JIT purchasing and performance: an exploratory analysis of buyer and supplier perspectives

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Abstract

In this exploratory analysis, a model is developed and tested to determine whether the use of JIT purchasing reduces logistics costs for both suppliers and buyers. The results indicate that JIT purchasing directly reduces costs only for buyers. An indirect path, however, was found between JIT purchasing and logistics costs for suppliers. To the extent that JIT purchasing may result in suppliers adopting JIT manufacturing techniques, then suppliers too can benefit, at least indirectly, from JIT purchasing. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

It has been well documented that the implementation of just-in-time (JIT) purchasing systems can result, on average, in reduced inventory costs, shorter lead times, and improved productivity for buying organizations (Ansari and Modarress, 1990; Tracey et al., 1995; Hall, 1983; Schonberger, 1982; Schonberger and Gilbert, 1983; Shingo, 1981, for example). It is less clear to what extent suppliers benefit from engaging in JIT purchasing with buyers (although, for consistency, the term JIT purchasing is used throughout this paper, the program may also be termed JIT selling, from the supplier’s perspective). For example, researchers have found that JIT purchasing results in inventory costs being transferred from buyers to suppliers (Romero, 1991; Fandel and Reese, 1991; Zipkin, 1991). This transfer of costs may be due to poor implementation of JIT purchasing by suppliers, to poor information flows between buyers and suppliers, or, in general, to poor implementation of JIT purchasing from a supply chain perspective. In this paper, we develop and test a model to determine whether JIT purchasing benefits suppliers, as well as buyers. The results indicate that JIT purchasing has direct benefits, in terms of cost reductions, only for buyers. However, to the extent that JIT purchasing may result in suppliers adopting JIT manufacturing techniques, then suppliers too can benefit, indirectly, from JIT purchasing. This paper provides both empirical and theoretical contributions to the literature. Based on a study of buyers in three industries — Industrial Machinery and Equipment, Electronic and Other Electrical Equipment, and Transportation Equipment — and suppliers in one industry — Electronic and Other Electrical
Equipment — this is the first research (known to these authors) that tests how both buyers and suppliers can benefit from the implementation of JIT purchasing. As such, it allows for an exploratory examination of the JIT conditions that might improve supply chain performance; that is conditions that affect both the buying and selling organizations of a supply chain. As well, the paper makes theoretical contributions in the development and refinement of scales measuring JIT purchasing and manufacturing, supply chain integration, and logistics costs.

The rest of the paper is structured as follows. Section 2 reviews the literature on JIT adoption and performance. Section 3 describes the model, data, and methodology used for the analysis. Section 4 presents and analyzes the results. Finally, Section 5 draws conclusions, advances managerial implications, and discusses the limitations of the research.

2. Literature review

JIT refers broadly, according to Ballou (1992, pp. 528), to a philosophy “where the entire supply channel is synchronized to respond to the requirements of operations or customers.” A number of authors differentiate between JIT manufacturing (or production) and JIT purchasing (or, from the supplier’s side, selling) (see, for example, Hahn et al., 1983; Schonberger and Ansari, 1984). JIT manufacturing consists of Japanese Kanban production techniques, such as reduced manufacturing lot sizes, reduced manufacturing lead times, and enhanced quality assurance programs, required to implement flexible manufacturing processes. JIT purchasing, on the other hand, refers to those practices, most notably the frequent deliveries of small lot sizes, that facilitate inventory reduction of raw materials. As Hahn et al. (1983, p. 5) outline, the two JIT systems, manufacturing and purchasing, are by necessity often intertwined: “Implementation of such a [JIT] production system... requires heavy involvement of the purchasing function which, in reality, is the starting point for the materials flow cycle.” The coordination of JIT manufacturing with JIT purchasing has been used as the basis for the JIT II concept, introduced by the Bose Corporation (Harvard Business School, 1994).

A number of papers have investigated the Japanese usage of JIT and other similar arrangements. Sako (1992) differentiated between “arm’s length contractual relationships” between buyers and sellers, commonly used by the British firms that he studied, and the longer term “obligational contractual relations”, more commonly found in Japan. Using a case study approach, he studied the technological, economic, legal and other factors underlying the use of these two relationships, as well as the differential effects of relationship choice on firm performance. Sako’s (1992) conclusion, among others, was that neither long term nor short term contractual relationships were clearly superior. Whereas long term relationships reduce transactional costs, shorter term relationships allow for greater flexibility, for example, with respect to price adjustments. These results were, in part, supported by a later work co-authored by Sako (Helper and Sako, 1995). In this paper, the authors differentiated between “voice” relationships between suppliers and customers, where customers work with suppliers to solve problems, and “exit” relationships, where customers change suppliers when problems persist. The authors did not find either of the relationships to be clearly superior at cost reduction, among US firms surveyed.

Nishiguchi (1994) studied Japanese industry in order to investigate the persistence of subcontracting. He found that one of the most important reasons for the competitiveness of Japanese producers was the nature of Japanese subcontracting, which emphasized synergistic problem solving over antagonistic bargaining between buyers and suppliers. Nishiguchi (1994) concluded that Japanese firms have enhanced their performance by creating arrangements with their suppliers based on the goal of continuous improvement. Prime contractors benefit from enhanced performance of the subcontractors, while subcontractors benefit from rules allowing for the fair distribution of benefits among supply chain members.

Supply chain coordination should clearly increase the usage and performance of JIT. The importance of a well established and maintained buyer–supplier relationship for a successful JIT strategy has been addressed in many studies (St. John and Heriot, 1993; Billesbach et al., 1991; Chandrashekar, 1994; Gilbert et al., 1994; O’Neal, 1987). However, coordination alone, does not necessarily imply that the
supplier’s performance will improve with JIT. Buyers may experience inventory cost reductions once JIT is implemented while supplier inventory costs are less likely to decrease (Dong, 1998). A buyer’s inventory costs may be reduced only because costs are transferred to suppliers after JIT is implemented (Romero, 1991; Fandel and Reese, 1991; Zipkin, 1991). The disadvantageous position that suppliers often are in (vis-a-vis their customers) does not imply that they are always worse-off with JIT. In his theoretical work, Dong (1998) found that suppliers benefit from JIT if they have high carrying costs and low order costs and, therefore, prefer the small lot sizes associated with JIT.

In summary, it appears from the literature that supply chain efficiencies should result from the adoption of JIT. The literature also suggests that the adoption of JIT purchasing, while benefiting buyers, might not lead to benefits for suppliers. Despite these anecdotal and theoretical indications, we are unaware of any empirical work that expressly compares the benefits garnered by buying organizations versus suppliers, when implementing JIT purchasing. In the following section of our paper, we introduce a theoretical model exploring this phenomenon, and describe the research methodology used to test the model.

3. Research model, methodology and data

This exploratory research is intended primarily to investigate the impact of JIT purchasing on both buyers’ and sellers’ logistics costs. The literature suggests that the impact of JIT purchasing on buyer’s performance should be positive, but is not clear on the impact of JIT purchasing on supplier’s costs. Following the concept of Hahn et al. (1983) and others, that JIT purchasing and JIT manufacturing are often implemented together, we include a construct for the supplier’s JIT manufacturing. This construct allows us to test for indirect effects of JIT purchasing (through JIT manufacturing) on logistics costs, as well as for the direct effects on logistics costs of the supplier’s use of JIT manufacturing. Finally, given that the literature suggests supply chain integration is supportive of JIT, we model supply chain integration as an antecedent of JIT purchasing, as well as a direct determinant of logistics costs (see Fig. 1). Each of the constructs is discussed below.

3.1. JIT purchasing

As outlined above, a JIT purchasing strategy is aimed at a synchronized and timely product flow from supplier to buyer. The basic elements of a
JIT purchasing strategy would include the following (see, for example, Ansari and Modarress, 1990; Celley et al., 1986; Chapman and Carter, 1990; Freeland, 1991; Gilbert et al., 1994; Hahn et al., 1983; Manoochehri, 1984; Mehr and Inman, 1992; Oliver, 1990; Sakakibara et al., 1993; Schonberger and Ansari, 1984; Tracey et al., 1995; Vonderembse et al., 1995; Waters-Fuller, 1995):

- Reduction in order sizes.
- Reduction in order lead time.
- Quality control measures, including supplier quality certification, preventive maintenance programs, and receiving quality inspection.
- Supplier selection and evaluation. Suppliers are chosen based on geographical locations, product and delivery qualities, etc. so that other JIT purchasing activities such as lead time reduction and quality control can be undertaken. Some researchers have emphasized the importance of a reduced supplier base as part of the JIT purchasing strategy and others have suggested single sourcing.

Hahn et al. (1983) stress that the characteristics of JIT can be divided into two major categories: technical factors — including minimized setup times and a Kanban pull system — that are specifically germane to JIT, and ‘behavioral/environmental factors’ — such as quality at the source, bottom-up management, and lifetime employment — that help to support JIT but are also parts of other management philosophies such as TQM. Similarly, Sakakibara et al. (1993) use exploratory factor analysis to discover that their 16 dimensions of JIT manufacturing constitute the broad categories of simplified process flow — which includes small lot sizes and Kanban — and JIT support activities and supplier management — including preventive maintenance and managing supplier quality levels. We submit that among the four key JIT purchasing elements, the first two are the ones that make JIT unique. The other two, although as important as the first two, can be used separately or with other supply chain activities to develop other strategies (e.g. vendor managed inventory). A classification of the key JIT purchasing elements, therefore, results in two broad categories: core JIT purchasing features, referring to the first two JIT elements, and facilitating JIT purchasing features, covering quality control elements and supplier selection elements of JIT purchasing. These two categories both have to be implemented in a JIT purchasing program.

3.2. Supply chain integration

This construct is defined in a manner similar to that of Narasimhan and Jayaram (1998), as including decisions relating to supplier management and coordination. Supply chain integration measurements include using electronic data interchange (EDI), integrating management teams in product design, information sharing, and working with suppliers to improve the management of their (second tier) suppliers (Ellram and Cooper, 1990; O’Neal, 1992; Scott and Westbrook, 1990).

3.3. Supplier JIT manufacturing

This construct includes elements of the Kanban system of JIT manufacturing as outlined in Hahn et al. (1983), Schonberger and Ansari (1984), and others. Included in the construct are elements measuring reduced manufacturing lot sizes, reduced manufacturing lead times, and quality assurance programs.

3.4. Logistics costs

Included in the construct are logistics costs relating to inventory, transportation, purchases (for buyers only), and production (for suppliers only). These scales follow Tracey et al. (1995), where performance is measured by cost decreases and improved operational performance.

Based on the extant literature and the constructs described above, five hypotheses have been developed using both buyer and supplier data. The five hypotheses are as follows:

H1: Supply chain integration directly increases the extent of JIT purchasing.
H2: Supply chain integration directly reduces logistics costs.
H3: The extent of JIT purchasing directly increases supplier use of JIT manufacturing.
H4: The extent of JIT purchasing directly reduces logistics costs.
H5: The extent of JIT manufacturing by the supplier directly reduces logistics costs.

The hypotheses are displayed in Fig. 1.
A survey method was adopted to gather data for this research. Two near-mirror-image versions of a survey, one for buyers and one for suppliers, were developed and pre-tested. The development of the survey and the sampling procedures were along the lines suggested by Dillman (2000) and Churchill (1979). Seven-point Likert scales were used to measure survey responses. Respondents were asked to what extent (1: to no extent and 7: to a great extent) each of the statements in the questionnaire were true (exceptions were the items used to measure logistics costs where respondents were asked to rate performance changes for the items on a seven-point Likert scale from 1: very much decreased to 7: very much increased).

Before the questionnaire was finalized, a pretest was conducted to reduce measurement error (Churchill, 1979). The preliminary questionnaire was pretested with logistics managers working for major manufacturing companies, and with logistics professors. Comments were collected and modifications to the questionnaire were made before the final survey was mailed.

One possible sampling strategy would have been to send the survey to matched pairs of buyers and suppliers. However, prior studies have had difficulty in generating large sample sizes using such a dyadic approach (Carter, 2000, p. 205). A strategy was adopted to focus on industries that were often targeted by other researchers in JIT studies, so that the results would allow for possible comparisons. The research sample was chosen from the subscriber list of Purchasing magazine. The industries selected for the buyer sample were Industrial Machinery & Equipment (SIC 35), Electronic & Other Electrical Equipment (SIC 36), and Transportation Equipment (SIC 37). By looking into the product categories that the purchasing managers in these industries are most likely responsible for, electronics products were chosen to represent the target inputs for buyers. Thus, Electronic & Other Electrical Equipment (SIC 36) became the corresponding industry segment for suppliers. Buyers were asked to focus their answers on, "one of your suppliers. This supplier should be providing your end firm with critical electrical/electronic components or supplies that are used in your firm’s major end product(s)." Suppliers were similarly asked to focus their responses.

The combined sample size (buyer sample plus supplier sample) was 5000, with 2305 in the buyer group and 2695 in the supplier group. The buyer group represented purchasing managers from the three targeted industries, while the supplier group consisted of sales, marketing, and traffic/distribution managers from the electronics industry. The survey and a follow-up postcard were mailed following Dillman’s (2000) approach.

Employees from purchasing (sales) functions are employed in positions that span the boundaries of their organizations and those of their suppliers (customers) (Webster, 1992; Williams et al., 1994). Thus, purchasing (sales) personnel are likely well informed about their firm’s inbound (outbound) logistics activities as well as the processes of their suppliers (customers), particularly given the significant expansion of both the purchasing and sales professional’s job content during the past decade (Tracey et al., 1995; Pooley and Dunn, 1994; Weitz and Bradford, 1999).

A total of 159 completed buyer surveys were returned, while another 37 were not deliverable, producing a response rate of 7.0%. Of the 159 completed buyer surveys, 35 respondents indicated that their firms had no JIT operations, leaving 124 responses that were used in the analyses discussed in Section 4. One hundred and ninety-seven completed supplier surveys were returned, while another 42 were not deliverable, producing a response rate of 7.4%. Sixty-six supplier respondents indicated that their firms did not have JIT operations, leaving 131 responses. Given the low response rate, additional precautions were taken to test for the presence of non-response bias. The study was designed so that the buyer and supplier respondents originated from entirely separate samples. As an added safeguard, the data were manually inspected to ensure that in no cases were buyer and supplier respondents from the same firm.

In order to test for nonresponse bias, surveys were mailed to a randomly selected group of the nonrespondents, followed by a round of telephone calls (Lohr, 1999). A total of 20 buyer surveys were returned, 13 of which indicated that JIT was used, while 24 supplier surveys were returned, 15 of which indicated JIT usage. A multivariate t-test was employed to test for any overall difference among the study’s major variables. The variables tested included the extent of JIT purchasing, the use of JIT manufacturing by suppliers, supply chain integration, and logistics costs. No significant differences were found between buyer or
supplier respondents and non-respondents ($P = 0.5722$ and $0.3275$, respectively), suggesting the absence of non-response bias.

4. Analyses

4.1. Construct measurement

Confirmatory factor analysis was used to evaluate the reliability and validity of the study’s constructs (Anderson and Gerbing, 1988). The two dimensions of JIT purchasing were assessed through a second-order confirmatory factor analysis (Rindskopf and Rose, 1988). The scale items used to measure the study’s constructs for the buyer sample are displayed in Appendix A. The GFI, Bentler’s (1989) CFI, and Bentler and Bonett’s (1980) NNFI were all above the 0.90 recommended minimum levels at 0.91, 0.94, and 0.91, respectively. All factor loadings were large and significant ($P < 0.0001$), providing evidence of convergent validity (Gerbing and Anderson, 1988). All constructs also displayed composite reliability values (Fornell and Larcker, 1981) in excess of the 0.60 minimum for exploratory studies (Churchill, 1979; Flynn et al., 1990; Van de Ven and Ferry, 1978), with the exception of the ‘facilitating’ dimension of JIT purchasing, which was 0.55.

The chi-square difference test between the standard measurement model and a fixed measurement model was used to assess discriminant validity of the study’s constructs (Anderson and Gerbing, 1988; Bagozzi and Phillips, 1982). The chi-square difference test indicates that discriminant validity exists between such constructs as core JIT and facilitating JIT ($P < 0.001$), and thus these factors were modeled as separate constructs. Finally, there were no large, standardized residuals. Together, these findings suggest that the scale items displayed in Appendix A are reliable and valid indicators of the study’s constructs for the buyer sample.

Appendix B shows the near-mirror-image scale items that measure the study’s constructs for the supplier sample. As with the buyer sample, the GFI, Bentler’s (1989) CFI, and Bentler and Bonett’s (1980) NNFI were at or above the 0.90 recommended minimum levels with values of 0.90, 0.92, and 0.90, respectively. All factor loadings were large and significant ($P < 0.0001$). All constructs also displayed composite reliability values at or near the 0.60 recommended minimum.

As with the buyer sample, all $P$-values from chi-square difference tests were significant, providing evidence of discriminant validity among the constructs. Finally, there were no large, standardized residuals. Together, these findings suggest that overall the scale items displayed in the appendices are reliable and valid indicators of the study’s constructs.

4.2. Hypothesis testing — buyer firms

Structural equation modeling is an appropriate statistical technique when assessing the relationships among latent constructs that are measured by multiple scale items, where at least one construct is both a dependent and an independent variable (Hair et al., 1992). For this reason, we tested the study’s hypotheses using structural equation modeling with latent variables. In the case of JIT purchasing, the core and facilitating dimensions were first transformed into manifest variables. This was done by creating a linear composite of the responses to the survey questions, which were weighted by the standardized factor loadings shown in Appendices A and B (see, for example, Nunnally, 1967; Thurstone, 1947). The JIT purchasing variable was then measured by these two composite variables.

A test of the full latent structural model for buyers, displayed in Fig. 2, resulted in an excellent fit between the model and the data. The GFI, Bentler’s (1989) CFI, and Bentler and Bonett’s (1980) NNFI were 0.92, 0.94, and 0.92, respectively — all above the 0.90 recommended minimum levels. Further there were no large normalized residuals, providing additional evidence that the model fits the data.

The results displayed in Fig. 2 show that the path from supply chain integration to JIT purchasing is positive and significant, indicating that as supply chain integration increases, so does the extent of JIT purchasing. The path from JIT purchasing to buyer logistics costs is negative and significant, suggesting that as the extent of JIT purchasing increases, logistics costs decrease. The relationship between JIT purchasing and supplier JIT manufacturing is positive and significant, indicating that as JIT purchasing increases, so too does the extent of supplier JIT manufacturing. Finally, no significant relationships were found between
buyer logistics costs and either supply chain integration or supplier JIT manufacturing.

4.3. Hypothesis testing — supplier firms

Fig. 3 shows the results from a structural equation analysis conducted using the data from the supplier firms. Again, we found a strong fit between the model and the data, with GFI, CFI, and NNFI values of 0.93, 0.96, and 0.94, respectively. In addition, there were no large normalized residuals. An examination of the path loadings in Fig. 3 shows significant positive relationships between supply chain integration and the extent of JIT purchasing and the extent of JIT purchasing and supplier JIT manufacturing. A significant negative relationship exists between supplier JIT manufacturing and supplier logistics costs. Thus, as a supplier’s JIT manufacturing increases, the supplier’s outbound logistics costs decrease. As is the case with buyers, no direct relationship exists between supply chain integration and logistics costs. Unlike the buyer group, JIT purchasing has no direct effect on supplier logistics costs.

The issue of scale equivalence between the buyer and supplier sample was considered by conducting sensitivity analyses in analyzing the path model in Fig. 2. We reanalyzed the model in Fig. 3 using the path loadings from the buyer scale items displayed in Appendix A. All paths remained unchanged, in terms of the direction and level of significance.

4.4. Summary of results — buyer and supplier firms

Table 1 includes a summary of the results from the buyer and supplier models. As indicated in the table, the first hypothesis, that supply chain integration would directly increase the extent of JIT purchasing, was supported for both the buyer and the supplier firms. This result confirms those from a number of previous studies, including St. John and Heriot (1993), Billesbach et al. (1991), Chandrashekar (1994), Gilbert et al. (1994) and O’Neal (1987).

The second hypothesis, that supply chain integration would directly reduce logistics costs, was not supported in either the buyer model or the supplier model. Although supply chain integration may serve to reduce logistics costs, we found that this occurred only through one or more mediating variables (JIT purchasing for the buyer sample and JIT purchasing and supplier JIT manufacturing for the supplier sample).

The third hypothesis, that the extent of JIT purchasing directly increases supplier use of JIT
Fig. 3. JIR purchasing and performance, supplier organizations (**P < 0.001, ****P < 0.0001; dotted lines indicate the lack of a statistically significant relationship).

Table 1
Summary of results from hypotheses tests

<table>
<thead>
<tr>
<th>Hypothesis number</th>
<th>Hypothesis</th>
<th>Supported/not supported</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Buyer model</td>
<td>Supplier model</td>
</tr>
<tr>
<td>H1</td>
<td>Supply chain integration directly increases the extent of JIT purchasing</td>
<td>Supported</td>
</tr>
<tr>
<td>H2</td>
<td>Supply chain integration directly reduces logistics costs</td>
<td>Supported</td>
</tr>
<tr>
<td>H3</td>
<td>The extent of JIT purchasing directly increases supplier use of JIT manufacturing</td>
<td>Supported</td>
</tr>
<tr>
<td>H4</td>
<td>The extent of JIT purchasing directly reduces logistics costs</td>
<td>Supported</td>
</tr>
<tr>
<td>H5</td>
<td>The extent of JIT manufacturing by the supplier directly reduces logistics costs</td>
<td>Not supported</td>
</tr>
</tbody>
</table>

managing, was supported using both buyer and supplier samples. This result coincides with the view of Hahn et al. (1983) and others, that JIT purchasing and JIT manufacturing are often implemented together.

The fourth hypothesis, and the major research hypothesis addressed in this paper, that the extent of JIT purchasing directly reduces logistics costs, was supported only for the buyer sample. This result would provide at least conditional support to Romero (1991), Fandel and Reese (1991), Zipkin (1991) and Dong (1998), that logistics costs may be pushed upstream in the supply chain when JIT purchasing is implemented, resulting in gains for buyers but not suppliers. However, JIT purchasing did result in a reduction of logistics costs for suppliers as well, not directly but through the mediating variable, supplier JIT manufacturing. The latter relationship, that supplier JIT manufacturing directly reduces logistics costs (i.e. hypothesis 5) was confirmed only for the supplier group.

5. Conclusions and discussion

5.1. Conclusions

The main purpose of this paper was to determine how both buyers and suppliers might benefit from the use of JIT purchasing. Due to our analysis of a limited and select group of industries
and given the new scale construction required for the analysis, the results must be interpreted as exploratory. Near-mirror-image models were developed and tested for buyers and suppliers, each resulting in a highly significant fit to the data. Five specific paths were tested in both the buyer and supplier models.

An important finding was that the extent of JIT purchasing has a direct effect on reducing costs in buyer organizations but not in supplier organizations. Previous research has found that JIT purchasing can result in inventory costs being transferred from buyers to sellers (Romero, 1991; Fandel and Reese, 1991; Zipkin, 1991). Although our results do not directly support this conclusion, they do lend credence to this view. On the other hand, significant paths were found, using supplier data, between JIT purchasing and supplier JIT manufacturing and between supplier JIT manufacturing and supplier logistics costs. This result indicates that JIT purchasing can indirectly lead to lower logistics costs for suppliers; that is if suppliers implement JIT manufacturing in conjunction with a JIT purchasing program.

We also found, as might be expected, that integrating operations between buyers and suppliers was positively associated with JIT purchasing for both buyers and suppliers. More surprising, however, we did not find significant direct paths between supply chain integration and cost reduction in either of the models. It may be that supply chain integration is best implemented as part of a wider program, such as JIT purchasing, in order to produce significant logistics cost reductions.

In summary, our exploratory research suggests that buyers can directly benefit from JIT purchasing while suppliers may need to adjust their manufacturing practices to benefit as well.

5.2. Managerial implications

In order to build a long term supply chain relationship, it is likely that all members of the supply chain need to profit. Our exploratory research shows that JIT purchasing produces direct positive logistics results only for buyers, suggesting that long term JIT purchasing relationships may not necessarily be stable. In order to implement a successful JIT purchasing program from a supply chain perspective, managers in both the supplier and buyer organizations must act to produce the conditions conducive to JIT adoption and success for both buyers and sellers. Given our finding of a direct path from supplier JIT manufacturing to supplier logistics costs, instituting a JIT program that includes specific supplier JIT manufacturing activities appears to be a key in producing positive results for supplier organizations, and long term success for the buyer–supplier relationship.

5.3. Limitations and suggestions for future research

Two of the study’s scales had values below the 0.60 minimum recommended by Churchill (1979), Flynn et al. (1990) and Van de Ven and Ferry (1978). However, it is not uncommon to find reported values falling below this 0.60 level, particularly when scales are first developed and tested. Nunnally (1967) notes that coefficient alpha values may be low either because there are too few scale items or because the items have little in common. Given the face validity of the items that comprise the model’s scales, the former is likely the cause. Further, the items comprising the study’s scales are all positively and significantly correlated with each other. However, we suggest that researchers adopting the study’s scales for future projects augment those scales where reliability values are lower than 0.70 (Nunnally and Bernstein, 1994).

As well, a study that includes longer term performance results from JIT implementation would be useful. We found that JIT purchasing did not directly result in improved logistics performance for suppliers, indicating that suppliers may not be willing to participate in JIT programs over the longer term. Therefore, a study that tracks JIT implementation and success (or lack thereof) over a longer time horizon would be useful in determining the stability of JIT relationships.

Acknowledgements

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Appendix A. Buyer scale items (standardized factor loadings in parentheses)

<table>
<thead>
<tr>
<th>Scale and item</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of JIT purchasing (to what extent have you used the following JIT programs with this supplier?)</td>
<td>0.67</td>
</tr>
<tr>
<td>Core JIT (0.69)</td>
<td>0.85</td>
</tr>
<tr>
<td>Order size reduction (0.74)</td>
<td></td>
</tr>
<tr>
<td>Negotiation process simplification (0.78)</td>
<td></td>
</tr>
<tr>
<td>Open-order status paperwork reduction (0.78)</td>
<td></td>
</tr>
<tr>
<td>Expediting, receiving count, and inspection cost reduction (0.64)</td>
<td></td>
</tr>
<tr>
<td>Order lead time reduction (0.70)</td>
<td></td>
</tr>
<tr>
<td>Facilitating JIT (0.73)</td>
<td>0.55</td>
</tr>
<tr>
<td>Quality assurance program (0.46)</td>
<td></td>
</tr>
<tr>
<td>Formal supplier evaluation and selection program (0.54)</td>
<td></td>
</tr>
<tr>
<td>Sole sourcing (0.60)</td>
<td></td>
</tr>
<tr>
<td>Supply chain integration (to what extent do you and this supplier have the following logistics agreements and programs?)</td>
<td>0.67</td>
</tr>
<tr>
<td>Electronic data interchange (EDI) connections (0.53)</td>
<td></td>
</tr>
<tr>
<td>Information sharing (e.g. demand forecasts and costs) with this supplier (0.51)</td>
<td></td>
</tr>
<tr>
<td>Sharing joint cost savings with this supplier (0.68)</td>
<td></td>
</tr>
<tr>
<td>Working with this supplier to improve the management of its own suppliers (0.61)</td>
<td></td>
</tr>
<tr>
<td>Supplier JIT manufacturing (to what extent has this supplier adopted the following operations to adjust to your JIT operations?)</td>
<td>0.74</td>
</tr>
<tr>
<td>Reduced manufacturing lot sizes (0.68)</td>
<td></td>
</tr>
<tr>
<td>Reduced manufacturing lead times (0.73)</td>
<td></td>
</tr>
<tr>
<td>Enhancement of quality assurance (TQM) programs (0.69)</td>
<td></td>
</tr>
<tr>
<td>Buyer logistics costs (With JIT, to what extent have the following performance and other measures increased, decreased, or remained unchanged?)</td>
<td>0.63</td>
</tr>
<tr>
<td>Your inventory costs (0.96)</td>
<td></td>
</tr>
<tr>
<td>Your inbound transportation costs (0.38)</td>
<td></td>
</tr>
<tr>
<td>Your purchase prices (0.42)</td>
<td></td>
</tr>
</tbody>
</table>

*a* All scale items were measured on a seven-point Likert scale, from 1: to no extent to 7: to a great extent, with the exception of inbound logistics performance, which was measured on a seven-point Likert scale, from 1: very much decreased to 7: very much increased.

*b* Loading of sub-dimension on second-order latent factor.
Appendix B. Supplier scale items (standardized factor loadings in parentheses)

<table>
<thead>
<tr>
<th>Scale and item</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent of JIT purchasing (To what extent has this customer used the following JIT programs with you?)</td>
<td>0.59</td>
</tr>
<tr>
<td>Core JIT (0.64)</td>
<td>0.85</td>
</tr>
<tr>
<td>Order size reduction (0.64)</td>
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<td>Expediting, receiving count, and inspection cost reduction (0.84)</td>
<td></td>
</tr>
<tr>
<td>Order lead time reduction (0.55)</td>
<td></td>
</tr>
<tr>
<td>Facilitating JIT (0.66)</td>
<td>0.70</td>
</tr>
<tr>
<td>Quality assurance program (0.73)</td>
<td></td>
</tr>
<tr>
<td>Formal supplier evaluation and selection program (0.68)</td>
<td></td>
</tr>
<tr>
<td>Sole sourcing (0.56)</td>
<td></td>
</tr>
<tr>
<td>Supply chain integration (to what extent do you and this customer have the following logistics agreements and programs?)</td>
<td>0.74</td>
</tr>
<tr>
<td>Electronic data interchange (EDI) connections (0.49)</td>
<td></td>
</tr>
<tr>
<td>Information sharing (e.g. demand forecasts and costs) with this customer (0.82)</td>
<td></td>
</tr>
<tr>
<td>Sharing joint cost savings with this customer (0.68)</td>
<td></td>
</tr>
<tr>
<td>Help from with this customer to improve the management of your suppliers (0.61)</td>
<td></td>
</tr>
<tr>
<td>Supplier JIT manufacturing (to what extent have you adjusted to this customer’s JIT programs in your own operations?)</td>
<td>0.65</td>
</tr>
<tr>
<td>Reduced manufacturing lot sizes (0.54)</td>
<td></td>
</tr>
<tr>
<td>Reduced manufacturing lead times (0.60)</td>
<td></td>
</tr>
<tr>
<td>Enhancement of quality assurance (TQM) programs (0.70)</td>
<td></td>
</tr>
<tr>
<td>Supplier logistics costs (with JIT, to what extent have the following performance and other measures increased, decreased, or remained unchanged?)</td>
<td>0.79</td>
</tr>
<tr>
<td>Your inventory costs (0.96)</td>
<td></td>
</tr>
<tr>
<td>Your outbound transportation costs (0.60)</td>
<td></td>
</tr>
<tr>
<td>Your production costs (0.63)</td>
<td></td>
</tr>
</tbody>
</table>

a All scale items were measured on a seven-point Likert scale, from 1: to no extent to 7: to a great extent, with the exception of outbound logistics performance, which was measured on a seven-point Likert scale, from 1: very much decreased to 7: very much increased.
b Loading of sub-dimension on second-order latent factor.
References


Fornell, C., Larcker, D., 1981. Evaluating structural equation models with unobservable variables and measurement error. Journal of Marketing Research. 18 (1), 39–50.


