System Dynamics Modelling to Study the Effects of Investment in Information Technology on Logistics Performance: A Case Study from India

Amrita Jhawar, Delhi Technological University, India
S.K. Garg, Delhi Technological University, India

ABSTRACT

In this era of globalization, adoption of information technology (IT) is one of the critical contributing factors of logistics companies’ competitiveness and growth. This paper investigates the investment in IT by an Indian based logistics company on the logistics performance. Technologies like RFID, EDI, GPS/GIS and ERP are chosen for improving processes like tracking and tracing, planning and forecasting, transportation automation, coordination with suppliers and customers and decision optimization. Simulations are carried out using system dynamics modelling and scenarios are generated. Through 15% investment in RFID, 30% investment in EDI, 15% investment in GPS and 40% investment in ERP of the total investment amount, the logistics cost reduced by 0.21%, delivery time reduced by 0.17%, reliability of services improved by 4.61%, flexibility improved by 5.52% and safety improved by 5.8% leading to an 0.52% improvement in LPI and 0.049% improvement in profit.

KEYWORDS
EDI, ERP, GIS, GPS, India, Investment, Logistics Performance, RFID

1. INTRODUCTION

Many studies since 1990s suggest the important role information technology plays in enhancing the effectiveness and efficiency of logistics management (Introna, 1991; Hammant, 1995; Closs, 1997; Loebbeck and Powell, 1998). Timely, accurate, well managed and shared information is a valuable logistics resource and plays a very important role to enhance logistics competitiveness. Logistics competitiveness is an important factor in determining the competitiveness of nations and industries and to compete in today’s environment, IT tools are a necessity, no matter the size of the organization.

The logistics cost of India is around 13-14% of GDP, which is much higher than Europe (10%), US (9%) and Japan (11%) (Deloitte, 2012). The main reasons for the high costs are low rate of technology adoption along with poor infrastructure and complex government regulations. The emerging market survey 2011 conducted by Transport Intelligence, highlights India’s attractiveness as a strong growth area for logistics in future and emerging as a major logistics hub (Deloitte, 2012). And as information is a valuable logistics resource, adoption and successful implementation of IT is said to be a pre requisite for logistics success (Closs et al., 1997).

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The Indian logistics industry spends hardly 0.3% of its revenues on ICT as compared to 2-3% in developed countries and the need of the hour is 4-5% of revenues need to be ploughed back in ICT to advance quickly and generate competitive advantage (Srivastav and Chandra, 2013). Figure 1, shows the overall trend of investment in information technology by the Indian logistics players in the year 2010. As shown in Figure 1, almost 50% of the players are investing less than ten lakh rupees and only 2.58% are investing more than 1 crore rupees. Use of IT will help in reduction in costs, decrease in inventories, better space utilization, accelerate receiving and inspection of deliveries and easy transportation of items faultlessly as per customer preferences to achieve competitive advantage.

Logistics requires high level of organizational and inter-organizational communication systems such as radio frequency identification (RFID), electronic data interchange (EDI) and Enterprise Resource Planning (ERP) at various levels of the logistics chain for better coordination, planning and decision optimization. For automatic tracking of vehicles, freight, containers etc. including location, speed and time can be measured with the help of global positioning system (GPS). And this information can be correctly used by geographic information system (GIS) for corrective actions. Although, there are innumerable technologies being used, the authors have considered the above mentioned five technologies to be studied further in this study.

EDI and RFID emerged as the two technologies that were addresses most often in SCM literature accounting 32% of all the articles in which IT is the primary focus (Hazen and Byrd, 2012). The other technologies which are used most often are ERP, GPS with GIS. Also, these are independent technologies which can be combined with other technologies to get customised solutions. This paper studies the effect of investment in RFID, EDI, GPS/GIS and ERP on the logistics performance using system dynamics (SD). Logistics performance has been measured in terms of the logistics performance index (LPI), which is the weighted average of the five performance measures namely logistics cost, delivery time, reliability of logistics services, flexibility in logistics services and safety.

Therefore this paper is an attempt to develop an implementation plan for IT technologies by logistics service providers to improve the logistics performance. In this regard technologies have been identified by thorough literature review which will help in improving the logistics processes. These processes in turn will help reduce the cost, reduce the delivery time, improve the reliability of logistics services, improve the flexibility of logistics services and safety which makes the logistics performance index.

2. LITERATURE REVIEW

2.1. RFID

RFID is a term used for technologies utilizing radio waves for identifying individual items automatically and is designed to track items in the supply chain without requiring a line of sight (Mehrjerdi, 2010). It is a technology that enables radio frequencies to send and receive data to and from one or many RFID

![Figure 1. Investment in IT by Indian logistics players in 2009 (Source: Softlink (2009))](image)
Effects of Discount Scenarios on Chaotic Behavior of Inventory Level Under Price-Dependent Demand
[www.igi-global.com/article/effects-of-discount-scenarios-on-chaotic-behavior-of-inventory-level-under-price-dependent-demand/95237?camid=4v1a](www.igi-global.com/article/effects-of-discount-scenarios-on-chaotic-behavior-of-inventory-level-under-price-dependent-demand/95237?camid=4v1a)

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