THE USE OF INTRALOGISTIC SYSTEMS IN THE ENTERPRISE

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Abstract

In the era of Industry 4.0, most enterprises strive for optimising production. While eliminating waste and implementing lean manufacturing tools, Just-in-Time concept or Kanban system in the manufacturing processes, it is worth considering the aspect of internal transport within the plant. This paper presents the possibilities of transport optimisation by using intralogistic solutions. Implementing the Milk Run concept, combined with the means of transport used for handling of various raw materials and product components, may be a step towards cost optimisation. This publication describes the possibility of using a logistic train and the benefits of its implementation in comparison to the most common means of internal transport within the manufacturing plant - forklift truck.

Keywords: Milk Run, intralogistics, Just-in-Time, lean, transport, management

1. INTRODUCTION

The major goal of every organisation is to gain profit [1]. Facing the constantly increasing requirements of customers, companies offer a variety of tailored products, keeping high quality standards. Additionally, organisations bear the costs of implementation and maintenance of quality management systems in order to confirm the standards with a proper certificate, that is used in many cases as a benchmark in evaluation of a potential supplier. Enterprises improve the quality of their services intending to offer a right product, at a right time and price, which quite often entails reduction of production costs. Today's organisations, aware of the purpose of their existence, invest in streamlining and optimisation of performed processes, improving the supply chain management element, integrating processes and exchange of information [2,3]. That goal is fulfilled, among others, by the implementation of lean management tools, focused on proper workplace organisation, reducing machine set-up time, preventive maintenance and incorporating the quality component in the performed processes, eliminating waste of resources. In many cases, the production process is completely lean, and possibilities of improvement should be identified in other areas. *Muda* lists seven possible loss sources: overproduction, excessive inventory, quality faults, waste of waiting, overprocessing, unnecessary workers motion and unnecessary transport [4,5]. The last two elements are highly challenging for most organisations.

Route optimisation methods are often used when goods are shipped from A to B location at large distances, however internal transport has a great improvement potential in this aspect [6]. Supplying internal recipients just in time, at a right place, could mean high integration of processes, involving other lean methods adopted in the organisation [7-9]. One of the possible solutions might be the use of a logistic train instead of the commonly used forklift trucks. This paper presents the possibilities of implementation of intralogistic solutions in combination with the Milk Run concept, lists related benefits, contains a comparative analysis of means of internal transport within the plant and indicates further development possibilities, with focus on automation of internal logistic processes.

2. THE MILK RUN CONCEPT COMPLEMENTS THE LEAN APPROACH

Recently, a growing trend of business interest in the lean management concept has been noticed. Increased popularity is followed by the benefits from the implementation of lean tools, including increased flexibility,

savings and possibility to adjust product prices without the loss of quality. Lean management is not limited to implementation of popular tools, but it also concerns proper approach and planning the supply of resources necessary for production Just-in-Time.

The pull production system (Kanban) forces adjustment of precise deliveries, eliminating excessive inventory [10]. This approach entails the necessity of more frequent deliveries, in smaller product lots, corresponding to the current demand and consistent with the current production process. One of the methods used by companies that order precise amounts of goods according to the 7R principle, to eliminate waste and gain economic benefits, is the Milk Run [11].

The Milk Run concept encompasses a transport network in which a single vehicle arrives at all stations to take input and output materials (I/O), according to a prearranged schedule. According to that principle, a given means of transport receives various materials from different suppliers, based on the demand. This concept works well at every stage of the logistic chain (supply, manufacturing, distribution and recycling). It can be used outside and inside the manufacturing plant, involving the procedures of raw material supply, end product supply, waste management, receipt and delivery of input and output components and empty containers between production stations, assembly stations and the warehouse [7,12,13].

Production based on the Kanban pull system requires precisely adjusted supplies, so that no excessive inventory or other losses that may occur in traditionally planned production are generated. It means that supplies are frequent, but consist of smaller batches of goods, delivered just in time. In order to meet these requirements, and to gain economic benefits, supplies are performed according to the so-called Milk Run scheme. The benefits of following the Milk Run concept include reduction in transport costs, due to consolidation, improved delivery of goods Just-in-Time as a result of synchronising orders necessary at a given time and at particular work stations, shortening the total distance of transport. Frequent deliveries of smaller volumes are followed by an increase in flexibility of enterprises, that are able to respond faster to the needs of their customers [7].

The implementation of the Milk Run concept, as well as its results, have been described by Xu (2003), who presented the developed distribution routes and schedules reflecting the everyday needs of Shanghai GM. The implementation of the Milk Run approach had been followed by saving 30 percent of warehousing space. More frequent deliveries, consistent with the demand, allow organisations to order resources that are necessary for the production, reducing warehousing costs. An additional benefit had been the reduction of the length of routes and increased usage of resources [9].

During the financial crisis in China, Xu and Han (2010) analysed the relations of logistics and the production industry. The financial crisis, being an important period for structural economy and industry restructuring, forced producers to cooperate with logistic companies to overcome the current obstacles. The Milk Run method has been implemented, and after the analysis of its practical use, it has been found that the costs of inventory decreased due to timeliness of deliveries. Planning of routes resulted in the reduction of transport costs to 67.5 percent [8].

The cases analysed in the literature indicate the benefits of the Milk Run approach implementation, including improved efficiency of transport processes, reduction of inventory-related costs, reduction of warehousing spaces and shortening the routes [14-16]. Michael and Claudia (2009) have been studying the use of the Milk Run concept inside the organisations, in transport of stocks to production lines. In a single transport activity, routes have been introduced to supply several stages of a performed cycle. Bundling the routes leads to increasing the frequency of deliveries to the production lines. Increased frequency of deliveries has a positive effect on reducing the stocks at particular work stations. The implementation of this concept allows to optimise the use of transport equipment, which in turn leads to a reduction in the transport costs [17]. However, the means of transport used for relocating various batches of materials needed at individual work stations or

assembly stations within the organisation, as well as determining the optimum route and frequency of deliveries are of key importance.

3. TRANSPORT OPTIMISATION WITHIN THE ORGANISATON

In every organisation, properly analysed and optimised supply chain management, generating high efficiency with low cost of delivery, may contribute to gaining competitive advantage. Order and supply system should be effective and efficient, allowing to ensure smoothness of performed processes, preventing delays in delivery or even stoppages of entire production lines. The effect of the continuity of performed processes is the reduction of the basic product prices, which is reflected in increased profit.

Enterprises seek and implement solutions that are Lean Management tools, allowing to produce faster and cheaper. In order to ensure effective and agile material management, every organisation needs a well-organised logistics that guarantees efficient functioning of the manufacturing system. Reorganising is worth considering in this field, leading to improvement of raw materials and end product circulation, due to its direct effect on maximising general operating revenue [18]. The methods derived from the Toyota manufacturing system, most often implemented in organisations, relate to manufacturing stations, machinery or devices. Systematic elimination of waste, in form of excessive inventory, inefficient usage of resources, unplanned stoppages, may be also supported by good organisation of the transport system within the plant.

Proper selection of logistic infrastructure has effect on the speed of circulation, maintaining proper product quality and degree of efficiency of logistic processes. In the economic aspect, transport should be characterised by the shortest path to the destination and maximum usage of available means of transport, with the lowest possible degree of wear. Taking into account the definitions specified above, as well as the lean management concept, the use of logistic trains instead of popular forklift trucks should be considered.

A logistic train is one of the Lean Manufacturing tools, based on determining a proper route passed by the means of transport in specific time intervals, performing a number of unloading and loading procedures (resources, materials, components, end products, empty packages), with reduced number of empty trips. The route is most often arranged according to the Milk Run concept. Combining this rule and the use of a logistic train, due to higher frequency of deliveries, ensures that minimum inventory is kept at the manufacturing stations. Additionally, synchronising the transport and deliveries of components allow to use minimum amount of transport vehicles by using as many trailers as it is required [19]. **Figure 1** presents a sample logistic train with two trailers.

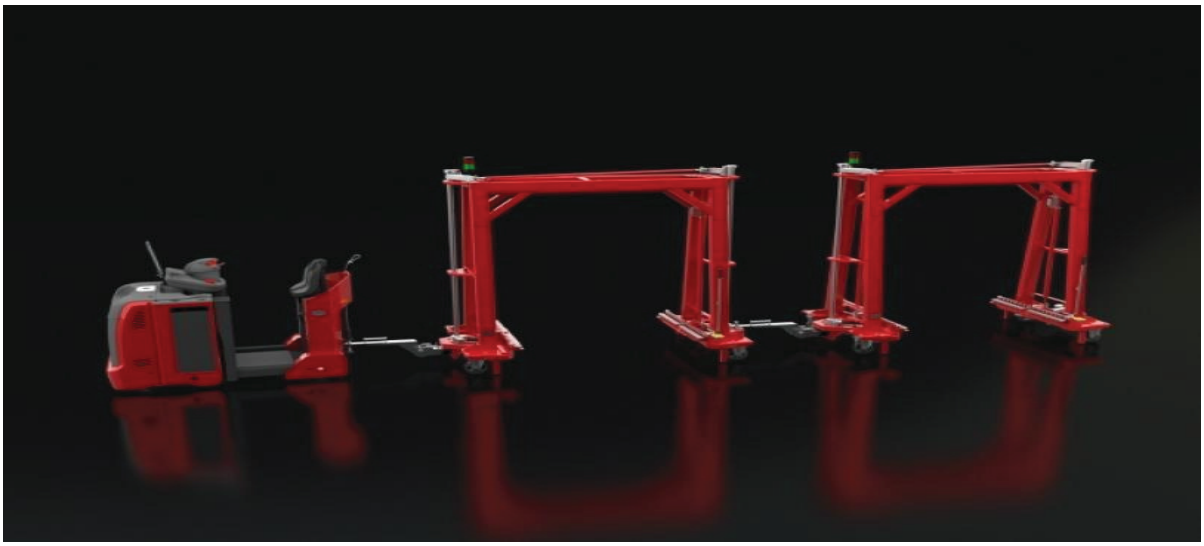

Figure 1 Logistic train example [21]

The purpose of the logistic train is to deliver specific materials according to the request submitted to the warehouse, moving along a specific route, in particular time intervals. Raw material or components request can be linked to the Kanban system, that determines a proper amount of materials required at a given work station, submitting the request in form of charts or Kanban containers [20].

Currently, manufacturers can use simulation software, such as Flexim or Enterprise Dynamics, that allows to input an actually performed process and conduct a simulation of using a logistic train and its effect on the efficiency and functioning of the organisation. With input of appropriate parameters, such software allows to perform a real-time comparison of operation of forklift trucks and a logistic train and also compare the efficiency of these two means of transport within a plant. **Table 1** presents a comparison of a standard forklift truck and the Wamech intralogistic train with E-liner platforms [21].

The comparison published on the website of a supplier of intralogistic trains with platforms (Wamech) illustrates the use of both means of transport. In terms of placing goods on warehouse racks, time of loading and unloading of lorries, forklift trucks are still irreplaceable. However, a regular forklift truck used with intensive circulation of materials, on an extensive production line, may be 2.5 to 5 times less effective than the logistic train [21]. Performing a single transport cycle using the logistic train allows to handle more materials, replacing several forklift trucks required to perform the same task. Additionally, this solution is a perfect complement of the Kanban system. Platforms (trailers) are adjusted to the characteristics of a given organisation, which allows to handle materials in required quantities and size, without being limited to transporting pallets. Another feature is flexibility - possibility to use the logistic train to deliver materials to manufacturing stations and also to receive empty packages [6]. The most important aspect of implementation of logistic trains is increased work safety, which is confirmed by the trend of eliminating forklift trucks from production areas [20].

Table 1 Comparison of parameters of internal transport performed with a forklift truck and an intralogistic train [22]

	STANDARD FORKLIFT TRUCK	INTRALOGISIC TRAIN WITH E-LINER PLATFORMS
Maximum capacity	2000 kg	5000 kg
Number of 1200x1000 pallets that can be carried in a single trip	1 pallet	5 pallets
Route - transport of 5 pallets, 1000kg each, from a to b location, at a distance of 1km	10km route 5km empty trip	2km route 1km empty trip
Time - transport of 5 pallets, 1000kg each, from a to b location, at a distance of 1km	40 minutes - forklift truck speed 15km/h	12 minutes - train speed 10km/h

The internal supply scheme entails a number of challenges related with optimisation of route planning, receipt sites or creating supermarkets. The pull system, Kanban and Just-in-Time complement each other perfectly in combination with the use of the logistic train and a route set according to the Milk Run concept. The use of the logistic train conforms to the Kaizen concept in terms of delivery time reduction and route shortening through the possibility to deliver more materials than using a standard forklift truck.

KLE Group has performed a comparative analysis of forklift truck and logistic train efficiency. The results are presented in **Figure 2**. The comparison is based on the total distance of travel required to deliver the same quantity of materials.

The results of a survey performed with 44 organisations in Poland indicate that 59.09 percent of them implement the Milk Run concept, out of which 52.57 percent use the logistic train for that purpose. Among the

analysed entities, the most significant group are large enterprises, followed by very large, small and medium enterprises [19]. The survey results indicate that intralogistic systems are used in all organisations, irrespective of their size. The awareness and willingness to change are highly important in the selection of the logistic train.

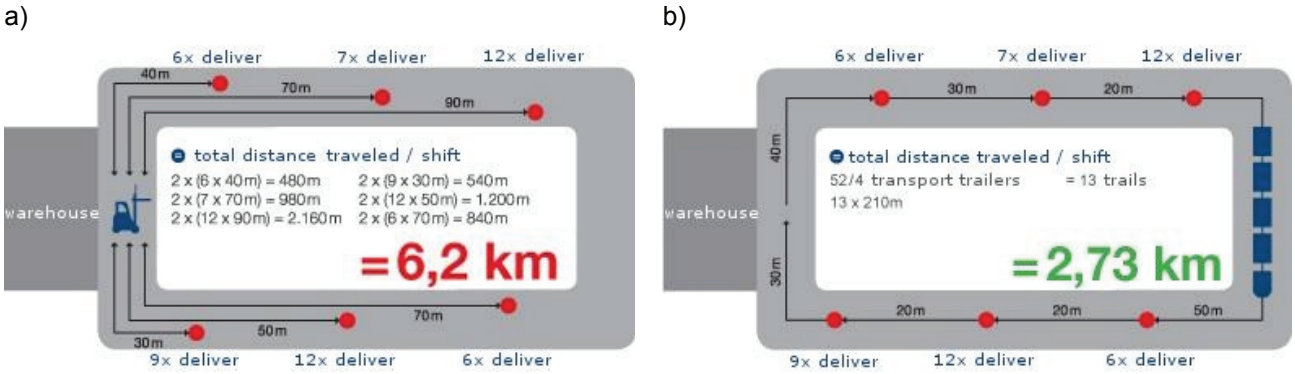

Figure 2 Comparison of total distance of travel in case of a) using regular means of transport, b) using a logistic train [23]

Currently, in the era of digitalisation, it is hard to imagine a supply chain organisation without intensive exchange of information. Using the available technologies, it is desirable to combine the implemented solutions with the possibility of quick responding to the market demands and process management [7]. Logistic trains can be additionally equipped with real-time locating systems (RTLS), which allows to gather and report data, track location, determine access to zones and control process fulfilment. The logistic train and trailers may also be connected to commissioning and completion systems. Automated Guided Vehicles (AGV) or Laser Guided Vehicles (LGV) are also available on the market [21,24]. Currently, the market offers a number of possible solutions adjusted to the specificity of the organisation, thus it is advisable to consider and analyse the scheme of internal transport within the enterprise.

4. CONCLUSIONON

Every enterprise aware of the need of improvement optimises its production processes. The relation of internal supplies of materials and component and the efficiency of production or assembly lines is worth analysing. The major components of overall costs of production are logistic costs, therefore supply chain management is of key importance. The implementation of intralogistic systems, such as logistic trains, along with setting optimum routes, based on the Milk Run and similar concepts, may be one of the possible solutions resulting in improving the efficiency of the entire organisation. Considering the current trends related with customised production, workflow systems that can be adapted dynamically and ensure cost reduction, facilitate adjustment to Industry 4.0.

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