

# A Study on User Satisfaction in u-IT New Technology Verification Projects

Focused on Domestic RFID/USN Pilot Projects\*

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## Abstract

Since 2004, the Korean government has been engaged in u-IT new technology verification projects in an effort to level up the industries. Recently, cases are reported that RFID/USN technology has been adopted and applied to business processes, mainly by large enterprises. However, further policies and support for the industries have been restrained because of unavailability of essential data for policy making. Therefore, the study examined the level of satisfaction among the actual recipient organizations from the 27 pilot projects to draw implications from the study result. Accordingly, the level of satisfaction was assessed in four project phases from RFID/USN building, utilization (technical quality), utilization (business quality), to maintenance. The study result showed that the technical stability reached a significant level but the level of satisfaction in the maintenance phase for the utilization and proliferation of the technology remained at the lowest. It suggested that a more specified policy support is needed in the maintenance phase to include inexpensive supply of tags and devices, a maintenance establishment of consortium to maintain reliability and continuity of service, strengthening internal competence of the beneficiary organizations for utilization of RFID/USN.

**Keywords :** u-IT, RFID/USN, Pilot project, Level of satisfaction, Policy supports

## 1. Introduction

Since 2004, the Korean government has

been engaged in promoting distribution and propagation of RFID<sup>2)</sup>/USN<sup>3)</sup> technology as it is the foundation to upgrade the existing

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2) Acronym of Radio Frequency Identification. A system composed of a tag containing a unique information of a person or a product and a reader that recognizes the information from the tag.

3) Acronym of Ubiquitous Sensor Network. A network that recognizes and manages the information through the Internet by attaching RFID to an object.

industries and for the industry integration with IT[1]. Accordingly, the government supported pilot projects have been carried out step by step while considering the characteristics of a new technology in terms of marketability and applicability.

Recently, the RFID/USN applied IT sector has experienced increasing investment flows to include policy and budget allocation. It surely is important to receive support and investment for this new technology to take root and be incorporated with different industries. On the other hand, the basic information and data have not been established sufficiently enough to properly evaluate the performance of the related projects and the technology application. Hence, it is necessary to evaluate the performance of RFID/USN pilot projects carried out in 2008 so that the investment efficiency can be raised while identifying areas for improvement.

The purpose of this study is to investigate the pilot projects in the categories of technology and service satisfaction, to identify constraints that hinder implementation and application of RFID/USN technology, finally to provide policy implications and suggestions.

The structure of this study is as follows. Section 1 is the introduction describing research goals and process. Section 2 is the review of RFID/USN industry trends and related researches. Section 3 is the proposal of research methods and composition. Section 4 is the result of survey. Final section is the explanation of policy implications and suggestions.

## 2. Theoretical background

### 2.1 RFID/USN Industry Trend in Korea

The industry in Korea has been actively

engaged in various RFID related projects involving quadripartite parties, i.e., the industry, academy, research, and public, institutions to pursue early settling in the RFID market and invigorate the industry.[5] To foster the technology development in the RFID industry, the government allocated and executed 31.4 billion Korean Won (KRW) in 2005 and will continue its investment for the total of 162.6 billion KRW by 2010. The goal is to take over 5% of the world's RFID/USN markets (approx. 0.95 billion US dollars) by 2007 and expand the market share up to 7% (approx. 5.37 billion US dollars) by 2010. However, the domestic market still remains at the stage of forming a small scale market, albeit showing the rapid growth[2][6].

As shown in <Table 1> , the domestic RFID market reached 236.9 billion KRW in the total annual turnover in 2006. The 2007 estimates expect the growth by 99.1% to 471.6 billion KRW. The average annual market growth is 71.2% in the period from 2003 to 2007, while the number of sales generating organizations have also continued to increase every year by 20 to 30 organizations, reaching 158 in 2006 from 52 of 2003. On the contrary, the range of increase in average turnover per organization still remains small, which indicates that the industry's profitability has not been improved due to the intensifying competition.

<Table 1> RFID Domestic Market Growth Trend  
(unit : m won)

Classification	2003	2004	2005	2006	2007
Turnover	54,905	123,585	154,775	236,854	471,631
Avg. Turnover per organization	1,056	1,670	1,446	1,668	2,985

(Data Source: Korea RFID/USN Association, 2006)

## 2.2 Trend of Government Supported Projects

The Korean government has been engaged in the projects as it recognized the industrial importance of RFID/USN technology. Accordingly, the government supported projects have been executed step by step as site tests, pilot projects, and expansionary projects. This step-by-step approach is adopted to embrace the characteristics of technology i.e., technology evolution, marketability, and market applicability[4][8].

Although the market is expanding with the RFID/USN application projects as led by private sectors throughout the industries to include automobile, pharmaceutical, logistics, and aircraft & shipbuilding industries, the industry's infrastructure development is still insignificant to create a favorable environment to generate and utilize the outcomes and the model cases from the application of the new technology. For the reasons, the need for the industry policies and support has become more important to enhance productivity of the entire industry; develop a successful model case for cooperative operation between industries and stakeholder partners; and provide an appropriate support for proliferation of the model case[1][10].

## 2.3 RFID Research Trend

Recently, studies regarding RFID are appeared and diffused in various forms, that is, survey research and technical development study, case study, practical

research and reported in many fields(e.g., service, machinery, manufacturing, food, IT, security, medical industry etc)[7].

## 3. Research Methods & Composition

### 3.1 Research Methods

The study aims to evaluate the level of satisfaction among recipient users and identify factors that need to be improved for the promotion of the domestic RFID/USN market. Accordingly, the study adopted a research method reviewing the preceding literature to identify the characteristics of RFID/USN service.

To accomplish the goal, the study reviewed the literature related to the technological characteristics and the characteristics of technology utilization from the preceding RFID/USN cases. The study identified the characteristics that can influence the level of user satisfaction in the RFID/USN services to use them for the construction of survey questionnaires. The survey was conducted on the participated recipient users of the 2008 pilot projects in an effort to analyze the level of satisfaction and the characteristics of the RFID/USN services. The 27 target organizations were individually visited for the survey.

The target samples were drawn among the participated recipient organizations of the 2008 u-IT new technology verification projects sponsored by National IT Industry Promotion Agency (NIPA)[2]. One recipient organization from the 27 recipient organizations was selected for each project. The survey questionnaires are largely divided into two parts. Part 1 is composed of questions asking general characteristics

of the survey respondents. Part 2 is subdivided into four stages from RFID/USN building, utilization (technical quality), utilization (business quality), to maintenance with questions asking the degree of satisfaction at each phase. The survey questions adopted the Likert scale of 5 points. The main points acquired from the survey are described as follows.

### 3.2 Subject Parties for Research

As a part of the government supported pilot and expansionary projects executed since 2007, the projects of technology verification and other selected projects have been carried out. At the same time, the industry standardization and the promotional activities have also been progressing along the projects[3][9].

As shown in <Table 2>, the subject parties for research were selected among the recipient organization of the 2008 support projects and the organizations that have been utilizing the RFID/USN service at least one year or more after the he he tion of the service establishment. The target unit for research analysis in this study is a organization. The survey respondents are limited to responsible personnel in the RFID/USN service related job of the selected organization for survey, who are experien ut; have understanding about the industry; and can provide a response to the questions on the level of RFID/USN service utilization and the organization's strategy for the service.

<Table 2>Service Provider & Recipient Organizations for 2008 u-IT New Technology Verification & Expansionary Projects

Project Name	Recipient Co. (Survey Respondents)
System establishment for consistent growth management for pigs, U-Pork, by utilizing u-IT	Bogyeong Pig Farm Cooperative
Establishment of u-IT based red dragonfly traceability system	Gyoesan Pepper Cooperative Corporation
Establishment of premium seafood production support system based on RFID/USN	Tongyeong City
Establishment of RFID infrastructure to foster premium rice brand	Haenam Okcheon Agricultural Cooperative
Establishment of u-IT comprehensive management system for diseases and insects of fruit bearing trees	National Institute of Horticultural & Herb Science
Establishment of RFID based system for distribution & information of precious stones & jewelry	Korea Jewellers Association, Inc.
u-Farming Village Tour pilot project	Oeiam-ri Folk Village
u-Premium Brand G Mark Mushhearttraceability management	Mushheart
Establishment of RFID based information system for distribution center	Gyeongin ICD
Establishment of seafood distribution information portal system utilizing u-IT	Gyeongin North Fishery Cooperative Seafood Processing Business Team
Establishment of safe and carefree u-foods environment	Namyang Dairy
Establishment of quality management system for traditional food based on u-IT	Sunchang-gun Bean Paste Product Research Institute
Establishment of clean Jeju, premium u-fish farm support system	Seunghye Fishery, Daegwang Fishery
RFID/USN based Jeju pig farm FCG management system establishment	Seogwipo City Livestock Cooperative
Establishment of distribution information system for alcoholic beverage (incl. 2009)	National Tax Service
RTLS/USN based u-Port establishment project (incl. 2009)	Korea Express Busan container Terminal
Development of gauge inspection management system using RFID	Korea Machinery-Meter and Petrochemical Testing & Research Institute (MPRI)
Establishment of integrated energy management system for public buildings based on power line communication	Jeju National University, Jeju Provincial Office
Establishment of energy conservation system for electric machinery in large buildings based on USN	Chungbuk Knowledge Industry Promotion Agency
u-IT based integrated management system for power generating facility (incl. 2009)	Korea Midland Power Co., Ltd.
Advanced comprehensive disaster prevention system for petrochemical complex based on USN	Hanhwa Chemical
Development of u-IT based integrated management system for marine transportation	Jin-In Marine Transportation
u-Wojeongsa cultural asset disaster prevention system	Wojeongsa
A pilot project for u-floriculture growth environment management system establishment	Goyang City Hall
Establishment of u-Defense (u-Army Experimentation Project)	Ministry of National Defense

### 3.3 Method of Indexing User Satisfaction Level

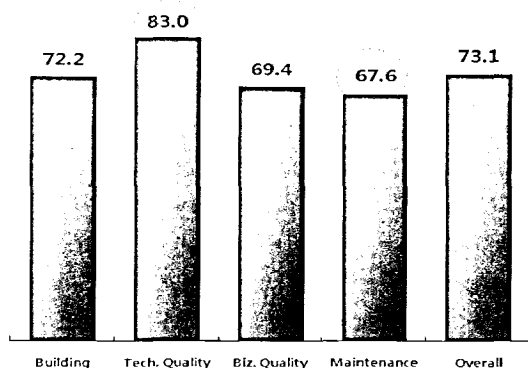
The level of satisfaction is trans-

calculated into an index by assigning a different weight to each survey question upon the degree of importance by phase to capture the level of satisfaction more precisely. The assigned weights are: building (30) - utilization (50) - maintenance (20) for the overall satisfaction and technical quality (20) and business quality (30) for the satisfaction level in the utilization area.

#### 4. Survey Result

##### 4.1 Overall User Satisfaction Level

As seen in [Figure 1], the overall satisfaction score in the u-IT new technology verification expansionary projects is 73.1, belonging to the descriptive category of 'satisfied'. It is interpreted that the overall satisfaction was raised from the high level of satisfaction in technological quality of the established system. The satisfaction level of technological quality in the utilization phase is 'very satisfied', while the building phase is 'satisfied' but close to 'very satisfied' range. The business quality in the utilization phase and the maintenance category are 'satisfied', but close to the range of 'acceptable' scores.



[Figure 1] Overall Satisfaction

##### 4.2 Satisfaction Scores at System Building Phase

As shown in the <Table 3>, the respondents showed their dissatisfaction by giving poor scores to the required time to build a system (66.8 points) and the required investment cost (72.0 points). In most cases, the completed and delivered system from the project was not optimized to the business specifics due to the insufficient time allocated for system building, raising a lot of complaints from the recipient about the available time period for system building. The reason for dissatisfaction in the area of investment cost is interpreted as coming from the insufficient budget allocation. The requests from the recipients in relation to the system were not adequately incorporated due to lack of financial means.

<Table 3> Satisfaction Scores of Detailed Categories at System Building Phase

Classification	Required Cost	Required Period	Technology & Quality	Suitability to Business Specifics	Status of Goal Accomplishment	System Building Phase Total
Scores	72.0	66.8	73.2	76.8	73.2	72.2

##### 4.3 Satisfaction Scores at Utilization (Technical Quality) Phase

As shown in <Table 4>, all survey categories at the utilization phase gained high scores, except the category of standardization. The highest score in the tag recognition is the result of the actual performance of tag recognition maintaining at around 90%. On the contrary, the

standardization has the lowest score. It is because the applied RFID/USN systems are not commercialized and standardized but specifically developed ones to the specifics of the individual project. It is also interpreted that the completeness of system has not yet reached the expected level by the recipient organizations.

<Table 4> Satisfaction Scores of Detailed Categories at Utilization (Technical Quality) Phase

Classification	Tag Recognition	Data Accuracy	Convertibility	Scalability	Speed	Ability of Technological Functions	Stability	Standardization	Technology Quality Total
Scores	91.3	89.8	80.9	79.0	86.0	80.8	81.2	70.7	83.0

#### 4.4 Satisfaction Scores at Utilization (Business Quality) Phase

As shown in <Table 5>, the business quality shows comparatively lower levels of satisfaction to the ones gained in the technical quality categories. It is because the system did not bring beneficial effects, such as cost or time reduction, to the recipient organizations. The low satisfaction in the category of cost reduction is because there was no cost saving effect from the system implementation projects other than the projects of which objective is energy conservation (e.g., an integrated energy management system in public buildings based on power line communication infrastructure, energy saving management system for electric facilities in large buildings based on USN infrastructure). In particular, the investment cost even rose in the projects of implementing RFID technology because of the additional cost to

procure tags. The low satisfaction of the time reduction category is interpreted as caused from the unskilled system operation by the recipients, resulting in extra time spending. It is because the system operators in the recipient organizations in general are not an IT intelligent user.

<Table 5> Satisfaction Scores of Detailed Categories at Utilization (Business Quality) Phase

Classification	Availability of Needed Functions	User Interface	Business Enhancement	Efficient Management	Time Reduction	Efficiency Achieved for Cooperative Work	Cost Reduction Effect	Business Quality Total	Utilization Phase Total
Scores	71.2	70.4	75.6	67.6	61.2	72.0	60.4	69.4	75.7

#### 4.5 Satisfaction Scores at Maintenance Phase

As shown in the <Table 6>, all survey categories at the maintenance phase generally show a low level of satisfaction. The cost level category marked the lowest score, which is from many complaints due to the financial burden for maintenance cost. The communication between the recipient organizations and the service provider was also not smooth because they are physically located far apart. This impaired the activities to provide prompt and active maintenance caused low level of satisfaction among the recipients. Overall, the survey revealed that recipient organizations are not satisfied in many areas during the phase of maintenance. It is analyzed that the recipients feel burdened that they have to incur the cost for system maintenance while they have not seen any clear outcome or effects from the system installation. This problem is deemed to be caused from no

financial support provided for the cost of maintenance after the system installation is completed because the most cases of u-IT new technology verification & expansionary projects are a pilot type project.

<Table 6> Satisfaction Scores of Detailed Categories at Maintenance Phase

Classification	Cost Level	Supporting System	Speediness	Quality	Communication	Maintenance Total	Total Score
Scores	62.0	69.6	68.4	69.2	70.0	67.6	73.1

## 5. Policy Implications & Suggestions

### 5.1 A Strategic Approach Is Needed to Support Priority Area First

When the industries and the targeted business fields do not have a basic computer infrastructure, the level of understanding is low among the recipients. Therefore, it is hard to expect to have a successful utilization of the system in a short period of time. In order to harvest a visible outcome in one or two year time frame, the support with priority should be given to the industries or business fields that are currently equipped with a system infrastructure that can be joined with RFID system and generate outcomes in a relatively near future. For the long term aspect, the support should be oriented to establish a high-value generating infrastructure in the agriculture, livestock, and fishery industries. If the supported recipients are small and medium agricultural cooperations, the scale of system utilization and the expansionary effect are limited. Accordingly, it is more desirable to give a priority for support to either an organization representing

a single business item throughout the nation or an allied business organization

### 5.2 Policy for Mandatory Utilization of RFID to Induce Industrial Productivity Enhancement

The reactions from the recipient organizations were passive in many cases of RFID system implementation because of the financial burden to procure RFID tags. There was even a case that the system operation was ceased in the middle of operation due to the cost burden to purchase RFID tags. In the case of the information system implementation for alcohol beverage distributors, the RFID tag costs raised the unit selling prices of the products, and thus caused productivity deterioration, imposing a burden to the manufacturers. Such perception that the RFID system implementation may rather cause losses can be overcome by making a policy that enforces mandatory utilization of the system in the related industries. This will significantly encourage the recipient organizations and business entities to actively participate in the project and adopt the system.

### 5.3 Improvement of Post Supporting System to Induce a Better Environment for Utilization

The current one year term is too short to feel any favorable outcomes from the system implementation, particularly adopting a new technology. To accumulate appropriate level of data and enjoy its value from the system utilization, it requires several years of system utilization and subsequent upgrades at minimum. Nevertheless, the policy support

is not enough to sustain the entire process and, in some cases, it is reported that the system utilization after implementation is restrained due to the cost burden and insignificant level of expected effect.

The majority of recipients feel excessively burdened from the cost for maintenance. They also expressed the difficulty in cooperative relationship with the service provider for maintenance. In addition, the recipient requested policy support that can improve the environment to continuously utilize and maintain the system, such as support for the lack of an operational expert in the institution and the burden of adaptation to the changes in process.

The goal to adopt the RFID/USN system is to create new service products by obtaining new or more accurate information from the new technology while linking it with the existing system. Hence, the support system should be designed to help resolve diverse problems for the maintenance and management of new services, covering a range of areas such as integration of various systems and operational support, changes in internal business process, and improvement of utilization capacity.

## 6. Conclusion

For the advancement of the existing industry and to promote distribution and propagation of RFID/USN technology as a foundation for the IT integrated industries, the Korea government has led the pilot projects step by step in a consideration of the characteristics of a new technology in terms of marketability and applicability. As a result, the utilization of RFID/USN technology has been growing voluntarily, though mainly centered on the large scale organizations. The number of service

providers has also increased. While the RFID/USN technology has gained more attention, the government's role is getting more important in order to put this early growing stage industry into the right and mature trajectory.

Accordingly, the study conducted a survey to investigate the 27 recipient organizations of the 2008 pilot projects in the categories of technology and service satisfaction, quality satisfaction when applied to the business, and maintenance issues. To identify constraints that hinder implementation and application of RFID/USN technology, the satisfaction levels at a different project phase were analyzed.

The study results revealed that the score gained for the overall satisfaction was 73.1 points. The utilization sector (technical quality) showed a very satisfied level with score of 83.0 points. It is mainly from the high scores gained in the categories of tag recognition (91.3 points) and data accuracy (89.8 points). The lowest satisfaction was seen in the maintenance phase with the score of 67.6 points. It was mainly caused from the burden of cost level (tag price), dissatisfied service support system, as well as the recipients' dissatisfaction in other various areas of maintenance phase.

In conclusion, the study clarified that the technical stability of the RFID/USN technology has accomplished a significant status. Nevertheless, it is now necessary to come up with specified efforts from the industry and the government to raise user satisfaction at the phase of maintenance to further expand the utilization and propagation. Further studies are demanded on the categories of dissatisfaction in the maintenance phase as they are identified by survey and suggested by the actual users.



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# u-IT 신기술 검증프로젝트의 사용자 만족도에 대한 연구

임규관 · 임영환

## 요 약

2004년부터 정부는 기존 산업의 고도화를 위해 RFID/USN활용 지원사업을 단계적으로 추진해 왔다. 최근들어 일부 대기업을 중심으로 RFID/USN활용 성과들이 확인되고 있으나, 추가적인 산업 정책 및 지원을 위한 기본적인 정책 자료가 부족한 실정이다. 이에 2008년도 시행된 27개의 시범사업을 대상으로 실 수혜기관의 만족도를 조사하여 RFID/USN의 구축단계, 활용단계(기술적 품질), 활용단계(업무적 품질), 그리고 유지보수단계 등 4단계에서의 만족도를 평가하고, 시사점을 도출하고자 하였다. 연구 결과, RFID/USN 기술의 안정성은 상당한 수준에 도달하였으나, 활용 및 확산을 위한 유지보수단계의 만족도가 가장 낮게 나타났다. 정책적 시사점으로 태그 및 기기의 저렴한 제공, 서비스 신뢰성 및 지속성을 위한 유지보수 컨소시엄 구성, RFID/USN 활용을 위한 수혜기업의 내부 역량 강화 등 RFID/USN 유지보수 단계의 구체적인 정책지원등을 제시하였다.

주제어 : RFID/USN, 시범사업, 만족도, 정책지원