MERGE-IN-TRANSIT(MiT) RETAILING: RAPID FULFILLMENT, MASS CUSTOMIZATION, AND POSTPONEMENT

Oliverio Cruz-Mejía[1], Eliseo Vilalta-Perdomo[2], Mario Monsreal[3]
Universidad Autónoma del Estado de México, México
University of Lincoln, UK
Texas A&M University, USA
Email: ocruzm@uaemex.mx ; evilaltaperdomo@lincoln.ac.uk ; m-monsreal@tti.tamu.edu

Abstract

Purpose: The paper discusses the links between Rapid Fulfilment, Mass Customization, and Postponement in the light of Merge-In-Transit Retailing. The value offering of MiT can be exploited only if this operational strategies can be understood for implementation.

Research Approach: The paper reviews concepts in the literature of highly regarded journals in Logistics, SCM, Operations Management to build a conceptual framework framing MiT and the supporting concepts.

Findings and Originality: With the explosion of on-line retailing in the last decade a deeper understanding of MiT is required for it evolution in the practical feel. So far limited work has been published on MiT and their operational supporting strategies.

Research Impact: The paper contributed in the deeper understanding the logistics under the Internet Retailing therefore his impact is promising.

Practical Impact: Managers and people in charge in the design and operations of logistics systems supporting internet retailing can find this paper of interest as the fourth linked concepts have not been yet discussed together.

Introduction

Merge-in-Transit (MiT) is a logistics process introduced in practice at the end of the 1990s (see Table 1. Merge-in-Transit is defined as a distribution process that brings together at a consolidation center multi-product order components, coming from different origins, consolidates them into a single order, and then ships it for final delivery to the end customer. See Figure 3 for a graphical description of the process.

Company	Introduction of MIT (Year)	Business sector
Cisco Systems	1997	Telecommunications
Sun Microsystems	1997	Computers
Lucent Technologies	1997	Telecommunications
Dell Computers	1998	Computers
Micron Computers	1998	Computers
Ericsson	1999	Telecommunications

Table1 Business Sector and Year-of Introduction of MiT Distribution

Sources: O'Leary, D 2000a. and 2000b, Hoffman, K. C. 1998

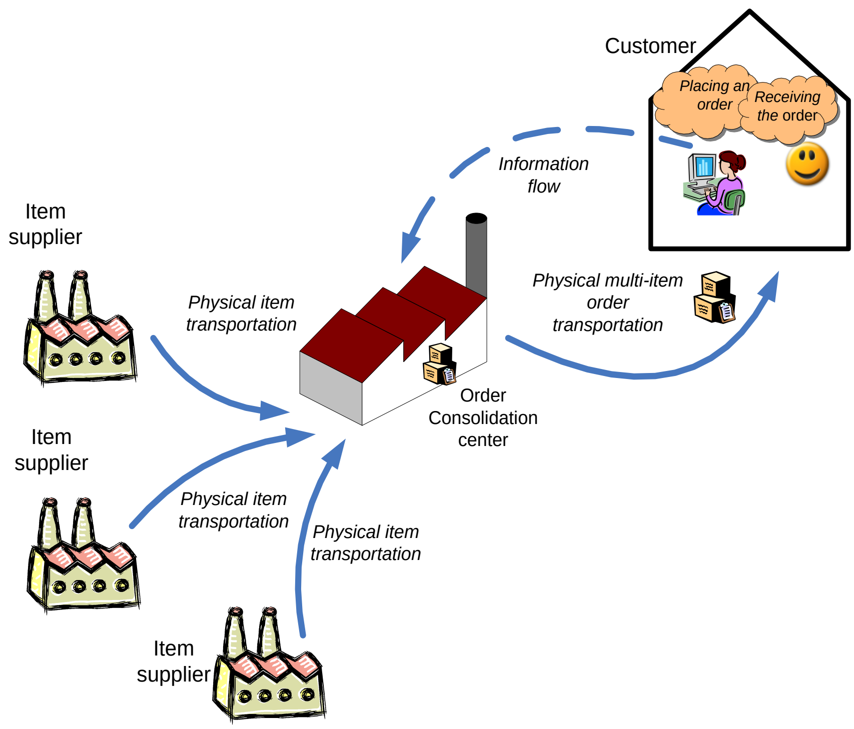

Figure 3 Typical MiT Transit Distribution Operation

Some of the advantages obtained with MiT are:

- Higher customer satisfaction is obtained by delivering multi-product orders in one event instead of making more than one delivery, one for each component or partial group of them.

- Savings are achieved by not keeping inventories in the distribution process; since merge-in-transit centers just hold order components for a short time (usually less than 24 hours) so the order is all the way in transit to its final delivery point. Holding costs associated with warehousing operations are avoided or at least minimized.

- Third, savings also arise by avoiding the risk of keeping obsolete inventories. MiT is normally applied to distribute orders where at least one component has been made-to-order. Those tailored components have been made for a specific need and are never kept in stock so there is no risk of keeping obsolete components (Ala-Risku et al., 2003).

However, this distribution principle can truly deliver its benefits only if a sophisticated information system backs up the operation of MiT. Manufacturers merge centers and delivery equipment must be linked with advanced information systems to ensure that all pickups and deliveries are made within the required time windows **(Simchi-Levi et al., 2000).**

Otto and Chung (2000) developed a comparative table (Table 2) of potential advantages and disadvantages registered between Internet Retailing and traditional Physical Retailing.

	Online retailing	*Physical retailing*
Inventory selection	+	-
Order tracking for products assemble-to-order	+	-
Market area size	+	-
Touch and feel	-	+
Purchase price comparison	+	-
24 hrs. shopping	+	-
Personal service	-	+
Multi-item consolidated delivery	+	-
Immediacy	-	+

Customer equipment Requirements	-	+
Receipt of product	-	+

Table ¡Error! No hay texto con el estilo especificado en el documento.**.2: Advantages and Disadvantages between Online Retailing and traditional Physical Retailing**

Adapted from Otto and Chung, 2000

Note: '-' represents 'disadvantage' while '+' represents 'advantage'

However, some of the disadvantages that Online Retailing has can be offset by the use of Merge-in-Transit product delivery programs. We next discuss some of these advantages.

- Convenience in payment. When multi-item purchasing is required by a customer, having the convenience of paying for the group of items in a single transaction can be appreciated by customers. This means that there is a single payment from the customer to the retailer. This feature can save time to customers as they do not need to repeatedly key in payment details such as delivery address, credit card number and purchase security data as examples. This feature is well used by retailers like Amazon, as an example, that allows customers to select products to purchase in more than one visit to their web portal to later purchase them in a group of items. O'Leary (2000a) has addressed this advantage also but in the context of saving paperwork processing and invoicing time, savings that deal with the convenience for the retailer side.
- Saving in transportation. Shipping a group of items to the same location allows consolidation of the transportation operation. Transportation consolidation is a well-established practice by transportation companies to realize economies of scale and therefore savings. These savings for carriers can be translated into savings in delivery fees to multi-item shoppers. Some online retailers have been successful offering the charge of delivery fees in a "per order" policy rather than a "per product" policy. This strategy has been an incentive to buy online and reduce delivery costs.
- Convenience of receiving an order. Receiving orders of products purchased online can be problematic to customers that find it difficult to receive deliveries any time during the day. This issue becomes worse when the purchase is multi-items as the problem of having unattended deliveries is multiplied. The consolidation of transportation allows the consolidation of receiving operations into one delivery and potentially a higher customer

satisfaction. This is the way that unattended deliveries can be potentially reduced by MiT programs.

Bayles (2001) points out that payment processing, order fulfillment, product delivery, and other back-end logistics represent the messiest parts of e-commerce but they are also the most crucial challenges in building customer satisfaction and customer loyalty.

Another distribution principle that does not generate inventories is Crossdocking. Sometimes MiT is confused with crossdocking. In both, there are intermediate coordination points called merge-in–transit centers and crossdocking centers for each case. In a typical Crossdocking system, goods arrive into crossdocking centers from the manufacturer, then are transferred to vehicles serving the retailers and finally are delivered to retailers as rapidly as possible. Both MiT and crossdocking minimize inventory costs and decrease lead times by avoiding storage time. However they are applied in different environments:

- Customers: MiT is used to satisfy end customers and no retailers are involved. Crossdocking is used to distribute products from manufacturers to retailers.
- Nature of the product: MiT is applied to multi-product orders, which consolidate independent shipments in one delivery to end customers. Products are normally made-to-order and with high obsolescence costs. Crossdocking is used in high consumption products for which continued replenishment to a retailer is needed. Crossdocking is used mainly in products with stable demand.
- Main goals: MiT focuses on delivering made-to-order product orders with very high customer satisfaction on the delivery while Crossdocking is basically interested in minimizing the holding and handling costs by removing intermediate distribution warehouses.

Literature Review

The amount of academic papers reflecting research work in MiT distribution has been limited. MiT has been in use since 1997 in the distribution industry (O'Leary, 2000a; Hoffman, 1998). Kopczac (1995) was first on aborting the Study of MiT when analized the partnership of manufacturers with 3PL and supply chain restructuring . A logistics partnership is seen as the process of making strategic alliances of manufacturers with logistics service providers (FedEx, Excel, UPS, etc.) while supply chain restructuring is the reengineering of the organizational functions in the supply chain. MiT is used as an example of a distribution system that requires a strongly linked operational partnership between a manufacturer and a logistic service provider. Analytical models focusing on the trade-off between inventory holding cost, planned shipment lead-time, and on-time delivery, given stochastic shipment times are used to build conclusions.

Cole and Parthasarathy (1998) develops a linear programming model to design optimal MiT distribution networks and a decision support system for the same purpose. The model considers MiT costs simultaneously with production, warehousing and inventory costs. Experimentla variables of the model include location, type of merge points, selection of transportation channels, and allocation of customers and retailers to merge points. In the DSS, users interact with a geographic information system (GIS) which functions as a user interface. The interface has access to the database and runs the optimization model to finally call the solver.

Croxton et al. (2003) develop integer programming formulations and solution methods for addressing operational issues in MiT distribution. The models account for features including the integration of inventory and transportation decisions, the dynamic and multimodal component of MiT distribution and the specific structure of particular cost functions that arise in MiT. In particular the paper tries to find which merge centre to use in a trade-off between what can appear best for different merging components. For example, while one MiT centre might be optimal for a given component (if it is in a direct line between the source and the customer), it might be less costly to merge the order at another MiT centre that is closer to the source for some of the other components.

Ala-Risku et al. (2003) develops a guideline for logistics managers on how to evaluate the applicability of MiT operations for their particular business situation. This paper presents a systematic procedure for the evaluation of MiT distribution in a specific supply chain. The procedure is based on activity-based costing models for distribution operations. The paper includes a structured approach to define whether MiT is suitable for a business considering the nature of the product, current distribution costs, profitability of changing to MiT, capabilities of current information systems and lastly a feasibility study is presented.

Karkkainen et al. (2003) present a description of differences between MiT and crossdocking from the point of view of how operations are carried out in merging points and cross docks respectively, customer service implications and suitability for different business sectors. Additionally, the effects of MiT distribution on delivery costs are examined in a maintenance and repair distributor as a case study in Finland. The costing model used four attributes to calculate the distribution cost of a delivery: location of suppliers, number of orders per supplier, weight per shipment and location of the customer.

Brewer et al. (1999) argue that Intelligent Tracking Technologies (including global positioning systems (GPS), geographic information systems (GIS), wireless telecommunications, and radio frequency identification (RFID)) have the potential to contribute to improvements in manufacturing and to the entire supply chain. From orders of raw materials and sub-assemblies through product assembly, testing, and distribution, intelligent tracking technologies offer opportunities for increased efficiencies and improved customer service.

In O'Leary (2000a), Merge-in-Transit is investigated as an approach for reengineering, warehouse and billing processes for electronic commerce. MiT is defined and examples are given to illustrate its use. Processes necessary to accomplish MiT are developed, while advantages and disadvantages of Merge in Transit are studied. The paper also provides examples of successful implementations of MiT. The central part of the paper consists of comparing the traditional process flow for handling multi-item orders with a MiT approach. An interesting element of O'Leary's work is the inclusion of the simplification in the purchase order management and invoices handling. It is clear that MiT reduces the number of purchase orders and invoices handled due to the consolidation. This is a factor that simplifies back office operations with impact on office efficiency and operating costs.

Rao et al. (1999) provide a detailed retrospective look at how Third Party Logistics (3PL) companies capitalize on the rise of electronic commerce. Rao et al. argue that by integrating virtual-world information technology and electronic commerce capabilities with real-world physical delivery of products through air and ground transportation network, global 3PL companies exploit the new opportunities emerging in the digital economy.

Operations Management Strategies and MiT

MiT is an alternative way to physically deliver multi-item orders to customers as it relies on fundamental principles from the theory of Operations Management. This section introduces each of them and provides a discussion about how this benefits retailers and customers.

Postponement

Bucklin (1965) was first to talk about Postponement. It was defined as a strategy to speculate with the delay of operations activities (i.e. inventory holding, assembly, and manufacturing) in the distribution channel to reduce cost and deal with competitive forces. The concept has changed over time as the needs of the markets change. van Hoek (2001) analyses Postponement in a more contemporary context and developed a comprehensive analysis that reflects the evolution of the concept. Postponement remains as a speculative strategy to delay operations but the objectives have changed and will continue to change as markets evolve.

In MiT distribution, the assembly of the customer needs in a purchase order is delayed and only put together or assembled when the multi-item order needs are informed to the retailer in the form of a customer order. Multi-item orders could have been preassembled or put together with anticipation but possibly it can lead to unwanted costs or the expected demand of multi-item orders may be estimated wrongly.

MiT also has implicit Postponement as it speculates in the geographic dispersion of potential customers. MiT distribution systems are designed to fulfil the multi-item needs of a geographical region within the same country and sometimes more than one country (Hammond, 2005). Once the delivery location wanted by the customer is identified, it is defined the optimal location for the consolidation based on item availability, sourcing and taking into consideration also the minimization of transportation costs to provide acceptable delivery times.

<u>Mass Customization</u>

Mass customization refers to a customer co-design process of products and services which meet the needs of each individual customer with regard to certain product features. All operations are performed within a fixed solution space, characterized by stable but still flexible and responsive processes. As a result, the costs associated with customization allow for a price level that does not imply a switch to an upper market segment (Piller, 2005). Mass Customization has at its core a tremendous increase in variety and customization without a corresponding increase in costs providing strategic advantage and economic value (Pine II 1999).

Some new concepts emerged as consequence of Mass Customization realization. One of them is the development of some sub classifications within Mass Customization. Make-to-Order products (MTO) products is the term used to define the products that were made under the needs of a specific customer. A working definition of the differences between (MTO) products, Make-to-Stock (MTS) and Assemble-to-Order (ATO) products can be drawn from table 2 proposed by Vollmann et al. (2004).

Task	MTO	MTS	ATO
Information	Product specifications	Provide forecast	Configuration management

Planning	Provide engineering capacity	Project Inventory levels	Determine delivery dates
Control	Adjust capacity to customer needs	Assure customer service levels	Meet delivery dates
Sales and Operations Planning	Demand forecasts, engineering detail	Demand forecast	Demand forecasts, product family mix
Master Production Scheduling	Final configuration	Actual demands	Mix forecast, actual demands
Customers	Design status, delivery date.	Next inventory replenishment	Configuration issues, delivery date.

Table 2 Characteristics for MTO, MTS and ATO

MiT distribution allows the co-design mentioned by Piller (2005) in different forms. One is the configuration of products ATO where customers normally have access to web applications that allow the selection of features in the ATO contained in the multi-item order (Cruz-Mejia and Eglese, 2005). The second form is slightly more abstract. In the case of a multi-item order, the need of the customer is integrated for the election of multiple items; they can be all MTS products or a combination of MTS products and ATO products. MiT, by its capacity to integrate multiple items in a single order, is able to deliver a "multi-product need" that is co-designed in the selection process among the items available.

Quick Response Operations

Quick response supply chains are the evolution of the quick response manufacturing strategy developed by Japanese companies in the 1980s. This strategy is also known as time-based competition (TBC). Quick response supply chains rely on the use of speed to gain competitive advantage (Suri, 1998). A supply chain under quick response operation is able to deliver products and services faster than its competitors. Lead time analysis is a key performance indicator in Quick Response Supply Chains. Christopher et al. (2004) provide the following quote to describe quick response supply chains:

> *"The ability to respond to customers' requirements on a time basis has always been a fundamental element of the marketing concept. However, there has perhaps never been as much pressure as exists today to accelerate further the responsiveness of marketing systems. Time*

based competition has become the norm in many markets from banking to automobiles. The challenge to marketing and logistics in the current environment is to find ways in which product development times can be reduced, feedback from marketplace made more rapid and replenishment times compressed"

MiT distribution not only implements mass customization and postponement strategies but it is also able to compress delivery times to customers. Companies like Dell Computers and Cisco Systems mentiones in the introduction are examples of organizations running quick response operations. Lead times in those organizations are well controlled and customers, when they consider purchasing a computer system, already know that they will be able to have a customized computer system within a reasonable delivery time. At the time of purchase, customers placing an order at Dell computers are given an estimated delivery time. This estimated delivery time is normally the tardiest they can realize under stable conditions of operation in their supply chain. Normally Dell Computers deliver items earlier than the date they communicate in their estimate, bringing a sensation of high satisfaction to their customers.

Quick response supply chains are time sensitive in the whole range of processes involved in the delivery of multi-item orders. In the capacity analysis of suppliers is important, to consider how they will react in the case of high fluctuations of demand, as an example. The Quick response operations that allow MiT to deliver short lead times on the delivery is heavily supported by the use of information systems within the organization.

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