# Developing Ubiquitous Computing Service Model for Family Restaurant Management

**Kyung Kyu Kim, Chris Seoyun Choi, Sungyul Ryoo***
Graduate School of Information
Yonsei University, Seoul, Korea

*ABSTRACT*

*The purpose of this study is to seek new u-business services in restaurant management. Using the concept of business model methodology in family restaurant management domain, this study identifies customers' needs in services at the stage of management of purchase of materials, the production management, and the sales management. In addition, this study suggests two killer applications of a family restaurant management linking with the latest ubiquitous computing technologies: the service of the customer-oriented menu recommendation and the service of the inventory-oriented menu recommendation. These findings may offer practical insights in the context of ubiquitous service model of restaurant management.*

***Keywords***: *Business Model, Killer Application, Ubiquitous Computing, u-Restaurant Management.*

## 1. INTRODUCTION

Ubiquitous computing is a concept that has emerged through deliberation on methods of which computing technologies are used in all activities conducted by men in their daily lives [1]. Emergence of ubiquitous computing creates a new concept of space connecting offline with online [2], [3] while that of the online virtual space has helped physical space that has been far away from human cognizance re-perceived as a subject of new ubiquitous computing services.

On the other hand, u-City is to develop new services by overcoming the spatial limit of information technology and considering human activities and will become a useful research area to secure practical aspects and acceptability of models of new ubiquitous computing services. However, the existing studies related to u-City in Korea and other countries mainly focus on analysis of element technologies for establishment of fundamentals for ubiquitous computing environment [4]-[6], definition and evaluation of conceptual services [7]-[9] and development of system and applications [10], [11]. In conclusion, systemic methodologies to substantially confirm which spatial services are required and how to establish services based on such requirements are almost non-existent [12].

Thus, this study aims to develop new services of ubiquitous computing in the area of family restaurant management based on the business model methodology. This study example is not only a service model that can be utilized for u-City, "a future city" [13] but it also belongs to the area of city management that has greatest spill-over effects among ubiquitous computing services [14]. Especially, the model of family restaurant management services using ubiquitous computing technology will be able to provide stakeholders of restaurant business with benefits like cost reduction through effective management of food materials, development of a menu that is fit to customers' needs, and so forth.

* *Corresponding author. E-mail : ryusr@yonsei.ac.kr*
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## 2. THEORETICAL BACKGROUND

Ubiquitous computing can create new business values through expansion of the concept of space and innovation of interaction with human beings. For expansion of services using ubiquitous computing technologies and making this into business, clear identification of values of services provided to target customers to use the relevant service and the validity of the values shall be prepared. In this aspect, the concept of business models can provide a very useful methodology.

### 2.1 Business model methodology

Business model is a concept to explain main elements constituting business of a company or to describe specific business [15]. As this business model provides systemic composition and methods to approaches necessary to create new customers and business values [16], there is a high probability to be used as a methodology to develop ubiquitous computing services [17]-[18].

Recent studies define business carried out in the ubiquitous environment as u-Business [3], [17], [19]. However, some of the u-Business models diversely presented so far are carried out as an approach with a technological perspective rather than a user perspective and there is a risk of low acceptability of users and hindrance to expansion of u-Business as services failing to reflect users' requirements are presented [17], [20], [21].

On the other hand, u-Business is considered as expansion of

the existing e-business rather than a new concept of service models that are far from the existing services [17], [18], [21]. Thus, this study aims to develop ubiquitous computing services based on the methodology of planning e-business presented by [22].

## 3. UBIQUITOUS COMPUTING SERVICE FOR FAMILY RESTAURANT

This study aims to present u-Restaurant management services that can improve both transactions among companies and customer satisfaction. It also aims to find a basic model for evaluation of possibilities of u-Business model as business not only for early practical use of technologies but also for support of the relevant domain in the future.

For this, one among family restaurants located in the COEX Mall has been selected based on the standards presented in the previous chapter. Problems were derived out through analysis of operation process of the restaurant while methods to introduce new ubiquitous technologies to solve the problems were explored.

Analysis for development of killer services of ubiquitous computing is established based on steps of analysis of u-Business opportunities through studies into the existing value system [23], development of u-Business model, identification of u-Business killer services, and identification of resource system of u-Business killer services [Figure 1].

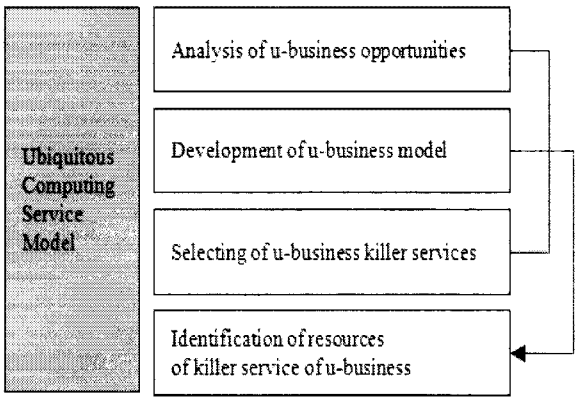


Fig. 1. Research procedure

### 3.1 Analysis of market opportunities

Analysis of business opportunities takes place at the stage to write a scenario by summing up work behaviors step by step to derive new services and to find needs unmet at each stage or needs currently not presented. In other words, it aims to find an opportunity to improve the existing value system or to create new values. For this, value systems of u-Restaurant management services were analyzed and a research into users' needs was conducted toward actual target customers of this service.

**3.1.1 Analysis of process of behaviors**: This is a process to analyze opportunities of provision of services in the area where development of ubiquitous computing services is intended and analysis of the relevant market and customers takes place. At this stage, opportunities for new services are explored through analysis of the existing value system [23] while decision making or process of behaviors of target customers and unmet needs are identified.

**3.1.2 Interview on customers' unmet needs**: Interview studies were conducted to find customers' unmet needs for detailed services in u-Restaurant management. First of all, to compose interview materials, contents validity of work process made through literature review of restaurant management was confirmed through request to people responsible for family restaurant management.

Then, this study conducted semi-structured interviews as this method can secure rich and diverse answers and is useful to acquire new information [24]. Interview studies were carried out by presenting examples of detailed services, questioning about what the customer finds it inconvenient, and having the customer describe problems. Interview at this stage was carried out toward staffs responsible for domestic family restaurant management. Customers' unmet needs in each detailed service analyzed through interview studies are as follows.

3.1.2.1 Customers' unmet needs in services at the stage of supplier management and management of purchase of materials

- There is no information or ways through which safety can be objectively confirmed with total inspection of delivered food materials.
- There is a problem coming from the difficulty to confirm information on barriers to safety that may arise in the process of production of food materials.
- There is no way through which whether delivery was made through distribution process that is appropriate to characteristics of keeping of food materials (freezing, refrigeration, dry cooling) can be decided. There is a problem of decay of food materials a few days after warehousing without confirmation at the time of total inspection.

3.1.2.2 Customers' unmet needs in services at the stage of production and quality (sanitation) management

- There are no accurate standards on factors affecting sales in environment surrounding the restaurant and it is difficult to obtain information on such standards. In other words, there is no information on exhibitions held at the COEX, potential customers in the relevant exhibition, the scale of the potential customers, and so forth and there are many problems when acquiring such information.
- While amount of materials necessary shall be calculated based on the expected weekly sales estimated every week, it is difficult to estimate economic amount of order as the unit of materials used for the relevant menu and the unit through which orders are made to suppliers are different from each other.
- In terms of securing food safety which is the most important element in restaurants, security of objectivity of standards and the relevant information, storage and management are difficult.
- It is difficult to be aware of all elements of barriers to

safety that may arise in the whole process of restaurants.

3.1.2.3 Customers' unmet needs in services at the stage of service and sales management

- While the most secure way to reinforce customers' satisfaction is to reduce the whole length of time from customers' waiting and ordering to eating, it is difficult to identify customers' circumstances and employees' works taking place in the whole area of the restaurant on a real-time basis.
- It is difficult to identify dispositions of and information on customers when recommending a menu tailor-made to customers to improve customers' satisfaction and to reduce the waiting time.
- As for food materials used for a specific menu, loss occurs from needing to close the menu when the sale of the specific menu is slow.
- While customers' complaints are raised based on delay in responding to their requests in the restaurant, there is a problem of increase of personnel expenses.
- It is very difficult to make a plan on a real-time basis by considering selection of potential customers and inventory information when establishing local marketing plans that are appropriate to circumstances around the restaurant. Information on inventory to be consumed first and information on the menu using the relevant inventory are not easily associated.

### 3.2 Development of business model

**3.2.1 Deriving detailed services to solve unmet needs**: Detailed services by each gradual work process of u-Restaurant management services were derived to solve customers' unmet needs identified through interviews. As can be seen from table 1, there are 11 including three at the stage of supplier management, three at the stage of production management, and five at the stage of service management.

Table 1. u-Restaurant management services

| Process | Intelligent u-Services |
|---|---|
| Supplier and Material Purchase Management | - Service of tracking the location information of food materials<br>- Service of tracking the production process of food materials<br>- Service of tracking the distribution process of food materials |
| Production and Quality Management | - Service of sales projects<br>- Service of calculating the necessary amount of food materials<br>- Service of food safety evaluation |
| Service and Sales Management | - Service of the customer-oriented menu recommendation<br>- Service of the inventory-oriented menu recommendation<br>- Service of the waiting time estimation<br>- Service of the customer response<br>- Service of the local marketing |

**3.2.2 Value proposition and definition of services provided at each step of customers' decision making**: Based on unmet needs of the subject of u-services and the following core benefits identified in value propositions, detailed services to satisfy customers' needs can be linked.

- Services enabling to collect information related to safety of food materials when warehousing, to select methods of keeping that are appropriate to characteristics of the relevant material, to manage information on the expiry date of food materials and to deliver considering advance coming and going of food materials to improve efficiency of the restaurant's management of food materials.
- Services enabling to manage safety information over the whole process from supply of food materials to delivery to customers as well as rational estimation of food materials and selection of economic amount based on it to improve efficiency of management of information on safety of products produced by the restaurant and to maximize reduction of prime cost through maintenance of economic amount of inventory.
- Services enabling sales increase and inventory consumption by improving customers' satisfaction with responsiveness to customers and services and using customer information to improve customers' satisfaction and to maximize sales.

### 3.3 Selection of killer application

**3.3.1 Design of service evaluation model**: This stage is to derive the most useful killer service by evaluating various detailed services derived for u-Restaurant management services. Items of evaluation used in this study were selected based on variables proved in the representative theory for service use, TAM [25] as well as the Theory of Planned Behavior [26], studies by [27]-[29], the GBF theory [30], the Trust theory [31], the Risk theory [32], and so forth. Also as for u-Restaurant management services, companies were selected as main customers and the following three items for service evaluation were drawn considering the analysis level of organizations.

- Usefulness: the possibility that the relevant service is helpful to works.
- Economical efficiency: the possibility that much cost is not invested for use of the relevant service.
- Universal usability: the possibility that the relevant service is universally used by many people

**3.3.2 Service evaluation**: Interview tools were developed for the final questionnaire to evaluate 11 services presented for solving customers' unmet needs based on three items of evaluation of u-Restaurant management services.

Based on verification of statistically significant differences among services through MANOVA [Table 2] for data collected through questionnaires answered by restaurant managers and management staffs, the means of values of evaluation items of each service were estimated and the means' totaled value was estimated as the evaluation index of each service. The final killer application was selected through ranking based on the evaluation index of each service.

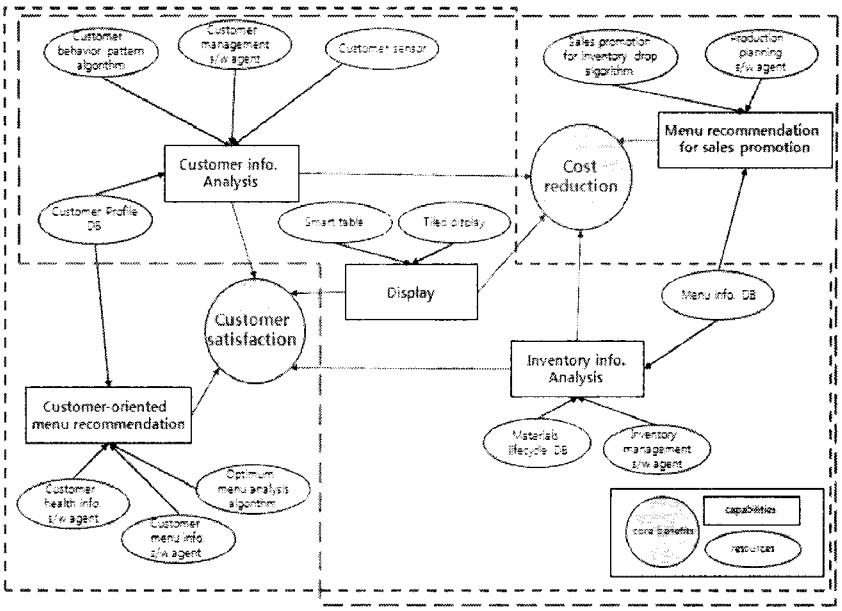


Fig. 2. Resource map for killer applications

Finally, based on the statistical analysis of 20 questionnaires collected, there were the following five services derived as killer application of u-Restaurant management: 1) service of the local marketing, 2) service of the customer-oriented menu recommendation, 3) service of the inventory-oriented menu recommendation, 4) service of the waiting time estimation, 5) service of the customer response,

Table 2. MANOVA

| Effects | | value | F | Sig. |
|---|---|---|---|---|
| Intercept | Pillai's Trace | .987 | 5183.38(a) | <.005 |
| | Wilks' Lambda | .013 | 5183.38(a) | <.005 |
| | Hotelling's Trace | 75.121 | 5183.38(a) | <.005 |
| | Roy's Largest Root | 75.121 | 5183.38(a) | <.005 |
| Service | Pillai's Trace | .205 | 1.53 | .036 |
| | Wilks' Lambda | .805 | 1.56 | .031 |
| | Hotelling's Trace | .231 | 1.58 | .026 |
| | Roy's Largest Root | .164 | 3.42(b) | <.005 |

[a] Exact statistic
[b] Design: Intercept + Service

### 3.4 Identification of resources of killer service of e-business

Among five services derived as killer application of u-Restaurant management, the "service of the customer-oriented menu recommendation" is a killer service in terms that it can improve customers' satisfaction, the greatest asset of restaurants and the "service of the inventory-oriented menu recommendation" is the other in terms that it can reduce cost through efficient and economic use of materials in restaurants. On the other hand, there was a high level of interrelation between the "service of the customer-oriented menu recommendation" and the "service of the inventory-oriented menu recommendation." The resource map drawn based on methodologies of business models for killer application is as shown in figure 2.

**3.4.1 Killer application 1**: Killer application 1 of u-Restaurant management services is the "service of the customer-oriented menu recommendation" that can bring about profits by improving customers' satisfaction based on information on customers visiting family restaurants, food materials, and so forth. The short dashed line on figure 2 is the requirement map that schematizes core benefits for this service.

**3.4.2 Killer application 2**: The requirement map that schematizes core benefits, key capabilities, and relations to resources for the "service of the inventory-oriented menu recommendation", killer application 2 of u-Restaurant management services is presented through the long dashed line in figure 2. This service provides the core benefit of cost reduction by accurately analyzing the customer and inventory information, and by recommending menu for sales promotion.

## 4. CONCLUSION

Ubiquitous computing technologies provide new opportunities to create innovative business services. However, many studies into ubiquitous computing services focus on element technologies of ubiquitous computing while systemic methodologies are absent.

Thus, this study analyzed ubiquitous computing killer services for restaurant management based on methodologies for e-business presented by [22]. Also, in this study, killer services were selected through evaluation of results from analysis of ubiquitous services by actual potential customers and security of its validity was promoted based on associating element technologies of ubiquitous computing currently being developed with killer services.

Methodologies carried out in this study are expected to enable to graft the existing services on to new services by ubiquitous computing technologies. Also they will provide the

insight to grasp opportunities to provide customer-oriented, value-oriented and innovative services. That is to say, development of ubiquitous computing services based on methodologies to develop e-business services is expected to contribute as the most appropriate tool to develop ubiquitous computing services in terms that it applies procedures and methods identifying men's behavior process, needs and all resources to solve these.

The limits of this study are as follows. First, there was a small number of valid questionnaire and the future studies using samples with representation are considered to be necessary. Second, as identification of resources necessary for each service in this study was based on analysis of contents of technology development in the "Project to Develop Proprietary Technology for Ubiquitous Computing and Network" of the Ministry of Knowledge and Economy, additional studies for ubiquitous computing technologies in wider areas will be necessary. Third, while there was no design, materialization and evaluation of information system for ubiquitous services in this study, methodologies to develop e-business services are expected to be helpful in the process of design and analysis of actual information system in the future. Finally, analysis of profit model and service growth model in the contents of establishment of business model was not conducted and these can be considered in the future studies.

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**Kyung Kyu Kim**

He is a Professor of Information Systems at Yonsei University, Korea. He has been a faculty member at University of Cincinnati, Pennsylvania State University, and Inha University. He has published his research works in Accounting Review, Journal of Management Information Systems, MIS Quarterly, Decision Sciences, Information and Management, Database, and Journal of Information Systems. His main research interests are B2B e-commerce, supply-chain management, and knowledge management.

**Chris Seoyun Choi**

She received the B.A. in Digital Media Art from San Jose State University, U.S.A. in 2001 and also received M.S. in Multimedia from Yonsei University, Korea in 2004. She is currently a Ph.D. student in Digital Culture Contents at Yonsei University. Her main research interests include social networking services, ubiquitous computing, and virtual communities.

**Sungyul Ryoo (Corresponding author)**

He received his Ph.D. in Information Systems from Yonsei University, Korea in 2008. He is currently a postdoctoral researcher at Yonsei University. His main research interests include knowledge management, supply chain management, and ubiquitous computing service.