

# Research on Inventory Control in Supply Chain Management Environment

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## Abstract

**With the rapid development of the economy, cost is becoming more and more prominent in the automobile manufacturing industry, and inventory is becoming an important link to reduce the cost of automobile manufacturing enterprises, and a more reasonable control of inventory can enhance the competitiveness of enterprises and create more profits for them. In this paper, we firstly introduce the inventory control in the supply chain environment, then analyze the overall status of inventory control in China's auto manufacturing industry, discuss the problems and causes, and finally analyze the conditions and methods of implementing zero inventory management in Toyota's production method, and propose solutions for the inventory control problems in China's auto manufacturing industry by combining Toyota's zero inventory management. In the end, we analyze the conditions and methods of implementing zero inventory management under Toyota production method, and propose solutions to the problems of inventory control in China's automobile manufacturing industry.**

## Keywords

**Inventory Control; Zero Inventory Management; Automobile Manufacturing Industry; Toyota Production System.**

## 1. Introduction

Inventory has the role of regulating production and sales. Once inventory control is not properly controlled, it can cause great loss to the enterprise. For a company, inventory control is about keeping inventory at a suitable level, which requires the company not to waste limited storage space by accumulating inventory, but also to maximize the market demand. Therefore, the key to inventory control is to use the most economical means to make the inventory meet the market demand and at the same time reduce the cost and improve the overall efficiency of the enterprise. Therefore, theoretically and practically, we need to find out the problems in the implementation of inventory control and propose solutions to strengthen the organizational management environment and help solve the negative effects of the lack of attention to inventory control, which is of great importance to promote the development of inventory circulation and improve the overall efficiency and effectiveness of enterprises.

Along with the ever-changing science and technology and the continuous influence of economic globalization, China's auto manufacturing industry is being suppressed and crowded out by more and more powerful competitors. In order to ensure a lasting competitive posture, companies must make thoughtful and optimal consideration of inventory costs.

However, for a long time, China's auto manufacturing companies have not been able to eradicate inventory, a problem that hinders the rapid development of the auto industry. Although many auto manufacturers have explored and learned from Toyota's zero inventory management, in practice, they have not achieved significant success in inventory control due to the lack of thorough knowledge and understanding of zero inventory. Therefore, an in-depth

discussion of zero inventory management under Toyota production method, combined with the problems and causes of inventory control in China's auto manufacturing industry, and the inspiration of inventory control in China's auto manufacturing industry according to Toyota's zero inventory management, can help enterprises reduce overall costs in the complicated competitive environment, improve their core competitiveness and accelerate the pace of going abroad.

## **2. Overview of Inventory Control Methods in a Supply Chain Management Environment**

### **2.1. Supply Chain**

The chain-like structure formed by the horizontal integration of suppliers, intermediaries and end markets is called the supply chain. It encompasses the functions and structures of the internal and external parts of the organization, which together form a value chain that provides goods and services to the market. In this chain, not only manufacturers and suppliers are covered, but also transporters, warehouses, distributors and markets. It is a kind of functional network chain that combines suppliers, manufacturers, distributors and the final market into an integrated body around the core enterprise, starting from the purchase of raw materials to the output of intermediate products and final products, and finally distributing goods to consumers through sales agents. It is a value-added chain that creates a comprehensive structure for the whole chain. It is a value-added chain that brings benefits to all the companies in the supply chain.

### **2.2. Inventory Control**

Goods in storage are called inventory, which is a concrete expression of storage. Inventory in a broader sense also refers to products in the production and transportation states. It is simply considered that inventory is the relevant products stored by a company for future sales.

In terms of properties, the inventory of an enterprise has two aspects: on the one hand, the prerequisite for the production and processing of an enterprise is to have an inventory, without which the implementation of the enterprise's production plan would be put on hold; on the other hand, the inventory becomes a liability for the production and circulation of the enterprise, because the enterprise not only has to pay a lot of expenses for the storage of goods, but also has to suffer from the troubles caused by the loss and damage of the inventory. Theoretically, inventory is a waste, but in reality, it cannot be avoided. Inventories exist between all parts of the business process and between all parts of the value chain of social and economic activities. It is the inventory that allows each link to be independent of each other's activities and makes the connection of each link and each sector a lubricant and a buffer. That is why it is said that inventory is the indispensable devil.

Traditional inventory management conceptually considers inventory as a security and inventory materials as a valuable asset of the company, as stipulated by the current corporate accounting standards. However, contemporary inventory management views inventory in normal operations as a waste and considers inventory materials as a burden to the business. Therefore, the management concept should emphasize the goal of zero inventory, hoping to further form a virtuous cycle of "reduce inventory → expose the problems of the whole system → improve the system → more complete system → further reduce inventory .....". The virtuous cycle. In short, inventory control is to achieve "customer satisfaction and cost minimization", i.e., to satisfy customers and minimize costs at the same time. In view of this, some inventory control methods and techniques are needed.

## 2.3. Methods and Evaluation of Inventory Control in Supply Chain Management Environment

### 2.3.1. Vendor Managed Inventory (VMI)

#### 1. Meaning of VMI

VMI is a cooperative inventory control model between suppliers and their partners, in which the supplier manages the user's inventory under a system that is negotiated with the partner in order to reduce the overall inventory cost. In addition, the supplier periodically monitors and corrects the system for continuous improvement purposes. In short, the idea of VMI is that the supplier builds inventory with the promise and help of the user, establishes inventory safety levels and inventory replenishment, and enjoys the rights of inventory control.

#### 2. Steps of VMI implementation

(1) Negotiate with the customer and obtain the cooperation intention of the other party. The supplier and the retailer negotiate and draft a contract, which covers ownership and transfer statute of limitations, credit terms, ordering terms, performance evaluation criteria, inventory levels, etc.

(2) Building a comprehensive information framework. In order to efficiently manage customers' inventories, suppliers need to be able to grasp the real needs of end customers at all times. In view of this, it is necessary to go through an information link that should have the function of interconnecting the point-of-sale systems of retailers and suppliers so that they can communicate with each other in a timely manner.

(3) Identify order processing steps and inventory control related data. The two parties should work together to confirm the information and inventory data used by the supplier to process customer orders, standardize the order processing, and unify the ordering, delivery, and invoice processing on the supplier side.

(4) Continuous improvement. In the process of supplier management of partner's inventory, both parties work together to identify boards that can continue to be improved, and continue to correct the target structure in the process to achieve continuous improvement. Promote sustainable development of both parties.

#### 3. Evaluation of the implementation of the VMI model

There are countless benefits of implementing VMI model, the most critical one is to reduce the adverse effects of "bullwhip effect". Under the VMI model, suppliers can collect the closest information to the end market through the retailer's POS system, and the strategy based on this can significantly reduce lead times and significantly improve service quality. In addition, suppliers can use VMI to reduce the instability of demand forecasts and better align production with distribution. In addition, it can provide a suitable opportunity to reinvent the retailer-supplier relationship.

There is no doubt that the VMI model will encounter some problems in the implementation process: the information system will take up a lot of investment; in addition, the process of sharing information between retailers and suppliers may have the potential for misuse and leakage of information. In this way, suppliers will shoulder more responsibilities than before and the cost will rise, so it is especially important to build a mechanism to allocate equal benefits and ensure the fair sharing of benefits.

### 2.3.2. Joint Managed Inventory (JMI)

#### Meaning of JMI

JMI is a new type of partnership in which all nodes of the supply chain cooperate together to highlight a win-win partnership. Unlike VMI, JMI emphasizes joint participation in the formulation of inventory strategies to ensure the consistency and effectiveness of information and forecasts among supply chain nodes, thus eliminating the "bullwhip effect". In this

management model, inventory control becomes the key to connect the two parties because the determination of commodity demand between neighboring nodes is the result of negotiation between them.

Implementation method of JMI

(1) Joint negotiation and unification of goals. To build a VMI model, it is necessary to ensure that both parties have the same goals. To do so, we need to identify the points of agreement and contradiction in market objectives, and through communication and negotiation, form a unified goal under the principle of seeking common ground while reserving differences and mutual benefit.

(2) Establish the main content of inventory control. The joint inventory management center is responsible for linking supply and demand and coordinating the interests of both. The effective operation of this coordinating controller depends on a clear division of labor and cooperation between the two. Before that, the main elements of inventory control must be determined, such as the coordination and distribution of inventory among different customers, maximum and minimum stock levels, safety stock levels, demand forecasting, etc.

(3) Create a platform for information sharing and communication. Through information transfer and sharing among supply chain node enterprises, it can improve the transparency of the whole supply chain and reduce the instability in the process of supply chain operation, to achieve the purpose of reducing the overall inventory quantity and improving the efficiency of logistics operation. In view of this, it is necessary to effectively use the advantages of network tools to build an advanced logistics information system.

(4) Construct a reasonable benefit distribution mechanism and incentive mechanism. To successfully implement JMI, it is necessary to construct a fair benefit distribution entry and reasonably distribute the benefits implemented through supply chain management among the supply chain member companies. In addition, a scientific incentive system can be adopted to give incentives to each enterprise involved in coordinated inventory management, so as to enhance the consistency and coordination of supply chain operation.

Evaluation of JMI

Compared with the previous inventory control, joint inventory management has the following advantages.

1. It ensures the synchronization and consistency of supply chain operations.
2. Reduces the impact of the "bullwhip effect" in the supply chain and makes the supply chain operation more reliable.
3. As a bridge between suppliers and customers, inventory directly discloses problems in the supplier management process and provides a factual basis for improving the continuous and effective operation of the supply chain.
4. it creates favorable conditions for the realization of zero inventory.

In order to bring the utility of JMI into play, both the supply and demand sides should take mutual benefit and win-win situation as the starting point, build a coordinated management program, establish the goals and responsibilities of both sides, build a channel for information communication, and propose more effective solutions for JMI control strategy.

### **2.3.3. Just-In-Time (JIT) Production**

#### **1. Meaning of JIT**

JIT means just-in-time in Chinese. The basic principle of JIT is to determine supply by demand, i.e., the supplier will deliver the goods to the designated place according to the variety, specification, quantity, time and place required by the demander. No more and no less, no earlier and no later, and the quality of the delivered materials must be guaranteed.

Implementation steps of JIT

JIT is a pull production method, i.e., reverse process, which starts with market demand and goes through: orders → components → accessories → parts and raw materials, and finally to

suppliers. the key point of JIT is that each link of the company cooperates with each other, minimizing the amount of inventory and effectively improving the overall production efficiency of the company.

## 2. Evaluation of JIT

The advantages of JIT are.

(1) Minimizing the amount of inventory, reducing the capital employed by the enterprise in terms of inventory, making the enterprise's capital turnover more flexible, and improving the enterprise's competitive vitality.

(2) The high operating cost of inventory in terms of distribution is cut because it is picked up on demand.

(3) Reduces the possibility of quality changes in inventory materials and products becoming unpopular with consumers due to obsolescence.

(4) Avoidance of sudden changes in demand that would prevent many inventory items from being distributed to the market.

(5) Reduces inspection and reworking time.

However, since JIT is designed to reduce the amount of inventory, it does not have any surplus inventory, except for the scattered inventory of products that are rebuilt due to poor quality. Thus, if a company makes a mistake at any point in the production organization process, there is no inventory available to remedy the situation; moreover, the manufacturer relies heavily on the suppliers who provide the materials to the manufacturer, and if the suppliers are unable to meet the deadline requested by the manufacturer, the manufacturer will not be able to produce according to the original production and processing plan. This disrupts the integrity of the entire production-shipment process. It causes irreparable loss.

## 3. Analysis of Inventory Control Problems in China's Automotive Manufacturing Industry under the Supply Chain Management Environment

### 3.1. The Current Situation of Inventory Control in China's Auto Manufacturing Industry

Along with the rapid development of the global economy and the intensifying market competition, exploring how to make enterprises enhance their core competitiveness and promote the coordinated and orderly development of enterprises in the face of many rivals has long been on the agenda of the head of enterprises. While the automobile manufacturing industry is making great contribution to our economy, we must consider the inventory cost of automobiles. Inventory cost in the operation of each automobile manufacturing enterprises in the prominent position cannot be overstated. The cost of inventory is inextricably linked to the purchase of large and small parts and the manufacturing and welding of each component. In view of this, companies are trying to control the inventory by all means.

However, at this stage, China's auto manufacturing industry has not yet made significant achievements in terms of a complete inventory control system, nor has it yet applied advanced concepts to explain the importance of inventory control. Most of the automobile manufacturing companies continue the traditional inventory control mode. However, this is not helpful to the long-term development of automobile manufacturing industry.

### 3.2. Problems of Inventory Control in China's Auto Manufacturing Industry

#### 3.2.1. Lack of Overall Concept of Supply Chain

Although the overall performance of the supply chain depends on the performance of the nodal enterprises in the chain, however, each node almost does its own thing and is independent, and there are unilaterally set goals and tasks. Some goals are set inconsistently with the supply



chain, and some are even contradictory. This kind of self-centered thinking is bound to bring trouble to the overall efficiency of the supply chain.

### **3.2.2. The Level of Information is not High**

In the supply chain, the forecast of the market, the condition of the warehouse and the production strategy are of extraordinary significance to each supply chain node enterprise. The information is scattered among these related enterprises, and the enterprises must pass the information all the time if they want to achieve an efficient response to the market needs. For this reason, changes need to be made to the information system of the supply chain, so that the inventory information in the supply chain can be shared out adequately, effectively and quickly. However, most domestic automotive manufacturing companies do not currently integrate the information systems they have, which inevitably results in delays and inaccurate information entries in the information systems. This results in a situation of information errors, which affects the accuracy of the calculation of inventory quantities.

### **3.2.3. Simplicity of Inventory Management Strategies**

Most of the companies are using the old single inventory control strategy, and the information they receive is mostly from within the organization, and the inventory control implemented under this strategy does not fully reveal the core idea of supply chain management. In addition, when a company uses a single inventory control strategy for all inventory, the uncertainty between supply and demand is not reflected in a simple classification. Therefore, how to develop an efficient inventory control strategy and reflect the core idea of supply chain has become the main content of supply chain inventory control.

### **3.2.4. Lack of Cooperation and Communication**

In order to cope with the uncertainty of market needs, the relevant nodes of the supply chain are equipped with appropriate safety stocks, although setting safety stocks is a conservative strategy for enterprises. However, in the globalized supply chain system, the unilateral coordination of enterprises involves many stakeholder organizations, and each enterprise has low information transparency. In the end, companies can only set safety stock at a high level, resulting in a low level of inventory control.

### **3.2.5. Incomplete Quality of Management Staff**

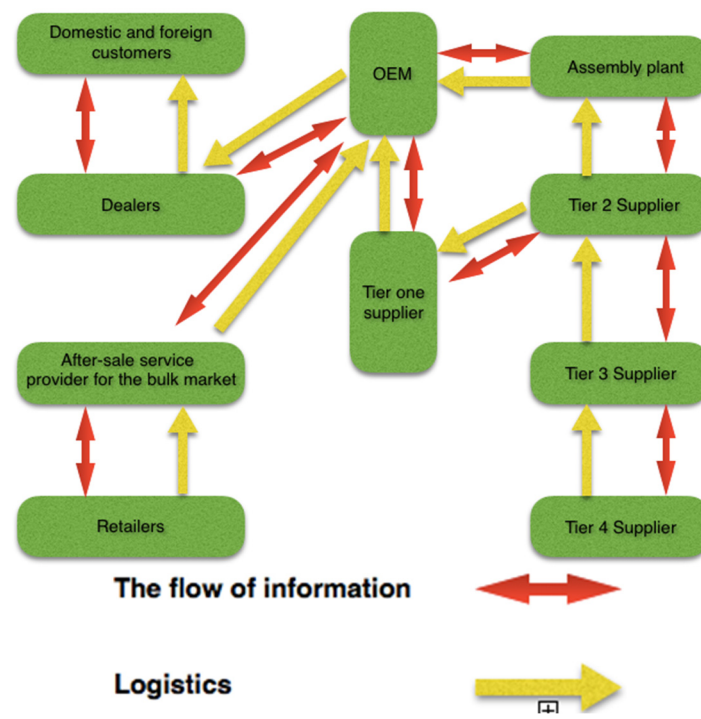
There are two goals of supply chain management, one is to reduce operation cost and the other is to improve service quality. However, in most domestic enterprises today, because most of their energy is spent on finding resources and markets, they do not put the improvement of service level in an important position. The reason for this is that the management staff's own management level is not high enough and their management quality is not comprehensive, and too much interest in the heart eventually leads to insufficient market response and low organizational evaluation, which makes it difficult to establish a strong competitiveness among many enterprises.

## **4. Toyota Zero Inventory Management based on Supply Chain**

### **4.1. Toyota's Supply Chain Management**

Toyota is able to penetrate its products into the European and American markets and form a fairly strong competitive advantage not only because of its customary sophisticated production processing forging methods, but also because of the many advanced production and management concepts implemented in its production and management, the management model adopted, the organizational system constructed, and the advanced corporate culture implemented in the supply chain system, known as "Toyota Production System". The establishment of this complete supply chain includes the following

Main points as well as steps:



**Fig 1.** A complete supply chain

In the operation of Toyota's supply chain, OEMs play a key role, and all logistics and information flows go through this important node, which is responsible for the design and development of new products, control of sales channels, and the design, distribution and production of complete vehicles using the technologies they have acquired. In addition, the four levels of suppliers have different focuses but are interlinked: the four levels of suppliers are at the uppermost level, supplying raw materials and production accessories to the three levels of suppliers downstream; the three levels of suppliers provide parts to the two levels of suppliers for processing and assembly; the two levels of suppliers provide key components for the system suppliers; and finally, the system suppliers provide complete systems for the vehicle manufacturers.

#### 4.2. Conditions for Toyota's Zero Inventory Management

As early as the end of last century, Toyota Motor Corporation in Japan has been advocating the management mode of zero inventory, and at the same time, more enterprises have emerged to implement the management mode of zero inventory. For China's auto manufacturers, it would be counterproductive to copy the traditional zero inventory management model. Because the implementation of zero inventory requires certain conditions and opportunities.

##### 4.2.1. 6S Management

6S management is the foundation of the Toyota Manufacturing System, which is a way to control and manage the manufacturing elements such as machines and materials in a production plant. It includes organization, tidying, cleaning, sanitation, safety, and literacy. They are not independent of each other, but rather a mutually inclusive relationship designed to ensure that each element of the production site exists in standard quantities. The main functions of implementation are: to separate the needed items from the unneeded ones clearly and distinctly through tidying, and to dispose of the unneeded items as soon as possible, to create a comfortable workplace, to ensure that the production plant is free of clutter, to greatly increase the effective space for operations, and to help increase work efficiency; to sort and distinguish the things left in the workplace after tidying, to count the quantities, and to mark them so that

The workplace can be clearly identified, reducing the time to search for items to achieve the purpose of shortening the work preparation time and process changeover time; through cleaning can effectively and timely find the malfunction in the machinery and equipment, and timely solve, to maintain and protect the accuracy and stability of production equipment purposes. The main purpose of cleaning is to protect the effect achieved by finishing, tidying and cleaning; safety is mainly through making the staff at the work site wear the appropriate protective clothing, and the use of fire, electricity and water are checked at all times in the factory to avoid leakage of electricity and water, and to take precautions against lightning to ensure the safety of the workers and avoid the loss of property; literacy requires employees to develop a spirit of self-discipline, and to consciously maintain this spirit. and consciously maintain this spirit. Through the implementation of thorough management, production efficiency can be effectively raised to a new level, and after the production efficiency reaches a certain level, which is able to meet the requirements of the enterprise at this time, it is possible to ensure rapid and on-time production, thus creating the conditions for achieving zero inventory.

#### **4.2.2. Total Quality Management**

Total quality management is the key condition for implementing zero inventory, because if one of the processes produces poor quality products, there will be no material for the next process, resulting in the undesirable result of having to stop production. If a company must stop production to prevent such poor-quality products, it must keep a certain amount of the material in stock, which is contradictory to the idea of zero inventory management. In addition, the frequent occurrence of poor-quality products can disrupt the entire production schedule and increase costs.

The previous quality management advocated post-production inspection, i.e., the product is processed to find out the qualified products and poor-quality products, for those poor-quality products that cannot be returned to the factory, usually because they cannot be sold out and cause the inventory backlog, in addition, the previous processing often to save too much raw materials and processed products inventory to cope with the appearance of defective products. In contrast, total quality management changes the post-processing inventory to pre-processing prevention, so that when a quality problem is found in a process, processing is automatically stopped and corrective measures are taken immediately. Because total quality management ensures that the items processed in each production process are problem-free, there is no need to keep too much stock of raw materials and processed goods in advance, thus reducing inventory and costs.

#### **4.2.3. Standardized Work**

Standardized work is an important element of the Toyota Manufacturing System, which determines the number of machines to be operated by one production personnel, and the processing sequence and processing method of production personnel within a limited period. It covers three main factors: processing beat, sequence of operations, and standard process reserve. Processing beat means how long it takes to produce a unit of product, i.e., how long it takes to process a task time node of a product; operation sequence means the process of multi-skilled operators operating several different machines at the same time, according to the time sequence. That is, the process of processors taking out raw materials, producing on the machine, taking them down after production, and then transporting them to the next equipment; standard process stock means the materials required to ensure the required processes within normal production, and includes the items being produced on the machine and equipment. Standard work becomes a necessary condition for the implementation of zero inventory management mainly in these aspects: First, the tempo of each processing process has been defined for each production employee's operating tempo, so all operators can neither be too



fast in order to catch up with the work, nor negative slack to keep up with the tempo, in this way, not only can prevent laziness, slackness and other phenomena, but also ensure that the operators can be in the specified This will prevent the workers from slacking off and slacking off, and ensure that the workers can complete the necessary tasks within the specified period. At the same time, it prevents some workers from having too much work in progress in one of the processes due to the confusion of the rhythm. Second, the sequence of operations specifies the time sequence of each work process, which prevents workers from starting another process after finishing a certain process, thus ensuring that each process in the entire processing line is carried out at the same time, thus achieving balanced production and preventing too much work in one process. Third, the standard process stock can also compress the processed goods inventory, so that each operation process only needs to hold the processed goods inventory according to the processing requirements between processes, which can ensure the smooth processing.

#### **4.2.4. Teamwork and Continuous Improvement**

The Toyota Production System is not only a series of theoretical methods and institutional principles, but also a symbol of organizational culture as the background for achieving zero inventory. In an organization, if there is no team culture of mutual help and continuous improvement, even if there are good methods and principles, even if there is some success, it is difficult to maintain this success. The contribution of this culture and spirit to achieving zero inventory is highlighted by the fact that at Toyota, veteran employees teach all the methods and skills they have learned to the newcomers. In the workplace, the relationship between the two is a clear student-teacher relationship, where the master can severely criticize the apprentice, and the apprentice will not be ashamed to ask the master for advice. In order to ensure the continuity of this relationship, Toyota has implemented a lifetime employment system in Japan. In Toyota's production system, most people are multi-skilled employees, for example, in the same production unit, when one of them appears too slow or some special conditions occur, other employees can help him to continue to complete the corresponding work, so that there is no excess of processed products produced by one of the processing processes.

The Toyota Production System is not a one-step process, but a long and continuous improvement process. Toyota's zero inventory is the result of this persistent improvement process, which reduces the amount of inventory by continuously identifying problems and eliminating waste. By continuously improving employee skills and work processes, the production preparation time can be reduced to a large extent, thus creating good conditions for achieving zero inventory by facing the ever-changing and complex market with higher efficiency.

#### **4.2.5. Supplier Partnership**

Toyota's zero inventory management is closely related to its suppliers. The reason why Toyota does not need to hold excessive inventory within the company is that Toyota's suppliers can deliver the specified goods to the corresponding workplaces within the specified period at the request of Toyota, which also creates good conditions for achieving zero inventory. This on-time delivery by Toyota's suppliers is attributed to Toyota's constant and regular procurement, so that the suppliers can be close to the construction of warehouses around Toyota and have the conditions to achieve small-lot and multi-batch supply in all aspects. In addition, Toyota will also sign long-term contracts with suppliers to keep the number of suppliers stable at a certain amount, so that they can grow and develop together with the company.

Toyota believes that a weak supplier may be able to provide good quality parts in real time and give price concessions, however, at some important moment, this weak supplier will always be out. Toyota and its suppliers build a strong trust between them and learn from each other Toyota Manufacturing System suppliers also develop a sense of total quality management

under Toyota's guidance to ensure that all parts they supply are free from quality problems, thus preventing the problem of inventory backlog caused by excessive purchases in response to the presence of inferior quality products in the procurement process.

### **4.3. Methods of Toyota Zero Inventory Management Implementation**

The above-mentioned conditions for the implementation of Toyota Zero Inventory are known to be implemented in the context of the Toyota Production System, therefore, the investigation of the methods for the implementation of Toyota Zero Inventory Management is focused on the strategies implemented by the Toyota Production System. The JIT model and the VMI model are mainly used.

#### **4.3.1. JIT Model**

##### **1. Pull production**

Under the Toyota Production System, pull production is an important means of implementing zero inventory. It's can combine the information of customer demand with the business within the organization, and the process of processing and the demand of the product depend on the customer demand. The pull production adopted by Toyota was inspired by the supermarket replenishment method in Europe and the United States, and it allows production to be determined by customer demand information. Under the pull-type production method, the processing task is handed over to the last process, and the process in the front process treats the process in the back process as the customer, and the product and output of the front process depend on the latter process; after the connection of the Kanban, the front process processes only the parts required by the latter process. With the pull-type production method, each process in the production system can produce parts within a limited period, which greatly reduces the excess inventory backlog caused by blind processing under the traditional push-type production method. In addition, since the previous process considers the subsequent process as its own customer throughout the production system, it ensures the quality of its own parts and prevents the backlog of inventory caused by defective parts. The pull production system also helps to ensure the flexibility of the entire production system by assigning processing tasks only to the last process. When customer demand changes, only the last process needs to be changed, so that the product can be quickly transferred. In contrast, in the push production method, processing starts from the first process and proceeds backward one by one. When customer demand changes and production is changed, the processed products from the completed process must be kept in stock; if production is not changed, the processed parts may not be able to meet the customer's order and may be kept in the form of finished goods inventory.

##### **2. Kanban Management**

Kanban management means that production is carried out according to the existing market demand, and the products produced can be sold immediately, so that they are produced and sold immediately. However, if demand cannot be determined, production cannot be started. In the previous section, Kanban management treats the back-end process as a customer, and the front-end process is allowed to produce only when the front-end process is requested by the back-end process. In this process, the Kanban serves as a delivery point for instructions. In this way, it is possible to effectively reduce the amount of inventory. In addition, Kanban management is flexible because it can control the production schedule and adjust the production plan at any time.

Through Kanban management, we can accurately produce according to the market needs, thus avoiding the backlog of materials due to overproduction; at the same time, Kanban can accurately and timely understand the delivery and shipment time, effectively reducing the waste of time and space, and greatly reducing inventory.

##### **3. Small batch production**

In the JIT model, each process is required to have no excessive work-in-process, i.e., the current production process is completed and immediately transferred to the next one. In contrast, conventional production emphasizes that parts are sent to the next process only when a certain number of parts are produced in each process. In this way, the materials produced in each process are piled up, resulting in a large amount of work-in-process. And during the production of the previous process, the latter process wastes time because the spare parts used for processing are not available in time, thus causing an extension of the overall processing cycle. Once the processing cycle is extended, it is not possible to quickly adapt to changes in the market, making the products produced directly into inventory.

Toyota has implemented "one stream" processing of small lots within the organization, solving the problems of excessive work-in-process and extended processing cycles caused by high-volume processing, where parts are processed and handled in a single process rather than in a uniform manner. This way, it is possible to ensure that the production of the previous product is completed before starting the production of the next product, thus avoiding inventory backlogs caused by excessive processing.

#### 4. Reduced job changeover time

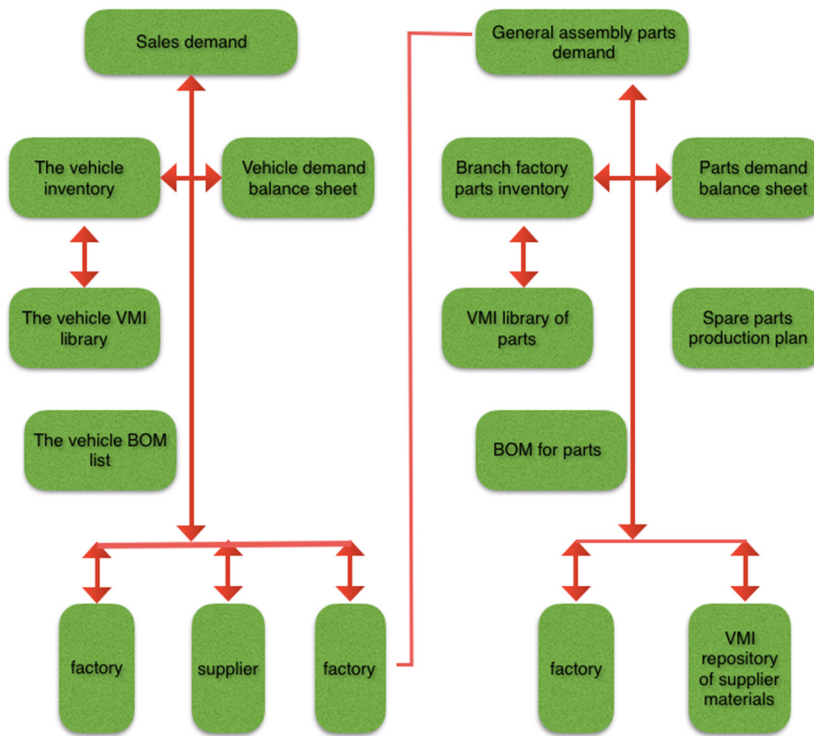
In the JIT model, small batches are processed in a balanced manner, but the frequency of job changeover becomes cumbersome and complicated, so reducing job changeover time is a particularly important factor. Job changeover time is the time required to complete the processing of one part to the completion of the next part, including auxiliary work such as changing product molds and machine inspection. Since these auxiliary tasks do not create value and waste production time, many companies have traditionally increased production batches to reduce changeover time. However, this practice of increasing production batches resulted in long production cycles, a single product range that did not meet the diversity of market demand, and a backlog of inventory due to overproduction of some products, increasing inventory costs. In view of this, Toyota created the Quick-Change Method, which allows all production equipment to be replaced and repaired in less than ten minutes. This method divides the work related to equipment replacement and refurbishment into external refurbishment and internal refurbishment. The external and internal dressing operations are strictly separated, and every effort is made to convert the internal dressing operations into external dressing operations in order to reduce the dressing time of the equipment.

When the dressing time of the equipment is shortened, the number of batches produced will be increased accordingly without any change in the total length of time, so that the lot size of processing can be reduced, thus reducing the inventory of work-in-process. And with the reduction of processing batches, both batch processing and unit product processing time are correspondingly shortened. The processing system in this case can largely meet the changing and demanding needs of the market and avoid causing inventory backlog.

#### 4.3.2. VMI Model

Toyota proposes the VMI management model based on rapid response and efficient customer response. As mentioned earlier, the basic idea of VMI is that suppliers and partners share the existing inventory and data, and replenish it according to the real consumption trend and replenishment plan. In this way, both companies abandon the traditional single forecast model and minimize the waste caused by the "bullwhip effect", thus reducing the overall cost of the supply chain.

Toyota specific implementation:



**Fig 2.** The model of VMI implementation in the company

Toyota, as the core company in this model, firstly asks the material supplier to implement the inventory management model of VMI for it, according to the demand of general assembly parts, issues the production plan of parts, submits the BOM order of parts, and the material supplier replenishes the inventory to it through the VMI library, and the finished parts arrive at the parts branch through transportation; secondly, according to the sales demand of cars for production, issues the BOM order required for the whole car BOM orders required for assembly, at this time, parts suppliers replenish the parts required for assembling cars for Toyota through the VMI library, and the assembled cars are transported to the complete vehicle depot, and finally the complete vehicle suppliers replenish the complete vehicle inventory for Toyota through the VMI library according to its demand.

By establishing VMI pools with different suppliers, Toyota gets help from upstream suppliers in terms of inventory, and as a result, information is shared between them, which greatly controls the occurrence of advance purchase and excess transportation, and ultimately reduces the overall inventory volume in the supply chain.

## 5. Conclusion

Inventory has long been a key factor in the development of manufacturing companies, and excessive inventory not only leads to increased costs, but also hides problems in the production process. At present, the methods and techniques of inventory control in China's automotive manufacturing companies are not high. Although some enterprises are also learning zero inventory management, but want to try to reach zero inventory state, as mentioned before, zero inventory is not a quick fix, cannot be rigidly applied, need to start according to their own situation, even if they cannot do zero inventory state, but also can try to reduce the inventory of the enterprise.

Through the above research analysis, the main conclusions of this paper are.

(1) In the supply chain environment, more emphasis is placed on organizational alliance and system optimization. In this emerging environment, China's automobile manufacturing

enterprises must implement and follow the integrated inventory control methods and principles, and realize the overall optimization of inventory control by gradually strengthening the information sharing and collaboration among enterprises.

(2) The realization of Toyota's zero inventory has its rationality. The benefits of zero inventory for Toyota in Japan are greater than the costs, so it is necessary for Chinese auto manufacturers to learn from zero inventory management.

(3) The realization of Toyota's zero inventory has its own conditions. These conditions include 6S management, total quality management, standardized operations and other 5 aspects. In order to successfully implement zero inventory, companies should measure whether they have these conditions.

(4) Toyota has its own method to achieve zero inventory. Toyota uses the JIT model and VMI model in the process of achieving zero inventory. Among them, the JIT model includes pull production, Kanban management, small batch production and shortened job changeover time. The author believes that in the supply chain management environment, after learning this continuous improvement idea from Toyota, China's auto manufacturing companies can effectively solve the problems in inventory control, and continuously improve the inventory management level of the enterprise, and finally approach zero inventory infinitely.

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