Original scientific paper
(accepted November 18, 2020)

ACHIEVING THE CUSTOMIZED "RIGHTS" OF LOGISTICS BY ADOPTING NOVEL TECHNOLOGIES: A CONCEPTUAL APPROACH AND LITERATURE REVIEW

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Abstract
From the early 2000s, with the rapid expansion and increasing complexity of supply chains, the logistics literature has frequently referred to "the seven rights of logistics (7Rs)" that linked business logistics to the key strategic objectives of cost competitiveness, quality, flexibility, and agility. The 7Rs are described as to deliver the "right product", in the "right quantity", in the "right quality", at the "right place", at the "right time" for the "right customer" and at the "right cost". The 7Rs suggest a generic roadmap for achieving efficiency, effectiveness, and a higher level of customer satisfaction in logistics services. However, within the last decade, customers' demand for customized products and services has increased dramatically. The generic 7Rs of logistics tends to differ for almost every individual customer, so the new focus is "the customized rights of logistics". This new paradigm forces businesses to explore and to experience new methods and tools to transform logistics processes to be faster, more flexible and more customer-oriented than ever before. The aim of this paper is to explore the benefit of adopting novel technologies in business processes to achieve the customized rights of logistics. Our research findings reveal that the adoption of novel technologies in logistics processes significantly leverages the ability of logistics service providers to offer customized solutions for their customers.

Keywords: customized logistics, novel technologies, the seven rights of logistics

JEL classification: M11, O33

INTRODUCTION

Business logistics is the art of adding value to products by providing a place and time utility. "Place utility" refers to the value provided by having products available *where* they are needed by customers. "Time utility" refers to the value provided by having products available *when* they are needed by customers (Coyle and Bardi, 1976). The important is that the place and time value added to the products by logistics services are in compliance with customer requirements. This is the main concern of logistics management. Council of Supply Chain Management Professionals defines logistics management as "the part of supply chain management that plans, implements, and controls the efficient, effective forward, and reverse flow and storage of goods, services, and related information between the point of origin and point of consumption to meet customer requirements" (Mentzer, Min, and Bobbitt, 2004). This definition of logistics management highlights the importance

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of providing logistics services in an efficient, timely, and reliable manner for a high level of customer satisfaction. The logistics literature often refers to the "seven rights (7Rs)" that must be achieved simultaneously for a high level of customer satisfaction. The 7Rs are to deliver the "right product", in the "right quantity", in the "right quality", at the "right place", at the "right time" for the "right customer" and at the "right cost" (Swamidass, 2000; Rushton, Croucher, Baker, 2017). The 7Rs links business logistics to the key strategic objectives of cost competitiveness, quality, flexibility, and agility. Considering this paradigm as a guide, logistics managers seek to determine the 7Rs of logistics for their target market, product or customer segment, and to identify and implement the most effective strategies to achieve them.

Within the last two decades, digitalization, mobility and "always connected" lifestyle have drastically changed consumer behavior and requirements. Because of the wealth of information available through Internet customers continue to become more demanding and selective. Furthermore, where a customer perceives little technical difference between competing offerings, the need is for the creation of differential advantages through added value, and a prime source can be customer service. Therefore, logistics must differentiate the product and/or service offerings to fulfill unique customer requirements. The focus of today's customer-driven market place is on creating value through personalized and customized offerings, not only of products, but also of services, targeted to individual customers rather than "one size fits all" products and services. Besides, today's customers are very aware, attached, and knowledgeable about how to best use the latest digital technologies. Hence, the direction of technological focus is shifting from serving companies towards serving individuals (Büyüközkan and Göçer, 2018).

As a result, for logistics providers, achieving the generic 7Rs to provide a place and time utility may not be sufficient fully to satisfy customers. Instead, it is necessary to focus on the "customized 7Rs" of logistics. Table 1 presents the definitions of the generic 7Rs and our new definitions evolved into customized 7Rs.

It is clear that this new paradigm has led to a further challenge for logistics service providers. They have to explore and to experience new methods and tools to transform logistics processes to be faster, more flexible and more customer-oriented than ever before. We consider six key abilities that logistics processes have to embrace to achieve the customized 7Rs. They are:

- *Speed* – the ability to react quickly to demand and deliver orders quickly
- *Flexibility* – the ability to recognize and respond to a customer's changing needs
- *Scalability* – the ability to quickly add or remove resources to allow the better matching of resources to workload
- *Proactivity* – taking actions prior to the occurrence of issues or requirements
- *Visibility* – real-time traceability of in-transit product information by all service stakeholders, such as the location, condition and inventory level.
- *Sustainability* – efficient use of scarce energy resources, and eco-friendly practices to reduce negative impacts on the environment and society.

This study discusses the benefits of adopting new technologies in logistics services to achieve the customized 7Rs of logistics by developing the aforementioned capabilities in business processes.

Previous studies on logistics performance have focused on the generic 7Rs. We believe that this study, which evaluates logistics service performance through the customized 7Rs of logistics, is the first and contributes to the logistics literature.

The rest of the paper is structured as follows. Section 1 presents our literature review on novel technologies and implications for the logistics industry, research findings are given in Section 2, and the conclusion in the last section.

Table 1. Definitions of the generic and customized 7Rs of logistics

The 7Rs of Logistics	Definition of the Generic 7Rs	Definition of the Customized 7Rs
Right CUSTOMER	Providing services meeting the requirements of a specific market or region	Providing services meeting the requirements of any customer regardless market or region.
Right PRODUCT	Product-specific service design with appropriate equipment and resources	Being capable to service for any kind of product (in any size, weight, or nature)
Right PLACE	Delivery of the customer order at the destination predefined by the customer	Delivery of the customer order at any location desired by the customer, even it is not a predefined destination
Right TIME	Delivery of the customer order at the scheduled time or time-window	Delivery of the customer order at anytimeortime-window preferred by the customer
Right QUANTITY	Delivery of the customer order in an amount that will reduce delivery costs and not cause excess stock and stock shortage	Being able to deliver the customer orders at once in any amount required.
Right QUALITY	Delivery of the customer order in safe and good conditions.	Delivery of the customer order in the condition that meets product-specific quality standards, as well as in customer-specific conditions
Right COST (PRICE)	Delivery of the customer order at the lowest possible cost	Delivery of the customer order at the price that the customer is agreed to pay provided that the above six are met

1. LITERATURE REVIEW ON NOVEL TECHNOLOGIES AND IMPLICATIONS FOR LOGISTICS

In this section we present a literature review on facilitating role of emerging technologies on customization of logistics services. The literature on emerging technologies that we examine within the scope of this study is fairly new. While most studies focus on a specific technology, some studies examine the impact of all novel technologies effective on logistics (e.g., DHL Logistics Trend Radar Report, 2020). Each paragraph below presents a brief description of the technology into consideration, followed by recent literature on its implications on logistics services.

The Internet of Things (IoT) refers to a network system where the everyday objects that feature an IP address for internet connectivity can exchange and share data, and so communication occurs between these objects and other network devices and systems. IoT intelligently identifies, locates, tracks, monitors and manages all items connected to the Internet, through information sensing devices. IoT aims to connect any "Thing" independent of place, time and motion (Wei and Lv, 2019). Liu S., Zhang, Liu Y., Wang L., and Wang V. (2019) propose a real-time information-driven dynamic optimization method for vehicle routing and logistics tasks, through using IoT technology. The study shows that IoT-enabled methods contribute to improved efficiency of logistics and the utilization rates of vehicles, avoid errors in loading/unloading tasks, reduced logistics cost, and achieving sustainable logistics services. Chen J., Xu, Chen H., Zhao, and Xue (2020) analyze the significance of using IoT to optimize the food cold chain logistics distribution route. The results verify the effectiveness of the cold chain logistics vehicle routing optimization method based on the IoT and improve the efficiency of distribution services. Through an extensive literature survey, Ben-Daya, Hassini and Bahroun (2019) state that improvements brought by IoT to the logistics functions are as follows: (1) product identification through RFID informs the system about the *right goods*, (2) tracing allows the detection of when items are lost and guarantees the *right quantities*, (3) location tracking guarantees the *right place* aspect, (4) monitoring the product state ensures the *right quality*, and (5) this information provides the necessary visibility that allows responsiveness to unforeseen events and taking action at the *right time* and the optimization of the whole process. Wei and Lv (2019) apply the IoT to cold chain logistics of agricultural products, using RFID, GPS, and GIS technologies to ensure real-time dynamic monitoring of the temperature and humidity of agricultural products in transit and their fast and efficient distribution. By leveraging the IoT applications logistics providers can dramatically improve the following areas: (1) end-to-end visibility – complete visibility facilitates more effective, timely decisions and reduces delays through quicker detection of issues, (2) warehouse and yard management – with IoT-enabled mobile devices designed to track inventory data, equipment and vehicles, enterprises can give their physical assets a digital voice, and (3) fleet management – with mobile scanners, computers and RFID systems alone, enterprises can gain visibility into their assets and better streamline operations to keep their fleet moving (Tadejko, 2015).

Cloud Computing (CC) is a virtualized IT resource that allows businesses to access software applications, other manipulative data services, and data storage and processing power over the Internet. CC delivers a network of virtual services so that users can access them from anywhere in the world on subscription at competitive costs. Compared with the traditional IT solutions, CC offers clear superior advantages such as dynamically scalable IT capabilities which allow users to increase and decrease their demand and usage as and when required and, most importantly, the zero initial fixed cost investment requirement for its usage (Subramanian, Nachiappan, Abdulrahman Muhammad D., and Zhou Xiaolai, 2014). According to the DHL Logistics Trend Radar 2020 report, the main opportunities provided by CC for logistics are; (1) New commercial opportunities enabled by seamless integration within an ecosystem of third-party vendors, web shops, e-commerce platforms and logistics marketplaces, (2) Expanded service offerings with better pricing transparency for customers, (3) Scalable automation processes, lowering cost and increasing business agility, and (4) CC allows carriers and third-party logistics providers to integrate and scale software services using centralized cloud-based platforms, replacing existing electronic data interchange (EDI) solutions.

Unmanned Aerial Vehicle (UAV), commonly known as **Drone**, could be simply defined as "an aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board" (EU, 2019). UAVs have many use areas in internal and external logistics. UAVs delivery applications are very wide and include package deliveries to remote rural regions and first- and last-mile deliveries in urban and suburban areas as well as express deliveries of, for example, medical supplies, especially of vaccines and blood or customized parts to assembly lines (Perboli and Rosano, 2019). Drone delivery services enable e-retailers to cost-effectively offer unprecedented delivery speed and customized delivery lead times using dedicated aerial vehicles for individual orders (Perera, Dawande, Janakiraman, and Mookerjee, 2020). According to Olivares, Cordova, Sepúlveda, and Derpich (2015), the use of drones in a manufacturing plant to transport materials and semi-finished products in a 3D space at the stage of assembly and/or customization of products will lead to a higher level of efficiency, effectiveness, and productivity. The use of drones in warehouse operations, in particular picking and auditing, allows carrying out repetitive and dangerous tasks without almost any human intervention or supervision (Mészáros, Bona, and Bertalan, 2018). UAVs are commonly used outdoors for the inspection of logistic or industrial facilities like bridges, railways, ports, pipelines, or building facades (Máthé, Buşoniu, Barabás, and Iuga, 2016). Maersk (Drone Blog News - Maersk, 2016) is sponsoring the adoption of drones for the active monitoring of the logistic activities performed in ports. The main goal of the project is to ensure a higher control and safety level on the handling operations, which will be performed following the strict regulations.

Self-driving (Autonomous) Vehicle is defined as a vehicle that is capable of sensing its environment and navigating without direct action of human such as steering, accelerating, or braking. Presently the technology is so advanced that vehicles may transport things on chosen routes without the activity of drivers (Wieczorek, 2017). Autonomous vehicles use in logistics are often split into four different categories: (1) Automated Guided Vehicles (AGVs) for indoor facility operations, (2) Automated Guided Transport (AGT) systems for outdoor facility operations, (3) Self Driving Road Transport Vehicles for long-haul trucking, and (4) the Last-Mile Delivery Robots (Flämig, 2016). From long-haul trucking to last-mile rovers, self-driving vehicles will upgrade logistics by unlocking new levels of safety, efficiency, and quality (Kückelhaus, 2014). The opportunities are; faster, more efficient transport thanks to optimized routing, greater lane density, and 24/7 operation, better road safety and operational productivity as human errors are eliminated, and reduced greenhouse gas emissions and overall environmental impact due to more efficient fuel consumption (DHL's Logistics Trend Radar, 2020).

3D Printing, also known as **Additive Manufacturing**, is a technology used for making three dimensional solid objects up in layers from a digital file without the need for a mold or cutting tool (Kubáč and Kodym, 2017). Encouraged by opportunities for greater customization, less waste, and more localized manufacturing and delivery, 3D printing technology may lead to fundamental changes in operations and logistics strategies. Instead of mass production of a limited variety of products concentrated in a small number of factories, geographically distributed low volume production of highly customized products becomes increasingly attractive (Olsen and Tomlin, 2020). Advances in 3D Printing technology allow more product types to be made closer to the consumer which turns to reduced transportation costs, customs duties, and the product security that accompanies long-distance transportation. 3D Printing increases the agility of supply chains and change the supply chain cost equation reducing inventory and transportation costs (Bhasin and Bodla, 2014).

The Blockchain technology is based on a method by which previously unknown parties can jointly generate and maintain practically any database on a fully distributed basis where transaction correctness and completeness is validated using a consensus of independent verifiers. Features of this technology increase confidence through transparency within any transaction of data, goods, and financial resources (Pournader, Shi, Seuring, and Koh, 2020). Blockchain technology can easily provide secure business operations in logistics. Results of a survey conducted by DHL shows that 50% of 1300 senior executives considered blockchain in their top 5 strategic priorities. Higher levels of transparency between disparate supply chain parties, and product traceability throughout production and the supply chain are the primary use cases for blockchain-adopting industry giants across multiple industry sectors. For example, Walmart aims at improving last-mile deliveries through coordinating delivery drones using the blockchain. It can drive process optimization and better visibility for customers, operators, and authorities (DHL Logistics Trend Radar, 2020). Another potential benefit gain from blockchain adoption is the automation of commercial processes through blockchain-based smart contracts that have streamlined service and payment transactions while reducing errors in the back office. In the logistics sector, blockchain technology could dramatically reduce time delays, added costs and human errors. This technology can facilitate logistics tasks: it can be used to track purchase orders, order changes and freight documents, and it can help in information sharing about manufacturing process and delivery (Tijan, Aksentijevic, Ivanic, and Jardas, 2019).

Augmented Reality (AR) technology is defined as the expansion of physical reality by adding layers of computer-generated information to the real environment. AR could augment the environment in real world with additional and valuable virtual information (such as text, video, sound, etc.), so that human senses and abilities can be enriched (Wang W., Wang F., Song, Su, 2020). AR can be used in many human-operated areas of logistics such as goods receipt, storing, picking, shipping and inventory., where handling errors could be considerably diminished with additional provided information. AR can give logistics providers quick access to anticipatory information anytime and anywhere. This is vital for the prospective and exact planning and operation of tasks such as delivery and load optimization and is critical to providing higher levels of customer service. In warehouse operations, AR has the potential to significantly reduce cost by improving the picking process (Stoltz, Giannikas, McFarlane, Strachan, Um, and Srinivasan, 2017). AR applications support and reduce the cost of warehouse redesign and planning. AR has the potential to further optimize freight transportation in areas such as completeness checks, international trade, driver navigation, and freight loading. Another important field of application for AR is last-mile delivery services. AR devices for parcel handling, loading, and delivery processes improve parcel handling, avoid improper handling, and ensure load optimization Equipping staff with AR devices could also increase security and improve the quality of customer contact (Glockner, Jannek, Mahn, and Theis, 2014)

Advanced Robotics, compared with conventional robots, have a superior perception, integrability, adaptability, and mobility. These improvements permit faster setup, commissioning, and reconfiguration, as well as more efficient and stable operations (Küpper, Lorenz, Knizek, Kuhlmann, Maue, Lässig, and Buchner, 2019). A logistics robot is with one or more grippers to pick up and move items within a logistics operation such as a warehouse, sorting center or last-mile. Logistics robots are diversifying and achieving proficiency that matches and exceeds human capabilities. Robotic e-commerce logistics automation is highly flexible for managing disparities among online orders. Multiple robots work collectively to bring different items of the same order and deliver them in a synchronized sequence to the pick station to reduce picking costs and increase accuracy and speed. (Huang, Chen, and Pan, 2015). Driven by rapid technological advancements and greater affordability, robotics solutions are entering the logistics workforce, supporting zero-defect processes and boosting productivity. Mobile or stationary, robots will adopt more roles in the supply chain, assisting workers with warehousing, transportation, and even last-mile delivery activities (DHL Logistics Trend Radar, 2020).

Big Data & Artificial Intelligence (AI). AI can be defined as human intelligence exhibited by machines; systems that approximate, mimic, replicate, automate, and eventually improve on human thinking. Throughout the past half-century a few key components of AI were established as essential: the ability to perceive, understand, learn, problem-solve, and reason (Gesing, Peterson, and Michelsen, 2018). AI can help the logistics industry to redefine today's behaviors and practices, taking operations from reactive to proactive, planning from forecast to prediction, processes from manual to autonomous, and services from standardized to personalized. AI will enable logistics companies to exploit the big data that supply chains generate on a daily basis (Wang, Gunasekaran, Ngai, and Papadopoulos, 2016). The predictive capabilities of AI are helping logistics operators proactively streamline operations, increase customer satisfaction through the personalization of services and reduce costs through highly efficient and effective processes. For example, AI helps logistics operators to overcome the challenges in complex last-mile operations like balancing delivery time windows, fuel consumption, travel distance, traffic patterns, load capacity, and ad hoc pickups while simultaneously communicating accurate arrival times and updates to customers. (Zheng, Zhang, and Song, 2020). As AI becomes more intelligent, predictive technology could take logistics players a step further into the territory of anticipatory delivery models. Instead of waiting for customers to order, AI will go beyond same-day or same-hour delivery, supplying goods to customers before they even realize what is needed.

2. FINDINGS

In this section, we present the findings obtained from the literature review. Our findings show that the adoption of all new and emerging technologies in business processes contributes to the development of logistics providers' capabilities to achieve the customized 7Rs of logistics.

The implications of adopted technologies on logistics capabilities are shown in Table 2.

Table 2. Emerging technologies and implications for logistics

Technology	Implications on Logistics	Supporting Literature
Internet of Things (IoT)	- Improve efficiency - Better utilization of resources - Reduce errors in handling - Accurate product identification - Increase visibility - Better route optimization - Support sustainability	Wei and Lv, 2019; Liu S., Zhang, Liu Y., Wang L., and Wang V., 2019; Chen J., Xu, Chen H., Zhao, and Xue, 2020; Ben-Daya, Hassini and Bahroun, 2019; Tadejko, 2015
Cloud Computing (CC)	- Scalable processes - Pricing transparency for customer - Reduce capital investment - Increase business agility - Integration with service partners	Subramanian, Abdulrahman, and Zhou, 2014; Gantzia and Sklatinioti, 2014; Novais, Marin and Moyano,2020;DHL Logistics Trend Report, 2020
Augmented Reality (AR)	- Reduce handling errors - Provide anticipatory information - Facilitate design and planning - Increase security - Improve customer contact quality - Optimize last-mile deliveries	Glockner, Jannek, Mahn, and Theis, 2014; Wang W., Wang F., Song, Su, 2020; Stoltz, Giannikas, McFarlane, Strachan, and Srinivasan. 2017; Tatasciore, 2018
Big Data & Artificial Intelligence (AI)	- High efficiency and speed - Proactive operations - Process automation - Predictive logistics - Personalization of services	Zheng, Zhang, and Song, 2020; Gesing, Peterson, and Michelsen, 2018; Wang, Gunasekaran, Ngai, and Papadopoulos, 2016
Blockchain	- High level of transparency - Better product traceability - Automation of external processes - Reduce transaction errors - Reduce time delays - Secure operations	Pournader, Shi, Seuring, and Koh, 2020; Tijan,Aksentijevic, Ivanic, and Jardas, 2019; DHL Logistics Trend Report, 2020; Dobrovnik, Herold, Fürst, and Kummer, 2018
Additive Manufacturing / 3D Printing	- Greater customization - Shorter delivery distances - Reduce last-mile delivery costs - Reduce inventory costs	Kubáč and Kodym, 2017; Olsen and Tomlin, 2020; Bhasin and Bodla, 2014; Daduna, 2019
Autonomous (Self- Driving) Vehicles	- Less human error, better road safety - Optimized routing, lane density - Reduce environmental impacts - More efficient indoor operations - Increase last-mile delivery quality	Wieczorek, 2017; Flämig, 2016; Kückelhaus, 2014; DHL Logistics Trend Report, 2020; Bergvall and Gustavson, 2017
Unmanned Aerial Vehicles (UAVs) / Drones	- Customized delivery lead-times - Faster and automated delivery - Easy delivery to rural areas	Perboli and Rosano, 2019; Máthé, Buşoniu, Barabás, and Iuga, 2016; Perera,

Table 2. (continuet)

Advanced Robotics	- Inspection of outdoor operations - Remote surveillance of infrastructure - In-plant material movements - Remote stock control and count - Scalable workforce and infrastructure - Limitless (24/7) workforce - Increase speed and accuracy - Better asset utilization - Automation of repetitive tasks - Improve worker safety and health	Dawande, Janakiraman, and Mookerjee, 2020; Olivares, Cordova, Sepúlveda, and Derpich, 2015; Mészáros, Bona, and Bertalan, 2018 Küpper, Lorenz, Knizek, Kuhlmann, Maue, Lässig, and Buchner, 2019; Huang, Chen, and Pan, 2015; DHL Logistics Trend Report, 2020

CONCLUSION

"Customization" is the phenomenon of today's business world and is the focus of this study within the business logistics context.

The development of the Internet and mobile communication technologies and anywhere anytime connected lifestyle of the people have particularly increased the scope and importance of the time and place values added on products by logistics. Besides, customer orders have dramatically diversified and delivery lead times have decreased almost to hours. Today's customers have the power to determine even the packaging material and color for their orders. Logistics systems are struggling to meet the highly customized demands of customers. In order to respond to these developments, logistics systems are needed to be much faster, much more flexible, and much more agile than ever before.

The findings of this study reveal that the novel technologies such as the Internet of Things, Big Data, Artificial Intelligence, Augmented Reality, Cloud Computing, Blockchain, Self-Driving Vehicles, 3D Printing, Unmanned Aerial Vehicles, and Advanced Robotics have significant potential to contribute to logistics service providers' capabilities for providing customized solutions to their customers in a cost-efficient manner.

We believe this study provides an insight into logistics service providers' decision to adopt the latest technologies in their business processes.

It is noteworthy that, besides their positive impacts on logistics operations, the technologies examined in this study have some constraints and limitations.

Thus, as a further study, this analysis can be enhanced with negative factors that may affect the logistics businesses' decision to adopt new technologies.

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