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QR 도입업체와 미도입업체간에 QR 요소의 수준 비교연구

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Comparision of the level of Quick Response elements between adopters and nonadopters

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Abstract

본 연구의 목적은 미국 신속대응시스템의 요소별 사용현황을 조사하고, 도입업체와 미도입업체의 신속대응시스템의 요소별 수준을 비교하며, 신속대응시스템 도입업체와 미도입업체의 기업규모, 제품종류를 비교분석하였다. 조사방법은 미국의 103개 의류업체를 대상으로 설문조사를 하였고 자료분석은 기술통계와 t-test, Fisher's Exact test를 사용하였다. 신속대응시스템의 4요소는 상품기획, 재고관리, 정보공유, 유연한 생산체제이며 각 요소는 단위기술의 조합으로 측정되었다. 신속대응시스템을 도입하고 있는 업체들은 미도입업체보다 모든 4요소의 도입수준이 유의적으로 높았다. 신속대응시스템의 도입업체들은 유연한 생산체제 요소에 대한 도입수준이 가장 높게 나타났고, 재고관리 요소에 대한 도입수준은 상대적으로 낮게 나타났다. 신속대응시스템 도입업체는 종업원이 500명이상인 대기업규모에, 여성복업체에 가장 높은 비율을 나타내었고, 미도입업체는 종업원이 10-19명 정도인 중소규모에, 유아동복에 가장 높은 비율로 나타났다.

Key words: QR elements, adoption theory, apparel manufacturers;
신속대응시스템 요소, 도입이론, 의류 제조업자

I. Introduction

A successful company is one of that develops an appropriate strategy to reach its goals, builds an appropriate organizational structure to carry out this strategy, and equips the organization with effective systems of information, planning, control, and feedback(Kotler, 1988). Quick Response has been considered as an appropriate strategy for the apparel industry under the competitive environment. QR is defined as "the establishment of new business strategies, new relationships, and new procedures to speed the flow of information and merchandise between retailers and manufacturers of apparel and textiles" (Voluntary Interindustry Communications Standards [VICS], 1989, p. 8). This strategy can increase the speed and accuracy of the industry's response to the consumer. When a company adopts and processes QR, feasibility, and elements of QR should be known.

QR has been adopted by approximately 40% of U.S. apparel manufacturers(Kurt Salmon Association [KSA], 1992). Although QR has been perceived as a profitable strategy, the number of QR adopters has not changed much since 1988 (KSA, 1992). For increased QR adoption in the apparel industry, information about QR adopters and nonadopters should be available.

The purpose of this study is to identify the usage of QRT by QR elements, to examine differences of the level of the four QR elements (i.e., production planning, flexible manufacturing, inventory control, information sharing) between QR adopters and nonadopters, and to determine variables related to QR adopiton. QR elements were theorized to be critical for QR adoption built on close working partnership between manufactures and retailers(Hunter, 1990).

The findings of this study will assist industry trade associations to adjust their strategies to promote QR adoption by apparel manufacturers and will provide consultants with information about the apparel manufacturers' usage of QR technologies. The results of this study can be used when apparel manufacturers and retailers do strategic planning and evaluate the adoption of QR technologies. Informed decisions are critical when firms are developing better linkages and market channels, using their resources more efficiently, and serving the final consumer.

II. Literature Review

1. QR Elements and Technologies

To accomplish the objectives of QR, firms must use a variety of technologies(VICS, 1989). Technology was defined as "the physical combined with the intellectual or knowledge processes by which materials in some form are transformed into outputs used by another organization or subsystem within the same organization" (Hulin & Roznowski, 1985, p.47). A variety of technologies related with QR has been identified from numbers of industry sources(고은주와 김재욱, 1996; 고은주, 1997; 한국섬유산업연합회, 1995; Andersen Consulting Company, 1991; Coopers & Lybrand Technologies, 1991; Hunter, 1990; King, & Maddalena, 1998; KSA, 1990, 1992; Little, & Heinje, 1998; Musselman, 1997) and research studies(Ko & Kincade, 1998a, 1998b). The most commonly mentioned seventeen technologies are: (1) computer aided design (CAD), (2) computer aided pattern making, (3) shade sorting, (4) product planning with customers, (5) computer aided manufacturing, (6) unit product system (UPS), (7) automated sewing operations, (8) short cycle cutting planning, (9) short cycle sewing, (10) computerized inventory systems, (11) reduction in inventory size, (12) small lot orders, (13) bar coding, (14) scanning of fabric rolls, (15) electronic reorder, (16) sharing product information with trading partners, and (17) receiving point of sale (POS) data.

Kincade(1993) has tested correlations among technologies in her study and through factor analysis has identified five factors: inventory control, shade sorting, product planning, information sharing, and bar coding. Inventory control includes reducing inventory size, using small lot orders, reducing wait time for inventory, short cycle production, and reducing redundant testing. Product planning consists of CAD systems and planning of product with customers(i.e., specification buying). Information sharing includes product information shared with trade partners, electronic data interchange(EDI) for orders, and garment dyed products. Bar coding is used to identify and provide information about both fabric rolls and the finished garment. Shade sorting is used for the matching, layout, and cutting of

fabric rolls(Kincade, 1989). Only 14 of the original 17 technologies were used among the five factors. In a more recent study, Kincade(1989) has tested the correlation of the five factors to adoption of a QR strategy. All five factors were positively and significantly correlated with QR, but product planning was most closely related to QR.

For the present study, 17 technologies are grouped into four elements: (1) Production Planning(PP), (2) Flexible Manufacturing(FM), (3) Inventory Control(IC), and (4) Information Sharing(IS). PP, IC, and IS were developed from Kincade's study(1989). FM is added because it is considered to be one of the major QR elements (Hunter, 1990). Bar coding and shade sorting are examples of the QR technologies rather than QR elements, and bar coding as a QR technology is included under the element of IS. Shade sorting is included under PP. Each QR element is accomplished by a variety of QR technologies. Production Planning(PP) is achieved by CAD, computer-aided pattern making, shade sorting, and product planning with customers. Flexible Manufacturing(FM) is done through computer-aided manufacturing, UPS, automated sewing operations, short cycle cutting planning, and short cycle sewing. Inventory Control(IC) is done through computerized inventory systems, reduction in inventory size, and small lot orders. Information Sharing(IS) is done by bar coding, scanning of fabric rolls, electronic reorder, sharing product information with trading partners, and receiving POS data. These four elements are hypothesized to be critical for QR success built on close working partnerships between manufacturers and retailers(Fig. 1)(Ernst & Young, 1990). This discussion leads us to formulate our first hypothesis.

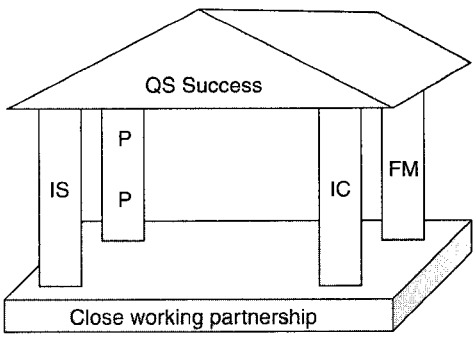

Fig. 1. A Schematic Diagram of QR Success

Hypothesis 1: The usage level of QR elements is associated with QR adoption.

2. QR Adoption

Adoption is defined as "a decision to make full use of an innovation as the best course of action available"(Rogers, 1983). According to the Rogers' adoption theory, five stages are needed when an individual adopts an idea or innovation. Five stages are awareness, interest, evaluation, trial, and adoption. First, the individual is exposed to the new innovation with a lack of information. Interest stage is to seek of information. Evaluation and trial stage is essential to adoption. By examining the variables affecting change, the innovation can be evaluated as adopted or rejected.

In the apparel industry, QR as an innovation has been adopted since 1985. But the adoption rate has had a limited increase since 1988, and apparel manufacturers' adoption of QR has remained about 40%(KSA, 1992). Ernst and Young's study (1990) found that 88% of the respondents thought QR has potential benefit to their companies, less than 50% of U.S. apparel manufacturers have adopted QR. In a study of North Carolina apparel manufacturers, most manufacturers had implemented some level of one or more QR technologies, but few manufacturers had implemented all five components of QR(Kincade, 1993).

The, what are the variables determining QR adoption? The adoption of innovations has been studied about factors influencing innovation adoption. Previous studies have investigated that adoption of innovation is affected by several factors: firm size, organizational strategy, product category, and perception of innovation benefits(고은주, 1997; Kincade, 1993; Ko, 1998b; Mansfield, 1968, 1983; Rogers, 1995; Sullivan, 1990; Sullivan & Kang, 1999). This study emphasized two variables: firm size and product category.

Firm size has been shown to influence the adoption of innovation such as micro-computer adoption in the food processing industry and hospitals(Mansfield, 1968; Rogers, 1983). Larger firms tend to access information and the resources for investment in new technologies, because capital is available. This discussion leads us to formulate our second hypothesis.

Hypothesis 2: The firm size is associated with the QR adoption.

Product category has been hypothesized to influence adoption decisions(Mansfield, 1983). The apparel industry has many specialized product lines(Glock & Kunz, 1990). Product category may be divided into three groups: men's, women's, and children's/infants' wear according to SCI code. Women's wear are more seasonal and fashionable, and are more difficult to predict than other goods (Office of Technology Assessment, 1987). Men's and children's/infants' wear are less changeable and are more suitable to larege scale production. This discussion leads us to formulate our third hypothesis.

Hypothesis 3: The product category is associated with the QR adoption.

Ⅲ. Method

1. Sampling, Data Collection and Data Analysis

A random sample of 306 apparel manufacturers without locational limitation were selected from a purchased list in U.S. The sample was stratified by firm size(i.e., number of employees) and product category(i.e., men's, women's, children's/infants' wear). The total design method by Dillman(1978) was adopted for data collection. A mail questionnaire was pilot tested for content validity and instrument reliability, and the revised questionnaire was used to survey a company manager.

Adjusted response rate was 47%(n=103). One hundred and three responses were collected and grouped by firm size and product category. The most common firm size was over 500 employees (23.53%) and the least common firm size was 10-19 employees(9.80%). The three product categories (i.e., women's[35.29%], men's[23.53%], children's wear[32.35%]) were equally represented. For data analysis, two sample t-test, Kruskal-Wallis test, and Fisher's Exact test were conducted. The statistical significance level was set at .05.

2. Instrument

Questions include the level of four QR elements, QR adoption, and firm characteristics(e.g., firm size). The level of four QR elements(e.g., PP) was measured by the summation scores of several QR technologies(e.g., computer aided design, production planning with customer). Respondents were asked to rate each technology by circling from 0 (not at all) to 5 (very much). Production Planning was measured by the usage level of computer aided design(CAD), computer aided pattern making, shade sorting, and product planning with customer. Flexible Manufacturing was measured

by the usage level of computer aided manufacturing, unit product system, automated sewing machines, short cycle cut planning, and short cycle sewing. Inventory Control was measured by the usage level of computerized inventory system, reduction in inventory size, and small lot orders. Information Sharing was measured by the usage level of bar coding, scanning fabric rolls, electronic reorder, sharing product information, receiving POS data, and electronic data interchange.

QR adopters/nonadopters was determined by a yes/no question as a company manager perceives whether adopt QR or not. The QR definition was given as follows:

> QR is defined as a new business strategy to optimize the flow of information and merchandise between channel members in order to maximize consumer's satisfaction. This strategy is accomplished by close working partnership and new processes(eg. electronic reorder) in the manufacturing and distribution.

Firm characteristics were measured by firm size (i.e., number of employees) and product category (i.e., men's, women's, children's wear, others).

IV. Results and Discussion

1. Usage of QRT

To identify the usage of QR technologies, the usage of each of the 17 QR technologies was measured with rating the scale from 0 to 5 by the apparel manufacturers. The frequency distribution shown in Table 1 describes how the usage of QR technologies differs among apparel manufacturers. Technologies used by most number of manufacturers were small lot orders, short cycle cut planning, short cycle sewing, and production planning with customer. Technologies used by fewest number of manufacturers were electronic reorder, scanning fabric rolls, shade sorting, and

Table 1. QTR Usage

Element	QRT	n	0	1	2	3	4	5
PP	CAD	97	48.5	6.2	7.2	8.3	8.3	21.7
	computer aided pattern Making	98	43.9	4.1	7.1	4.1	5.1	35.7
	shade sorting	95	52.6	4.2	3.2	12.6	9.5	17.9
	product planning with customers	95	29.5	3.2	10.5	14.7	12.6	29.5
FM	CAM	94	41.5	6.4	7.5	13.8	12.8	18.1
	UPS	91	60.4	6.6	6.6	12.1	9.9	4.4
	automated sewing operations	93	38.7	10.8	16.1	18.3	7.5	8.6
	short cycle cutting planning	90	24.4	8.9	14.4	17.8	15.6	18.9
	short cycle sewing	92	27.2	4.4	15.2	14.1	16.3	22.8
IC	computerized inventory system	95	30.5	3.2	6.3	11.6	15.8	32.6
	sreduction in inventory	89	30.4	3.5	9.0	10.1	12.4	33.7
	size small lot orders.	90	21.1	4.4	10.0	20.0	10.0	34.4
IS	bar coding	96	40.6	5.2	5.2	9.4	8.3	31.3
	scanning of fabric rolls electronic reorder	94	56.4	3.2	10.6	8.5	8.5	12.8
	sharing product information with trading partners	91	63.7	5.5	2.2	6.6	7.7	14.3
	receiving POS data.	94	43.6	5.3	6.4	16.0	13.8	14.9

Note: PP=production planning, FM=flexible manufacturing, IC=inventory control, IS=information sharing

UPS. Seventy-nine percent of manufacturers used some level of small lot orders technology. In contrast, 36% of manufacturers used some level of electronic reorder technology.

2. Hypothesis testing 1

The purpose of the study was to examine the usage level of the four QR elements(i.e., PP, FM, IC, IS) and their relationship with QR adoption. Two sample t-test and Kruskal Wallis test were conducted. The results from t-test are shown in Table 2 and Fig. 2. Significant difference of the level of QR elements were found between QR adopters and nonadopters. Results from Kruskal-Wallis test: for PP, χ^2 (1, n=92)=44.28, $p<.01$; for FM, χ^2 (1, n=80)=45.87, $p<.01$; for IC, χ^2 (1, n=80)=41.19, $p<.01$; for IS, χ^2 (1, n=85)=44.36, $p<.01$. Research Hypothesis was accepted.

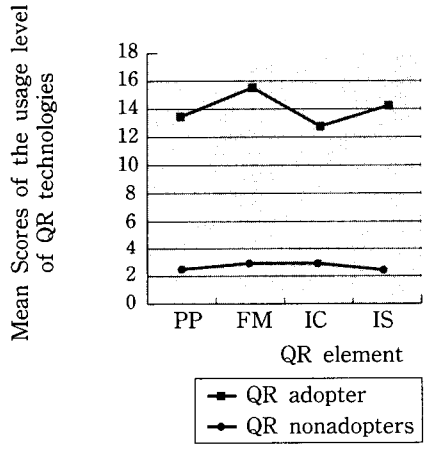

Fig. 2. Mean Scores of QR Elements between Adopters and Nonadopters

QR adopters had much higher level of QR elements than nonadopters. Most QR adopters were using the four elements and one may conclude that QR adopters will tend to have all four elements. Flexible manufacturing was the most frequently used QR elements. Inventory control and product planning were the least used QR elements.

This result supports theorized literature with empirical evidences. PP, IC, and IS were identified as important factors for QR(Kincade, 1989). FM is considered as one of the major QR elements (Hunter, 1990; Sullivan, 1990). These four elements are critical for QR success which is built on close working partnerships between manufacturers and retailers(Bravman, 1992; Ernst & Whinney, 1988).

3. Hypothesis testing 2

To determine variables related to QR adopiton, Fisher's Exact test and frequncy distribution were employed for testing hypothesis 2. Association between firm size and QR adoption was significant from Fisher's Exact test at p<8.74E-08. A frequncy distribution of QR adoption were examined for differences between levels of firm

Table 2. Results of t-tests between Four Elements for QR and QR Adoption

Four Elements	QRA	n	Mean	Std.Dev	t	p
PP	Yes	53	12.70	5.68	10.71	0.0001
	No	39	2.64	3.26		
FM	Yes	47	14.47	5.65	12.00	0.0001
	No	33	3.09	2.68		
IC	Yes	51	11.49	3.70	9.66	0.0001
	No	34	3.26	3.93		
IS	Yes	48	13.58	7.13	9.67	0.0001
	No	37	2.51	3.06		

T ıe 3. Percentile of Firm Size by Number of Employees on QR AdoptionFirm Size

Frim Size	Adoption		Nonadoption	
	N	%	N	%
1−9	4	4.12	7	7.22
10−19	0	0	10	10.31
20−49	4	4.12	6	6.19
50−99	11	11.34	9	9.28
100−499	17	17.53	5	5.15
500+	23	23.71	1	1.03
Total	59	60.82	38	39.18

size shown in Table 3. Research Hypothesis 2 was accepted. The larger firm with many employees were more likely to adopt QR. Firms with over 500 employees had the highest percentage on QR adoption(23.71%) while firms with 10−19 employees had the highest pecentage on QR nonadoption (10.31%).

This results of this study were consistent with previousstudies (Kincade, 1993; Sullivan, 1990) which showed that a strong positive relationship exists between firm size and QR adoption.

4. Hypothesis testing 3

Association between product category and QR adoption was significant from Fisher's Exact test at $p<0.031$. A frequency distribution of QR adoption were examined for differences between the groups by product category shown in Table 3. Research Hypothesis 3 was accepted. For the product category, women's wear firms had the higher percentage on QR adoption(25.59%) than remaining categories(for men's wear firm, 10.20%; for children's/infants wear firm, 15.31%)(Table 4).

Table 4. Percentile of the QR Adoption of Product Category

Product category	Adoption		Nonadoption	
	N	%	N	%
Women's wear	29	29.59	8	8.16
Men's wear	10	10.20	12	12.24
Children's/ infants's wear	15	15.31	15	15.31
Others	5	5.10	4	4.08
Total	59	60.20	39	39.80

Women's wear firms were more likely to adopt QR, although men's wear firms were perceived to be ideal for QR because of standardization of style and slower fashion turn. This result might be explained by the fact that more women's wear firms have adopted QR than others, because more competition from imports and domestic markets exists in women's wear.

V. Conclusions

Informed decisions are critical when developing strategic planning for an apparel company. Specifically in the steps of control and feedback, the results of this study can be used to identify the status of a company's QR adoption. From the results of this study, the researcher draws several conclusions.

The four elements(i.e., production planning, flexible manufacturing, inventory control, information sharing) were associated with QR adoption. Most QR adopters were using the four elements, and one may conclude that QR adopters will tend to have all four elements. QR nonadopters also use four QR elements but usage is minimal. Also, QR is more than just EDI, more than computer usage, more than any single technology. Overall, QR usage remains low from the results of this study.

Firm size and product category were significantly associated with QR adoption. The larger firms with many employees were more likely to adopt QR. Larger firms may be able to invest in the technology more often than smaller ones. Women's wear firms were more likely to adopt QR than men's and children's/infants' wear. This result could be explained by the reason that

women's wear does change styles more often than men's and children's/infants' wear; so, women's wear firms had more need to adapt to fashion change.

The developed models of this study could be useful to industry trade associations to adjust their strategies for potential adopters and to promote QR adoption. QR information assembled in the review of literature and results of the study may provide information about QR adopters and nonadopters.

QR is not a homogeneous construct(Kincade, 1989; Sullivan, 1990). Although the usage level of four QR elements were significantly related to QR adoption, further research is needed to verify reliability of the results of this study.

For the future research, we need to know why nonadopters do not adopt and why overall the usage remains low. Also the investigation if new technologies should be added(e.g., costing, quality, teams) should be done.

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