

New Paradigm of e-Logistics System Management - An Proactive u-Logistics System Based on Ubiquitous Technology -

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Abstract

The emergence of ubiquitous autonomic computing and network environment will change the service architecture information system which will be a new application area in SCM/logistics systems. In this study we surveyed the technical trend map of ubiquitous and its application in SCM/logistics support system design. We described the evolutionary model of ubiquitous computing community for SCM/logistics system. It is consisted of three view points; self-growing, autonomic, and context-aware, which will allow the decision makers to be benefited from web and mobile technology and are useful for proactive SCM/logistics support system. Finally, we suggested a cooperative research planning for the development ubiquitous system between the government research center, university, and industry research activities.

Keywords: Ubiquitous computing, Logistics support system, RFID

1. Introduction

Recently information technology, IT (information technology) has become one of the most innovative research contributions for the SCM and logistics system design. Since 80' IT has provided a new possibility on competitive logistics area with changes by internet based and global web technology. We can summarize the major changes in SCM/logistics system management in these days as: 1) logistics system became an "integration of key business process from end-users through original suppliers that provide products, services, and information and add value for customers and the other stakeholders", 2) e-business. The transformation into the e-business is not simple changes of the management paradigm, but it can be expressed as a culture revolution which will change all the features of human life. The other changes in SCM/logistics are e-SCM/logistics centric age which means SCM/logistics becomes a core area of e-business, automation and agent processing.

The vision and strategy for this e-SCM/logistics system can be summarized as: 1) market-oriented system which means deregulation and fair competition of market mechanism, 2) knowledge-oriented system which means systems for creation, expansion and utilization of knowledge, and 3) globe-friendly system which means global standard, encouragement of foreign direct investment and business transparency. This paper is organized as follows; second section marshals a new paradigm of SCM/Logistics system for the objective of this study. The third section provides a basic concept of using ubiquitous computing technology for SCM/logistics system management and provides a survey of new technology with overview of related references. Section 4 provides a new trend of research on SCM/logistics system management using RFID and Ubiquitous technology. Section 5 proposed a government based integrated research planning for these new technologies. Section 6 concludes.

2. New Paradigm of SCM/Logistics System Management

Generally, supply chain management and logistics system deal with the networks of businesses involved in the extraction and transformation of raw materials into tangible finished goods through manufacturing process and the delivery with any complementary services to the end consumers. Recently a new trend of considering information and network technology becomes one of the evident areas of important points in logistics/SCM system. This section provides an overview on e-SCM/logistics system management and paradigm shift. Especially the following areas are reviewed:

- 1) Recent changes toward successful e-business and new paradigm of e-SCM /logistics,
- 2) e-business and e-logistic system,
- 3) Introducing RFID for logistics information automation and a new technology of ubiquitous for next generation of e-logistics.

The rapid growth of e-commerce in the entire industries is enabling strategic procurement, collaborative supply chain planning and logistics

system design. The adoption of new information technologies in supply chain system became a new paradigm of integrated value added information system. To realize the new paradigm of SCM/logistics system management, various researches are being conducted (Paul, & Thomas, 2004), Dan (2002), Prekop & Burnet (2003). One of these researches is Douglas (2005) “collaborative-commerce” (Ohio University professor, 2005 SCM Forum). He presented the future SCM/logistics structure as a horizontal and non-linear integrated type of collaborative-commerce SCM/logistics structure while it has been a vertical structure in past and present. Finally, he suggested the ubiquitous computing technology will be as a providing SCM/logistics system so called u-SCM/logistics system. The key external drivers in logistics system are e-commerce (rapid advances in information technology), customer centric, cash flow (interest rate), globalization, and automation. Thus, in future SCM/logistics system will change into a type of object-to-object from system-to-system type. On the other way, these systems will be changed into an ideal e-business for the purpose of process innovation and knowledge management. Figure 1 shows the concept of e-business compared with e-commerce and e-marketing.



Figure 1. Comparison of e-marketing, e-commerce and e-business

The new situation of major element of e-logistics can be summarized as: 1) forecasting & planning-procurement, 2) manufacturing, 3) distribution, 4) retail, and 5) customer service. We have to do new the challenge against these new changes as:

- 1) Increased need to differentiate,
- 2) Time comparison – order today, ship tomorrow,
- 3) Customer expect perfect accuracy,
- 4) High velocity – more inventory pressure,
- 5) Down market – reduce non value added cost,
- 6) Seek to leverage more outsourced logistics process (3rd party logistics)
- 7) Agile responding to change faster and managing more inventory locations.

For this new situation of major elements of e-logistics, we have to provide an ideal e-Business as shown in Figure 2 and customer driven SCM/logistics system. In this study, we introduce RDID and ubiquitous computing technology for these new elements.

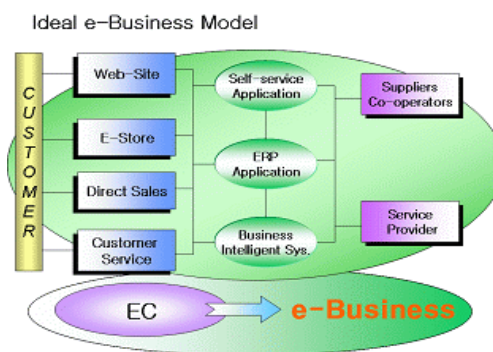


Figure 2. Ideal e-Business Model

3. RFID and Ubiquitous Technology for SCM/Logistics System

Ubiquitous means “being scattered” of which functions are embedded processors, wireless communication and sensors as shown in Figure 3. Ubiquitous computing has introduced one of the most innovative research contributions on the logistics design.

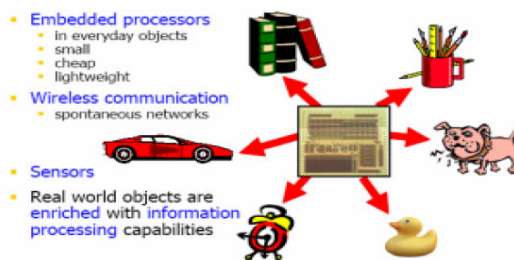


Figure 3. Basic Concept of Ubiquitous



Figure 4. The Schematic Frame Work of Ubiquitous SCM/logistics

The schematic frame work of ubiquitous SCM/logistics system is shown in Figure 4. This solution consisted of several sub-technology solutions such as: RFID for data sensor, simulator for proactive, visibility for event management and wireless communication for mobile, voice.

3.1 Sub-system of Ubiquitous Logistic System and RFID System

RFID system is a subsystem of ubiquitous system for sensing the data. RFID means radio frequency identification and it is an information recognition method by wireless/automatic/non-touch which is well known as a telecommunication model. By the progress of network and information technology, e-business is

based on wire communication but u-business is based on wireless communication method of RFID which is called a kind of ubiquitous system. RFID system is consisted of tag, reader and data processor. Figure 5 shows a typical RFID system.

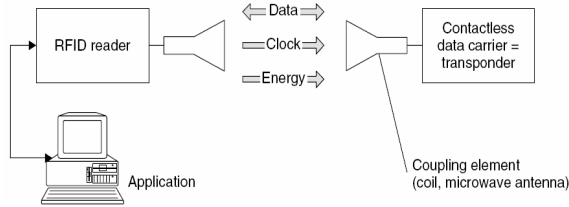


Figure 5. A General RFID System Component
Source: Klaus (2003), RFID Handbook

Recently there are many researches on RFID system and applications in logistics management as the post bar-code system (Albano, 2002), (Paul & Thomas, 2004), (Klaus, 2003), (Dan, 2002).

Comparing RFID with bar-code system, we can summarize the differences as following:

- RFID: - Reusability, storage capability, automation, readable distance
- Diversity of application than barcode system
- International networking

- Bar-code: - Non-reusable, line of sight, and small capacity

RFID system has good capabilities and much better than bar-code system, but still its cost is very high for small and medium industries to use, thus still it is not used widely. Table 1 is the comparison of RFID and bar-code system.

Table 1. The Comparison of RFID and Bar-code System

	BAR-Code	RFID passive	RFID active
Types of use	Non-Reusable	Reusable	Reusable
Capacity	1-100 bytes	1b – 8Kb	64–228Kb
Data correction	Possible	impossible	Possible
Line of Sight	Necessary	Unnecessary	Unnecessary
Read Distance	< 1M	~ 2M	~ 5-10M
Read Method	Successive	Same time	Same time
Cost	Less than 5 cent	~\$1	~ \$100

Recently US, EU and Japan developed RFID technology and use it in industries as:

- 1) USA:
 - ISO takes the initiatives in local standards and global applications,
 - Uses UHF (902-928 MHz) and has the basic technology in UHF,
 - World mart and ministry of defense will use in boxes and pallets,

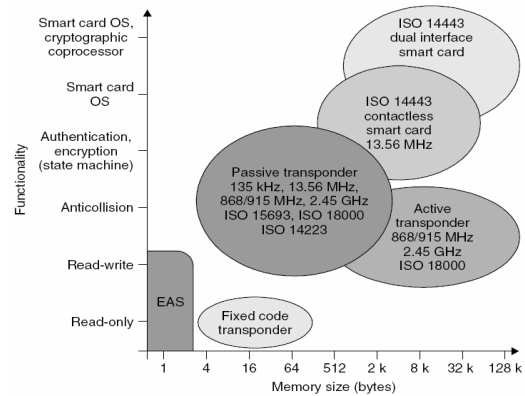


Figure 6. RFID Card Memory Size (bytes) and Standards (ISO),
Source: Klaus (2003), RFID Handbook

- 2) EU:
 - First used RFID technology, ID card, global standard
 - Tesco and Metro groups start to use in distribution logistics area,
 - 1005' UHF new service,
- 3) Japan:
 - Developed RFID technology as an international compatibility
 - 2005, Jan start new service of UHF.

3.2 Ubiquitous Technology and u-SCM/Logistics System

1) Evolutional Model of Ubiquitous Computing Technology for Logistics System

For the ubiquitous SCM/logistics system, many of sub-systems of ubiquitous have to be developed such as: RFID system, u-WMS which is based on web, u-simulator to optimizing system, SCM/logistics visibility system, u-mobile and u-voice tech. For many years, these technologies have been developed (Prekop & Burnet, 2003). Figure 7 shows the technical trend map of ubiquitous.

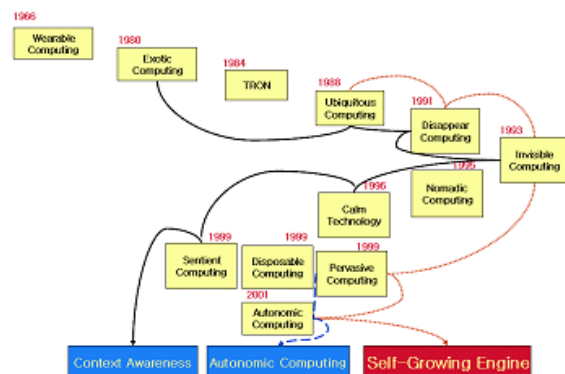


Figure 7. The Technical Trend Map of Ubiquitous Technology Development
Source: Cho (2004)

In addition to general definition of ubiquitous, we can define the ubiquitous technology by following three keywords as; context of awareness, automatic computing and self-growing engine. The IT technology has developed by personal computing device, mobile device, and IT convergence and into ubiquitous technology. The major keywords of ubiquitous computing and present technology status are summarized in Figure 8.

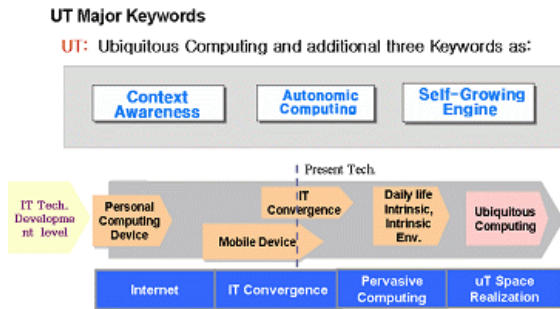


Figure 8. UT Major Keywords (Source: Cho (2004))

2) Development Steps of Ubiquitous Computing Technology

Ubiquitous technology has developed from mobile phone technology which communicates person-to-person based and by the video technology it was progressed person-to-person based communication system. After development of ubiquitous sensing and network technology, machine-to-machine based communication system is appeared. Again this technology will provide the object-to-object communication by its self-engine capability. Figure 9 shows the development steps of this ubiquitous computing technology.

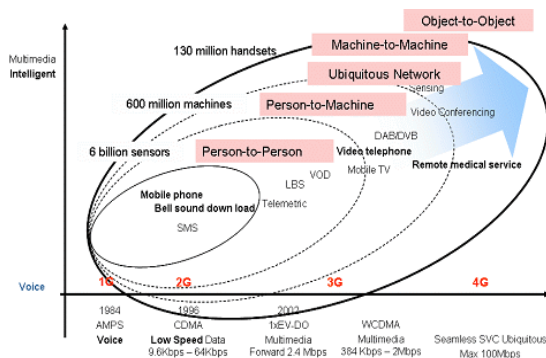


Figure 9. The development steps of ubiquitous computing technology
Source: Cho (2004)

4. u-SCM/Logistics System

Conventional SCM/logistics system is based on dynamic operation support, multi-architecture, logistics performance object, visibility manual customization and based on bar-code system and serial code tracking system (Sparacino, 2003), (Streitz, et al., 2003). This conventional approach has many limits

which are caused by characters of ubiquitous computing environment. By introducing automated operation support, multi-agent system, embedded visibility module, RFID, wireless tracking system, and voice and digital pad, the conventional SCM/logistics system can be first step of ubiquitous SCM/logistics system development. Then for the next step of u-SCM/logistics system, the following sub-technologies are developed:

- Purge operation support,
- Machine-to-machine structure,
- Automatic decision engine,
- Proactive management,
- Context-awareness,
- u-chip networking.

Figure 10 shows a comparison of conventional and a new SCM/logistics infrastructure based on ubiquitous. An example application of ubiquitous technology applied in industrial logistics system has shown in Figure 11. In this system, RFID tags are used in manufacturing process, warehouse and delivery

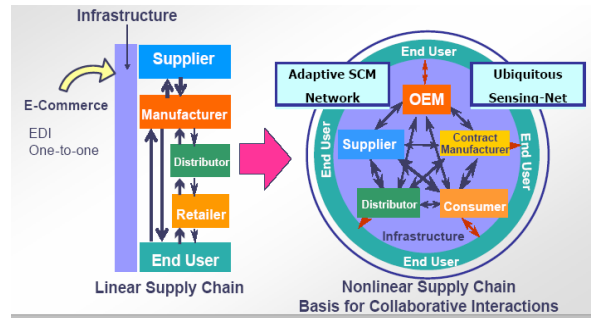


Figure 10. U-SCM/Logistics Infrastructure Based on Ubiquitous

process connected with wireless u-network. In production control center and marketing office use the u-SCM/logistics solutions at the same time. Even though we used ubiquitous system, the characteristics of physical SCM/logistics from production to customers are not changed. The major data are moved by sensing and mobile/wireless devices.

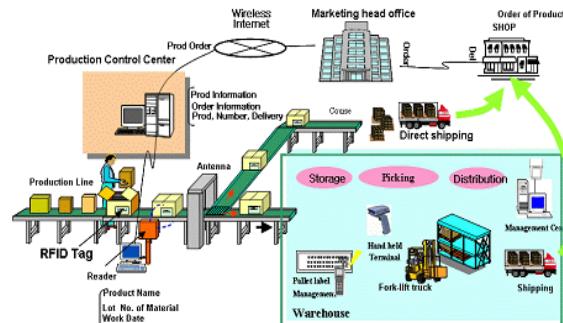


Figure 11. Example of ubiquitous technology in industrial logistics system
Source: Cho (2004)

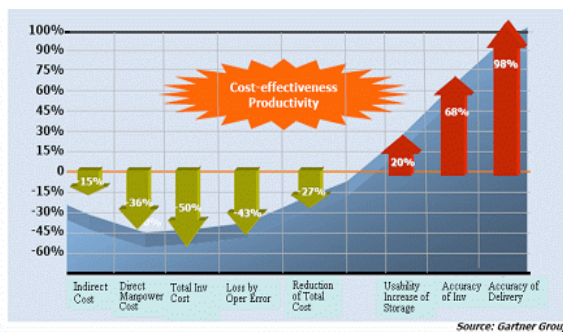


Figure 12. Effect when we apply u-SCM/logistics system

The estimated effect when we apply u-SCM/logistics system is shown in Figure 12.

The indirect cost, direct manpower cost, total inventory cost and cost by operational error will reduced about 30% while usability of storage accuracy of inventory will increase.

5. Prospective Research Planning for SCM/Logistics System

In near future u-SCM/logistics system will be used in the most of SCM/logistics works, and when RFID is used in the most of companies, the data processing will be increased by a certain level. During recent three or four years, many of ubiquitous sub-technologies are developed and are used in logistics systems management. On the other hand the tenderization of ubiquitous are delaying now, but it is urgently needed the development of best practices for SCM/logistics. For the further research, 1) we have to focused on developing process rather than technology development, 2) we are ready to process u-data traffic which will increase rapidly, 3) research for international standard, 4) reduce the impact of ubiquitous system on conventional system, and 5) cooperative research for ubiquitous society. For the government based development planning of ubiquitous system for SCM/logistic system, we proposed the following cooperative research:

- 1) R&D policy for new technology for next generation,
- 2) In 21 century, the basic and core technology for country,
- 3) In future, anticipated reaction in u-technology society,
- 4) Government based planning.
- 5) Cooperation for ubiquitous SCM/logistics and society,
 - Economic/social expectation and benefit for SCM/logistics system improvement,
 - For the u-SCM/logistics system and society,
 - For u-SCM/logistics system, integrating: IT, BT, NT, and ET,
 - Not only by one organization, but all the government-based cooperation system is needed

For the cooperative research for u-SCM/logistics, government, industries, university, and research centers have to organize for cooperative research activities as shown in Figure 13.

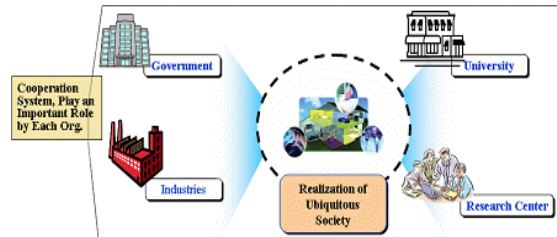


Figure 13. Cooperative research planning for u-SCM/logistics System

Source: Cho (2004)

6. Conclusion

In this paper, we have studied a new RFID ubiquitous computing system such as basic concept of ubiquitous technology and its application in the SCM/logistics system. We have surveyed e-commerce, e-business and ubiquitous computing technology by its technical trend map of development. We studied the sub-systems of ubiquitous such as RFID, u-simulator, u-network and wireless communication systems. To overcome of the conventional SCM/logistics system, we applied ubiquitous technology in SCM/logistics system and have shown a schematic framework of ubiquitous based SCM/logistics system, u-SCM/logistics system. An example of ubiquitous industrial logistics system using RFID technology, warehouse and delivery process connected with wireless u-network. For the importance of u-SCM/logistics system, we suggested cooperative research planning of u-SCM/logistics system between government, university, industries and research centers.

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