Manufacturing and Logistics Information Systems

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INTRODUCTION

Logistics information systems (LIS) are specially designed to support all elements of logistics processes, including coordination of logistics activities, material flow, and inventory replenishment (Douglas M. Lambert, 1998). By necessity, this involves a combination of hardware and software in addition to supporting data exchange and capturing technologies, supported over the interconnected manufacturing and logistics phases between different companies by specialised manufacturing and logistics information systems (MLISs). It is recognised that overall supply chain performance can be improved by using information technology (IT) and while many firms have enabled transactional processing, they still request improvements to enable IT to support improved planning and decision-support applications (Sundarakani, Tan, & Over, 2012). They have been used by both specific firms, as well as being a core enabler for many third-party logistics (3PL) firms to whom other companies outsource their logistics requirements (Srivastava & Wood, 2011).

This article examines individual elements of MLIS (relating to identification, warehouse management systems, transport management systems, quality management, information exchange, and enterprise resource planning (ERP) systems) and its key use to both capture and process transactions and support improved decision making. This is aided by the resurgence of interest in Radio Frequency Identification (RFID) technologies to support identification and tracking of inventory. Finally, we examine the weaknesses and challenges of MLIS and discuss future trends and approaches that will offer value in the near future.

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BACKGROUND

Effective management of the movement of physical goods largely rests on the ability to rapidly and easily identify what a particular physical item is. Thus, the ability to identify and track physical items and record movements becomes crucial to the success of a MLIS.

Identification Systems

Firms have developed many approaches to tracking and management of the movement of goods. Identification of materials is crucial in three main logistics processes: (1) the tracking and handling of materials during logistics processes, (2) the tracking and consolidation components or packages from multiple parties including third Party Logistics (3PLs) providers, and (3) the monitoring and handling of materials at point of sale (POS) in the retail environment. Initial attempts to identify inventory related to providing an identification code to different batches, which may take the form of a physically adhered label with a job or batch number written on it.

In contrast, barcode technology translates the identification number into machine-readable graphical representations (Figure 1). These can be interpreted using an optical reading device that captures the image, extracts the information, and converts it into useable data (i.e., unique identification number). It improves the speed and accuracy of reading labels and identifying items and reduces error rates. The technology supports picking orders, tracking orders and materials, and as part of the loading/unloading process (Shamsuzzoha, Ehrs, Addo-Tenkorang, Nguyen, & Helo, 2013). The

Figure 1. Examples of three different barcode formats

disadvantage of barcodes is the mandatory visibility of the code.

RFID (Radio Frequency Identification) does not require visibility or alignment as identification is transmitted by radio signals and does not need a line of sight. Tags also encode more information than barcodes, supporting the manufacturing/logistics process (e.g., update of manufacturing details). They can be used on items, boxes, pallets, vehicles, or animals; as well as with people when considering tracking systems in airports (RFIDs in board passes can coordinate passenger flows and identification to minimise waiting times or delays of planes). RFID technology enables firms to monitor and manage the freshness (or deterioration) of products. By knowing the state of inventories, delivery times, or whereabouts of items in transit or transportation (Pahl, 2011) firms can increase product visibility and process transparency, and use integrated and automated data capture (Liu, Tang, and Huang, 2008). The disadvantage of increased cost for the tags is compensated by several benefits; e.g. simultaneously reading every item in a pallet; faster scanning process; recording sensor data (e.g., humidity, temperature); and improved response and traceability capabilities. Effective use requires significant investment in infrastructure to support the introduction and implementation of a continuous tracking of RFID tags. Moreover, there is no globally accepted RFID standard.

Low-cost RFID tags can be integrated in labels during their production. However, GPS tags require an integrated source of energy to send their position to the controlling system with every movement. Thus, GPS tags are generally used in items of high value or which have a power source (e.g., vehicles or cooling containers). Another option for GPS usage is in combination with barcodes or RFID, where information about the materials come from the tags and the location from GPS devices installed in the transportation vehicles; thus increasing the accuracy of all information without the overhead of an infrastructure. Examples for such systems can be found in airline management (Reiners et al., 2012) or container depots (Ngai, Cheng, Au, & Lai, 2007).

Logistics Information Systems

LIS can be configured to work in different scenarios and often support warehousing and transport management by optimising processes and tracking locations and inventory movements. The LIS acts as a transactional system attempting to capture all information changes and material movements such that it is accessible to all stakeholders at all times. Figure 2 provides an overview of MLIS components.

Warehouse Management System

Warehouse Management Systems (WMS) support the management of the warehouse, particularly the flow of materials (incoming, storage, internal movement, and dispatching), monitoring of the progress, and the communication between stakeholders in the system. Users of WMS can receive and see relevant information on computer terminals about allocated tasks and locations of materials. The tasks are optimised, managed, and assigned by a central controlling and management system. A common task in a warehouse is to pick up a requested pallet and move it (or parts of it) to a new location. The tracking of each step can be done by (automatically) scanning barcodes; i.e., barcodes on the shelf to report the location, barcodes of each removed item to verify that it is the correct material and to keep accurate stock counts. If the pallet is transported completely, only the barcode of the pallet should be scanned as the WMS keeps track of pallet-material-associations. The process is repeated at the destination and at all intermediate stations. Hidden

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