Computers in Industry 81 (2016) 105–115

Contents lists available at ScienceDirect

Computers in Industry

journal homepage: www.elsevier.com/locate/compind

Intelligent logistics: Involving the customer

Duncan McFarlane *, Vaggelis Giannikas, Wenrong Lu

Institute for Manufacturing, University of Cambridge, 17 Charles Babbage Road, Cambridge CB3 0FS, United Kingdom

ARTICLE INFO

Article history:
Received 7 June 2015
Received in revised form 9 August 2015
Accepted 9 October 2015
Available online 11 January 2016

Keywords:
Intelligent logistics
Customer orientation
System requirements

ABSTRACT

The role of logistics in effective supply chain management is increasingly critical, and researchers and practitioners have recently focused their attention in designing more intelligent systems to address today's challenges. In this paper, we focus on one such challenge concerning improving the role of the customer in logistics operations. In particular, we identify specific developments in the systems governing core logistics operations, which will enhance the customer experience. This paper proposes a conceptual model for customer orientation in intelligent logistics and describes a number of specific developments the authors are involved in.

1. Introduction

This paper concerns the introduction of new logistics technologies, systems and practices to improve logistics processes. We are specifically concerned with improving the role of the customer in logistics as part of these developments. This can relate—for example—to improving the ability for a customer to customise and/or change an order or for the customer to be able to expedite an order if it has been faced with unexpected delays. In this section we provide some general background to the challenges modern logistics is facing and outline a general framework for addressing these challenges. We then identify those areas that are specifically "customer-oriented" and focus the reminder of the paper on this. This paper focuses on distribution logistics although some of the remarks made are also applicable to other logistics functions such as production logistics and procurement.

1.1. The problem

Logistics is increasingly identified as a core element of supply chain management [1] yet it is also subject to an increasing number of challenges which require changes to existing operating practices. Some of these key challenges are:

1. Business efficiency: Increasing focus on "leaner" in industrial supply chains to reduce cost and waste and improve delivery performance. Main effects are to reduce inventory being held and to shift towards Just In Time (JIT) delivery models [2].
2. Uncertain operating environment: Congested transportation routes and complex access leading to uncertainties in collection and delivery times [3].
3. Needs of individual customers: Customers are also demanding the option to change orders after submission, both in terms of order composition and delivery options [4].
4. Market variability and changes: Rise of internet shopping and with it direct purchase from supplier warehouses, increased ranges on offer, vastly increased numbers of small orders, demanding delivery times with guarantees [5].

These challenges are complex and at times are also conflicting. Meeting each of these challenges requires considerable efforts of the part of the logistics provider, and—referring to Fig. 1—the provider must be:

- Cost-effective—able to provide services at a competitive pricing level.
- Robust/resilient—able to absorb disruptions such as delivery delays, employee absences, incorrect order preparation, etc.
- Customer-oriented—able to anticipate and respond to the changing customer base and the changing needs of customers.
- Adaptable—able to change logistics priorities rapidly without due cost increases.

As is indicated by the diagram, these four requirements should not be seen to be stand alone but rather integrated. For example, cost effectiveness critically affects the ability of a logistics provider to be adaptable, resilient and customer-oriented. Further, in order

* Corresponding author.
E-mail addresses: dcm@eng.cam.ac.uk (D. McFarlane), eg366@eng.cam.ac.uk (V. Giannikas), wl296@eng.cam.ac.uk (W. Lu).

http://dx.doi.org/10.1016/j.compind.2015.10.002
0166-3615/

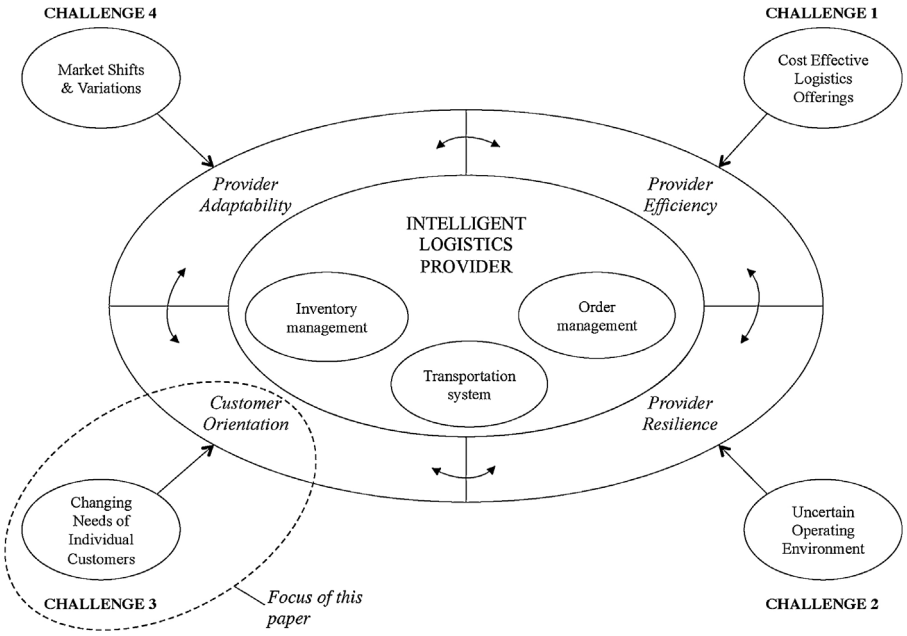

Fig. 1. Meeting today's logistics challenges.

to achieve these capabilities, logistics providers are also seeking to provide more integrated services in which the core operations of order management, inventory management and transportation are seamlessly tied together [1,6]. As in these references, we limit our view of logistics in this paper to those physical operations directly linked to order fulfilment.

1.2. The approach

The approach to be taken in this paper is to develop a simple conceptual model which combines the requirements for customer orientation in logistics with the current development areas in intelligent logistics. The paper then uses this model to identify specific developments in the core logistics operations, which will enhance the customer logistics experience. The aim of the diagram in Fig. 1 is to illustrate that—while it is possible to associate a particular challenge with one of the provider properties—in reality they are all intertwined. For example, the ability of a provider to manage deliveries in an uncertain transportation environment significantly affects his responsiveness to changing needs of individual customers. Hence, although this paper is focussed on Customer Orientation in logistics it is noted that it is rather artificial to separate this challenge from the others. Further, the implication of taking an "Intelligent logistics" approach to achieving greater customer orientation is that much of the developments will arise from improved information management and computer-based decision support.

1.3. The paper

This paper is structured as follows: in Section 2 the backdrop to this work on customer oriented logistics is provided. Perspectives from both academic literature and industrial practice are provided. Then in Section 3 we outline a simple, conceptual model for customer orientation in intelligent logistics, identifying specific systems developments needed to fully achieve customer-oriented intelligent logistics (COIL). Section 4 then describes a number of specific developments the authors are involved in which address aspects of the COIL agenda. The final concluding section then summarises what is still missing in the field and provides next steps.

2. Background

2.1. Overview

In this section, we will review academic and industrial developments related to intelligent logistics and particularly those aspects of intelligent logistics concerned with customer-orientation.

The academic literature will be examined from the point of view of intelligent logistics generally, and also the development of customer-orientated practices. We also review aspects of logistics research relating to adaptability and resilience because these directly link to the ability of a logistics provider to support customer orientation. Similarly we broadly review industrial developments relating to these themes noting that the ICT support for logistics and its ability to flexibility adapt is critical to addressing the challenges mentioned in Section 1. We conclude the section by identifying opportunities to improve current logistics practices.

2.2. Academic literature

2.2.1. Intelligent logistics

Even though the term *intelligent* or *smart* appears very often in the logistics, and more broadly in the supply chain management literature, there is no widely acceptable definition for the notion intelligent logistics. In the related literature, the terms *intelligent logistics* or *smart logistics* are often used to refer to different logistics operations (inventory, transport or order management) which are planned, managed or controlled in a more intelligent way compared to conventional solutions. Moreover, the type and level of the intelligence varies among applications and methods, ranging from product tracking and environmental sensing, to problem recognition and automatic decision making and execution.

Nevertheless, there is a number of approaches which aim to improve logistics systems by making them more intelligent: autonomous logistics [7], product intelligence [8], intelligent transportation systems, the physical internet [9], intelligent cargo [10] and self-organising logistics [11] are some of them. Among these examples, the area of intelligent transportation systems, focusing on transport and traffic management using information