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Quality assessment and improvement practices in the U.S. railroad industry

Cover Page Footnote

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QUALITY ASSESSMENT AND IMPROVEMENT PRACTICES IN THE U.S. RAILROAD INDUSTRY

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This article presents the findings of a comprehensive survey sent to members of the American Society of Transportation and Logistics. The survey investigated various elements of quality improvement programs in use among U.S. rail carriers, including program design and subsequent successes. Perhaps due to the heavy competition within the transportation industry, it was found that the vast majority of U.S. rail respondents did indeed utilize formal quality assessment and improvement programs, making this an interesting industry segment to study. The survey findings are summarized in the article.

INTRODUCTION

Competition in the U.S. among rail carriers and between rail and other modes of transportation has increased dramatically over the past twenty years, due in part to deregulation of the transportation industry, and more recently to the growing demands among shippers for intermodal and other transportation services (Assoc. of American Railroads 1998). Efforts to improve competitiveness, service, cost, and ultimately profit performance have led most railroads to consider their service capabilities and ways to improve or increase them.

Quality assessment and improvement efforts in the U.S. manufacturing sector have been the focus of many research efforts and the results achieved by these companies have been well documented (see for example Cusumano 1988; Finch 1986; Garvin 1983; Im and Lee 1989; Krafcik 1988). Conversely, research concerning quality assessment and improvement strategies of U.S. railroads has been quite limited, even though this industry is experiencing a substantial increase in service demands from shippers, and quality improvement efforts are prevalent throughout the industry.

In the transportation sector in general, and in particular the railroads, very little substantive research has appeared describing quality practices from the carriers' perspective. The objectives of our research were to review the relevant transportation and railroad-specific quality literature, address the apparent gap in the empirical quality improvement literature through use of a survey sent to railroads and other transportation companies, compare quality improvement practices within the railroad industry, and provide suitable benchmarks of quality improvement practices and programs to transportation company managers. Since service quality practices are somewhat generalizable, managers of all transportation companies should find the information useful. The survey utilized for this paper investigated various elements of the quality improvement programs and practices employed by rail carriers, the design of these programs, and the successes attributed to them. Related areas in need of further research are also discussed.

A REVIEW OF THE RELEVANT QUALITY IMPROVEMENT LITERATURE

To date, the few articles dealing with the subject of transportation quality, regardless of mode, have largely tended to be anecdotal, with little or no empirical data to accompany the discussions. In this review, articles discussing quality-related topics from the transportation industry in general will be reviewed first, followed by those more specific to the rail industry.

Service quality within the transportation industry in general has been the subject of several articles. Chow and Poist (1984) surveyed shippers to determine if and how they measured carrier service quality. They found six factors that many of the respondents measured and formally recorded

(transportation costs, freight loss and damage experience, claims processing experience, transit time reliability or consistency, experience with carrier in negotiating rate changes, and shipment tracing). Brown's (1989) conceptual article discussed the economic implications of freight service quality, namely that optimal service quality policies should minimize the sum of total shipping costs for both carriers and shippers.

Other research studied the service-intensive transportation requirements of Just-In-Time (JIT) manufacturers. Bagchi, Raghunathan, and Bardi (1987) compared JIT and non-JIT manufacturers and found that the JIT respondents placed significantly greater importance on the willingness to negotiate rate changes, equipment availability, frequency of service, shipment expediting, scheduling flexibility, and the willingness of carriers to negotiate service changes. In somewhat similar studies, Lieb and Millen (1988) and Harper and Goodner (1990) found more use of contract and common motor carriers, less use of rail, use of fewer carriers coupled with a greater requirement for on-time performance, greater responsiveness to short term needs, shipment tracing capabilities, greater use of specialized equipment, and more frequent communication among the JIT-oriented respondents. Perry (1988) looked at the distribution channels of a small number of JIT firms and found several common characteristics: substitution of transportation assets for inventory assets, more customized transportation systems, carrier contracting, and shipments scheduled for hour-of-day arrival instead of day-of-week. Higginson and Bookbinder (1990) described the impact of JIT requirements specifically on rail freight systems. Their "ideal JIT railroad" involved the use of dedicated intermodal equipment, proximity to TOFC (trailer-on-flatcar) terminals, use of EDI (electronic data interchange) devices, contract agreements with

buyers/shippers, and use of shipment consolidation/breakbulk services.

One study is conducted annually seeking the transportation quality or service assessments of shippers in each of six transportation categories, including rail. *Chilton's Distribution* (1998) asks shippers to rate various carriers on a number of quality-oriented characteristics. As in previous years, on-time performance and value or rates were seen as the two most important quality characteristics for rail shippers. Unfortunately, the assessment scores deteriorated in several of the categories for 1998.

To date, only a small group of articles have requested information directly from the railroads. Curtis (1984) described the use of quality circles (departmental employee groups meeting at regular intervals to solve work problems) at Milwaukee Road. Over the period of investigation, the railroad reported significant cost savings, combined with ultimately better labor/management cooperation and better quality of work life. Grimes (1989) described an information system to analyze service quality performance at railroads, that when properly used, could help measure service performance, identify service failures and their causes, and determine the impact of operating changes on service performance. Koot and Tyworth (1985) discussed the need for a track quality index to monitor the timing of track maintenance to reduce derailments. Carman (1993) presented a case study of Southern Pacific's use of continuous quality improvement since 1990. Their program involved getting top management commitment, use of performance information and benchmarking, developing and implementing action plans, and involving the unions.

While the previous research in this area has addressed numerous aspects of general transportation and railroad service quality, few articles have attempted to determine specific quality assessment or improvement practices among carriers, and in particular, among rail carriers. This research sought to fill this empirical gap in the literature by surveying current practices within the railroad industry in the area of quality assessment and improvement.

METHODOLOGY

A general transportation industry survey was designed to identify the types of transportation companies using formal quality improvement programs, the characteristics of these programs and the successes attributed to the use of these programs. The initial survey was pretested on a pilot sample of fifty transportation company managers (who were contacted using mailing lists obtained from the American Society of Transportation and Logistics and Delta Nu Alpha).

Based on feedback from the pretest, a revised survey was mailed to 851 transportation company members of AST&L (including thirty-one railroads, several with multiple regional offices). Efforts were made to delete non-transportation company members of the Society (for example transportation professors), and duplicate employees of the same local or regional transportation offices. Three complete mailings of the survey were conducted at approximately three week intervals. Survey recipients were asked to respond using the supplied, postage-paid envelopes and remain anonymous. The respondents were also offered a copy of the survey results in return for their participation. Most of the survey questions required either yes/no or 5-point interval scale

responses. Respondents were also encouraged to add other information to clarify their answers, if needed.

Ultimately, a total of 197 responses to the general transportation survey were received for a response rate of 23.1 percent. Of those, 47 responses were from rail carrier personnel. Forty-five or 95.7 percent of the rail carrier respondents reported the existence of formal quality assessment and improvement programs at their firm. These 45 responses provided the data for our study. Given the exploratory nature of this study and the length of the survey, the response rate was deemed acceptable and high enough to mitigate the bias potentially posed by the relatively small sample size of rail carriers. Again, it should be noted that multiple responses from different regional offices of the same rail carrier were most likely received. This was not seen as a problem considering that management perceptions are likely to vary from response to response, and also that regional offices are likely to have somewhat different operating characteristics and quality practices. Nonresponse bias was examined by comparing the surveys received from the first mailing to the surveys received from the second and third mailings (Armstrong and Overton 1977). No significant differences among the survey variables were found, therefore nonresponse bias was assumed to be minimal.

SURVEY RESULTS

The survey results revealed a number of interesting characteristics with respect to the design, use, and successes of the quality improvement programs used by railroads. A profile of the rail carrier respondents is presented first, followed by a description of the respondents' overall focus on quality and customers, descriptions of the respondents' formal quality improvement programs, and

finally, descriptions of the successes attributable to the quality improvement efforts of the rail carriers as well as the current status of the programs.

A Profile of the Railroad Respondents

Table 1 presents the profile information of the rail carrier respondents and their firms. Most respondents (over 74 percent) were either transportation/shipping managers or marketing/sales managers. The remaining respondents were either owners/CEOs or other (quality control managers, regional or district managers, or accounting/finance managers). Additionally, most of the rail respondents (93.6 percent) described themselves as *only* common carriers, while 6.4 percent said their firm offered common, contract, and private carrier services.

A wide range of firm size (based on annual sales) was also represented. Over 68 percent of the rail respondents worked for firms with annual sales of greater than \$1 billion while the remaining rail firms had annual sales ranging from \$5 million to \$1 billion. Thus, most of the respondents represented a number of the regional offices of the largest U.S. rail carriers.

The Respondents' Focus on Quality and Customers

Table 2 describes various aspects of the respondents' focus on quality and customer service. The survey asked if their firm had a formal quality improvement program and over 95 percent responded yes to this question. Another question sought to determine the nature of commitment to quality by asking respondents if their firm's mission statement contained any reference to quality goals. Again, a very large portion of the respondents (over 87 percent) stated their firm's mission statement did contain references to quality

TABLE 1
A PROFILE OF THE RAILROAD RESPONDENTS

	<u>Percent of Respondents</u>		<u>Percent of Respondents</u>
Respondent's Position with the Firm		Legal Status of Carrier	
Transportation/Shipping Mgr.	38.3	Common Carrier	93.6
Marketing/Sales Mgr.	36.2	Common/Contract/Private	6.4
Owner/President/CEO	10.6		
Other	14.9		
Annual Sales (\$)			
Less than 5,000,000	0.0		
5,000,001-50,000,000	12.8		
50,000,001-250,000,000	2.1		
250,000,001-1 billion	14.9		
Greater than 1 billion	68.1		
No response	2.1		

goals. Given the economic problems faced by most railroads, these general findings are not surprising.

Periodically assessing customer satisfaction, either formally or informally, and then using the customer feedback information for designing operating improvements is considered a necessary and extremely effective method of achieving long term competitiveness in service organizations (see for example Nagel and Cilliers 1990; Parasuraman, Zeithaml, and Berry 1985). The remaining items in Table 2 refer to this aspect of service quality improvement. The results showed that all railroad respondents asked customers for feedback concerning quality at least sporadically. The responses were split fairly evenly between obtaining customer feedback either monthly to quarterly (40.4 percent) or semiannually to annually (42.5) percent. Significantly fewer respondents asked

customers for information more frequently (daily or weekly).

Respondents were also asked if and how their customer feedback information was analyzed. Most indicated they either tracked the information to note internal improvements over time (53.2 percent) or to compare it to industry benchmarks (42.6 percent). A small percentage of the respondents asked for customer feedback, but did no apparent analysis of the information. It is interesting that while most or all respondents evidently saw the value of customer feedback information, less than half perceived a need to compare customer service performance to the industry's best. Industry benchmarks help clarify a carrier's competitive positioning. Thus, a railroad not measuring performance against industry benchmarks could potentially perceive their service performance as excellent (by looking only at internal service performance over time), while

compared to industry competitors, it might be considered poor.

Finally, respondents were asked to categorize the type of customer feedback information obtained. The feedback information most often obtained was overall customer satisfaction (over 95 percent of the rail carrier respondents). Information on several other areas of concern was requested by significantly fewer respondent companies. These included delivery satisfaction, sales staff problems, pricing problems, staff promptness, and shipment tracking problems. Several remaining customer feedback items were requested even less often by the respondents. These included information request problems, ordering/contracting problems, staff helpfulness, and damage/loss claim satisfaction.

Based on the data presented in Table 2, almost all of the railroad respondents had a formal quality improvement program and most of the respondents had some level of commitment to assess and improve transportation quality.

The Formal Quality Improvement Programs

Table 3 describes the characteristics and elements of the formal quality improvement programs of the 45 railroad company respondents stating they had such a program. Most of these formal programs (over 64 percent) were quite new and had existed for fewer than four years. None of the respondents had quality improvement programs in place for more than ten years.

The survey asked a number of specific quality improvement program design questions. Interestingly, while most respondents had formal quality improvement programs, relatively few had designed their own programs (28.9 percent) and had chosen instead to purchase their program from an outside source

(over 62 percent). Using an outside source for the design of a quality improvement program could pose problems for firms, particularly when using "experts" unfamiliar with railroad industry practices and specific operating characteristics of the firm. When asked to describe where the responsibility for the education, planning, and control of quality resided in their firm, the responses were fairly closely divided between a centralized quality control department (57.8 percent) and decentralized responsibility among all departments (40 percent). Since customer request response time is seen as an important aspect of service quality, this finding suggests a need for greater departmental flexibility and control over responding to customer service requests and service quality needs.

Since, over time, employees can lose their enthusiasm for continued attention to service quality assessment and improvement, top management encouragement and support is generally recognized as being a key element in the initial and continued success of any quality improvement program. The railroad respondents with formal quality programs were asked to state the level of support given by top management to the ongoing operation of the firm's quality improvement program. It appeared that top management strongly supported quality improvement efforts in these companies. The average response was a 4.18 level of support on a scale of 1 to 5, with 5 corresponding to the highest level of support. The 4.18 level of support was found to be significantly greater than the scale midpoint of 3.0.

Finally, the survey sought to determine the importance of certain elements contained in the quality improvement programs. The 45 railroad respondents were asked to state an importance level for a number of potential program elements (in this case, a "1" corresponded to not

TABLE 2
RESPONDENTS' FOCUS ON QUALITY AND CUSTOMERS

	Percent of Respondents	Significance
Does Your Firm have a Formal Quality Improvement Program?		
Yes	95.7	
No	4.3	.000*
Quality Goals		
Formally stated in mission	87.2	
Not formally stated in mission	12.8	.000*
Frequency of Customer Feedback Request Concerning Quality		
Semiannually-annually	42.5	.01*
Monthly-quarterly	40.4	
Daily-weekly	8.5	
Sporadically	8.5	
Never	0.0	
Analysis of Customer Feedback Information		
Tracked to note improvements	53.2	.01*
Tracked and compared to industry benchmarks	42.6	
Obtained but not tracked/compared	4.3	
Not obtained	0.0	
Feedback Information Requested From Customers		
Overall satisfaction	95.7	.01*
Delivery satisfaction	80.9	
Sales staff problems	80.9	
Pricing problems	74.5	
Staff promptness	72.3	
Shipment/tracking problems	68.1	
Information request problems	63.8	
Ordering/contracting problems	63.8	
Staff helpfulness	61.7	
Damage/loss claim satisfaction	59.6	
Service flexibility problems	55.3	
Shipment damage/loss problems	53.2	
Expediting problems	48.9	

* Significance level is based on a t-test of equal response rates.

^b No significant differences in response rates were found among bracketed items using t-test comparisons at the .01 significance level.

important and a "5" corresponded to very important). Four elements that received importance averages significantly greater than 4.0 were continuous quality improvement efforts, obtaining customer feedback, using quality measurements, and finding the root causes of poor quality.

A second group of elements were found to be slightly lower in importance (statistically equivalent to an importance level of 4). These elements were instituting quality awareness training, the ongoing commitment of top management, using quality goals and standards, decentralizing the responsibility for quality,

using quality circles or teams, benchmarking quality performance, empowering workers, facilitating mutual respect between workers and managers, using statistical quality control techniques, and determining the costs of quality.

A third, somewhat less important element (an importance level significantly greater than 3.0, but less than 4.0) was the use of non-monetary rewards for quality improvements. Elements seen by the respondents as only moderately important were the use of Deming's 14 quality principles, the use of the Baldrige Quality Award criteria to assess quality improvement efforts, and finally, using monetary rewards for quality improvements. Unfortunately, while the literature is filled with examples of firms adhering to Deming's quality principles and using the Baldrige Quality Award application as a self-assessment tool, these practices have yet to find themselves as popular within the rail carrier sector.

The Performance of the Formal Quality Improvement Programs

The 45 rail carrier respondents with formal quality improvement programs were also asked several questions pertaining to the performance characteristics and success of their quality programs. These responses are summarized in Table 4. When asked to assess the relationship between their quality program and various performance changes, respondents indicated improvements in competitiveness, customer service, on-time deliveries, expectations of future sales growth and equipment utilization were strongly related to their firm's quality program. These performance characteristics were found to be statistically equivalent to 4.0 on a 5-point interval scale.

Six other performance improvements were found to be more than moderately related to the quality improvement programs of the respondents (significantly greater than 3.0, but less than 4.0).

These were decreases in customer complaints, late deliveries and damage/loss claims, and increases in the number of services offered, sales and employee productivity.

A third group of thirteen performance characteristics were found to be moderately related to the quality improvement programs (statistically equivalent to 3.0). These included increased preventive maintenance, profits, JIT capabilities, use of automation, shipment tracking ability, tonnage shipped, employee morale, and partnership agreements with competitors. Thus, firms seeking to begin measuring service quality performance should consider using some or all of these elements.

Another survey question asked the respondents with formal quality improvement programs to compare the current level of success of their quality programs to their initial expectations. The results here were somewhat mixed. While most of the respondents (86.7 percent) thought their programs met at least some of their initial expectations, only about one-third of the respondents felt their programs had met most, all or exceeded initial expectations. This suggests some need for improvement in the quality programs themselves, or that perhaps many managers' initial expectations were simply unrealistic.

The railroad respondents were also asked if the costs of their quality improvement programs were being recovered by either decreases in firmwide operating costs or increases in revenue as a result of implementing the quality programs. An impressively large portion (over 77 percent) said program costs were being recovered. This information could potentially be useful for managers seeking to justify the investment of resources to improve quality.

Finally, the 45 railroad respondents were asked if the emphasis on transportation quality at their organization was increasing, decreasing,

TABLE 3
THE FORMAL QUALITY IMPROVEMENT PROGRAMS^a

Number of Years Program in Use	Percent of Respondents	Sig.	Perceived Importance of Quality program Elements	Importance ^e
0-2	15.6	.000 ^b	Continuous quality improvement	4.52
3-4	48.9		Customer feedback	4.52
5-6	24.4		Quality measurement	4.39
7-10	11.1		Finding the root causes for poor Quality	4.36
Greater than 10	0.0		Improving worker quality awareness through training	4.28
Overall Design of Program			Top management commitment	4.27
Purchased from outside source	62.2	.017 ^c	Quality goals/standards	4.11
Designed in-house	28.9		Making each dept. responsible for quality in their area	4.09
Combination of the above	8.9		Quality circles/teams	4.09
Responsibility for Quality Education, Planning & Control			Benchmarking performance to the best in the industry	4.07
Centralized in one quality dept.	57.8	.232 ^d	Worker empowerment	3.93
Decentralized among all depts.	40.0		Facilitating mutual respect between workers and managers	3.74
Combined central /decentral.	2.2		Statistical quality control	3.74
	<u>Support Level^f</u>		Determining the costs of quality	3.74
Top Management Support Given to Quality Program	4.18	.000 ^f	Non-monetary rewards to quality Improvements	3.48
			Deming's 14 quality principles	3.26
			Baldrige Quality Award criteria	3.21
			Monetary rewards for quality Improvement	2.93

^aThe results shown refer to the 45 respondents stating that they had a formal quality improvement program.

^bSignificance level is based on a t-test of equal response rates for 0-4 years versus greater than 4 years.

^cSignificance level is based on a t-test of equal response rates for in-house versus outside design.

^dSignificance level is based on a t-test of equal response rates for centralized versus decentralized responsibility.

^eScale: 1 = very low support, 3 = moderate support, 5 = very high support.

^fSignificance level is based on a t-test of the sample mean against the scale midpoint of 3.0.

^gScale: 1 = not important, 3 = moderately important, 5 = very important.

^hBracketed sample means were significantly greater than 4.0 in t-test at a significance level of .01.

ⁱBracketed sample means were not significantly different from 4.0 in t-test at a significance level of .01.

^jBracketed sample means were not significantly different from 3.0 in t-test at a significance level of .01.

TABLE 4
PERFORMANCE OF THE QUALITY IMPROVEMENT PROGRAMS^a

Performance Characteristics	Relationship to Quality Program ^b	Program Success in Relation to Initial Expectations	Percent of Respondents
Increased competitiveness	4.00	Met some expectations	53.3
Increased customer service	3.95	Met most or all expectations	26.7
Increased on-time deliveries	3.89	Met few expectations	13.3
Increased expectations of future sales growth	3.74	Exceeded all expectations	6.7
Increased equipment utilization	3.74	Met no expectations	0.0
Decreased customer complaints	3.59	Are Costs of Program Being Recovered by Success Factors?	
Decreased late deliveries	3.58	Yes	77.8
Increased number of services	3.55	No	15.6
Decreased damage/loss claims	3.42	No response	6.7
Increased sales	3.40	Current Emphasis on Transportation Quality	
Increased employee productivity	3.40	Increasing	68.9
Increased preventative maintenance	3.39	Staying the same	22.2
Increased profits	3.39	Decreasing	8.9
Increased JIT capabilities	3.29		
Increased use of automation	3.29		
Increased tracking ability	3.26		
Increased tonnage shipped	3.24		
Increased employee morale	3.22		
Increased "partnership" agreements with competitors	3.12		
Decreased average shipping time	2.93		
Decreased inventory costs	2.83		
Decreased shipping costs	2.77		
Increased backhauls	2.72		
Increased employee pay/benefits	2.68		
Increased use of third party services or agents	2.09		
Decreased use of third party services or agents	1.92		

^a The results shown refer to the 45 respondents stating that they had a formal quality improvement program.

^b Scale: 1 = not related, 3 = moderately related, 5 = highly related.

^c Bracketed sample means were not significantly different from 4.0 in t-test at a significance level of .01.

^d Bracketed sample means were significantly greater than 3.0 in t-test at a significance level of .01.

^e Bracketed sample means were not significantly different from 3.0 in t-test at a significance level of .01.

^f Bracketed sample means were significantly less than 3.0 in t-test at a significance level of .01.

^g No significant differences in response rates were found among bracketed items using t-test comparisons at the .01 significance level.

or staying about the same. Over 68 percent of the respondents said the emphasis on transportation quality at their firm was

increasing. Only 8.9 percent said the emphasis on quality was decreasing.

CONCLUSIONS

Based on these findings, it appears that most railroad companies have implemented formal quality assessment and improvement programs and are considering and formulating strategies to improve service quality. Thus, quality improvement efforts appear to be recognized as an important element in the quest to remain competitive or increase competitiveness. Most of the programs identified here were also experiencing at least partial success compared to initial expectations. This finding, coupled with the finding that many quality programs were less than four years old, indicates that many programs may have yet to reach their full potential.

The commitment to quality is characterized in our railroad sample by a widespread implementation of formal quality improvement programs, a high level of top management support, quality-oriented statements in company mission statements, the extensive use of customer feedback information, continuous efforts to improve quality, use of quality measurements throughout the organization, continuous efforts to find the root causes for poor quality and a generally increasing emphasis on transportation quality assessment and improvement.

Continuous quality improvement efforts and obtaining customer feedback information are considered the most important elements of the formal quality improvement programs. Respondents also felt that the improvements in competitiveness, customer service, on-time deliveries, expectations of future sales growth and equipment utilization were strongly related to their quality improvement program's existence.

Areas perhaps in need of additional emphasis by these quality programs include the use of a

quality improvement reward or motivation system, the integration of quality philosophies and performance criteria (for example, the philosophies of W.E. Deming and the Baldrige Quality Award criteria) into the programs themselves, and the decentralization of responsibility for quality improvement among the entire organization. It was interesting to note that while the respondents perceived the decentralization of responsibility for quality improvement as important, a large percentage of the respondent firms (40 percent) were not employing this practice.

Based on the apparent successes of the railroad respondents summarized in this article, other transportation industry practitioners should consider increasing their efforts in the area of quality improvement. It is hoped that this information will provide some direction to those companies seeking to gather information and justification for such programs.

While the findings here are generalizable to a large degree over the rail carrier sector, more detailed studies within this and other transportation modes remain to be performed. Transportation researchers might consider addressing the other modes of transportation or specific regional rail carriers or multimodal carriers. One limitation of this study was the relatively small number of railroad respondents. This limitation precluded more detailed analyses comparing, for instance, differences between carrier size, or geographic region of operations. Additionally, comparisons of transportation customer or shipper expectations and transportation company service quality offerings would be beneficial to identify performance gaps that should become the focus for further transportation quality improvement efforts.

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REFERENCES

- Armstrong, J. and Overton, T. (1977), "Estimating Nonresponse Bias in Mail Surveys," *Journal of Marketing Research*, 14(August):396-402.
- Bagchi, P., Raghunathan, T. and Bardi, E. (1987), "The Implications of Just-In-Time Inventory Policies on Carrier Selection," *Logistics and Transportation Review*, 23(4):373-384.
- Brown, D. (1989), "Freight Service Quality and Carrier Economics," *Transportation Research Forum*, 30(1):141-152.
- Carman, J. (1993), "Continuous Quality Improvement as a Survival Strategy: The Southern Pacific Experience," *California Management Review*, 35(3):118-132.
- Chow, G. and Poist, R. (1984), "The Measurement of Quality of Service and the Transportation Purchase Decision," *The Logistics and Transportation Review*, 20(1):25-44.
- Curtis, E. (1984), "Quality Circles in Transportation: The Milwaukee Road Experience," *Transportation Journal*, 23(3):63-69.
- Cusumano, M. (1988), "Manufacturing Innovation: Lessons from the Japanese Auto Industry," *Sloan Management Review*, 30(1):29-39.
- Finch, B. (1986), "Japanese Management Techniques in Small Manufacturing Companies: A Strategy for Implementation," *Production and Inventory Management Journal*, 27(3):30-39.
- Garvin, D. (1983), "Quality on the Line," *Harvard Business Review*, (Sept.-Oct.):65-75.
- Grimes, A. (1989), "Service Quality Information Systems for Railroad Operations," *Transportation Research Forum*, 30(1):28-37.
- Harper, D. and Goodner, K. (1990), "Just-In-Time and Inbound Transportation," *Transportation Journal*, 30(2):22-31.
- Higginson, J. and Bookbinder, J. (1990), "Implications of Just-In-Time Production on Rail Freight Systems," *Transportation Journal*, 29(3):29-35.
- Im, J. and Lee, S. (1989), "Implementation of Just-in-Time Systems in US Manufacturing Firms," *International Journal of Operations and Production Management*, 9(1):5-14.
- Journal Staff (1998), "The Quest Continues," *Chilton's Distribution*, 97(8):39-67.
- Koot, R. and Tyworth, J. (1985), "Railroad Track Quality Measurement by Multivariate Statistical Analysis," *Transportation Journal*, 25(1):51-65.

- Krafcik, J. (1988), "Triumph of the Lean Production System," *Sloan Management Review*, 30(1):41-52.
- Lieb, R. and Millen, R. (1988), "JIT and Corporate Transportation Requirements," *Transportation Journal*, 27(3):5-10.
- Nagel, P. and Cilliers, W. (1990), "Customer Satisfaction: A Comprehensive Approach," *International Journal of Physical Distribution and Logistics Management*, 20(6):2-46.
- Parasuraman, A., Zeithaml, V. and Berry, L. (1985), "A Conceptual Model of Service Quality and Its Implications for Future Research," *Journal of Marketing*, 49(4):41-50.
- Perry, J. (1988), "Firm Behavior and Operating Performance in Just-In-Time Logistics Channels," *Journal of Business Logistics*, 9(1):19-33.
- Railroad Ten Year Trends*, (1998), 15th ed., 1988-1997, Washington D.C.: Association of American Railroads, Economics and Finance Department.

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