found to be a significant variable in several previous studies (e.g., Ko & Kincade, 1998). For this study, product characteristics were measured in two ways: product line characteristics based on the fashion level with dipolar states of basic and fashion, and SIC code. The SIC code of 231 and 232 is for men's wear and 233 and 234 is for women's.

Fashionability of apparel products is one critical factor that characterizes the apparel industry. To assess the fashionability of respondents, the ratio of each product line production volume to the total production was obtained in percentage. Instead of calculating the ratio of fashion goods production volume to that of basic goods because 11 respondents' basic goods production volume was zero and the denominator cannot be zero, the percentage of fashion goods production volume was used as a indicator of respondents' fashion level. It is assumed that the higher the fashion goods production volume, the higher the fashion level of the respondent.

$H2a_0$. The levels of SCM activities do not differ based on apparel manufacturers' product characteristics.

Ratio of fashion production volume. To test the relationship between characteristics of products apparel manufacturers produce and their SCM activity levels, SCM activities were measured both as the three SCM activity clusters and the six-activity dimensions. To test this hypothesis ANOVA was used and Tukey test was used as a post

hoc. The results for the three SCM activity clusters and the product line characteristics are in Table IV-9.

Table IV-9

ANOVA and Tukey Test Results to Test SCM Activity Cluster and Fashion Goods Production Level

Ratio of Goods to Total Production	Mean by SCM Activity Clusters (%)			Mean Total (%)	F-value	Significant
	Cluster 1	Cluster 2	Cluster 3			
1. Fashion Goods	43.4 [b]	65.2 [a]	39.0 [b]	50.7	5.59**	.005
2. Basic Goods	56.6 [a]	34.8 [b]	61.0 [a]	49.3	5.59**	.005

[a, b] : shares same letter when the mean difference is not statistically significant.

** $p<.01$

The overall test with fashion production volume was significant. In further tests, the respondents in Cluster 2 were found to produce more fashion goods than basic goods compared to the other two groups. Their fashion goods volume accounted for about 65% of the total production and basic goods about 35%. On the contrary, Cluster 1 and Cluster 3 respondents' total production consist of 40% of fashion goods and 60% of fashion goods respectively. Cluster 2 respondents can be defined as the apparel manufacturers whose fashion level is relatively high and Cluster 1 and 3 are those with a low fashion production level. Based on the fashion production level and overall SCM activity level, respondents could be diagramed as shown in Figure IV-1. Cluster 1 respondents can be called 'Model of SCM' because of its higher average of SCM activity mean scores. Cluster 2 respondents' overall SCM activity mean scores fall into between Cluster 1 and Cluster 3 and these manufacturers produce more fashion goods than basic goods, therefore can be called 'Mixed User of SCM'. Cluster 3 respondents can be called 'Low Level of SCM' because they produce more basic goods like Cluster 1. However, their SCM activity level mean scores are relatively low. They do not seem to actively adopt the innovation such as SCM activities and may be slow to the environmental changes.

To further probe the relationship between SCM activities and product characteristics, correlation was used with the six SCM activity dimensions and the

product fashion level. Results are displayed in Table IV-10. Out of the six dimensions, no individual SCM activity dimension was found to have a significant relationship with both fashion/Basic goods production.

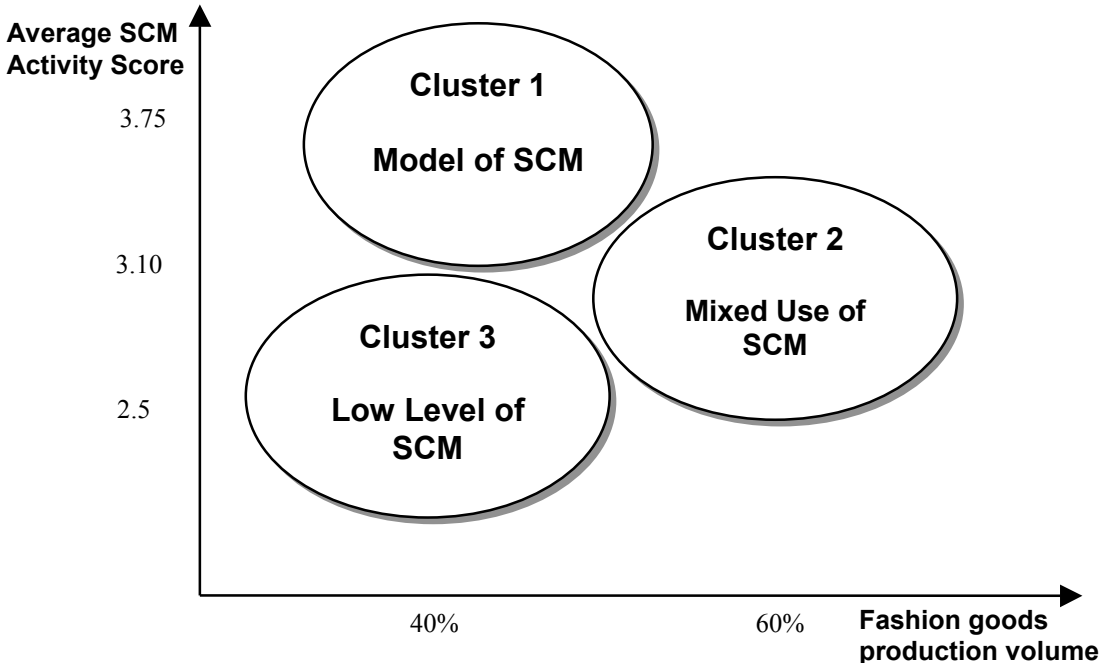

Figure IV-1. SCM Activity Clusters by Fashion Level

Table IV-10

Correlation between Six SCM Activity Dimension Scores and Product Fashion Level

		Fashion Goods	Basic Goods
Partnership	Corr. N	.197 91	-.197 91
Information Technology	Corr. N	-.151 93	.151 93
Operation Flexibility	Corr. N	-.102 93	.102 93
Performance Measurement	Corr. N	-.035 93	.035 93
Management Commitment	Corr. N	-.165 93	.165 93
Demand Characterization	Corr. N	.176 93	-.176 93

Note. six-point scale from 0 to 5

SIC code. Women's wear is assumed to be more fashionable than men's wear (Kang, 1999). For this reason, SIC code was used as a proxy of fashionability. An additional analysis was done in this study to examine the product category as one of product characteristics with the SCM activity levels. As described in the preceding demographic section (see Table IV-3), respondents reported that their major product category in their company in terms of SIC code could be categorized into two groups at large: men's wear SIC code 231-232 (n=35) and women's wear of SIC code 233-234 (n=46). To further examine the relationship between product characteristics and SCM activity level, chi-square analysis was used with the SIC code variable and the SCM activity clusters. No significant relationship was found between SCM activity level and product category manufactured by respondents in each SCM activity clusters (see Table IV-11).

Table IV-11

Chi-square Analysis to Test the Relationship between SCM Activity Cluster and Product Category

	SCM Activity Cluster			Frequency	Pearson Chi-square	Sig
	Cluster1	Cluster2	Cluster3	Total	7.736	.258
SIC 231-233 (Men's)	17	10	8	35		
SIC 233-234 (Women's)	12	22	12	46		
Total	30	32	20	81		

For alternative examination of SCI code and SCM activity level, the product category was compared with the second measure of SCM, the six activity dimensions. A t-test was used. Results are presented in Table IV-12. The results of the t-test showed that no significant mean differences were found between the two product categories, confirming the findings from chi-square analysis.

Table IV-12

ANOVA Results to Compare Six SCM Activity Dimension Scores between Product Category Groups

SCM activity dimension	SCM Activity Dimension Score Mean		t-value	Df	Sig.
	Men's	Women's			
Partnership	3.10	3.02	.245	79	.807
Information Technology	2.71	2.36	.944	81	.348
Operation Flexibility	3.14	3.27	-.359	81	.720
Performance Measurement	3.39	3.24	.592	81	.556
Management Commitment & Leadership	2.98	2.74	.972	80.7	.333
Demand Characterization	3.73	3.99	-1.222	81	.225

Note. six-point scale from 0 to 5

The examination of the relationship between product category and the SCM activity cluster and the six activity dimensions were not found to be significant. One aspect of product characteristics was significantly related to SCM activity dimensions. The relationship between fashion level and SCM activity cluster was found to be significant. When fashion level was compared with the six activity dimensions, no individual dimension was significant. For this reason, *$H2a_{0,}$ SCM activity level does not differ based on product characteristics,* was rejected.

SCM Activity Level and Production Systems

A second variable among company characteristics is the production system. The four production systems selected for this study included bundle system, Progressive bundle system (PBS), Unit Production System (UPS), and modular system. A direct question, as to the system being used, was asked in the survey. Respondents indicated the type of production system that they were using. Table IV-13 displays the frequency and percentages of each production system as reported by the respondents.

Table IV-13

Production Systems Used by Respondents

	Frequency	Percent (%)
Bundle	31	34.4
PBS	16	17.8
UPS	27	30.0
Modular	11	12.2
Others/No response	5	5.6
Total	90	100

Based on the frequency, bundle production system and UPS are used most often by respondents, accounting for 64.4% of the respondents. This commonly used system was followed by PBS and modular system in descending order. In the previous studies, bundle system and PBS, an advanced type of the bundle system are the most widely adopted production systems in the apparel industry (Kanakadurga, 1996; Lin, Kincade & Warfield, 1995; Lin, 1990). In this study, combined frequency of bundle system and PBS is 47 (52.2%) and combined frequency of UPS and modular system is 38 (42.2%). Piore and Sabel (as cited in Bailey, 1993) categorized the former two systems into *mass production* and the latter two systems into *flexible specialization.* The results in this study revealed that systems of two different categories are used at a relatively equal rate in the apparel industry. Considering the past propensity to adopt *mass production* system much more than *flexible specialization* in the apparel industry, the findings in this study implies that this industry is moving toward increasing operational flexibility.

$H2b_0$. The levels of SCM activities do not differ based on apparel manufacturers' production system.

To test the hypothesis, chi-square analysis was used. To control for cell size because of the small sample size, the five production system categories (i.e., bundle, PBS, UPS, modular, others/no-response) were reduced to two levels, according to the

classification used by Piore and Sabel (as cited in Bailey, 193). The bundle system and PBS were combined in one group and UPS and modular were combined in another group. Results of the analysis are shown in Table IV-14. As shown in the table, no significant relationship was found between SCM Activity Cluster and production system adopted by respondents.

Table IV-14

Chi-square Analysis to Test Relationship between SCM Activity Cluster and Production System

	SCM Activity Cluster			Frequency	Pearson Chi-square	Sig.
	Cluster1	Cluster2	Cluster3	Total	.2.89	.575
Mass Production	17	18	11	46		
Flexible Specialization	14	15	8	37		
Total	31	33	19	83		

To further explore the relationship between SCM activity level and production systems, independent samples t-test was used with the production system variable and the six SCM activity dimensions. The two production system groups consist of respondents with *mass production* and *flexible specialization* systems. The results of t-test showed that only one dimension, Demand Characterization, showed a significant mean difference between production systems (see Table IV-15).

The t-test revealed that apparel manufacturers who use flexible specialization in their production system (i.e., UPS, modular system) showed high level of Demand Characterization dimension score. This result is comparable with the discussions in the literature that flexible specialization in production system such as modular or UPS can be adopted by apparel manufacturers for the production of fashion goods of which demand is unpredictable and involves trend and seasonality (Bailey, 1993). Hypothesis $2b_0$, *SCM activity level does not differ based on production system* was thus rejected.

Table IV-15

T-test Results for the Relationship between Six SCM Activity Dimension Score and Production System

SCM activity dimension	SCM Activity Dimension Mean Score		t-value	Df	Sig.
	Mass Production	Flexible Specialization			
Partnership	3.08	3.05	.131	81	.896
Information Technology	2.46	2.79	-.963	83	.338
Operation Flexibility	3.10	3.37	-.794	83	.429
Performance Measurement	3.19	3.41	-.915	83	.363
Management Commitment & Leadership	2.74	3.11	-1.59	83	.114
Demand Characterization	3.62	4.13	-.2.36*	83	.020

Note. six-point scale from 0 to 5

SCM Activity Level and Fabric Supplier Characteristics

The third company characteristic was fabric suppliers. Fabric suppliers' characteristics of the respondents were evaluated on three variables: total cost concern, delivery performance, and the nature of the relationship with the respondent. The mean scores of the variables are presented in Table IV-16. Total cost concern, was measured on the six-point scale by asking respondents how much they are concerned about the total cost (i.e., unit cost plus transaction cost) in selecting their fabric suppliers on the six-point scale. The number of respondents who scored in the three top boxes (i.e., score=3, 4, 5) is 60 out of 85, indicating that many apparel manufacturers' primary concern in selecting the fabric suppliers is the total cost.

Delivery performance was measured by asking four relevant questions adopted from the Artz (1999) study on the six-point scales. Out of the four questions used, one question asking about the defect level of the component was deleted from the analysis due to its low correlation with the other questions. The questions used in the analysis asked respondents to evaluate their fabric suppliers' delivery performance in terms of product quality and on-time delivery rate, and overall satisfaction with the performance.

The reliability of the three scales was ensured by Cronbach alpha (alpha=0.8441). Delivery performance score was obtained by averaging the scores assessed on the three questions. Respondents who had the score of over 3, 4, or 5 in fabric suppliers' delivery performance amount to 67 out of 85, implying that most of respondents evaluate their fabric suppliers favorably.

The nature of relationship between fabric suppliers and apparel manufacturers was measured by asking three questions, i.e., how much the relationship is partnership-like, is long-term based, and is QR oriented. Some respondents (n=18) who participated in this study omitted the third question asking the level of their fabric suppliers' QR orientation. Comments written on the questionnaires indicated that this question was left blank because the respondent lacked knowledge about the term QR. This QR question was also deleted from the analysis when forming the nature of relationship score. Nature of relationship score was obtained by averaging the scores assessed on two questions. The reliability of the scales was ensured by Cronbach alpha (alpha= 0.6430). Most of respondents who scored in the three top boxes (i.e., score = 3, 4, 5), 75 out of 87, stated that their relationship with the fabric suppliers is more partnership-like than adversarial, and more long-term based.

$H2c_0$. SCM activity level does not differ based on fabric supplier characteristics.

One-way ANOVA and Tukey post hoc test were used to reveal whether a significant relationship existed between fabric suppliers' characteristics (i.e., cost as a primary concern, delivery performance, nature of the relationship) and apparel manufacturers' SCM activity level (i.e., Activity Cluster, Activity Dimension). Table IV-16 displays the results of ANOVA and mean scores of each aspect of fabric supplier's characteristics.

Table IV-16

ANOVA Results for the Relationship between SCM Activity Cluster and Fabric Supplier Characteristics

Characteristics	Mean by SCM Activity Cluster			Mean Total	F-value	Significant
	Cluster1	Cluster2	Cluster3			
1. Total Cost Concern	**3.25**	**2.71**	**3.17**	**3.01**	**1.70**	**.189**
2. Delivery Performance	**3.98** [a]	**3.54** [ab]	**3.22** [b]	**3.60**	**3.45***	**.036**
Quality of the component	4.29	4.06	3.64	4.02	2.03	.137
Satisfaction with the performance	375	3.29	3.00	3.36	2.55	.084
On-time delivery	3.89 [a]	3.24 [ab]	3.04 [b]	3.40	3.34	.040
3. Nature of Relationship	**3.86**	**4.04**	**3.59**	**3.87**	**1.43**	**.245**
Partnership-like than adversarial	3.70	4.03	3.14	3.69	4.10	.020
Long-term based	4.03	4.03	3.95	4.01	.044	.957

Note. six-point scale from 0 to 5

[a, ab, b] : shares same letter when the mean difference is not statistically significant.

*: $p<.05$

As shown in Table IV-16, fabric suppliers' characteristics in terms of delivery performance were found to have statistically significant relationship with the level of SCM activity. Regarding the cost aspect, respondents in any SCM activity cluster were acknowledged to be rather concerned about the cost. Respondents in Cluster 2 are those who least consider cost aspect in doing business with fabric suppliers. Cluster 1 respondents rated their fabric supplier delivery performance most high. And respondents in Cluster 3 seem to have fabric suppliers whose deliver performance is relatively less desirable.

In detail, in the result of the Tukey post hoc test, respondents in Cluster 1 evaluated their fabric supplier on-time delivery ability most high. In Table IV-7 that displayed the SCM activity dimension scores by cluster, respondents in Cluster 1 were found to be the manufacturers who had the highest score for implementing SCM activities in Partnership dimension and respondents in Cluster 3 were found to be those who are the least cooperative in information/technology sharing and forecasting with their suppliers/retailers. Cluster 1 respondents' high evaluation of their fabric suppliers'

delivery performance (see Table IV-16) might be related with the high score of Partnership dimension.

The variables of nature of relationship in terms of partnership-likeness and long-term basis were not found to be significantly related to the SCM activity level. Respondents in Cluster 3 are those who have the lowest mean score on this aspect; whereas respondents in Cluster 2 are those who have the highest mean score, showing the highest mean score in partnership-like relationship with their fabric suppliers. To further examine the relationship between fabric suppliers' characteristics and the six SCM activity dimensions, correlation analysis was used. Table IV-17 displays the results of the analysis.

Table IV-17

Correlation Analysis for SCM Activity Dimensions and Fabric Supplier Characteristics

		Fabric Supplier Characteristics		
		Total cost concern	Delivery performance	Nature of the relationship
Partnership	Correlation	.066	.261*	.199
	N	85	85	87
Information Technology	Correlation	-.049	-.039	-.205
	N	85	85	87
Operation Flexibility	Correlation	.018	-.105	.031
	N	85	85	87
Performance Measurement	Correlation	.125	.182	.207
	N	85	85	87
Management Commitment	Correlation	-.036	.276*	.039
	N	85	85	87
Demand Characterization	Correlation	-.011	.049	.133
	N	85	85	87

Note. six-point scale from 0 to 5

* Correlation is significant at the 0.05 level (2-tailed).

As one fabric supplier characteristic, delivery performance, showed a significant relationship with SCM activity cluster, two SCM activity dimensions (i.e., Partnership, Management Commitment) were found to have significant relationships with fabric suppliers' delivery performance. Respondents whose Partnership activity level is high and whose management commitment activity level is high have fabric suppliers whose delivery performance is high at the same time, implying that active implementation of

SCM activities might result in fabric suppliers improvement in delivery performance or vice versa, i.e., fabric suppliers improvements in delivery performance can enhance the SCM activity implementation level of apparel manufacturers. The significant relationship between fabric suppliers' delivery performance and high level of two SCM activity dimensions support the discussion that suppliers' performance have been a primary concern when buyers select suppliers (Doney & Cannon, 1997; Goffin, Szwejczewski, & New, 1997). Management Commitment is also positively related with the delivery performance, implying that more commitment from management is involved with more desirable company characteristics.

In summary, overall evaluation on their fabric suppliers in terms of delivery performance among three clusters was statistically significant. The mean scores of the three characteristics questions to measure three variables exceed the average score (2.50). In general, all respondents had positive relationships with their fabric suppliers. When examining the individual SCM activity dimensions, the dimensions of Partnership and Management Commitment were found to be related to the level of fabric suppliers' delivery performance. Therefore, $H2c_{0,}$ *SCM activity level does not differ based on fabric supplier characteristics,* was rejected.

SCM Activity Level and Retail Customer Characteristics

The fourth company characteristic was that of retail customers. Retail customers' characteristics were assessed to investigate the relationship to the level of SCM activities. In this study, five characteristics were selected: a major retail customer's cost orientation, ownership of retailers by the manufacturer, the relative size of the major retail customer to the respondent, the nature of the relationship with a major retail customer, and type of the major retail customer. Out of the five characteristics, ownership by the manufacturer could not be analyzed because 89 out of 93 respondents do not own their major retail customers and violated assumptions required for the analysis. Cost orientation, the relative size of a major retail customer and the nature of the relationship with the major

retail customer were evaluated on Likert-type scales. The type of the major retail customer was asked on a nominal scale.

Retail customers' cost orientation was measured on the six-point scale by asking respondents to evaluate how much their retail customer is cost oriented. Relative size was measured in the same way by asking them to evaluate how big their major retail customers are compared to themselves on the six-point scale. The results showed that 68 respondents out of 89 had rather cost oriented retail customers and 59 out of 84 respondents by assigning the score higher than mid point revealed that their major retail customer is a relatively big company compared to them. Mean scores of the two variables by the SCM activity cluster were presented in Table IV-18.

The nature of the relationship was measured by asking three questions (i.e., partnership-like vs. adversarial, long-term based vs. short-term based, QR-oriented vs. non-QR oriented). Several respondents (n=18) did not fully understand what QR stands for in the Fabric Supplier section and most of these respondents (n=14) also omitted the QR question in the retail Customer section. In obtaining the score for the nature of the relationship between retail customers and respondents, the QR question was omitted and only two questions were used to create the average. The Cronbach alpha score was 0.6629. A high score on the relationship means that the nature of the relationship between manufacturer and retailer is partnership-like and is long term. Seventy-seven respondents out of 89 had scores over the mid-point (2.5). This descriptive finding is inconsistent with the discussion in the literature that in the apparel industry, the relationship between retailers and manufacturers is rather adversarial and short-term based (Hammond, 1993; Rabon, 1998). Apparel manufacturers evaluated the relationship with their retail customers to be more favorable than expected.

$H2d_0$. SCM activity level does not differ based on retail customer characteristics.

To test the hypothesis ($H2d_0$) that stated no relationship between SCM activity levels (i.e., Activity Cluster, Activity Dimension) and retail customer characteristics, one-

way ANOVA and Tukey post hoc test were used for cost orientation, the relative size and the nature of the relationship The results are shown in Table IV-18

Table IV-18

ANOVA and Tukey Test for Relationship between SCM Activity Cluster and Retail Customer Characteristics

Characteristics	Mean by SCM Activity Cluster			Mean Total	F-value	Df	Sig.
	Cluster1	Cluster2	Cluster3				
1. Cost Orientation	**4.19** [a]	**2.71** [b]	**3.41** [ab]	**3.42**	**9.55****	**88**	**.000**
2. Relative Size	**4.10** [a]	**2.53** [b]	**3.10** [ab]	**3.25**	**8.17****	**83**	**.001**
3. Nature of Relationship	**4.14**[a]	**3.97** [ab]	**3.41**[b]	**3.89**	**4.07****	**85**	**.020**
Partnership-like	4.10 [a]	3.78 [a]	2.77 [b]	3.62	8.60	85	.000
Long-term based	4.25	4.09	4.05	4.14	.306	87	.737

Note. six-point scale from 0 to 5

[a, ab, b] : shares same letter when the mean difference is not statistically significant.

** P<.01

As revealed in Table IV-18, mean differences in all the three retail customer characteristics scores were statistically significant. In other words, SCM activity group can be characterized by the characteristics of their major retailers. Retail customers of respondents in Cluster 1 are the most cost oriented. Respondents in Cluster 2 have the least cost oriented retail customers compared to the other two groups. Overall, most retail customers of respondents in this study were perceived to have greater than average cost orientation (2.50) with the mean score of 3.42. Regarding the relative size of a major retail customer, respondents in Cluster1 do business with relatively big retail companies. Cluster 2 respondents were found to have relatively small retail customers. Regarding the nature of the relationship with a major retail customer, Cluster 1 respondents manage the most partnership-like relationship with their retail customers, and Cluster 3 respondents showed the lowest score in this characteristic.

To describe the relationship between SCM activity level and retail customer fharacteristics in more detail, correlation between three retail customer characteristics and

six SCM activity dimension scores were calculated. The correlation values were displayed in Table IV-19. Six of the 18 correlations were significant.

Table IV-19

Correlation between Six SCM Activity Dimension Scores and Retail Customer Characteristics

		Cost Orientation	Relative Size	Nature of Relationship
Partnership	Corr.	.029	.151	.406**
	N	89	84	89
Information Technology	Corr.	.461**	.420**	.062
	N	89	84	89
Operation Flexibility	Corr.	-.106	-.002	-.114
	N	89	84	89
Performance Measurement	Corr.	.120	.098	.198
	N	89	84	89
Management Commitment	Corr.	.267*	.182	.359**
	N	89	84	89
Demand Characterization	Corr.	-.180	-.084	.367**
	N	89	84	89

Note. six-point scale from 0 to 5

* $p<.05$ ** $p<.01$

The correlation between nature of the relationship and the partnership SCM dimension was significant. The higher score on the Partnership SCM activity dimension score was correlated with a higher score in the nature of relationship with a major retail customer. This finding is to be expected because with adversarial or short-term based relationship, trust can seldom be built between both parties. Consequently, Partnership SCM activities such as sharing information and technology and forecasting together with retailers are hard to implement (Ellarm & Cooper, 1990).

The information technology dimension score is significantly correlated with cost orientation and relative size of the major retail customers. This result might be attributed to the fact that cost oriented retailers tend to be department stores and mass merchandisers in their type and tend to be a big company in terms of the number of employees (see Table IV-20). These types of retailers may be able to invest more capital in implementing information technology. Relatively big retail customers, who are cost

oriented, invest in advance information technology and might motivate or force respondents to utilize computer-to-computer communication or EDI (Foley, 1995). Wal-Mart is an example of this type of retailer.

Table IV-20

Cost-oriented Retail Customer Profile

		Cost orientation	Relative size
Number of employee	Corr. N	.380** 81	.174 76
		Mean score[a]	Mean score[a]
Retailer type	Mass merchandiser.	4.60 (n=10)	4.60 (n=10)
	Dept. store	3.89 (n=9)	3.78 (n=9)
	Specialty chain	3.00 (n=27)	3.00 (n=27)
	Small store	2.81 (n=16)	2.00 (n=16)

Note. six-point scale from 0 to 5

** $p<.01$

The Management Commitment score showed statistically significant correlation scores with retail customers' cost orientation and the nature of relationship with retail customers. This result implies that, when dealing with a retail customer who is cost oriented and keeping a relationship that is partnership-like and long term based, management commitment is high. In situations with high management commitment, management needs to continuously improve such as in their production systems, educational training, and employee empowerment (Walton, 1986). A cause-effect relationship between the two incidents cannot be concluded but the relationship does exist.

Lastly, the demand characterization is correlated with the nature of relationship with retail customer, which implies that respondents, whose demand pattern is concerned with setting production capacity and run cycles and purchasing raw material tend to have more partnership-like and long-term based relationships with their retail customers.

When demand pattern is an important issue to apparel manufacturers, they might be a producer of fashion goods and have problem in forecasting the demand of coming season. They might be those who need assistance of retail customers who are closer to the end-use customers and have the sales data. Building a partnership-like relationship with retail customers might require sharing information on sales data because fluctuating demand pattern can cause the uncertainty in supply chain. These correlation results can support the belief that partnership can be built on the information sharing to reduce the risks in the supply chain (Ellarm & Cooper, 1990)

Chi-square analysis was used to test the relationship between the type of the major retail customer and respondents' SCM activity level because both variables had categorical values. In this analysis, to increase the validity, two options (i.e., direct mail, others) were excluded from the analysis to increase the cell size. As a result four retailer types were examined in this analysis (i.e., department store, specialty chain store, mass merchandiser/discounter, small independent store). (see Table IV-21).

Table IV-21

Chi-square Analysis for SCM Activity Cluster and Retail Type

	SCM Activity Cluster			Frequency	Pearson Chi-square	Sig
	Cluster1	Cluster2	Cluster3	Total	16.5*	.011
Department Store	6 (3.1)[a]	2 (3.5)	1 (2.4)	9		
Specialty Chain Store	8 (9.6)	14 (11.0)	6 (7.4)	28		
Mass Merchandiser	5 (3.4)	0 (3.9)	5 (2.7)	10		
Small Independent Store	2 (5.5)	10 (6.3)	4 (4.3)	16		
Total	27	31	21	79		

[a] : expected frequency in the parenthesis

Chi-square analysis revealed that four types of retail customers are not proportionately distributed according to the expected frequencies. Cluster 1 respondents have more department stores as retail customers and Cluster 2 respondents have more small independent stores and specialty chain stores as their major retail customer. To

probe the relationship between the type of a major retail customer and SCM activity dimension scores, one-way ANOVA and Tukey post hoc test were used. Table IV-22 displayed the results.

Table IV-22

ANOVA and Tukey test for SCM Activity Dimensions and Retail Customer Type

SCM activity dimension	SCM Activity Dimension Score Mean				F-value	Df	Sig.
	Dept.	Specialty	Mass	Small			
Partnership	3.70	2.94	3.50	2.60	1.96	62	.129
Information Technology	3.00 [ab]	2.22 [ab]	3.60 [a]	1.56 [b]	4.65**	64	.005
Operation Flexibility	2.95	3.12	2.55	3.75	1.16	64	.331
Performance Measurement	3.35	3.51	3.55	2.89	1.47	64	.231
Management Commitment	3.03	2.98	2.50	2.52	1.06	64	.373
Demand Characterization	4.13 [a]	4.03 [ab]	3.20 [b]	3.96 [ab]	2.54	64	.064

Note. six-point scale from 0 to 5

[a, ab, b] : shares same letter when the mean difference is not statistically significant.

** $p<.01$

Out of the six SCM activity dimensions, Information Technology dimension mean scores showed statistically significant differences across the retail customer types. Respondents who have mass merchandisers as their major retail customer tend to more actively implement computer-to-computer communication and EDI and respondents, whose retailer' type is the small independent store tend to be the least involved with the information technology. This result might be attributed to the fact that mass merchandisers or discounters handle larger lot size than the other four types of retail customers (i.e., department store, specialty chain store, small independent store, others). They need to invest in advanced technology for efficient order to delivery cycle, such is the case in Wal-Mart (Foley, 1995). To fulfill the demand of their major retail customers, respondents might need to invest more in computer-to-computer communication and EDI.

In brief, SCM activity dimensions showed statistically significant relationships with retail customer characteristics in terms of cost orientation, relative size, nature of relationship, and type of retail customer. All four selected retail customer characteristics were found to have a significant relationship with SCM Activity level. Therefore, hypothesis, $H2d_{0,}$ *SCM activity level does not differ based on retail customer characteristics,* was rejected.

Summary of the relationship between SCM activity levels and company characteristics

The results of $H1_0$ revealed the existence of three clusters differentiated in levels of six SCM activity dimensions. The profiles of companies in these clusters and these dimensions were examined in relation to company characteristics by testing $H2_0$. Cluster 1 showed the highest level of SCM activity implementation in five SCM dimensions excluding Operation Flexibility. Respondents in this cluster tend to manufacture about 43% fashion goods and 57% basic goods to the total production volume. They are likely to have fabric suppliers whose delivery performance is desirable. They are likely to maintain the relationship with major retail customers to be more partnership-like and long-term based. Their major retail customer is likely to be cost oriented and a relatively big company, and the type may be department stores. In terms of the number of employees, this cluster consists of rather big apparel manufacturing companies. These findings support the discussion in the literature that SCM is based on the partnership between chain members (Ellarm & Cooper, 1990), and large companies that produce basic goods are more apt to adopt the advanced technology in their operation (AAMA, 1987). Apparel manufacturers in this cluster can be called 'Model of SCM ' in the apparel industry.

Cluster 2 respondents' information technology level is low compared to the other two clusters, while their implementation level of Demand Characterization dimension is high. They are the manufacturers who produce more fashion goods (60%) than basic goods (40%). Their fabric suppliers' delivery performance is relatively high. Compared to the other two clusters, their major retail customers are less cost oriented and a relatively

small company. Their relationship with retail customers is partnership-like and long-term based. Their major customers are likely to be small independent stores and specialty chain stores. This cluster apparel manufacturers can be called 'Fashion-drive Players' in the apparel industry.

Lastly, Cluster 3 respondents were found to be least active implementation of the SCM activities compared to the other cluster members. Their SCM activity level is lowest except for Information Technology dimension. They manufacture basic goods (60%) more than fashion goods (40%). Their rating on major fabric suppliers' delivery performance was lowest. Their major retail customers are likely to be rather cost-oriented and rather big. Compared to the other clusters, the relationship with the retail customers is least partnership-like or long-term based. Apparel manufacturers in this cluster can be called 'Routineer' in the apparel industry. Although basic goods production has potential to adopt SCM more effectively than fashion goods production as proven in Cluster 1, basic goods production alone may not result in improvement in SCM.

The relationships between individual SCM activity dimensions and company characteristics were also examined. The summary of significant relationships found through statistical analyses is presented in Table IV-23 and Figure IV-2. When respondents' level of Partnership dimension activity implementation is high, their fabric suppliers' delivery performance is likely to be high, the nature of relationship with retail customers is likely to be more partnership-like and long-term based. Information Technology level is positively related with the retail customers' cost orientation, relative size, and retailer type. Manufacturers who have mass merchandisers or department stores as their major retailer tend to have high level of Information Technology activity implementation. Management Commitment dimension is positively related with the fabric suppliers' delivery performance, retail customers' cost orientation, and the nature of relationship with retail customers (i.e., more partnership-like, more long-term based). Manufacturers with high level of Demand Characterization dimension score are likely to have flexible specialization system as their production system, and they are likely to maintain a partnership-like and long-term based relationship with retail customers.

Overall, SCM activity dimension scores are more closely related with the retail customers' characteristics than any other company characteristics.

Table IV-23

Summary of the relationship between SCM Activity Dimension and Company Characteristics

SCM Activity	* Company Characteristics
Partnership	* Fabric suppliers' delivery performance(+) * Relationship with retailers (+)
Information Technology	* Retailers' cost-orientation (+) * Retailers' relative size (+) * Retailer type: department store, mass merchandiser
Operation Flexibility	None
Performance Measurement	None
Management Commitment	* Fabric suppliers' delivery performance (+) * Retailers' cost-orientation (+) * Relationship with retailers (+)
Demand Characterization	* Production system: flexible specialization * Relationship with retailers (+)

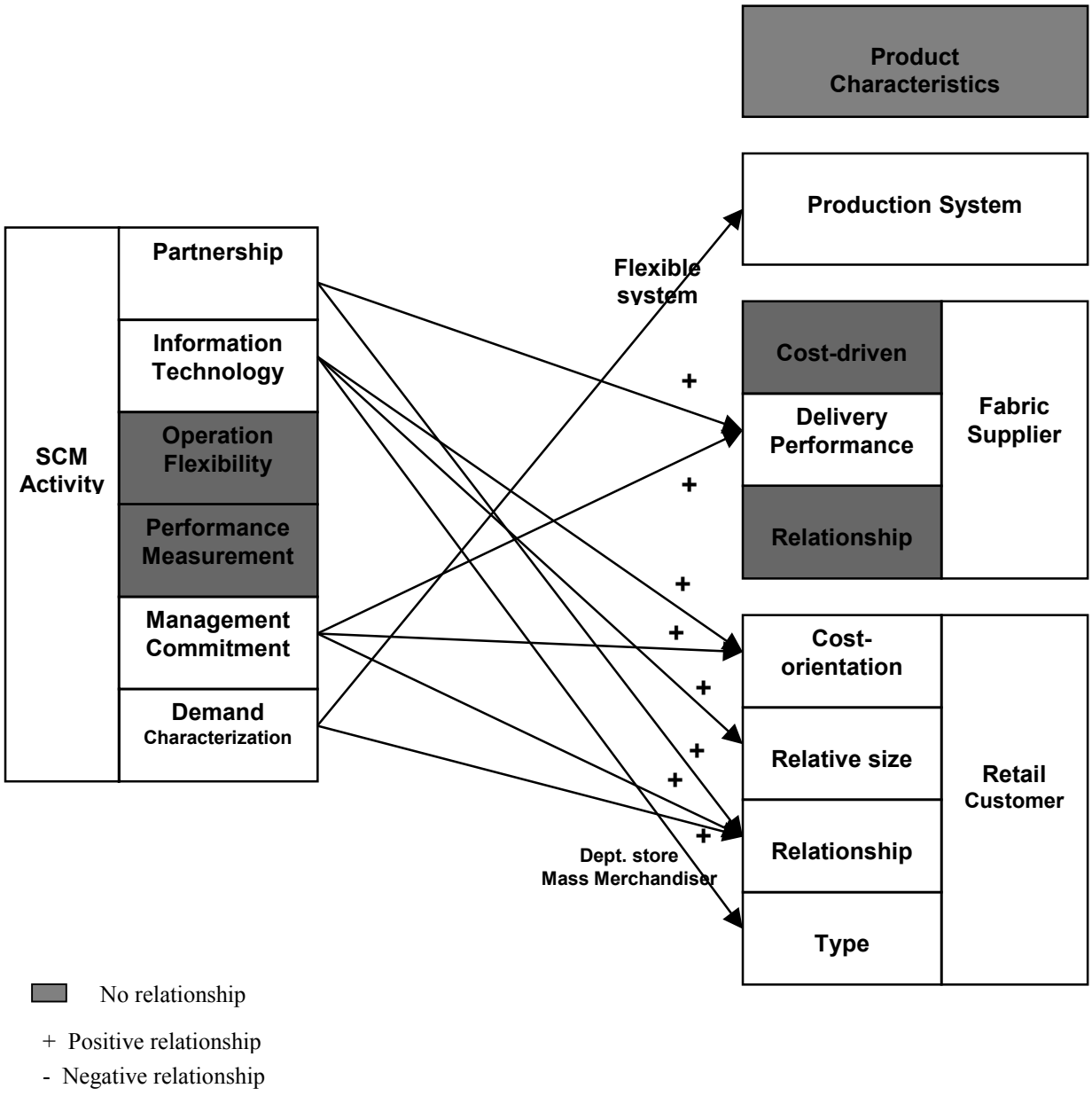

Figure IV-2. Company Characteristics and SCM Activity Dimension

Company Characteristics and Inventory Performance

Apparel manufacturers' inventory performance was studied in relation to the selected company characteristics: product characteristics, production system, fabric suppliers' characteristics (i.e., total cost, delivery performance, nature of the relationship), and retail customers' characteristics (i.e., cost orientation, relative size, nature of the relationship, retailer type). Inventory performance was evaluated on 17 measures. The 17 measures consist of eight for fashion goods, eight for basic goods, and one for expectation of improvement in five inventory performance measures. A set of eight measures consists of two for raw materials (i.e., inventory level as Week Of Supply, order lead-time), two for WIP (i.e., batch size, shop lead-time), and four for finished goods inventory performance (i.e., % of excess/surplus inventory, on-time delivery rate, inventory turnover ratio, delivery lead-time). This set of performance measures was asked for fashion goods and basic goods respectively. Lastly, respondents were asked to express their expectation of improvement in fill rate, order lead-time, on-time delivery rate, inventory turnover ratio, and inventory level. An average score of the five expectation measures was used as one expectation measure. The mean scores of raw material, WIP, and finished good inventory performance questions are calculated. Due to the missing values across the performance measures, the numbers of response differ. Statistical analyses such as ANOVA, Tukey test, correlation analysis and multiple regression analysis were used to test four hypotheses (i.e., $\mathbf{H3a_0}, \mathbf{H3b_0}, \mathbf{H3c_0}, \mathbf{H3d_0}$) that stated no relationship between company characteristics and inventory performance.

Fashion goods vs. basic goods inventory performance

Respondents were asked detailed inventory performance measures to specify probable differences between fashion goods and basic goods in inventory performances. Those detailed questions are to profile the inventory performance within the type (i.e., two questions for raw material, two questions for Work-In-Process, four questions for finished good). The mean values were displayed in Table IV-24, 25, 26, and 27.

Regarding inventory performance concerned with raw materials, inventory level of fabrics for basic goods is higher than fabrics for fashion goods and the time for procurement of fashion goods raw material takes longer than for basic goods (see Table IV-24).

Table IV-24

Mean Scores of Raw Material Inventory Performance Measures

Question	Mean scores	
	Fashion goods	Basic goods
Inventory level (in weeks of fabric inventory)	8.0 (n=75)	8.7 (n=75)
Order lead-time (in days)	49.4 (n=71)	35.5 (n=70)

Batch size in fashion goods production is smaller than that for basic goods and production takes slightly longer in four days for fashion goods (see Table IV-25). Based on the shop lead-time, parts of basic goods move faster in manufacturing site than fashion goods. As shown in Table IV-25, big difference in batch size of the two goods might result in higher WIP level of basic goods in manufacturing site because a large batch size is associated with the amount of parts waiting to be transformed between workstations.

Table IV-25

Mean Scores of WIP Inventory Performance Measures

Question	Mean scores	
	Fashion goods	Basic goods
WIP batch size (in dozens)	140.1 (n=69)	390.1 (n=69)
Production Shop lead-time (in days)	29.7 (n=69)	25.7 (n=70)

Inventory performance based on finished fashion goods and basic goods were probed in terms of excess/surplus inventory level, on-time delivery rate, inventory turnover ratio, and delivery lead-time (Table IV-26). Basic goods' excess/surplus inventory ratio to the total production volume is higher than fashion goods. On-time delivery rate of both goods were similar with a slightly higher rate for basic goods. Inventory turnover of basic goods was shown to be higher than fashion goods' implying that basic goods are moving faster from manufacturers to retailers. Regarding delivery lead-time from respondents to retail customers, more days are required to deliver fashion goods to retail customers than basic goods, implying that fashion goods are likely to stay in manufacturers' site longer than basic goods. This finding is consistent with the turnover ratio finding in that higher turnover ratio of basic goods means goods are moving faster from manufacturers to retailers. Longer delivery lead-time of fashion goods supports the previous study's discussion that fashion goods production may occur outside the nation because fashion goods manufacturers may seek for low-wage areas. Low wage rate can be traded off for longer transportation times. For products which are standardized, change little in style over time, production can be automated in the US using automated production (Christerson & Appelbaum, 1995; Fisher et. al., 1997).

Table IV-26

Mean Scores of Finished Good Inventory Performance Measures

Question	Mean scores	
	Fashion goods	Basic goods
Excess/surplus inventory ratio (in %)	11.0 (n=71)	16.6 (n=71)
On-time delivery rate to retailers (in %)	85.8 (n=76)	88.3 (n=79)
Inventory turnover ratio	4.6 (n=59)	6.3 (n=64)
Delivery lead-time (in days)	20.4 (n=69)	16.8 (n=69)

Respondents were found to expect to improve their overall inventory performance (i.e., fill rate from their fabric suppliers, order-lead time, on-time delivery rate, inventory turnover ratio, inventory level overall) (Table IV-27). Their mean expectation score is

higher than average score (2.50). The five expectation measures were averaged at individual level and used as one expectation measure.

Table IV-27

Mean Scores of Expectation of Improvement in Overall Inventory Performance Measures

Question	Mean scores
Expecting improved fill rate	3.74 [a] (n=93).
Expecting reduced order lead-time	3.52 [a] (n=93).
Expecting improved on-time delivery rate	3.78 [a] (n=93)
Expecting inventory turnover ratio	3.35 [a] (n=93).
Expecting inventory level	3.46 [a] (n=93).
Average of Expectation	3.59 [a] (n=93).

Note. six-point scale from 0 to 5

$H3a_0$. Apparel manufacturers' product characteristic is not related to their inventory performance of fashion goods and basic goods in terms of level within type.

To test the differences of each inventory performance measure based on product characteristics within the company, paired samples t-test was used. Table IV-28 displaye the t-test results. This test was used to examine whether apparel manufacturers who deal with both types of apparel goods (i.e., fashion goods, basic goods) would build differentiated inventory management strategies based on the product line characteristics. The respondents who answered that their total production volume is accounted for 100% by fashion goods or basic goods solely were excluded from the paired samples t-test.

Table IV-28

Paired Sample T-test Results of Inventory Performance Measures

Inventory Performance		Mean of Difference (fashion - basic)	N	t-value	Significant
Raw material	Inventory level (in weeks)	-.3	63	-.245	.807
	Order lead-time	15.0	58	4.55**	.000
WIP	Batch size	-445.1	57	-2.29*	.025
	Shop lead-time	3.0	58	3.09**	.003
Finished goods	Excess/surplus inventory (%)	.9	60	.498	.620
	On-time delivery rate (%)	-2.4	65	-1.258	.213
	Inventory turnover ratio	-.3	53	-1.00	.320
	Delivery lead-time (in days)	4.6	58	2.43*	.018

Note. six-point scale from 0 to 5

* $p<.05$ ** $p<.01$

As shown in Table IV-28, some inventory performance measures were found to be statistically different based on the fashion level of the goods. Fashion goods' batch size is significantly small compared to that of basic goods, implying that WIP inventory level of basic goods is higher than fashion goods. The lead-times to acquire fabrics (order lead-time), to produce (shop lead-time), and to deliver (deliver lead-time) fashion goods and basic goods are significantly different, too. Respondents took a longer time to procure fabrics for fashion goods, to produce fashion goods, and to deliver fashion goods than time for basic goods. This result contradicts the assumption that, because forecasting the demand of fashion goods long before the selling season is difficult, procurement of raw materials and production capacity for fashion goods should be reserved as close to the selling season as possible (Fisher, Hammond, & Obermeyer, 1997). However, average total lead-time from procurement through delivery to the retailer for fashion goods, which is the sum of order lead-time, shop lead-time, and delivery lead-time, is longer for fashion goods (i.e., 98.6 days) than for basic goods (i.e., 77.5 days)(see Table IV-29). This finding implies the potential for improvement for fashion goods manufacturers. When the lead-time is long, the risk of the forecasting is high. When

stockouts occur and manufacturers or retailers do not have enough stocks, consumers are unsatisfied and manufacturers and retailers lose the opportunity to sell in that selling season (Lambert, Stock, & Ellram, 1998). If manufacturers overproduce in anticipation of stockouts inventory holding costs accrue, thus resulting in profit loss. Manufacturers need to reduce the lead-time from procurement to delivery to minimize this risk.

Table IV-29

Mean Scores and Paired T-test Results of Total Lead-Time for Fashion Goods and Basic Goods

Total Lead -Time	N	Mean values (days)	Valid N (Listwise) for paired samples t-test	t-score	Significant
Fashion good	67	98.6	56	5.21**	000
Basic good	69	77.5	56		

** p<.01

Correlation analysis was used to examine the relationship of inventory performance measures with the fashion goods' proportion to the total production. Respondents were asked to write the proportion of fashion goods volume produced in percentage based on the total production of 100%. The higher the percentage, the more fashion goods respondents produce. The Correlation values were presented in Table IV-30.

Among the 16 detailed measures, four detailed inventory performance measures were found to have statistically significant relationship with the percentage of fashion goods production volume. Those measures are on-time delivery lead-time of fashion goods, shop lead-time for basic goods, on-time delivery rate of basic goods, and inventory turnover ratio of basic goods (see Table IV-30). Regarding the expectation measure listed at the bottom section of Table IV-30, no significant relationship was found. This measure assessed the respondents' overall expected improvements in inventory performance.

Table IV-30

Correlation to Test the Relationship between Fashion Goods Production Volume and Inventory Performance

Question		Correlation value with fashion goods production volume	N	Sig.
Fashion goods				
Raw material	Fabric inventory level (weeks)	.024	75	.837
	Order lead-time (days)	-.063	71	.604
WIP	WIP batch size (dozens)	-.054	71	.655
	Production Shop lead-time (days)	.190	69	.118
Finished goods	Excess/surplus inventory ratio (%)	.214	71	.074
	On-time delivery rate to retailers (%)	-.081	76	.488
	Inventory turnover ratio	-.056	59	.674
	Delivery lead-time (days)	.301*	69	.012
Basic goods				
Raw material	Fabric inventory level (weeks)	-.005	75	.965
	Order lead-time (days)	.094	70	.441
WIP	WIP batch size (dozens)	-.054	71	.652
	Production Shop lead-time (days)	.306*	70	.010
Finished goods	Excess/surplus inventory ratio (%)	-.155	71	.197
	On-time delivery rate to retailers (%)	-.355**	79	.001
	Inventory turnover ratio	-.293*	64	.019
	Delivery lead-time (days)	.061	69	.618
Overall	Expectation [1]	-.044	93	.677

[1] six-point scale from 0 to 5

* p<.05 ** p<.01

More focus on fashion goods production is likely to be connected to building high level of finished fashion goods inventory because, according to the respondents, the days finished fashion goods are waiting to be delivered to retailers (i.e., delivery lead-time), is longer than basic goods' delivery lead-time. As more fashion goods are produced, time to produce basic goods becomes longer. These manufacturers' on-time delivery rate of basic goods to retail customer has an inverse relationship with the fashion goods production

volume, implying that they tend to be less timely in delivering basic goods to their retail customers than manufacturers with more basic goods. Their inventory turnover ratio of basic goods also has an inverse relationship with the fashion goods production volume. That is, finished basic goods are likely to move more slowly when the apparel manufacturer focuses more on fashion goods production.

From the fashion goods point of view, increasing fashion goods production volume might result in less desirable inventory performance for basic goods. In brief, respondents whose focus is on fashion goods production showed less desirable inventory performances than those respondents with basic goods. Respondents seem to meet the demand of fashion goods at the expense of basic goods inventory performance. However, from the basic goods point of view, producing more basic goods is significantly related with apparent improvement in inventory performance of basic goods (i.e., reduction in shop lead-time higher on-time delivery rate, higher inventory turnover ratio). In other words, as more products are regarded to be standardized or to have less fluctuation in demand such as basic apparel goods in apparel industry, typical inventory performance measures (i.e., on-time delivery rate, inventory turnover, shop lead-time) can be improved as expected in other industries (Johnson, 1998; Sabath, 1995). This finding supports the belief that basic goods manufacturers who can produce in a repetitive way with little change in style are most appropriate to implement QR technologies (AAMA, 1987).

Considering the current trend toward more fashion goods, more apparel manufacturers will become involved with the fashion goods production. Fashion goods need to move quickly through the supply chain to satisfy the consumer (Aron, 1998). How to improve the inventory performance measures for fashion goods seems to be unidentified yet. Based on overall results of the analyses, *$H3a_{0,}$ Apparel manufacturers' product characteristic is not related to their inventory performance of fashion goods and basic goods in terms of level within type,* was rejected.

Production system and inventory performance

$H3b_0$. Apparel manufacturers' production system is not related to their inventory performance of fashion goods and basic goods in terms of level within type.

In this section, the relationship between production system adopted by apparel manufacturers and inventory performance measures were examined. Independent t-test results are displayed in Table IV-31. Out of 17 inventory performance measures, only two measures showed statistically significant relationships with the production system (see Table IV-31). Those measures are delivery lead-time of fashion goods and on-time delivery rate of basic goods. Therefore, $H3b_0$ was rejected. Respondents using UPS or modular system tend to deliver fashion goods in a shorter time to their retail customers. These systems can provide flexibility for manufacturers (Berg, et. Al., 1996). This finding implies that the time fashion goods stay as a finished good is shorter. Modular or UPS might be used by manufacturers who are agile to deliver fashion goods to retailers. Manufacturers who use bundle system or PBS tend to deliver finished basic goods more on time than those with modular or UPS can deliver basic goods.

Contrary to the expectation that UPS or modular system compared to bundle system and PBS (Bailey, 1993; Berg, et. al., 1996) would reduce the shop lead-time and batch size of WIP as represented by WIP level measures, no significant differences were found in both measurement between two production system types. This result might be due to the varying levels of production system attributes within each system. According to Kanakadurga (1996), production system can be characterized by the level of five attributes: workflow, method of retrieval between workstations, WIP inventory, number of tasks per operator, and interaction between workers. Respondents might not determine their production system solely based on WIP inventory level. Perceived production system can be a result of interactions among the five attributes in respondents' mind.

Table IV-31.

T-Test for Relationship between Production System and Inventory Performance

Question		Mean values		t-value	df	Sig.
		Mass Production	Flexible Specialization			
Fashion goods						
Raw material	Fabric inventory level (weeks)	8.8	7.7	.314	69	.755
	Order lead-time (days)	48.5	53.0	-.695	65	.490
WIP	WIP batch size (dozens)	126.1	161.2	-.682	63	.498
	Production Shop lead-time (days)	31.7	28.2	.795	63	.430
Finished goods	Excess/surplus inventory ratio (%)	12.4	9.8	1.08	65	.280
	On-time delivery rate (%)	86.9	83.3	1.06	70	.290
	Inventory turnover ratio	3.9	5.1	-1.88	53	.064
	Delivery lead-time (days)	15.1	27.9	-2.17*	47.6	.035
Basic goods						
Raw material	Fabric inventory level (weeks)	6.8	12.0	-1.28	34.5	.209
	Order lead-time (days)	34.8	36.2	-.284	62	.777
WIP	WIP batch size (dozens)	243.7	615.4	-1.76	29.2	.088
	Production Shop lead-time (days)	28.5	24.7	.833	62	.408
Finished goods	Excess/surplus inventory ratio (%)	21.9	10.8	.887	63	.378
	On-time delivery (%)	92.4	82.7	2.58*	38.1	.014
	Inventory turnover ratio	7.0	5.4	.638	57	.526
	Delivery lead-time (days)	15.1	20.8	-1.10	61	.272
Overall	Expectation[1]	3.46	3.72	1.70	84	.196

[1]: six-point scale from 0 to 5

* $p<.05$

Fabric supplier characteristics and inventory performance

$H3c_0$. Fabric suppliers' characteristics (i.e., total cost, delivery performance, nature or the relationship) are not related to apparel manufacturers' inventory performance of fashion goods and basic goods in terms of level within type.

Multiple regression analyses were used to examine the relationship between three selected fabric supplier characteristics and inventory performance measures. The objective of this analysis is to reveal whether fabric suppliers' cost offering and delivery performance, and the nature of relationship with respondents have a significant influence on respondents' inventory performance or not. If so, which variable can influence more on the variance of the inventory performance measures was examined. The results which showed a significant relationship were displayed in Table IV-32. The other results are presented in Appendix F.

Table IV-32

Regression Analyses between Fabric Supplier Characteristics and Significant Inventory Performance

Dependent Variable	Fabric Supplier Characteristics	R^2	Df	F-value	St. beta	t-value
Fashion goods Excess inventory		.118	66	2.79*		
	Cost				-.150	-1.18
	Delivery performance				-.091	-.712
	Relationship				-.220	-1.74
Fashion goods On-time Delivery rate		.118	68	2.91*		
	Cost				-.079	-.615
	Delivery performance				.221	1.76
	Relationship				.240	1.89
Basic goods Shop lead-time		.091	65	2.06		
	Cost				.045	.353
	Delivery performance				-.303	-2.29*
	Relationship				.189	1.49
Basic goods On-time Delivery rate		.083	70	2.03		
	Cost				-.061	-.491
	Delivery performance				.299	2.33*
	Relationship				.008	.063

*:p<.05 ** p<.01

Out of 17 inventory performance measures, four measures showed that their variance change could be explained by the variance of one fabric supplier characteristic or by the combined variances of the three characteristics. Four measures are from detailed inventory performance measures. The five measures are fashion goods' excess/surplus level, on-time delivery rate for fashion goods, basic goods' shop lead-time, and on-time delivery rate for basic goods.

Fabric suppliers' delivery performance was found to influence the respondents' delivery performance of fashion goods and shop lead-time for basic goods. Fabric suppliers' delivery performance measured in this study is relevant to the quality of fabrics, timeliness of delivery, and overall satisfaction by manufacturers. Less defective fabrics delivered on time might speed up the production flow. Especially, basic goods production is relatively standardized and without intermittence due to defective goods or idle time, shop lead-time might be reduced considerably.

In brief, findings of multiple regression analyses imply that apparel manufacturers' inventory performance are related in terms of lead-time control, and delivery performance can be affected directly by fabric suppliers capability of delivery. Though influences of individual fabric suppliers' characteristics were not found to be significantly related, combined influence of the three characteristics were found to be significantly related with fashion goods excess inventory level and on-time delivery rate for fashion goods. Findings in this analysis supports the discussion that suppliers' delivery performance is considered to influence a company's performance (Artz, 1999). The findings contradict the concern about the traditional and rather adversarial relationships between chain partners of the apparel industry (Hammond, 1992). Respondents are rating their relationship with fabric suppliers higher than average (see Table IV-16), and apparel manufacturers' inventory performance seems to be dependent on fabric suppliers' performance. Developing the relationship with fabric suppliers toward closer partnership is being realized in this industry for more desirable inventory performance for both fashion goods and basic goods. Therefore, *$H3c_0$. Fabric suppliers' characteristics are not related to apparel manufacturers' inventory performance of fashion goods and basic goods in terms of level within type* was rejected.

Retail customer characteristics and inventory performance

$H3d_0$. Retail customers' characteristics (i.e., cost-orientation, relative size, nature of the relationship, retailer type) are not related to apparel manufacturers' inventory performance of fashion goods and basic goods in terms of level within type.

Retail customers' characteristics were measured on four measures: cost orientation, relative size, nature of the relationship with respondents, and retailer type. For the analysis with the three retailers' characteristics, multiple regression analysis was used. ANOVA and Tukey test were used to test the relationship with the retailer type and inventory performance. Due to the number of missing values (n=10), the retailer type was not included in the regression analysis. Selected retailer types are department store, specialty chain store, mass merchandiser/discounter, small independent store, and others (i.e., direct mail, others). Dependent measures were the 17 inventory performance measures. The results are shown in Table IV-33. The results of the regression analyses that showed significant relationships between retail customer characteristics and inventory performance measures only were presented. The other regression results are presented in Appendix F.

Table IV-33

Regression Analysis Results for the Relationship between Retailer Characteristics and Significant Inventory Performance Measures

Dependent Variable	Retail Customer Characteristics	R^2	Df	F-value	Beta	t-value
Fashion goods Delivery lead-time		.075	61	1.56		
	Cost-orientation				-.046	-.316
	Relative size				.058	.391
	Relationship				.276	2.15*
Basic goods Order lead-time		.103	63	2.30		
	Cost-orientation				-.305	-2.30*
	Relative size				.253	1.91
	Relationship				.111	.903
Basic goods Delivery lead-time		.147	62	3.39*		
	Cost-orientation				-.284	-2.17*
	Relative size				-.007	-.058
	Relationship				.280	2.31*
Expectation		.160	80	4.88**		
	Cost-orientation				.010	.075
	Relative size				.293	2.31*
	Relationship				.282	2.68**

*p<.05 ** p<.01

Only one inventory performance measure of fashion goods, delivery lead-time, showed a significant relationship with retailers' cost orientation, relative size, and nature of the relationship with manufacturers (Table IV-33). This finding indicates that the three selected retailer characteristics are less closely related to the manufacturers' inventory performance of fashion goods. One measure, delivery lead-time, found to be statistically significant has a positive relationship with the nature of the relationships.

Regarding the inventory performance for basic goods, two performance measures, order lead-time and delivery lead-time, showed a significant relationship with retailers' characteristic (i.e., cost orientation, nature of the relationship). Manufacturers, whose retail customers' cost orientation is relatively high, are likely to perform desirably in lead-time measure for basic goods. To identify the characteristics of cost-oriented retailers in terms of the number of employees and retailer type, mean scores were calculated by retailer type and correlation analysis with employee was used. Cost-oriented retailers refer to those who tend to hire more employees and can be found in department store or mass merchandisers (see Table IV-20). Mass merchandiser and department stores' product variety is less varied than specialty chain stores (Diamond, 1993). Fashion goods take longer time to procure, produce, and deliver (see Table IV-4, 25, 26). Therefore, cost-oriented retailers are more likely to handle basic goods and the manufacturers who supply basic goods to the cost-oriented retailers would have shorter lead-time in procuring and delivering. The finding in the positive relationship between delivery lead-time and nature of the relationship is identical with the finding in that for fashion goods. Manufacturers are likely to store finished goods in their storage longer and deliver them on request from retailers to maintain the relationship with their major retail customers. Or, they may produce the goods in low-wage countries and transportation time contributes to the long delivery lead-time.

As the nature of relationship between retailers and manufacturers are more partnership-like and more long-term based, manufacturers' delivery lead-time of basic goods is getting longer. In other words the time finished basic goods are waiting to be delivered in the plant is getting longer. Manufacturers might produce basic goods in

anticipation of order from retail customers with whom they have built a long-term relationship like a business partner. In QR auto replenishment arrangements have complained that they must hold inventory for retailers (Mirsky 1997; Tersine, 1988). This situation defeats the purpose of a QR strategy.

The relative size and nature of relationship with retail customer were found to have a significant association with the manufacturers' expectation of improvement in inventory performance measures. As shown in Table IV-33, respondents who have a relatively large size retailers and a more partnership-like and long-term based relationship with major retail customers are likely to expect more to improve in inventory performance through SCM.

Retail customers' type has a relationship with respondents' delivery lead-time of fashion goods, shop lead-time, and delivery lead-time for basic goods (Table IV-34). Shop lead-time of basic goods for department store and mass merchandisers are longer than for the other two retail types. This might be related to the volume of order from retailers. Department stores and mass merchandisers may need a high volume of basic goods. Therefore, to produce the high volume of order would take longer time. Delivery lead-time of both fashion goods and basic goods were found to be significantly different among the retailer types. Delivering goods to specialty chain stores takes the longest time. This finding implies that manufacturers who have specialty chain store as their major retail customer might build high level of finished goods inventory because specialty chain stores tend to place order in a small lot size to assort their product mix in a wide variety.

Table IV-34

ANOVA and Tukey Test Results for the Relationship between Retailer Type and Inventory Performance Measures

		Mean values by retailer type				F-value.	df
		Dept. store	Specialty chain	Mass merch.	Small store		
Fashion goods							
Raw material	Inventory level (weeks)	14.5	6.0	14.8	5.4	1.14	55
	Order lead-time (days)	53.3	47.3	39.4	41.3	.553	51
WIP	Batch size (dozens)	137.7	81.7	268.7	204.4	1.99	52
	Shop lead-time (days)	34.8	28.4	32.1	22.7	.846	51
Finished goods	Excess inventory (%)	9.8	12.3	8.1	10.5	.417	52
	On-time delivery rate (%)	79.3	88.0	88.0	89.4	1.42	57
	Inventory turnover	4.7	4.3	6.7	5.2	1.73	45
	Delivery lead-time (days)	7.3	26.2	14.0	10.5	3.10*	51
Basic goods							
Raw material	Inventory level (weeks)	9.8	6.9	18.8	9.5	.929	51
	Order lead-time (days)	40.4	32.6	31.9	36.4	.386	48
WIP	Batch size (dozens)	151.5	571.4	1,740.5	483.9	1.19	49
	Shop lead-time (days)	37.4 [a]	25.7 [ab]	29.3 [ab]	11.4 [b]	4.38**	48
Finished good	Excess inventory (%)	6.2	12.4	14.6	8.5	.689	49
	On-time delivery rate (%)	83.2	84.1	91.5	93.6	1.39	55
	Inventory turnover	4.8	4.8	6.6	5.6	.638	46
	Delivery lead-time (days)	7.8	19.4	12.9	7.1	3.75*	48
Overall	Expectation[1]	3.72	3.70	3.18	3.08	2.37	64

[1] : six point scale with 0 to 5

[a, ab, b] : shares same letter when the mean difference is not statistically significant.

* $p<.05$ ** $p<.01$

In summary, all the detailed retail customers' characteristics were found to have a significant relationship with inventory performance measures. Therefore, *$H3d_0$. Retail customers' characteristics (i.e., cost-orientation, relative size, nature of the relationship, retailer type) are not related to their inventory performance of fashion goods and basic goods in terms of level within type,* was rejected.

Summary: Company characteristics and inventory performance

All company characteristics (i.e., product characteristics, production system, fabric supplier, retail customer) were found to have a significant relationship with individual inventory performance measures through the statistical analyses. Table IV-35 displays the company characteristics and inventory performances, which showed a statistically significant relationship.

Table IV-35

Significant Relationships Found between Company Characteristics and Inventory Performance Measures

Company characteristics		Inventory performance
Product line (fashion goods volume)		* Delivery lead-time of fashion goods (+) * Shop lead-time of basic goods (+) * On-time delivery rate of basic goods (-) * Inventory turnover ratio of basic goods (-)
Production system (flexible specialization)		* Delivery lead-time of fashion goods (+) * On-time delivery rate of basic goods (-)
Fabric supplier	Cost-driven selection	None
	Delivery performance	* On-time delivery rate of fashion goods (+) * Shop lead-time of basic gods (-) * On-time delivery rate of basic goods (+)
	Overall (i.e., cost, delivery performance, nature or relationship)	* Excess/surplus inventory of fashion goods (-) * On-time delivery rate of fashion goods : cost-driven (-), delivery performance (+), relationship (+)
Retail customer	Cost-orientation	* Order lead-time of basic goods (-) * Delivery lead-time of basic goods (-)
	Relative size	* Expectation (+)
	Nature of the relationship	* Delivery lead-time of finished goods (+) * Delivery lead-time of basic goods (+) * Expectation (+)
	Retailer type	* Delivery lead-time of fashion goods: specialty chain (+) * Shop lead-time of basic goods: dept (+), small store (-) * Delivery lead-time of basic goods: specialty (+)

As each company characteristic's level or extent increases or decreases, the company's inventory performances are likely to change accordingly. Especially, apparel manufacturers' product line characteristics, fabric suppliers' delivery performance, and retail customer's type were found to cover wider measures of inventory performance compared to the other company characteristics. On-time delivery rate and delivery lead-time regardless of product line, were found to be more susceptible to changes in company characteristics. Overall, basic goods' inventory performance measures were more likely to be related with the company characteristics. Therefore, the null hypotheses (i.e., $H3a_{0,}$ $H3b_{0,}$ $H3c_{0,}$ $H3d_{0}$) that stated no relationship between company characteristics and inventory performance were rejected. All the significant relationships between the four company characteristics and fashion goods and basic goods inventory performance were depicted in Figure IV-3 and Figure IV-4 respectively.

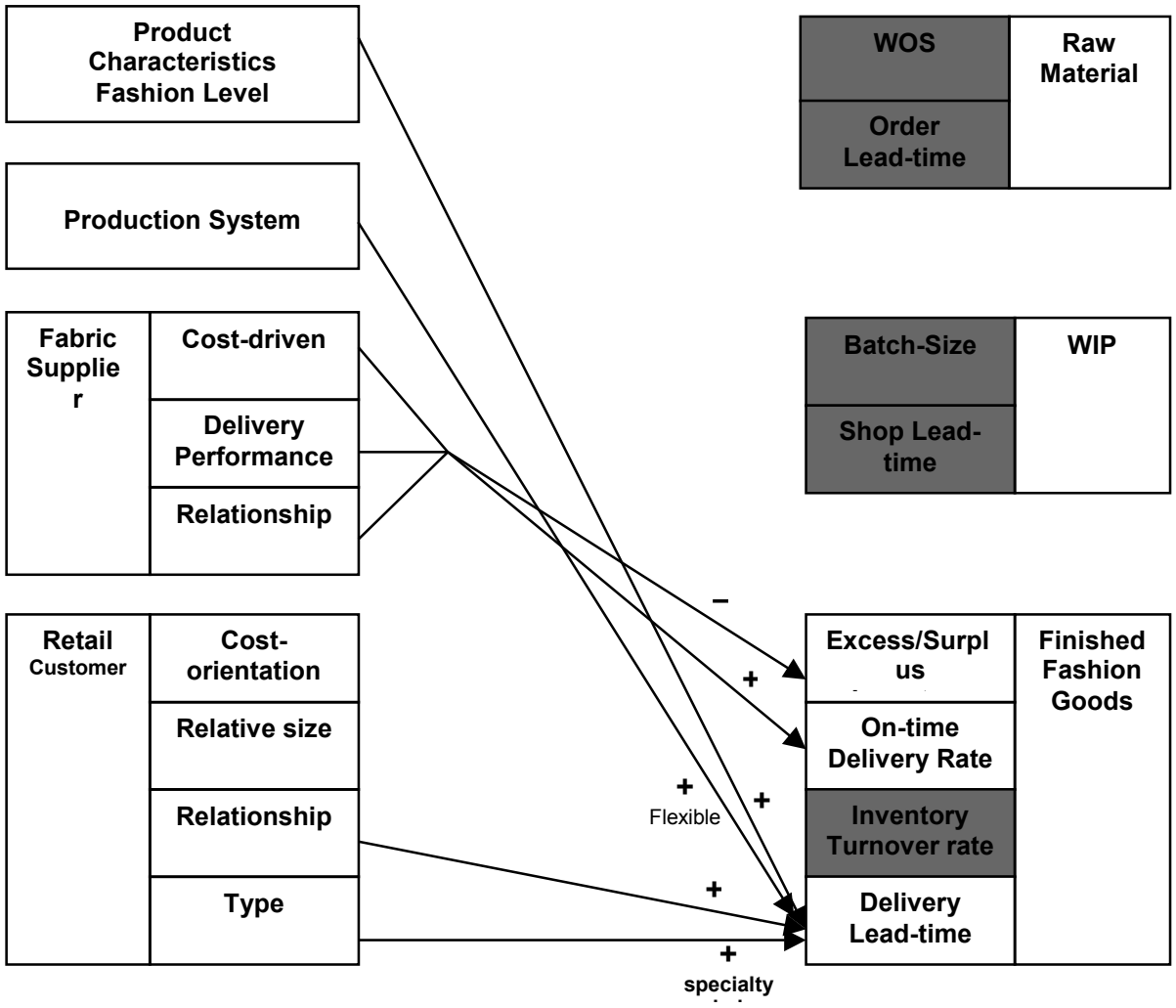

Figure IV-3. Fashion Goods Inventory Performance and Company

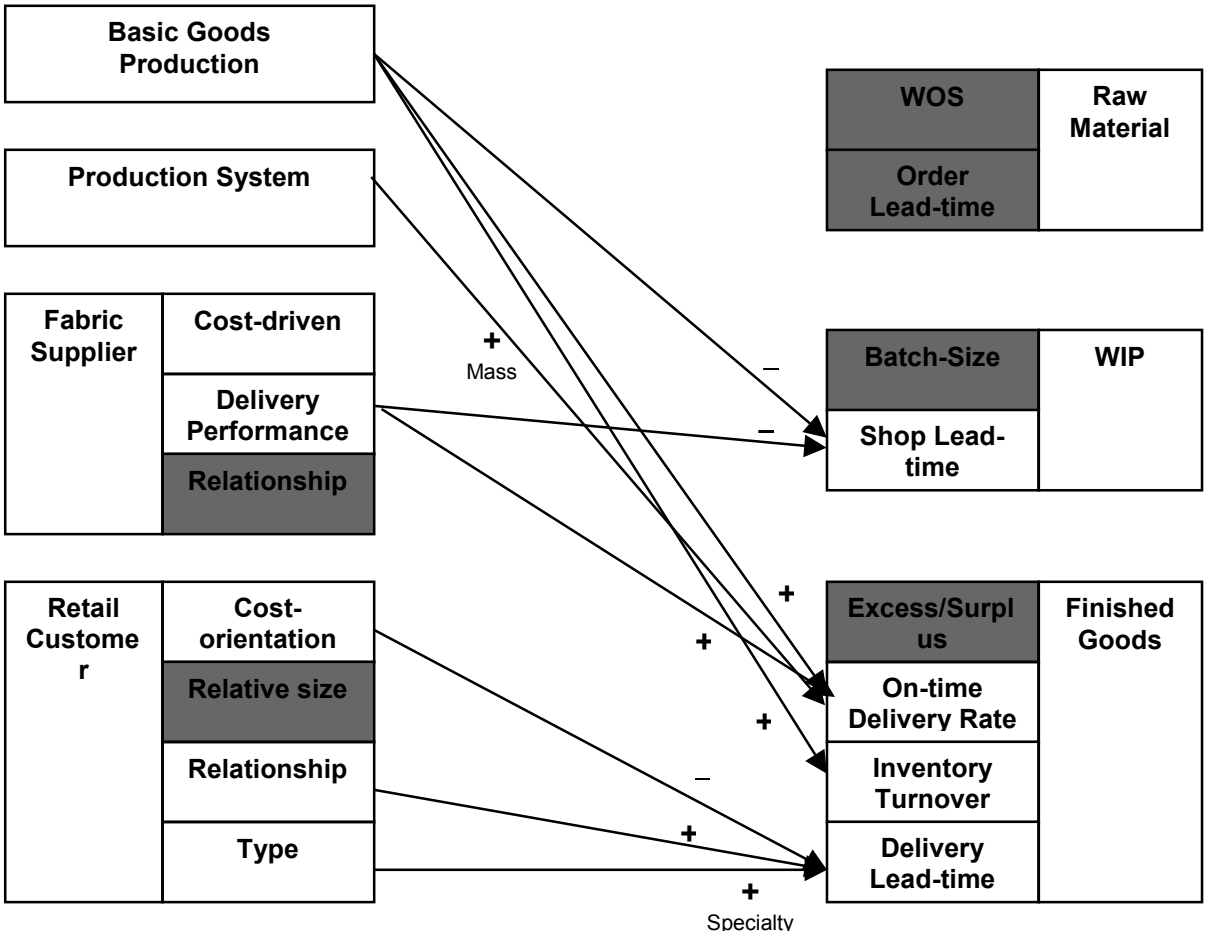

Figure IV-4. Basic Goods Inventory Performance and Company Characteristics

SCM Activities and Inventory Performance

In this section, the relationship between SCM activities and inventory performance were studied by using ANOVA, Tukey test, and multiple regression analysis. ANOVA and Tukey test were used to examine the mean differences of 17 inventory performance measures among three SCM activity clusters, which were identified through cluster analysis and factor analysis in the preceding section. Cluster 1 is characterized by its evenly high levels of implementation of five SCM activity dimensions: partnership, information technology, performance measurement, management commitment, and demand characterization. Cluster 2 showed high levels of SCM activity implementation in Performance Measurement and Demand Characterization but showed the lowest level of Information Technology SCM activities. Cluster 3 respondents can be identified as those whose SCM activity levels are evenly low in all SCM activity dimensions compared to the other two groups.

$H4_0$. Apparel manufacturers' level of SCM activities is not related to their inventory performance of fashion goods and basic goods.

The results of ANOVA and Tukey test revealed that two detailed inventory performance measures (i.e., weeks of supply of fabrics for fashion goods, shop lead-time for fashion goods) and the expectation measure mean scores were found to be significantly different across the three SCM activity clusters. This expectation measure assessed the respondents' expectation of improvement in inventory performance such as order lead –time reduction, on-time delivery rate increase, inventory turnover ratio increase, and inventory level reduction. The mean values of 17 inventory performance measures, f-value, df, and significant level are displayed in Table IV- 36. None of the inventory performance measures for basic goods were significantly different across SCM activity clusters.

Table IV-36

ANOVA and Tukey-test for SCM Activity Clusters and Inventory Performance Measures

		Mean values by SCM activity clusters			F-value.	df	Sig.
		Cluster 1	Cluster 2	Cluster 3			
Fashion goods							
Raw material	Inventory level (weeks)	4.5 [b]	6.7 [ab]	16.2 [a]	3.24*	72	.045
	Order lead-time (days)	54.5	43.9	45.9	1.30	69	.278
WIP	Batch size (dozens)	121.3	174.1	114.5	.615	66	.544
	Shop lead-time (days)	30.3 [ab]	23.7 [b]	40.1 [a]	4.47*	67	.015
Finished goods	Excess inventory (%)	10.7	11.1	11.5	.030	69	.970
	On-time delivery rate (%)	81.8	89.6	84.6	2.28	73	.109
	Inventory turnover	4.2	5.0	4.7	.489	58	.616
	Delivery lead-time (days)	22.0	15.9	27.4	1.18	67	.313
Basic Goods							
Raw material	Inventory level (weeks)	4.5	9.5	13.2	2.11	72	.128
	Order lead-time (days)	39.3	31.6	33.6	.939	68	.396
WIP	Batch size (dozens)	463.7	476.1	225.4	.787	66	.460
	Shop lead-time (days)	26.8	19.0	31.3	2.67	68	.077
Finished good	Excess inventory (%)	7.3	29.5	14.4	1.40	69	.253
	On-time delivery rate (%)	87.5	88.3	88.8	.047	76	.954
	Inventory turnover	5.9	4.7	8.9	1.03	63	.361
	Delivery lead-time (days)	11.8	16.1	24.3	2.29	67	.109
Overall	Expectation[1]	3.91 [a]	3.61 [ab]	3.10 [b]	5.98**	90	.004

[1] : six-point scale from 0 to 5

[a, ab, b] : shares same letter when the mean difference is not statistically significant.

* $p<.05$ ** $p<.01$

For fashion goods, the differences of mean value in WOS of fashion goods fabric revealed that Cluster 3 had a significantly higher level of raw material inventory and the production time for fashion goods took the longest among the three clusters, whereas Cluster 2 showed the shortest shop lead-time. Considering the fashion goods production volume, Cluster 2 respondents are manufacturers who produce more fashion goods and Clusters 3 respondents are basic goods producers. Basic goods producers' inventory performance measures (i.e., WOS, shop lead-time) for fashion goods are least desirable. Although Cluster 1 and Cluster 3 respondents produce more basic goods than Cluster 2,

Cluster 1 respondents' high level of SCM activity might also have a relation to the dissimilar results from Cluster 3.

The respondents' varied levels of SCM activity implementation are related to the varied level of expectation of improvement in inventory performance. This finding is consistent with the literature (e.g., Giunipero & Brand, 1996; Higginson & Allram, 1997) because as manufacturers invest their resources into SCM, they will expect to see more apparent improvement as a result of their investment. The expectation level of Cluster 1 and Cluster 2, who have executed the SCM activities more actively compared to Cluster 3, is higher than Cluster 3 in four inventory performance measures: fill rate, order lead-time, inventory turnover ratio, and inventory level. Regarding order lead-time reduction, the three clusters did not show significantly different expectation levels.

For basic goods, the results of ANOVA and Tukey test indicate that inventory performances are not different among SCM activity groups. Although two measures for fashion goods showed significant mean differences, most measures showed statistically insignificant performances among the clusters. In other words, although apparel manufacturers can be grouped into a homogeneous set based on their varied SCM activity implementation levels, the group membership is not significantly related to how well inventory performances are. This might be because each SCM activity dimension which determines the SCM activity cluster characteristics are associated with the inventory performance measures in a dissimilar pattern, for example, one is positively, another negatively. In other words, though SCM activity cluster membership was found to have a significant relationship with some of the company characteristics, and the company characteristics were significantly related to the inventory performance, the magnitude and the direction of the relationships vary to show little significant relationship between SCM activity cluster membership and the inventory performance measures.

In addition to looking at apparel manufacturers' SCM as a whole where the respondents' SCM activity implementation levels of the six dimensions are aggregated, probing the relationships between individual SCM activity dimensions and inventory

performance measures might reveal more about the relationship between apparel manufacturers' SCM and inventory performance. Table IV-37, Figure IV-5, and Figure IV-6 show that all but one dimension, Partnership, are significantly related with some of inventory performance measures. Improved capturing and sharing information about actual customer demand, between all parties in the chain could bring benefit to partners through reduced inventories, better use of capacity, fewer stockouts, and less obsolescence. (Christopher & Peck, 1997). Unlike the anticipated results, Information Technology dimension is positively related with the order lead-time and shop lead-time measures. This finding indicates that respondents who implement computer-to-computer communications and EDI at a higher level, are more likely to take longer time to acquire fabrics for fashion goods and transform the fabrics into fashion goods and basic goods. In addition to the three lead-time measures, Information Technology dimension score has a negative relationship with on-time delivery rate of both fashion goods and basic goods. Manufacturers with high level of information technology may outsource actively for low wage rate. These kind of manufacturers may trade off long lead-time with production cost. Another reason for the inverse relationship may be attributed to that, when manufacturers who have abnormally long lead-time and low level of on-time delivery rate need advanced information technology to shorten the lead-time from fabrics to apparel goods more than other manufacturers. Although manufacturers are adopting the technologies, the improvement in order lead-time, shop lead-time, and on-time delivery rate might not have changed yet. Because the cause and effect relationships cannot be inferred from this analysis, which one precedes the other cannot be determined here. The information technology might be used to enhance the communication with the retail customer's side rather than fabric suppliers' side, and order lead-time and shop lead-time might not be controlled by respondents' information technology. Additional unexplored variables may also be contributing to this issue. As suggested by the ANOVA, interaction may occur, which may affect the expected outcome of an innovation. Whatever the reasons, in the apparel industry at present, manufacturers who actively use computer-to-computer communication and EDI cannot be considered to have controlled lead-time and on-time delivery rate desirably at the same time.

Operation Flexibility showed a significant relationship with shop lead-time for fashion goods. Manufacturers, who have a high level of operation flexibility, are likely to show short shop lead-time. In this study, operational flexibility was measured by asking respondents to assess their level of small lot delivery on a daily basis and small lot order on a daily basis. Increasing operational flexibility seems to be related to the positive inventory performance of WIP for fashion goods. Considering the findings from $H3_0$, no company characteristics are found to be significantly related to fashion goods shop lead-time (Table IV-35). Though manufacturers can shorten the production time and increase flexibility, they tend to store a high level of finished fashion goods inventory to meet the retail customers' demand.

Performance Measurement dimension score is inversely related to shop lead-time and inventory turnover ratio of basic goods. This indicates that manufacturers, who use performance measurements to monitor performances, tend to have short shop lead-time and low inventory turnover ratio of finished basic goods. Low inventory turnover ratio means a high level of finished goods inventory, controlling the sales volume. As with Information Technology dimension, the need for using performance measurements might be acknowledged by those whose inventory level is less favorable. Their use of the measurements, however, is not directly connected to the benefit in inventory level yet, or may not deliver the outcome in practice as expected by the literature.

Management Commitment dimension score is inversely related to the inventory turnover ratio of fashion goods. In other words, high level of fashion goods inventory are found among respondents who have made improvements in their management (i.e., production systems, educational training, employee empowerment). Low inventory turnover is also inconsistent with the belief that more management commitment is involved in SCM, the company performance will be more desirable (Bechtel & Jayaram, 1997; Higginson & Alam, 1997). However, when we use a measure, inventory turnover, we should have additional information about the sales volume together because turnover ratio is calculated by dividing the sales volume by the average inventory level. If we do not know the sales volume of each company, comparing with only inventory turnover

ratio does not provide much information about the efficiency of the company (Pearson, 1994).

Demand Characterization dimension showed a significant relationship with inventory turnover ratio for fashion goods. Regarding basic goods, Demand Characterization is positively related to the order lead-time of fabrics for basic goods. Demand characterization measures consist of statements that evaluate how important the demand patterns are to setting production capacity, setting production run cycles, and raw material purchasing. High inventory turnover ratio implies that movement of the inventory from the manufacturing site to the retailer's shop is fast. Basic goods fabric order lead-time is longer when respondents consider the demand patterns more important. Reduction in lead-time for material acquisition is regarded to be the most difficult element for manufacturers to control (Fisher, Hammond, Obermeyer, & Raman, 1994). Although manufacturers expressed concerned about the demand pattern, their lead-times were not reduced. Another possible explanation of the finding is that as the fashion level of the product rises, manufacturers become more concerned about the demand pattern. At the same time, manufacturers with a relatively high level of goods might be less concerned the inventory performance, in order lead-time, of their basic goods.

Regression analysis to examine the relationships between SCM activity dimensions and expectation level of improvement in inventory performance revealed that levels of SCM activity implementation are related with the levels of expectation. Expectation measure was obtained by averaging the scores that assessed the respondents' expectation level of improvement in inventory performance (i.e., fill rate, order lead-time, on-time delivery rate, inventory turnover, overall inventory level). Three SCM activity dimensions, Performance Measurements, Management Commitment, and Demand Characterization were found to have a significant relationship with the expectation measures. Respondents who usually use performance measures such as fill rate, lead-time, on-time delivery rate, and product quality might be more familiar with the inventory performance measures and be more accustomed to evaluate their performance by means of these measures. They may be more knowledgeable about actual benefits;

therefore, they might expect to insure their improvement in inventory performance via progress in representative measures like the ones presented in this survey. Apparel manufacturers whose top management has made more investment expect more to see the improvement of inventory performance, a benefit of SCM. Apparel manufacturers who are concerned more about the demand pattern in their operation expect to see more improvement in their inventory performance.

Table IV-37

Regression Analysis Results for the Relationship between SCM Activity Dimensions and Inventory Performance Measures

Dependent variables	SCM activity dimension	R^2	Df	F-value	Beta	t-value
Fashion goods Order lead-time		.131	69	1.58		
	Partnership				-.199	-1.63
	Information Technology				.303	2.31*
	Operation Flexibility				-.031	-.255
	Performance Measurement				-.006	-.047
	Management Commitment				-.014	-.100
	Demand Characterization				.146	1.17
Fashion goods Shop lead-time		.285	67	4.06**		
	Partnership				-.040	-.350
	Information Technology				.372	3.09**
	Operation Flexibility				-.417	-3.69**
	Performance Measurement				-.151	-1.30
	Management Commitment				-.163	-1.26
	Demand Characterization				.134	1.17
Fashion goods On-time delivery rate		.137	73	1.77		
	Partnership				-.005	-.040
	Information Technology				-.346	-2.75**
	Operation Flexibility				-.033	-.274
	Performance Measurement				-.032	-.258
	Management Commitment				-.020	-.150
	Demand Characterization				.018	.152
Fashion goods Inventory turnover		.198	58	2.13		
	Partnership				.064	.491
	Information Technology				.105	.748
	Operation Flexibility				-.148	-1.13
	Performance Measurement				-.025	-.186
	Management Commitment				-.354	-2.30*
	Demand Characterization				.306	2.29*

*$p<.05$ ** $p<.01$

Table IV-37 (continued)

Regression Analysis Results for the Relationship between SCM Activity Dimensions and Inventory Performance Measures

Dependent variables	SCM activity dimension	R^2	Df	F-value	Beta	t-value
Basic goods Order lead-time		.145	68	1.75		
	Partnership				-.035	-.283
	Information Technology				.081	.627
	Operation Flexibility				.093	.746
	Performance Measurement				.158	1.31
	Management Commitment				-.261	-1.91
	Demand Characterization				.274	2.13*
Basic goods Shop lead-time		.241	68	3.28**		
	Partnership				.049	.419
	Information Technology				.394	3.22**
	Operation Flexibility				-.200	-1.71
	Performance Measurement				-.262	-2.30*
	Management Commitment				-.228	-1.77
	Demand Characterization				.129	1.06
Basic goods Inventory turnover		.204	63	2.42*		
	Partnership				-.080	-.645
	Information Technology				-.190	-1.47
	Operation Flexibility				-.198	-1.58
	Performance Measurement				-.305	-2.42*
	Management Commitment				.249	1.88
	Demand Characterization				.045	.352
Expectation		.407	90	9.59**		
	Partnership				.019	.217
	Information Technology				-.002	-.023
	Operation Flexibility				-.086	-.975
	Performance Measurement				.281	3.20**
	Management Commitment				.336	3.48**
	Demand Characterization				.329	3.62**

*:p<.05 ** p<.01

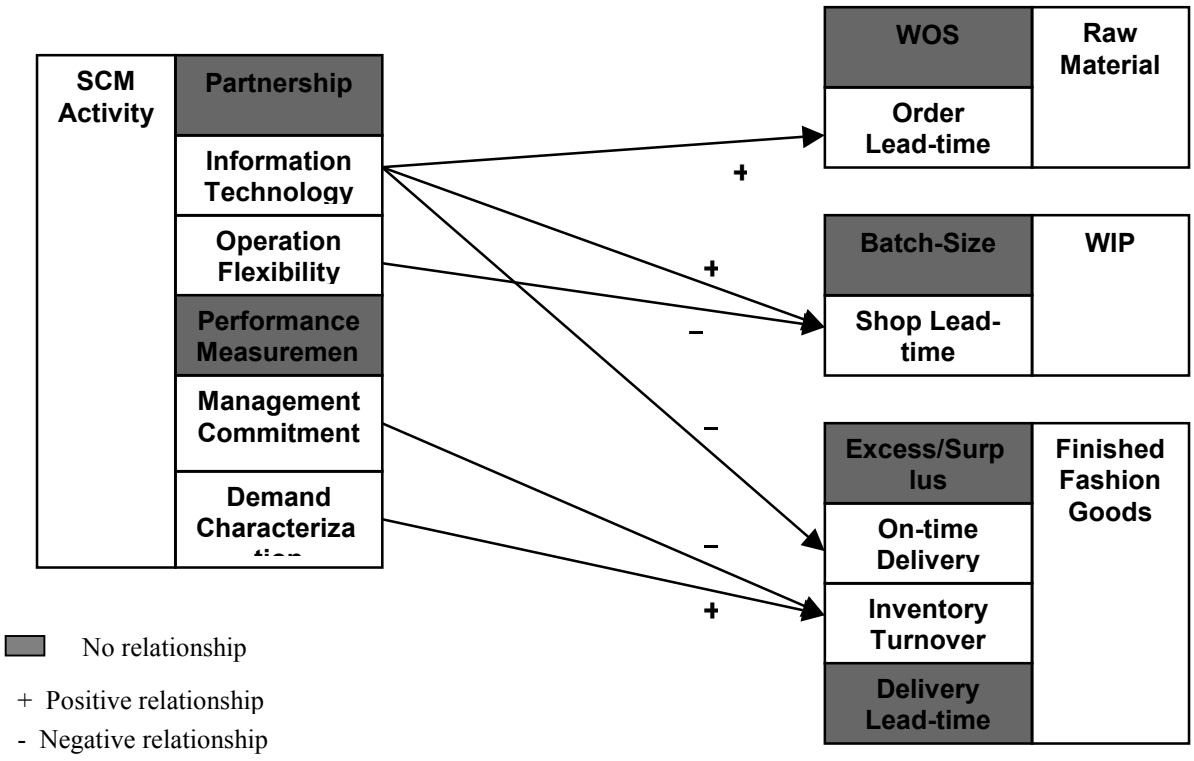

Figure IV-5. SCM Activity Level and Fashion Goods Inventory Performance

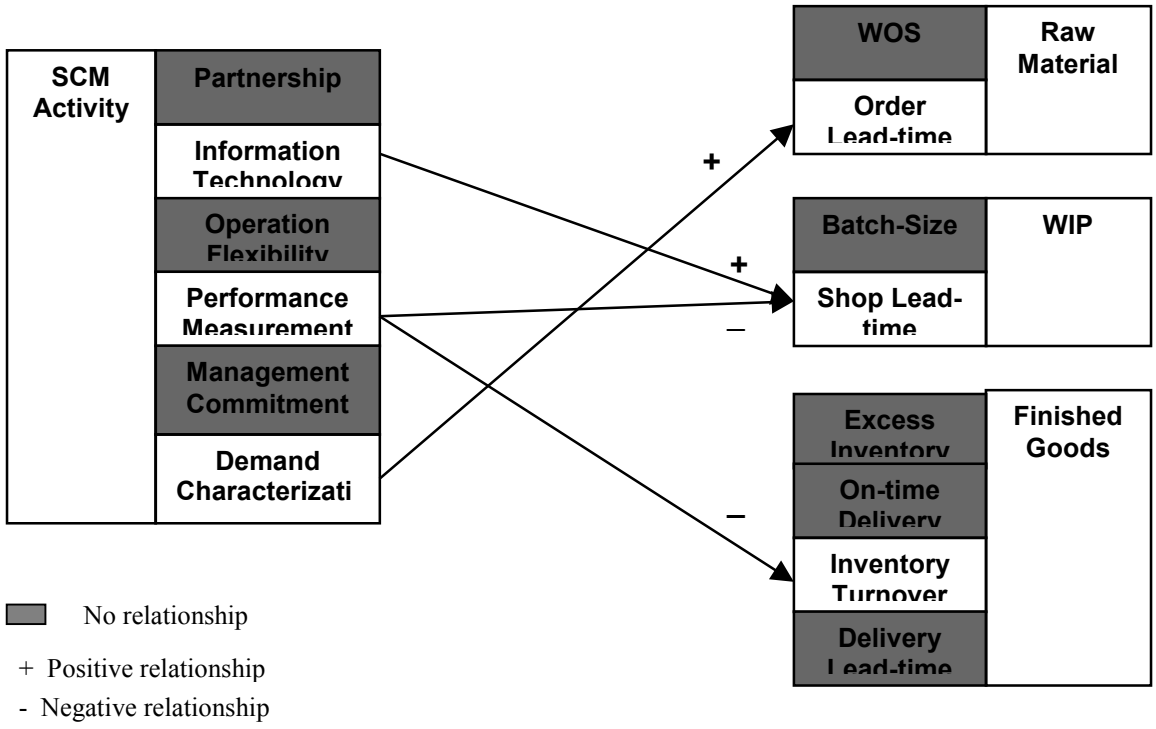

Figure IV-5. SCM Activity Level and Basic Goods Inventory Performance

In summary, although SCM activity group membership failed to show significant differences in inventory performance measures for fashion goods and basic goods except for two measures (i.e., WOS of fabrics for basic goods, shop lead-time for fashion goods), each group did show significantly different levels in expectation of inventory performance measures. Individual SCM activity dimension's level was found to have significant relationships with some of inventory performance measures and expectation measures, which are increasing or decreasing simultaneously according to SCM activity implementation level. Therefore, the hypothesis ($H4_0$) that stated no relationship between apparel manufacturers' SCM activity implementation levels and their inventory performance of fashion goods and basic goods was rejected.