

Applications of Lean Logistics on Engine Manufacturing Planning

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ABSTRACT

Lean logistics is an application of lean manufacturing principles. The core of lean logistics is to eliminate all non-value-added activities (waste) within productions, movements and storages. It reduces lead time, cuts cost, and improves quality. In order to be competitive, enterprises in western countries widely use lean manufacturing and logistics principles in automotive industries, especially for engine manufacturing system due to its high contents of assembly work. However, in China, lean logistics and its applications are fairly new to many companies. This article analyzes the current status of lean logistics in engine manufacturing in China, summarizes lean logistics principles, put forwards application of lean logistics principles based on a real case study of a new manufacturing system planning. In details, origins of the lean logistics are introduced, characteristics of engine manufacturing logistics are outlined, requirements of the lean logistics system are proposed, PFEP (Plan for Every Part) methodology is used, and packaging specifications are analyzed. This article also describes and analyzes supply chain logistics, warehouse storage, information system and production line logistics. Milk Run and Super Market concepts are applied in logistics planning of the manufacturing system.

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INTRODUCTION

As China becomes a member of the World Trade Organization at the beginning of 21st century, the Chinese domestic market becomes a part of the world market. The competitions in both markets are getting fierce. Enterprises are under the pressure of cost, delivery time, and quality. Logistics, the third profit source besides material consumption reduction and productivity improvement, becomes a focus and an increasing point of economic development. Therefore, enterprises should have effective lean logistics systems in order to improve overall economical efficiency.

Lean logistics is an application of lean manufacturing in logistics management. The core value of lean logistics is to eliminate all non-value-added activities, including inventory and storage. Implementations of lean logistics will not only lower the production cost, it teaches enterprise to think lean and to live lean [1]. Nowadays, the concept of lean logistics is blooming in China, but how to implement it into planning phases of a new engine plant is still being developed.

1. LEAN LOGISTICS IN ENGINE MANUFACTURING

1.1. Contents of Lean Logistics

The origin of lean logistics is a lean thinking from Toyota. The core value of lean logistics is to eliminate all non-value-added activities including inventory and storage. Many management

methods are developed according to the core value. Lean logistics is derived from lean manufacturing, and it is an application of lean manufacturing in logistics management [2]. Lean logistics maintains the following aspects:

1. Focuses on customer requirements, and eliminating non-value-added activities;
2. Analyzes every section in product designing, manufacturing and ordering for non-value-added activities;
3. Creates action plans based on principles of no-interruption, no-recurring, no-backwards, no-waiting and no-scraping;
4. Creates only customer driven value-added activities promptly.
5. Eliminates discovered non-value-added activities immediately for perfection.

1.2. Characteristics of Logistics in Engine Manufacturing

Because of the variation and non-predictability of market requirements, tight delivery time required by customers, most modern engine plants apply flexible production line in order to produce engines of different capacities and different types. Therefore, most modern engine plants are characterized as: large category, difficult to maintain the Bills of Material, wide range of material properties, dimensions and weights, short cycle time and difficult to delivery products. This article

explains these characteristics of logistics in engine manufacturing using a real case study of an engine plant in China.

1.2.1. Various Market Demands, Unstable Plan, and Difficult Inventory control.

The variation of market demands make it difficult to maintain a stable plan of supply chain (including production plans of machining line and assembly line). Look at the up-stream and down-stream of engine supply chain, the variation will also affect the inventory of vehicle plant and suppliers in all levels.

In order to keep the relative stability between customer demands and production, engine plant should prepare reasonable storage at every section of a production line. Inventory is the main analyzing object of lean manufacturing, and the goal is to set reasonable and flexible inventory for every section of the production line.

1.2.2. Wide Range of Components, Complex Structures.

As the power source, engine is the heart of a vehicle. Structures of engines are complex. Generally an engine consists of more than 200 components. The variation of components leads to the difficulty to maintain the Bill of Material. There are wide ranges of material properties, such as no-metal washers, metal standard components. Dimension variation of the components is large. For example, the volume of sealing ball for an engine is only 1 mm³, whereas the volume of the cylinder block in that engine can be as large as 750000 mm³. Consequently, it is difficult to unify the form and size of packaging. There are various weights in quite different scales of engine components. For example, the weight of a cup of an engine block is only 1g, whereas the weight of cylinder block is 42000g. Different weights of components affect the types of equipments, materials of packaging and methods of delivery.

1.2.3. Strict Requirements of Cleanliness, no Paper Boxes on the Production Line are Allowed.

Study shows that there is a significant correlation between the engine performance and the assembly process. In order to meet the cleanliness requirements of assembly line, no paper boxes are allowed on the production line.

2. PRINCIPLES OF LEAN LOGISTICS

Six principles of lean logistics are applied in logistics planning and management:

2.1. Principle of Lean Packaging

Recyclable container is the first choice in selection of packaging. Lean packaging is achieved through the design of standardization, serialization, flexibility, and unification.

2.2. Principle of Lean Purchasing

Purchase takes place in a fixed period and fixed batch size to guarantee the balance supplies of the components.

2.3. Principle of Lean Supplying

Fixed delivery mode, route, delivery window, receiving dock should be used to achieve multiple categories and small batch size supply.

2.4. Principle of Lean Storage

Layout of storage area should be optimized according to the requirement of production line. IT information system should be used to achieve effective picking and delivery.

2.5. Principle of Lean Pull System

The components are supplied onto the production line by pull system. Every part should be planned (Plan For Every Part, or PFEP) to ensure effective flow of the part.

2.6. Principle of Visual Factory

Factory takes visual markers to improve the efficiency of work, and to reduce the defect rate of product.

3. APPLICATION OF LEAN MANUFACTURING IN LOGISTICS PLANNING

Generally, logistics planning consists of specifications of component packaging, logistics of supply, storage, production, sales and IT system. Lean logistics follows Line Back Principle, which is from work station to factory warehouse, and then to suppliers. Materials information is transmitted by pull system, to cut cost, to reduce lead time, and to achieve lean logistics. The workflow is shown in [Figure 1](#).

PFEP list is the basic tool for the application of lean logistics. To meet the requirement of lean manufacturing in logistics system planning, PFEP is used in the industry [3]. PFEP is the standardized list for material flow. It specifies the management standards of every section in material flow. [Table 1](#) contains basic information of components, storage, delivery and packaging.

This article introduces the application of lean logistic in packaging specification, supply logistics, storage logistics, production logistics and IT system according to the priority of logistics business and planning.