Demand level investigation for future domestic system

Shuki Inoue[1], Eiji Mimura[1], Shingo Aoki[2] and Hiroshi Tsuji[2]

1) Department of Energy Use R&D Center
The Kansai Electric Power Co., Inc.   Hyogo, Japan
2) Department of Computer Science and Intelligent Systems
Osaka Prefecture University, Osaka, Japan
(Tel : 81-72-254-9353; Fax : 81-72-294-9915)
(inoue.shuuki@d4.kepco.co.jp)

Abstract: Although the future domestic system has been visualized as smart house, it is difficult to decide if each product or service in smart house is useful or not because value senses in our daily life are diversified. To forecast the strength of demand on future domestic system, this paper describes questionnaire analysis. Creating six kinds of future domestic systems which innovate our daily life, we design questionnaire which consists of question on personal attributes, value senses and requirement on designed systems. This paper also introduces original analysis methods and illustrates findings in the responses of questionnaire.

Keywords: *Future Assessment, Home Energy Consumption, Value Analysis, Market Analysis*

I. INTRODUCTION

To assess the future domestic system, experts have tried to create future living environment called smart house [1]. However, experts often created their ideas not based on consumers' requirement but on technical possibilities. Therefore, some ideas may fall into fans but do not contribute to new product and service development. In fact, our daily life is diversified based on our variety of value senses: convenience, housework support, health case, security, comfort and global environment.

In this research, we will create life domain map. Introducing six daily life scenes (inventory control for household, media database, health care by an electric dietician, home security service, daily case for children and aged persons, total control for illumination and air-conditioning), we will illustrated future domestic images. Each image allows us to create future domestic items. To find out the relation among personal attributes, value senses and their items, we will design questionnaire. Then, we will demonstrate findings from the questionnaire and finally describes future plan.

II. FUTURE DOMESTIC SYSTEM

First, in order to design questionnaire on future domestic system, let us imagine future artificial life. Referring to the conventional future assessment described in [2] [3], we have conducted brain storming. It took about three months.

Under the assumption that our daily life consists of communication, input, work, learning and entertainment,
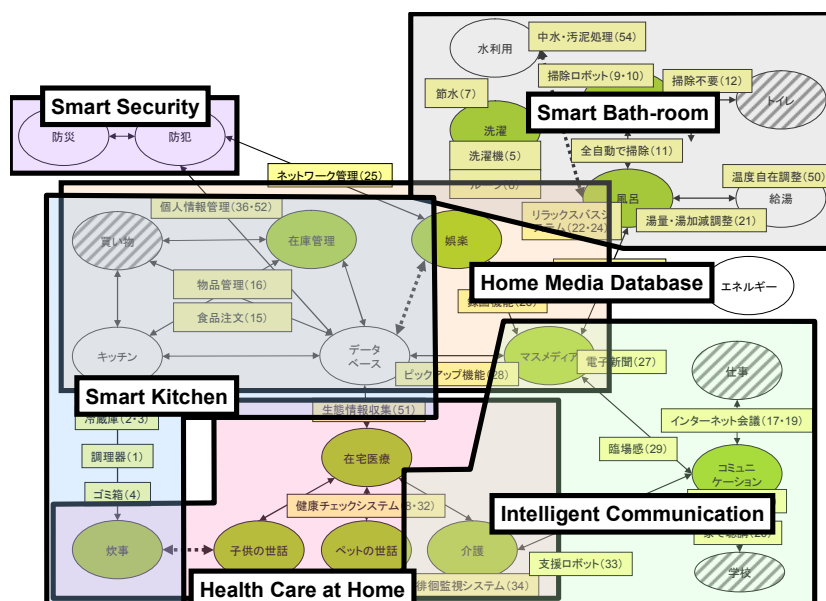

Fig. 1 Idea Map for Future Domestic System

the future domestic system shall satisfy our values such as healthy life, comfortable life, sustainable environment, and secure living space. The household support and convenience are another value senses in our life.

Based on value senses in our daily life, we depict imaginary future scenes in home security, intelligent air conditioner, smart kitchen and adaptive illumination. The idea on product domain has been induced by analyzing relation between place and action as shown in Figure 1.

While there are six categories in the product domain map, the example for home security service is shown in Figure 2. This figure implies that intelligent sensors with image recognition and voice recognition should connect with external network. We have collected a lot of suggestion from the product domain map.
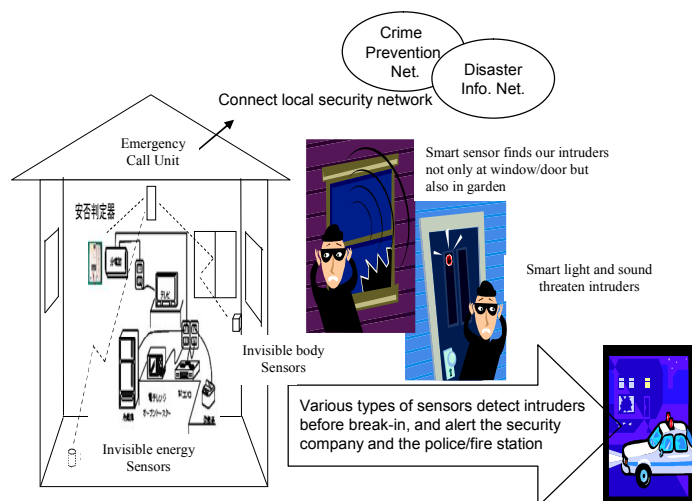

Fig. 3 Constitute of Questionnaire

Fig. 2 Future Home Security System

III. QUESTIONNAIRE DESIGN

Paying attention on daily value senses, we should find out relation between them and future domestic items. Because we prepare six kinds of value senses, there are fifteen pair wise comparison. Because we are afraid some consumers are sensitive for questionnaire (in other words, they may not have confirmative opinion on value senses), the questionnaire asks preference among value senses twice. The overview of questionnaire is shown in Figure 3 where some items are borrowed from [4] and [5].
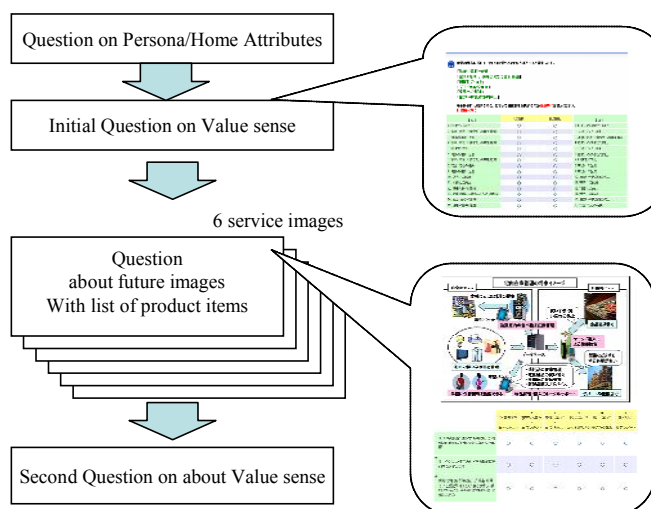
1. Future domestic items

From six kinds of future life scenery, we imagine future domestic items. In principle, these future domestic items are illustrated in scenery figures as shown in Figure 2.

Our demand level investigation has two layers: whether you like to use the illustrated items or not, and whether you think if most people like to use them or not. On the other hand, it has three requirement strengths: it will be in five years, in ten-twenty years or needless.

2. Value sense and life style

As introduced in the previous chapter, we first consider on four kinds of value senses: healthy life, comfortable life, sustainable environment, and secure living space. Because cost expresses the strength of requirement, we do not consider it as value. Then based on the introduced future domestic items, two are added: housework support and convenience.

Because life style as well as personal attributes and house attributes may affect on the strength of demand level, the questionnaire includes questions on behaviour of responders and their family.

3. Response collection

We conducted strata sampling for response collection. The stratum consists of gender and age. The age strata has five segmentation: 20's, 30's, 40's, 50's and elders than 60. Each stratum includes 103 samples and then totally the sample number is one thousand and thirty.

IV. RESULT OF ASSESSMENT

1. Overview

On occupation, twenty two percent of responders are housekeepers. There are also sixteen percent for office clerks and thirteen percent for engineers/ technicians.

On the demand levels for six kinds of future life scenery, home security service is the highest: 60 percent of responders like to live in the illustrated secure home environment in five years. As another remarkable result, fifty percent of responder requests to improve weak persons (children and aged persons) support in five years. The rate of responders who like to use adaptive illumination living space is fifty three percent.

On the other hand, most responders are afraid the excessive service in another scene, especially in inventory service. The detail rate of responders is shown in Table 1.

Table 1   Future Assessment for New Home Service

#		In Five Years	In 10-20 years	Worthless	Total
S1	Inventory control for household	354 (34%)	346 (34%)	330 (32%)	1030 (100%)
S2	Media database	415 (40%)	335 (33%)	280 (27%)	1030 (100%)
S3	Health care by an electric dietician	438 (43%)	339 (33%)	253 (25%)	1030 (100%)
S4	Home security service	619 (60%)	296 (29%)	115 (11%)	1030 (100%)
S5	Daily care for children and aged persons	564 (55%)	343 (33%)	123 (12%)	1030 (100%)
S6	Total control for illumination and air-conditioning	550 (53%)	295 (29%)	185 (18%)	1030 (100%)

2. Value sense

The result is summarized in Table 2. Many responders put their importance on their health care (32%) or home security (18%). Then Table 2 also shows that there are so many responders (26.5%) who cannot put importance on the unique value sense.

From the result of age strata in Table 2, importance on value sense strongly depends on the age of responders. In fact, there are clear differences as follows: For convenience, 20s is the highest. For housework support, 30s is the highest and for health care, 50S is the highest. On the other hand, 60 and more put their importance on sustainable environment.

The pair wise comparison can be described in VS-map [6] where the drawing algorithm is shown in Figure 4. The VS-map visualizes preference on value senses as bird-eye where health care and home security have large circle and housework support and sustainable environment have smaller circle totally.
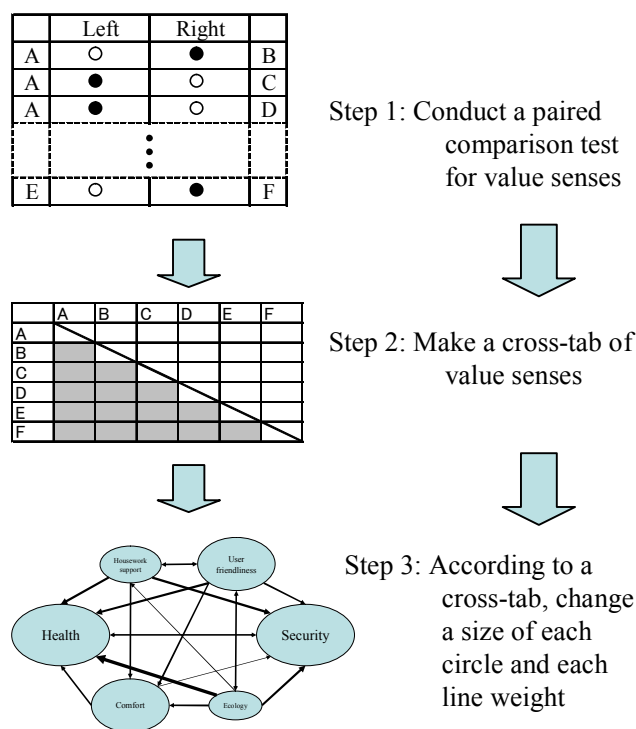

Fig. 4 Procedure for generating Value Sense Map

Table 2   Important Value Sense by Age

Age	Convenience	Housework Support	Healthy Life	Secure Living Space	Comfort	Sustainable Environment	Unclear	Total
20	18	9	58	39	17	9	56	206
30	11	17	41	50	21	9	57	206
40	14	10	64	33	17	14	54	206
50	11	10	81	26	22	9	47	206
60-	9	7	74	29	18	18	51	206
Total	63	53	318	177	95	59	265	1,030

V. CAUSAL RELATION

As found in the previous chapter, there is different importance on value sense among ages. Then it is expected that there is causal relationship among responder's demographics (gender, age, family occupation, living environment, etc.), their value senses and demand level for future domestic items in the created scenes.

To verify the existence of causal relation, we have built three layers Beyesian network. The network structure shown in Figure 5 allows us to examine sensitivity by assigning evidence on nodes in the network. The detail discussion of BN is presented elsewhere [7].
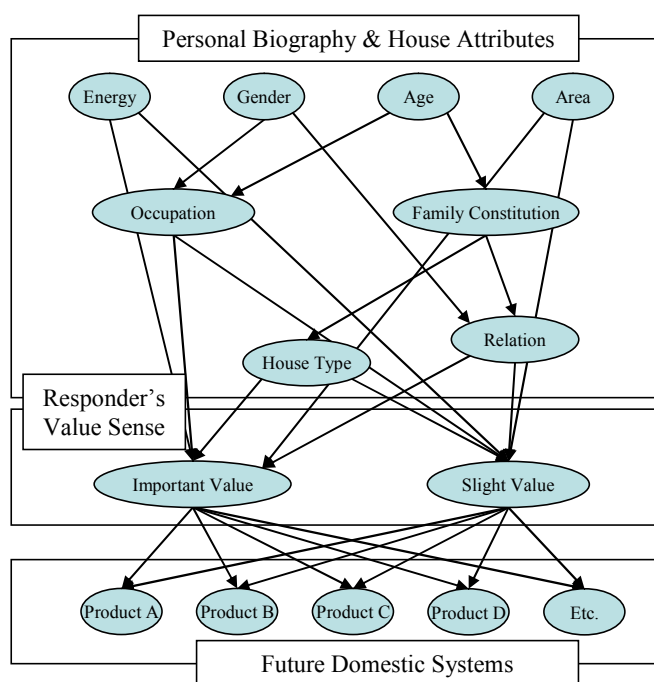

Fig. 5 Basic structure for Bayesian Network

VI. CONCLUSION

This paper has investigated the demand level for future domestic systems. Especially, this paper has contributed to find out the causal relationship between our daily life style and preference on future items generated from future life scenes. The remarks are summarized as follows:

(1) To create life domain map, we have introduced six daily life scenes. Further, based on the scenes, we have illustrated future domestic items.

(2) To find out the relation among personal attributes, value senses and their items, we have introduces four general values (health case, security, comfort and global environment) and two life-related values (convenience, housework support).

(3) As a result of pair-wise comparison on value senses, there are not always ordinal preferences on value senses. Then we have proposed visualizing method called VS-map.

(4) To analyze the causal relationship among personal biography, house attributes, responders' value senses and future domestic systems, we have constructed Bayesian network and found its possibility.

REFERENCES

(1) R. L. Smith (1987), The Coming Revolution in Housing. Go Courseware
(2) Yano Research Institute (2006), Digital Home Appliance Network Consumer Needs Survey (in Japanese). Yano Research Institute
(3) NISTEP Report No.82 (2005), The 8th Science and Technology Foresight Survey (in Japanese)
(4) NHK Broadcasting Culture Research Institute (2006), NHK Data book 2005 National Time Use Survey (in Japanese).
(5) Architectural Institute of Japan, Energy consumption for residential buildings in Japan (in Japanese) (2006). Architectural Institute of Japan ISBN978-4-8189-4202-8
(6) H. Tsuji, M. Kojoma, A. Takahashi, M. Nakano, S. Aoki, S. Inoue, K. Asari, E. Mimura (2008), Preference Mining on Future Home Energy Consumption, IEEE International Conference on Systems, Man & Cybernetics (IEEE/SMC 2008), pp.3697-3701
(7) A. Takahashi, S. Aoki, H. Tsuji and S. Inoue (2008), Bayesian Network for Future Home Energy Consumption, in Lecture Notes on Artificial Intelligence (LNAI 5243: Ed by A. Dengel et al. (Eds)), Springer-Verlag Berlin Heidelberg, pp.372-379