Chapter 59
The Benefits and Implied Costs of JIT Sourcing to Chinese Contractors: A Review of Literature

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Abstract The just-in-time (JIT) concept originates from the Toyota Production System (TPS) and has been adopted in the construction industry for decades to improve logistics and performance. The concept has proven to be effective in reducing inventory level, improving information exchange and supply chain performance. Many new benefits of JIT sourcing have been identified in recent years, such as the improvement in environmental performance for contractors. However, these new benefits are challenged by many academics based on the rigorous criteria that should be followed when applying the JIT sourcing concept.

It is therefore necessary to re-evaluate the benefits and costs of JIT sourcing, especially to identify what the implied costs are in order to achieve the benefits. This paper aims to take the first step to re-evaluate JIT sourcing for Chinese contractors for better implementation. According to the research aim, this paper is split into two parts. The first section focuses on explaining the traditional and new benefits of JIT sourcing while the second section aims to investigate the implied costs of these benefits. By knowing the benefits and implied costs, the contractors can be fully prepared to apply JIT sourcing to improve their performance.

Keywords JIT sourcing • Contractors • Performance

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59.1 Introduction

The just-in-time (JIT) concept originates from the Toyota Production System (TPS) [1]. One of the two pillars that support the TPS is JIT, which means that the right parts needed in production reach the assembly line at the time they are needed and only in the amount needed in a flow process [1]. Sugimori et al. [2] firstly examined the JIT concept and stated that the JIT production is a method whereby the production lead time is greatly shortened by maintaining the conformity to changes by having "all processes produced the necessary parts at the necessary time and have on hand only the minimum stock necessary to hold the processes together" ([2], p.555). There are many interpretations about the techniques of JIT sourcing. However, the major ones include long-term contracts, single sourcing, total quality suppliers, dependable deliveries, small lot sizes, exchange of data and stable production schedules [3].

The advocates of JIT sourcing stated that JIT method is a better strategy for making sourcing decisions than traditional forms of purchasing [3]. There are many surveys and case studies which support such statement (e.g. [3–5]). On the other hand, the pragmatic ones stated that the concept can provide many benefits to the buyer, but will create many problems at the same time. The concept should be carefully examined before being applied to the supply chain system.

This paper therefore aims to examine the concept of JIT sourcing for Chinese contractors for better implementation to reduce sourcing costs and improve efficiency. The objectives of this paper include: a) examine the different techniques in JIT sourcing; b) identify the benefits of these techniques; and c) identify the implied costs of these techniques. While the benefits and implied costs of JIT sourcing are identified, contractors will be able to choose the techniques which suit them the most.

59.2 JIT Sourcing Techniques

The concept of JIT sourcing originates from the Toyota Production System. According to Fawcett and Birou [5], the success of the JIT concept in Toyota has led to a wide spread adoption among Fortune 500 manufacturing firms. The original JIT concept in the Toyota Production system aims to: "produce and deliver goods just in time to be sold, subassemblies just in time to be assembled into finished goods, fabricated parts just in time to go into subassemblies, and purchased materials just in time to be transformed into fabricated parts" [1]. The JIT sourcing has extended the concept into supply chain management and aims to requiring frequent deliveries of small order quantities directly to the area of the production floor where and when they are to be used [5].

There are many interpretations about the JIT sourcing techniques (e.g. [3,5,6]). However, the most commonly recognized JIT sourcing techniques include:

- Long-term contracts. The long term relationship between contractors and suppliers will enable the suppliers to cater for all needs of the contractor.

- Single sourcing. Single sourcing concentrates on reducing the supply base by using fewer but more capable suppliers, thereby ensuring that the buying company becomes an important customer to the supplier, reinforcing good buyer/supplier relationships [7].
- Small lot size delivery. The small lot size delivery is considered as a hallmark of JIT sourcing. The literature concentrates on the logistics of getting small frequent batches to the manufacturer at least cost [3].
- Just-in-time. The right parts needed in production reach the assembly line at the time they are needed and only in the amount needed in a flow process [1].

59.3 Long-Term Contracts

The JIT sourcing concept advocates a long-term relationship between contractors and suppliers. According to Schonberger and Ansari [8], the long-term relationship can encourage loyalty and reduce the risk of an interruption to supply. The long-term contracts will also eliminate the re-tendering costs and ensure that costs are reduced in the long-term through repetition [3].

However, there are some problems that can be caused by establishing a long-term relationship with suppliers. The most commonly recognized problem is the loss of price control. According to Ramsay and Wilson [9], single sourcing increases the risks of supply disruption and further leaves the buyer open to pay non-competitive price. Wu and Low [10] found that the price is one of the major considerations when selecting suppliers and is preventing the contractors from using long-term contracts. This is one of the reasons why many contractors are using a backup supplier.

Therefore, in order for long-term contracts to work, a mechanism to reflect price change in the market should be established between the contractors and the long-term suppliers. The role of price in the contracts should be re-examined. As Swift [11] has pointed out, the objective of the contractor is to find the optimal supplier, not necessarily the one who offers the lowest price, the quickest delivery, or the best service. In addition, the suppliers should offer dependable deliveries, i.e. the right amount needed by the contractors should be delivered to the construction site at the right time. Penalties to delivery disruptions caused by suppliers can be added to the long-term contracts.

59.4 Single Sourcing

Ideally, the number of suppliers for each material, or class of materials is one [12]. Single sourcing will help to eliminate waste and improve quality. More importantly, the exchange of data (e.g. change of construction schedule, change of required amount, delivery problems) between contractors and suppliers will be

smoother upon the implementation of single sourcing. This will eventually help the contractor achieve better construction scheduling.

Although the objective of the firm is to find the optimal supplier, not necessarily the supplier who can offer the lowest price on the market [11], single sourcing can lead to the loss of price control if a mechanism to consider market price is not established between contractors and suppliers. It should be noted that single sourcing does not necessarily put the construction schedule to disruption. Contractor who will adopt single sourcing will conduct a quality audit of the supplier before such agreement is made. The quality audit is to make sure that the suppliers are competent to cope with the JIT sourcing activities.

59.5 Small Lot Size Delivery

Small lot size delivery is the hall mark of the whole JIT concept. The small lot nature of the delivery will ensure that the materials are used immediately when arrived, thus reducing inventory. The damages during inventory can therefore be reduced.

A consequence of small lot size delivery is the increased frequency of deliveries, which can lead to increased transportation costs. However, there some innovative delivery methods that can be adopted to balance the increased transportation costs, e.g. the Rim Delivery System (sometimes referred to as direct shipment with milk runs). The transportation costs under the milk runs can be reduced by having each delivery vehicle visit several customer locations, provided that the total quantity of goods to be delivered does not exceed the vehicle capacity [13]. The Rim Delivery System can significantly reduce the transportation costs by combining deliveries together, especially when a wide range of materials is required.

59.6 Just-in-Time

The most significant benefit of just-in-time is the reduced cycle time [14]. According to Koskela [14], the cycle time can be presented by the following equation:

$$\text{Cycle time} = \text{Processing time} + \text{inspection time} + \text{wait time} + \text{move time}$$

The just-in-time nature can help eliminate reduce time, wait time and move time, thus reducing the cycle time (construction duration). If the materials are used immediately when arrived at the construction site, inventory will not be needed at the construction site.

However, there are several important aspects that should be addressed before the just-in-time concept is applied to the supply chain. Ideally, the contractor needs to

maintain a stable construction schedule. A stable and predictable construction schedule will make just-in-time easier to achieve. The supplier can produce and deliver based on the stable and predictable construction schedule. However, if unfortunately, a stable and predictable construction schedule cannot be achieved, for example, because of change of construction method, a smooth exchange of data (e.g. [15]) should be used to minimize the impact of such changes.

In addition, using the JIT concept in construction may also expose the construction process to disruptions. For example, unanticipated traffic congestion may cause the delay of the delivery, therefore disrupting the onsite construction process. Some actions should be taken to reduce the impact of such disruptions, e.g. by ordering regionally manufactured materials.

59.7 JIT Sourcing and Environmental Benefits

The JIT sourcing techniques are also found to have some environmental benefits, such as low carbon emissions and low wastage. According to Wu and Low [16], immediate use of building materials after arrival can significantly reduce transferring and singling out activities, thus reducing carbon emissions. Nahmens [17] found that by applying some of the JIT techniques to a production line, 9–6.5 people (labour waste), 12 % space (equipment waste) and 10 % wallboard (material waste) can be reduced.

However, some of the practices, especially the JIT delivery, were challenged by some academics. For example, Rothenberg et al. [18] stated that the survey results did not significantly support that hypothesis that JIT is greener, and it was only interview data that supported the relationship between JIT and environmental management practices.

As to JIT delivery, many academics argued that the small lot nature of just-in-time would actually increase the carbon emissions level in the transportation cycle. Venkat and Wakeland [19] stated that just-in-time supply chain did not necessarily reduce carbon emissions. When cold storage is not required for a particular product line, emissions depend largely on the transportation mode, and larger deliveries at less frequent intervals all along the supply chain generally lead to the lowest emissions. Some project managers interviewed have raised the same concern.

However, it should be noted that whether JIT sourcing techniques can help achieve some green benefits should be analyzed case by case, because:

- Just-in-time. The just-in-time nature was believed to have benefits in reducing carbon emissions by reducing unnecessary movement during construction.
- Small lot size delivery. Small lot sizes were considered as an important feature of JIT sourcing and were believed flexible enough to overcome the obstacles of higher delivery costs and loss of discount rates [20]. The small lot nature of JIT delivery can possibly increase the carbon emissions. However, the amount of carbon emissions should be assessed case by case before conclusions can be

made. The small lot nature of JIT delivery can reduce the inventory level. The benefits achieved by lower inventory level, e.g. lower carbon emissions in this case, should also be assessed.
- Long-term relationship. A long-term relationship between contractors, subcontractors and suppliers is essential to a JIT delivery system. It can help improve the information exchange between contractors, subcontractors and suppliers, thus supporting the JIT nature as discussed earlier.

It is therefore necessary for contractors to balance the JIT sourcing techniques, if environmental benefits are going to be pursued. Starting with just-in-time and long-term relationship can help the contractors achieve some green benefits, such as low carbon emissions.

59.8 Conclusions

JIT sourcing techniques originate from the Toyota Production System and have been applied in the construction industry to improve the supply chain. As can be seen from Table 59.1, the most commonly recognized benefits include improved quality, reduced inventory and damages, smoother exchange of data and reduced construction duration. However, it should be noted that not all JIT applications can achieve positive results. The implied costs of JIT sourcing techniques should not be overlooked. The most commonly recognized implied costs include loss of price control, supply disruptions, increased transportation costs and construction disruptions.

It is therefore proposed that the contractors should evaluate the construction projects first before applying the JIT sourcing techniques. The JIT sourcing techniques can be used as stand-alone applications. It means that the contractor can choose one or two techniques that can best serve the construction projects.

In recent years, better environmental performance has been identified as one the major benefits by applying JIT sourcing techniques. However, as can been seen

Table 59.1 Benefits and implied costs of JIT sourcing techniques

JIT sourcing techniques	Benefits	Implied costs
Long-term contracts	Low risk of interruption	Loss of price control
	Low re-tendering costs	Supply disruptions
Single sourcing	Improved quality	Loss of price control
	Smoother exchange of data	
	Better construction scheduling	
Small lot size delivery	Reduced inventory	Increased transportation costs
	Reduced damages	
Just-in-time	Reduced construction duration	A stable construction schedule
	Reduced inventory	Smooth exchange of data
		Construction disruptions

from this paper, all benefits come with implied costs. Knowing the implied costs of JIT sourcing techniques, appropriate actions can therefore be taken for further improvement.

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