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BUILD TO SEQUENCE SUPPLY

TAMÁS BÁNYAI[1]

Abstract: The customer oriented market leaded to the growth of complexity of production and service processes. This growing complexity has increased the required logistics operations and leaded to the appearance of global supply chain strategies. There are several supply strategies, which are based on just-in-time philosophy and they are core tools of leaning. One of these JIT-based supply strategies is the just-in-sequence supply, which has different forms, depending on the characteristic tasks of members of the supply chain. Within the frame of this paper, the author focuses on the build to sequence strategy, within the frame of which products are built to the sequence in which they will be required by the customer. Different solutions of this supply strategy will be described, and the most important application areas will be defined.
Keywords: build to sequence, logistics, sequencing.

1. Introduction

The optimal design of logistics processes is one of the major tasks of the global economy since production and service companies can reduce their costs substantially by reducing logistics related expenditures. The logistics systems integrate the supply chain from the purchasing of raw materials required for the final products to the recycling/reuse of used products covering the four functional areas of logistics: purchasing, production, distribution, and the inverse processes. The lean became one of the magic words of production logistics, which is enterprise management, production organization method. On the basis of the application of this method companies try to increase the efficiency of their production [1]. The increase of efficiency and productivity can be achieved by the aid of fulfilling logistics strategies, such as capacity utilization, reduce inventories, increase flexibility, improve direct response to customer needs, reducing lead times, increase transparency of systems and processes [2]. The philosophical basis of lean production is the Toyota production system, on the basis of which more and more lean tools have been developed and applied [3]. Probably one the most popular tool of lean is the just-in-time supply strategy and the newer, so-called just-in-sequence supply strategy. According to the literature, the just-in-sequence supply strategy is based on just-in-time philosophy [4], except that the goal is not only to fulfil the 7R rule, but also to ensure the requested sequence of products. There are three different concepts of just-in-sequence supply. In the case of pick-to-sequence strategy products are collected and sequenced from internal storage and transported directly to the assembly or production plant. In the case of ship-to-sequence strategy, the products are collected and sequenced at the supplier and transported directly to the assembly or production plant. The third one just-in-sequence strategy is the build-to-sequence strategy, where items are produced in the sequence of the customer.

[1] PhD, University of Miskolc
H-3515 Miskolc-Egyetemváros, Hungary
alttamas@uni-miskolc.hu

2. Literature overview

There are three main streams of just-in-sequence literature: researches in the field of purchasing and supply chain, just-in-time production and supply strategies and optimisation of just-in-sequence supply. A milestone of the supply chain modelling was the appearance of cost-benefit models [5] and the researches in the field of selection and evaluation of suppliers [6]. Today, integrated management of the supply chain has become important that its success is essential in product design, manufacturing process and the integrated management of the supply chain, the application of decision making processes based on integrated knowledge [7]. Parallel with the development of Toyota production system just-in-time supply systems has become more and more application in mechatronic assembly and automotive industries. The supply chain complexity has increased so much that their planning cannot be carried out only on the base of analytical methods, but in many cases heuristic methods and simulation techniques are required [8].

Several models, can be founded in the literature, defining conditions to support the decision: when is it required to change the just-in-time supply to just-in-sequence [9]. These researches focus on the whole supply chain and highlight the macrologistic aspects of just-in-sequence supply [10]. These studies formulate the following trends: use of cross docking facilities to speed up the processes; intensive involvement of near-to-customer 3PL providers into the implementation of supply chains processes, reduction of the number of suppliers to simplify the structure of supply chain. The just-in-time supply system plays a key role in the elimination of warehousing activities [11] and transfers them to intermediate storages, which are basically logistics service centres and cross docking facilities.

Select product category covered by the just- in-time supply is always an important decision because different supply and order strategies have different preferences: just-in-sequence, just-in-time, just-in-case, EOQ based orders etc. There are in the literature different methods describing to create supply portfolios; the production depth optimization based on BOM-optimization seems to be the best method [12]. The operation of just-in-time supply systems needs real-time monitoring of stocks [13, 14], which require the development of advanced information and communication infrastructure. This is especially true for just-in-sequence systems [15].

3. Build-to-sequence supply

Within the frame of this chapter the three main just-in-sequence supply strategy will be introduced; especially the build to-sequence model. It is possible to make some statement without any analysis. The pick-to-sequence supply is not in any case a just-in-sequence supply for the whole supply chain because the sequenced loading unit is picked by the customer from stocks. The supply from these stocks to the assembly plants can be just-in-sequence, but from suppliers to the customer either just-in-time or just-in-case. In the case of ship-to-sequence strategy, the sequenced loading units are picked outside of the customers plant, either in an intermediate storage or a cross docking facility. In this case, we are not using high stocks in the customer's plant, they are shifted backward. The third just-in-sequence strategy is the build-to-sequence supply. In the case of this model, the parts are produced according to the required sequence of the customer's assembly plant. The just-in-sequence production of required parts can be insourced or outsourced and should be realised based on just-in-time philosophy.

Figure 1 demonstrates a general model of just-in-sequence supply, by the aid of which it is possible to describe special models of different supply strategies and analyse them. The model includes the following objects: suppliers, intermediate storages or cross docking facilities and customers. The produced parts of suppliers can be either directly picked and sequenced or stored. The parts can be shipped either to the intermediate storage or to the customer. In the intermediate storage or cross docking facility the parts after sequencing can be directly shipped to the customer or can be stored. In the customer's plant, the parts can be received in three different points: input storage, storage of the assembly plant or just-in-sequence storage.

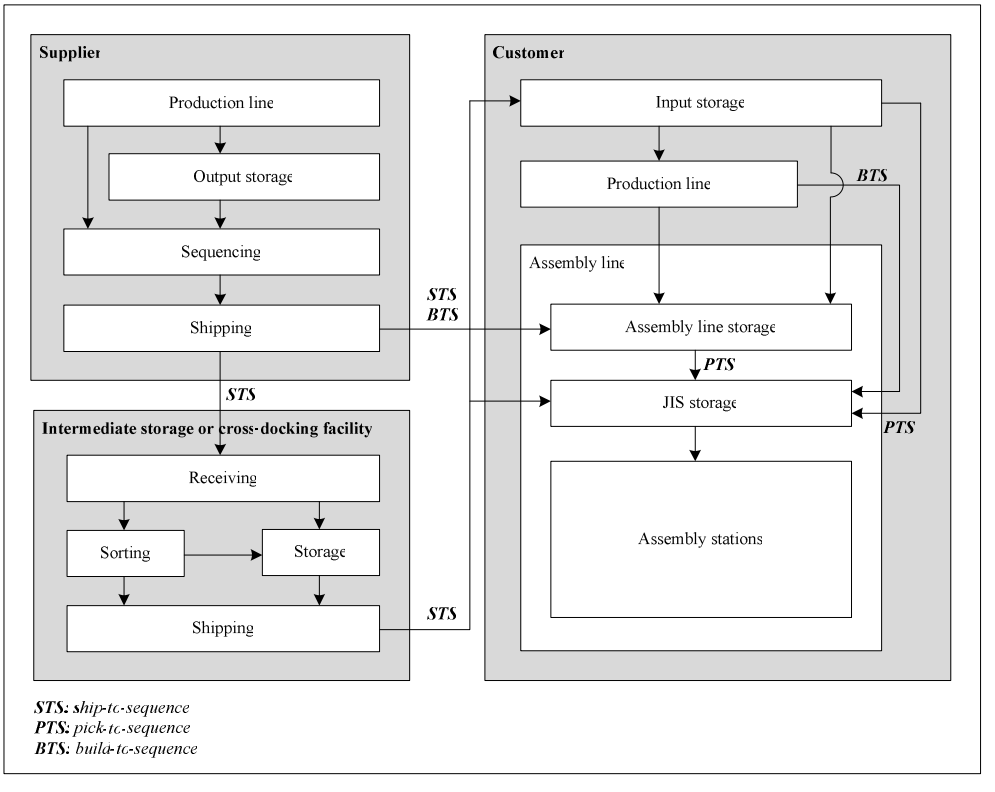

Figure 1. Multilevel cross docking supply

On the basis of this simple model, it is possible to analyse the build-to-sequence supply strategy. Figure 2 demonstrates 9 different build-to-sequence strategies, which have the following characteristic.

BTS1, BTS2: A very clear and short supply chain, the required parts are produced by the customer. In the optimal case, no storage is required; the produced parts can be transported directly to the just-in-sequence storage or to the store of the assembly plant. This supply is especially beneficial if the production is not outsourceable and the customer is able to produce the parts in the required sequence (it has the required know-how, resources, capacities and financial background). The costs of logistic operations are low,

but there are additional costs of supply, which are related to the required logistic operations of the production of parts.

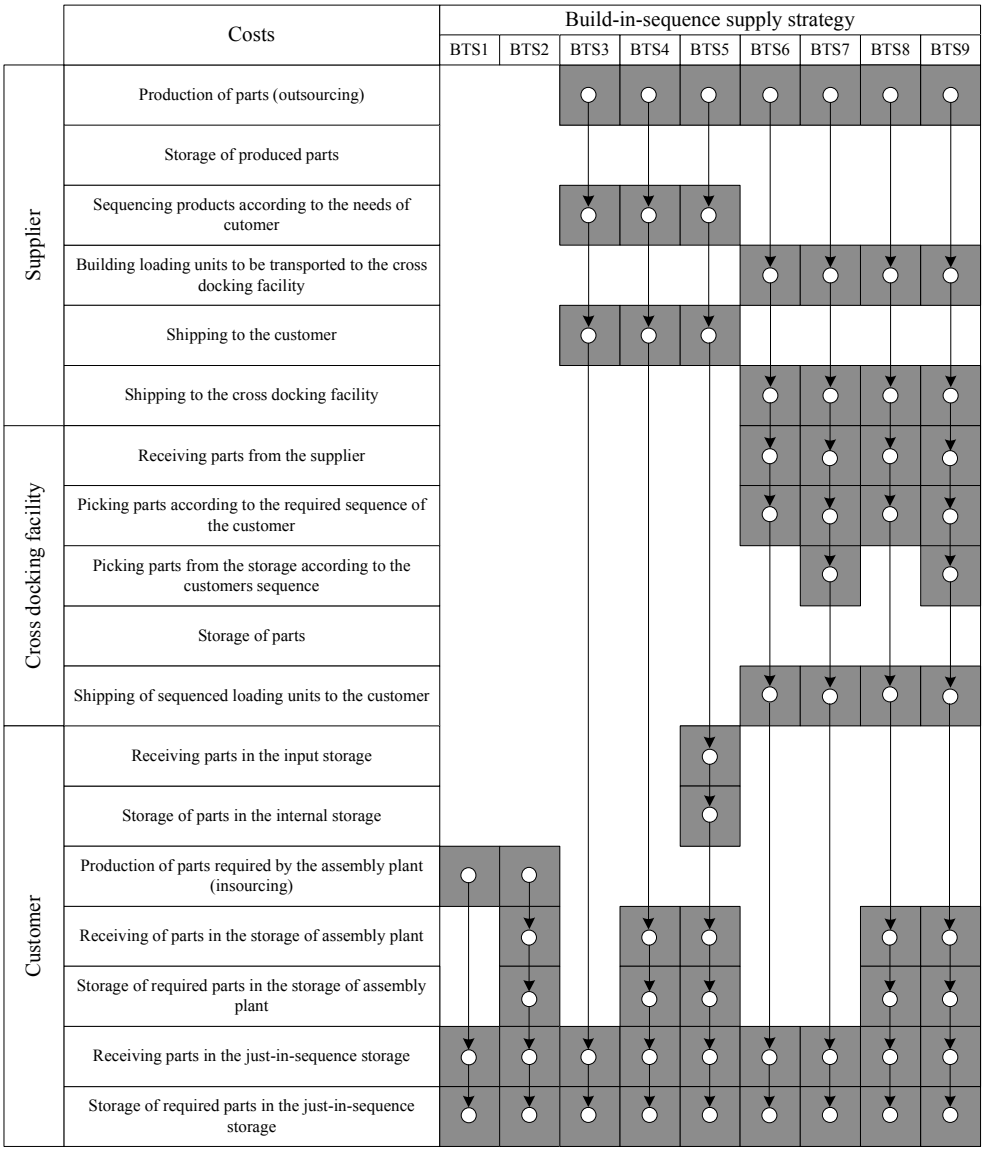

Figure 2. Cost components of build-to-sequence supply

BTS3, BTS4, BTS5: In these cases the production of parts can be outsourced, the required loading unit can be sequenced directly from the production line. The sequenced part can be shipped either to the input storage or to the storage of the assembly plant or to the just-in-sequence storage. This strategy can be used if the insourced production of parts is not possible and there is a supplier which is able to produce just-in-sequence.

BTS6, BTS7, BTS8, BTS9: In these cases parts are not produced just-in-sequence, they are shipped to a cross docking facility, where the sequenced loading units are picked. This strategy is a hybrid strategy, which has the characteristics of ship-to-sequence supply too.

The above mentioned build-to-sequence supply strategies require integrated data exchange, production segmentation and production synchronous purchasing, high availability of suppliers, horizontal and vertical integration of production and logistics operations.

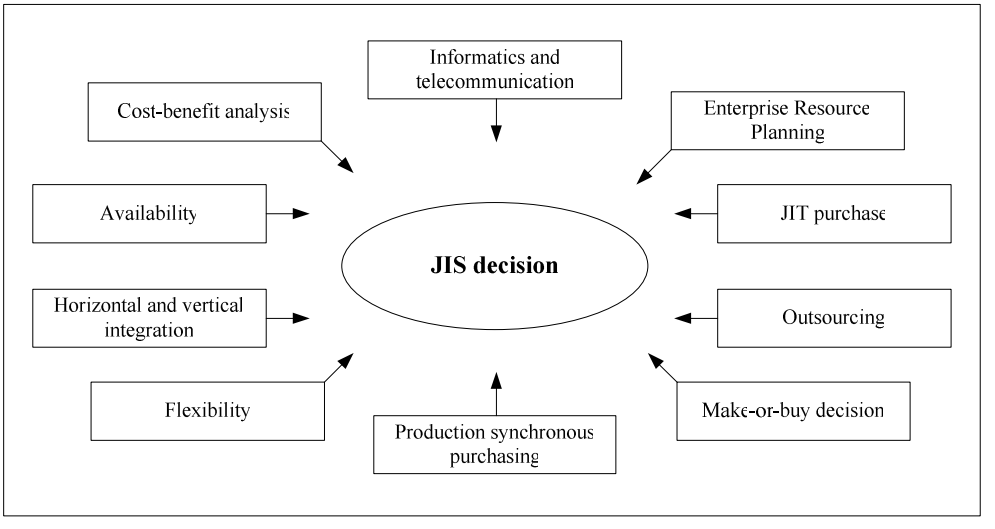

Figure 3. Influencing factors of just-in-sequence decision

The integrated data exchange means the use of integrated enterprise resource planning systems, which make it possible to assure the real time information flow among the partners of supply chain on different time windows. This real time information flow support the design and operation of production of parts and the scheduling of shipping from the suppliers through intermediate storages to the customers. The intermediate storages help to shift the stocks from the suppliers and customers out, but the just-in-time supply would be a basic requirement to the effective operation. The make-or-buy decision is another important part of the design process; the costs of the expensive just-in-sequence supply can be reduced by the aid of the definition of the important parts.

4. Summary

The aim of this research work was the description of build-to-sequence supply strategy. The author describes a general model of just-in-sequence supply including suppliers, intermediate storage facilities and customers. By the aid of this model different supply models were described. Future research direction can be the development of new supply models; the analysis of other just-in-sequence supply strategies and the development of an analytical method to study them.

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