

## **Identifying the Factors of Cost Issues in Development of Radio Frequency Identification Technology in Supply Chain Management**

Receipt: April 9 , 2011      Acceptance: may 25 , 2011

### **Reza Radfar**

Associate Professor in Industrial Management, Science and research Branch,  
Islamic Azad University, Tehran, Iran  
r.radfar@srbiau.ac.ir , radfar@gmail.com

### **A. Naderpour**

Master Graduate in Industrial Management, Science and research Branch,  
Islamic Azad University, Tehran, Iran  
Naderpour.a@gmail.com

### **Abstract**

RFID has lots of potential benefits for supply chain management; that's why it has attracted many industry practitioners all around the world, especially in recent years. RFID is one of the key solutions that information technology has provided for industry. The main issue in implementing and also developing this unique technology in the supply chain management of every industry appears to be the cost. This research would study this issue and its factors among other important issues of RFID development in the supply chain management of Iran's automotive industry. The results indicate that there is an exaggeration in counting the importance of cost issue in the development of RFID technology in supply chain management processes.

**Keywords:** Radio Frequency Identification (RFID) – Supply Chain Management – Structural Equation Modeling.

## 1. Introduction

The rapid development of information technology (IT), such as the Radio Frequency Identification (RFID), is one of the decisive factors to improve competitive advantage of enterprises (Lin, 2009). RFID was classified as one of the ten major innovation technologies in 2004 by CNN and one of the ten major IT technologies in 2005 by ZDNet (Wu, 2005). The value of the global RFID market is predicted to rise from USD 5.63 billion in 2010 to USD 24.13 billion in 2021 (Das and Harrop, 2010). RFID is a small tag containing an integrated circuit chip and an antenna, and has the ability to respond to radio waves transmitted from the RFID reader in order to send, process, and store information (Wu et al., 2006). It has a lot of advantages in comparison with barcode technology. RFID has more capacity for storing data on it, its tags are readable remotely and can be read simultaneously and better security for data would be provided by RFID. Therefore it's obvious that every industry have to pay great attention to this IT solution. According to Lin, there exist several barriers for a corporation to adopt RFID technology effectively and efficiently. For example there are financial requirements to prepare the facilities for RFID. There is the readability problem since RFID does not guarantee a 100% success rate in the item level. There is the coordination problem because the synergies would be sacrificed if some members in the supply chain do not adopt RFID technology (Lin, 2009).

RFID which is the abbreviation for Radio Frequency Identification is a

technology that uses radio frequencies or electromagnetic waves to connect an electronic device to a tag which is on an item. Two important part of this technology are tag and reader. Tag is the small device which is attached to the item we want to track it and reader is a device that identifies the presence of RFID tags in the environment, and detects the information stored on them. After that the reader can transmit and report the retrieved information to a computer system. Readers connect to applications by middle wares and there are antennas between readers and tags to amplify the connection between them.

Every industry needs the help of information technology and its solution-RFID- to track each part from the beginning to the end of its supply chain. Industry practitioners are constantly looking for innovative technologies to further improve both the quality of process-related data and thus the efficiency of their supply chain operations. RFID and its potential for seamless data capturing and processing, increased supply chain visibility, and significantly reduced cycle times is one of the most promising technologies today and for the foreseeable future. The adoption of RFID technology in supply chain processes is at the first stages. This includes all the processes that are associated with the movement and shipping of goods from raw-materials stage, up to the final products' like inventory management, assembly control, Procurement, order processing, distribution, warehousing, transportation, quality control and also theft control.

There are lots of factors influencing on the development of RFID in the supply chain management. According to Sanayei these factors can be grouped in 6 dimensions which include cost, technology, infrastructure, international standards, security and other factors. (Sanayei et al., 2011). At the first glance, the most important and effective factor seems to be the cost, which includes the cost of tags, readers, training, customization and IT infrastructures. In this paper the effect of this dimension will be discussed and compared with five other dimensions and the rank and importance of the cost issue in the development of RFID in the supply chain will be discussed.

## **2. Literature Review**

### **2.1. RFID Technology Background**

The first application of RFID technology was developed in 1939 and used by the British military in world war two. For the so called "identification friend or foe"(IFF) system, aircraft carry equipment which responds to electromagnetic transmissions in order to distinguish them from enemies. (EPCGlobal, 2004). Stockman's paper "communication by means of reflected power"( Stockman, 1984) represented a next step towards contemporary RFID systems. However, the first commercial applications appeared in the 1960s in form of electronic article surveillance systems, followed by applications in animal tracking, industrial use and payment on toll roads in the 1980s( RFID Survival,2003).

With advances in the technology and advantages over other automatic ID systems such as the barcode system, RFID becomes an important solution for automatic identification in supply chain operations.

#### **2.1.1. Components of a RFID System**

According to Sheffi (Sheffi, 2004), an RFID system which is used in supply chain operations typically consists of the following four elements.

- *Unique identification number/ Electronic Product Code (EPC)*

a unique identification number is assigned to a particular entity " in motion in the supply chain"(EPCGlobal, 2004,p.9). The EPC is the unique identification number which is used in the EPCGlobal Network Architecture. It is defined by the EPCGlobal tag data specification (EPCGlobal, 2005). The concept of the EPC allows for unique identification on all levels of implementation, i.e. each container, pallet, case or item can be individually identified.

- *Transponder*

The transponder is attached to or integrated in an entity. It carries the data. E.g. the EPC, and transmits the data to the reader when it moves through the electromagnetic zone of the reader. It contains a coupling element and a microchip(Finkenzeller,2003).

- *Networked readers and data processing systems*

The reader holds a radio frequency transmitter and receiver in order to read the information transmitted by the transponders. The readers pass the

collected data to processing systems such as manufacturing execution system (MES), supply chain management (SCM) system and enterprise resource planning (ERP) system (Chang et al., 2002).

- *Databases which store information and enable information exchange*

The databases which store information and enable information exchange are the above mentioned processing systems. With regard to the supply chain integration, the MES and the ERP system have a focus within the company whereas the SCM system typically includes information exchange with supply chain partners (Busch et al., 2003).

### **3. Hypothesis of Research**

The cost dimension is one of the top priorities in the development of RFID technology in supply chain management.

Every dimension of factors influencing on the development of RFID technology in supply chain has different effects and priorities.

### **4. Research Methodology**

Type of research based on the purpose is practical, because the results obtained of this study can be used for the development of RFID in industries, especially in Iran. In terms of method is descriptive-survey.

#### ***Method of data gathering:***

In this study, methods of data collection are in two forms, library and field, i.e. for the first one visiting the library, reading

books, articles and internet searches were conducted and after that field method was used for identifying and ranking each dimension of factors with influence on development of RFID technology.

#### ***Information gathering tools:***

When the researcher seeks to know exactly what and how to measure their variables, the questionnaire is used as an efficient tool for gathering information. (Omasakaran, 2006). for this study, a questionnaire with 28 questions and an scale ranging from 1 (strongly low) to 7 (strongly high) of LIKERT's scale has been used.

#### ***Validity of the measurement tools:***

Validity test is the ability of the desired tool in measuring the trait which test is made to measure it, and includes formal validity, predictive validity and content validity (moemeni, 2008). The questionnaire of this research is based on the standard questionnaire of the based research by Sanayei et al. in 2011, therefore has enough validity.

#### ***Reliability of the measurement tools:***

When a test is reliable, if we give it several times in a short period of time to groups of people, the obtained results are close together. Cronbach's Alpha is used to determine the reliability of the questionnaire (Memarzadeh, 2010). The coefficient was 0.904 which shows good reliability of the instrument and is much upper than 0.7.

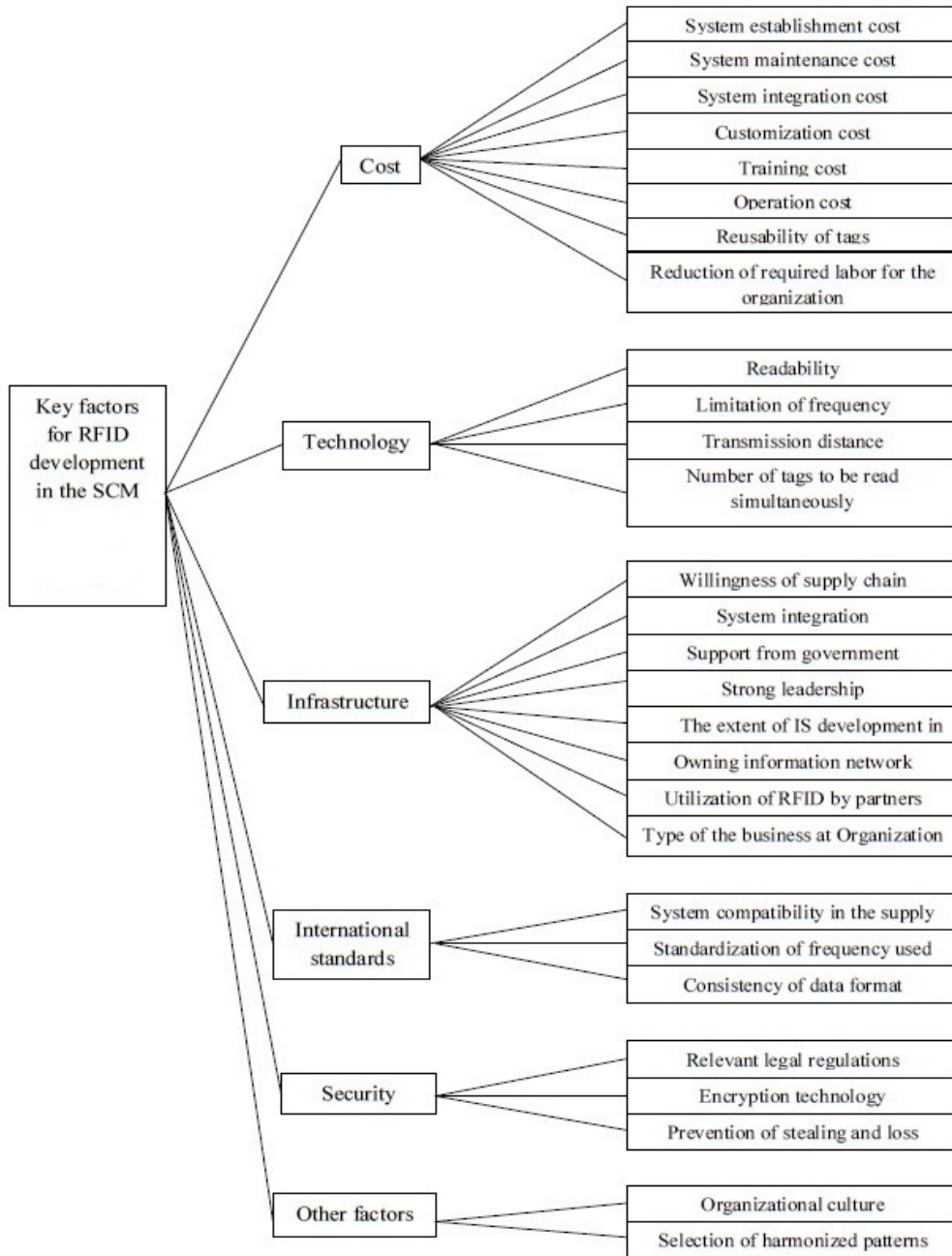


Figure 1: conceptual model of research (Sanayei et al., 2011)

**5. Data Analysis**

To validate the dimension analysis of RFID development in supply chain processes in this study, we applied SEM

(Structural Equation Modeling). It is a useful technique for testing and estimating causal relations between constructs.

The structural model fit was great with the results shown in table1, indicating a strong predictive validity. Figure 2 shows the structural equation model of the research.

**Table 1 indexes of the study**

Index	Value
CHI SQUARE	3509.89
DF	1344
CHI SQUARE/DF	2.611
RMSEA	0.032
GFI	0.91
AGFI	0.89

**5.1. Analyzing the Hypothesis First hypothesis:**

- The cost dimension is one of the top priorities in the development of RFID technology in supply chain management.

In statistical point of view this hypothesis can be written:

H0: The cost dimension is not one of the top priorities in development of RFID technology in supply chain management.

H1: The cost dimension is one of the top priorities in development of RFID technology in supply chain management.

The results of hypothesis 1 are depicted in table 2, as it's obvious the standardized coefficient is 0.72 and the t-value is 8.66 which is bigger than 1.96, therefore with 95% confidence it's possible to say The cost dimension is one of the top priorities in development of RFID technology in

supply chain management and the first hypothesis is supported.

**Second hypothesis:**

- Every dimension of factors influencing on the development of RFID technology in supply chain has different effects and priorities.

In statistical point of view this hypothesis can be written:

Ho: Every dimension of factors influencing on the development of RFID technology in supply chain does not have different effects and priorities.

H1: Every dimension of factors influencing on the development of RFID technology in supply chain has different effects and priorities.

The results of the value of the effect of each studying variable are mentioned in table 3.

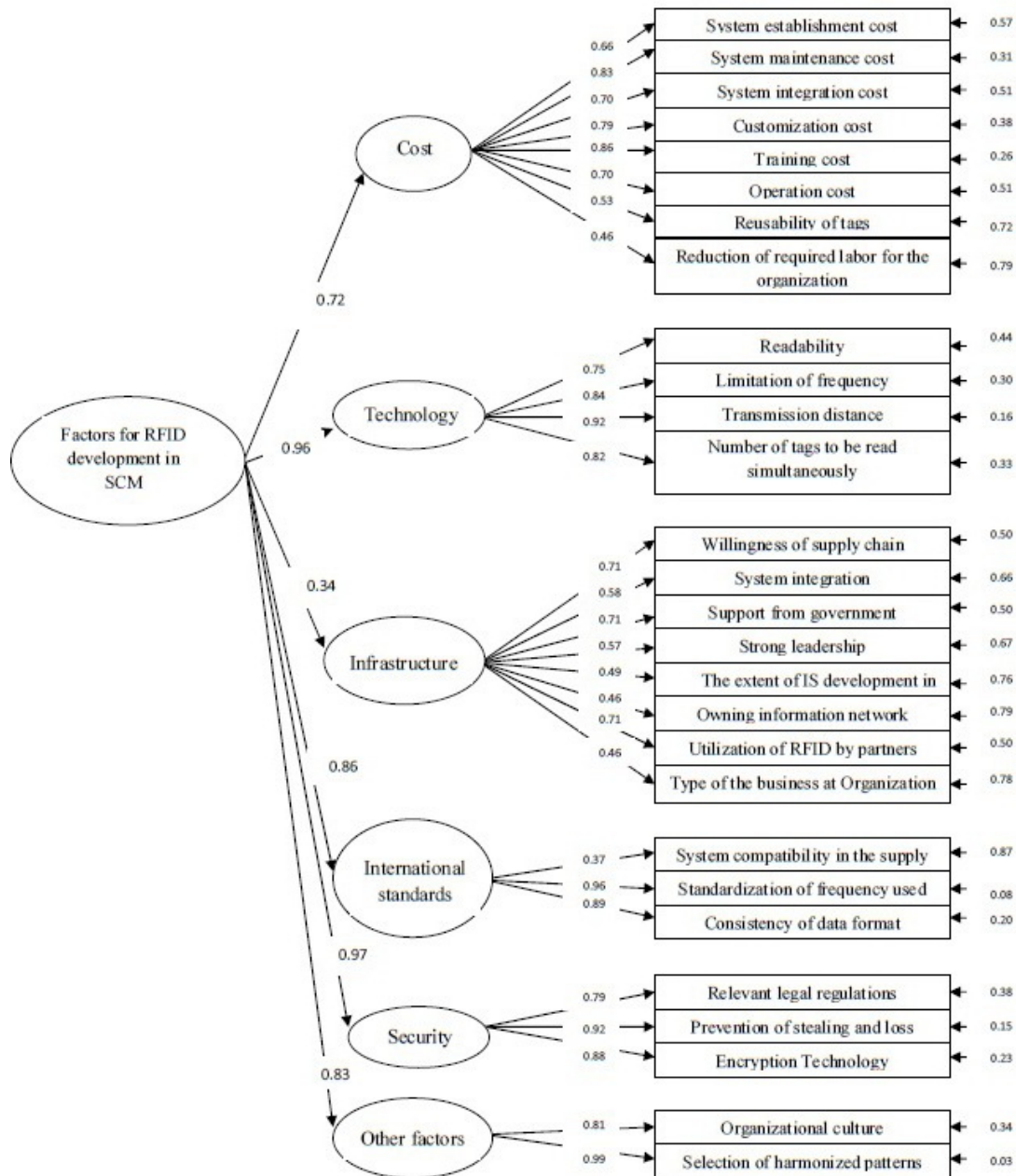


Figure 2: structural equation model

Table 2

Course of direction	T value	Standardized Parameter
Cost issues on RFID development	8.66	0.72

**Table 3 results of the value of the effect of each studying variable**

Factor	Standard coefficient	T value	Rank
Cost	0.72	8.66	5
Technology	0.96	15.62	2
Infrastructure	0.34	4.51	6
Standard	0.86	5.44	3
Security	0.97	13.63	1
Others	0.83	11.37	4

According to the findings as it's obvious the effect coefficient of Every dimension of factors affecting development of RFID technology in supply chain management is different and their sequence from high to low is the security, technology, international standard, other factors, cost and infrastructures.

## 6. Conclusion

The purpose of this paper was to study the place of the cost issue as a critical and important dimension in Radio frequency identification technology development in supply chain management among other dimensions which include technology, infrastructure, international standards, security and other factors. The results show that although at the first glance, the most important and effective dimension seems to be the cost, it is less important than security issue, technology issue and Standard issue. The cost dimension is included of 8 factors which are system establishment cost, system maintenance cost, system integration cost, customization cost, training cost, operation cost, reusability of tags and reduction of required labors for the organization.

The findings show that, among these factors, the training, maintenance and

customization costs have greater influence on cost dimension and its effect on the development of RFID technology in supply chain processes. "reduction of required labors for the organization" is the least important factor in cost dimension, showing that there is not any labor reduction policy for RFID technology implementation in the nation's auto-industry.

## References:

- 1) Busch, A., Dangelmaier, W., Pape, U., & R  ther, M. , *Marktspiegel Supply Chain Management Systeme – Potenziale, Konzepte, Anbieter im Vergleich*. Wiesbaden: Gabler, 2003.
- 2) Chang, Y., McFarlane, D., Koh, R., Floerkmeier, C. & Putta, L. *Methodologies for integrating Auto-ID data with existing manufacturing business information systems*. Retrieved June 12, 2005 from: <http://www.autoidlabs.com/whitepapers/cam-autoid-wh009.pdf>, 2002.
- 3) DasR. and Harrop D. P., *RFID Forecasts, Players and Opportunities 2011-2021*, IDTechEX, 2010.
- 4) EPCGlobal , *The EPCglobal network™: overview of design, benefits, & security*. Retrieved July 12, 2005 from:



- [http://www.epcglobalinc.org/news/position\\_handler.cfm?document=/News/008186%20Network%20Security.pdf.2004](http://www.epcglobalinc.org/news/position_handler.cfm?document=/News/008186%20Network%20Security.pdf.2004).
- 5) EPCGlobal EPC™ generation 1 tag data standards version 1.1 Rev.1.27 standard specification 10 May 2005. Retrieved July 12, 2005 from: [http://www.epcglobalinc.org/standards.technology/EPC\\_Tag%20Data%20Specification%201.1Rev%201.27.pdf, 2005](http://www.epcglobalinc.org/standards.technology/EPC_Tag%20Data%20Specification%201.1Rev%201.27.pdf, 2005).
  - 6) Finkenzeller, K. , RFID handbook: Fundamentals and applications in contact-less smart cards and identification. England: John Wiley, 2003.
  - 7) Lin, L. C. , "An Integrated Framework for the Development of Radio Frequency Identification Technology in the Logistics and Supply Chain Management". *Computers & Industrial Engineering*, Vol. 57, pp. 832-842, 2009.
  - 8) Lu, B.H.; Bateman, R.J. and Cheng, K.," RFID enabled manufacturing: Fundamentals, methodology and applications", *International Journal of Agile Systems and Management*, 1(1), pp. 73-92, 2006.
  - 9) Memarzadeh, A., Hajj Ali AKBARI, J. , "To study of the obstacles, the development of e-commerce, A case study of economical institution in ZANJAN province", *Journal Management*, Vol. 21, No 84, 2010.
  - 10) Momeni, M. , "Statistics analysis using SPSS", Tehran, KETABENO publication, second edition, 2008.
  - 11) Omasakaran "Research methods in management", translated by MAHDI SAEBI and MAHMOUD SHIRAZI, State management training center, 2006.
  - 12) RFID Survival , History of RFID. Retrieved July 7, 2005 from: <http://www.rfidsurvival.com/HistoryofRFID.html, 2003>.
  - 13) Sanayei, Ali; Amir Mehdi Ghazifard and Fariborz Sobhan-Manesh, "The Factors Influencing the Development of Radio Frequency Identification Technology in Supply Chain Management (Case study: IKCO)", the first conference of management and innovation. Iran, Shiraz, 2011.
  - 14) Sheffi, Y. RFID and the innovation cycle. *The International Journal of Logistics Management*, 15 (1), 1-10, 2004.
  - 15) Stockman, H. , Communication by means of reflected power. *Proceedings of the IRE*, pp1196-1204, October 1948.
  - 16) Strassner, M. and Fleisch, E., "Segment evaluation automotive-Applications of Auto-ID technology in the automotive industry", M-Lab Report, No. 15, St.Gallen, 2002.
  - 17) Wu, C. H., The new tools of logistics and circulation – Application benefit of RFID. *Taiwan Economic Research Monthly*, 28(6), 35–40 (Chinese edition), 2005.
  - 18) Wu N.C. , M. A. Nyystrom, T. R. Lin, and H. C. Yu, "Challenges to Global RFID Adoption," *Technovation*, vol. 26, 2006, pp. 1317-1323