Title	Smart physical feedback city : Smart physical feedback city
Sub Title	
Author	株式会社東芝(Toshiba Corporation) 清水建設株式会社(Shimizu Corporation) 牧野, 泰才(Makino, Yasutoshi)
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Notes	Student final reports Group 8
Genre	Research Paper
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=KO40002003-00002010-0279

Group 8

Group 8's Theme Proposed by Toshiba Corporation with Shimizu Corporation

Theme 12:

ALPS "safety and security" theme title: **Smart Physical Feedback City**

Proposer Organization's Name: **Toshiba Corporation with Shimizu Corporation**
Supporter Name and contact info: Naoshi Uchihira (naoshi.uchihira@toshiba.co.jp)

Abstract of your project theme :
How do Mono-zukuri companies survive competing against Google? Physical feedback is the key issue!
Recently, cyber-physical systems are becoming very important which gather information with the sensor network, process them, and then give useful information (**virtual feedback**). However, few systems give useful physical services with actuators (**physical feedback**). In this project, future vision, concept, and application of smart physical feedback city are requested to make cities safer and smarter with physical feedback. Moreover, service business strategy for Mono-zukuri companies to compete against Google in the future virtual and physical feedback world is very interesting. **This project supported by a physical device company (Toshiba) with a construction company (Shimizu).**

Examples:

- Smart energy-saving facilities in which controls air conditioners, lighting, window shades, etc. using environment sensor data (e.g. weather information) and human behavior modeling.
- Transportation scheduling system in which control commuter vehicles, elevators, robots, movable space, etc. utilizing real-time traffic flow information.
- Smart operation, maintenance and patrol of city facilities utilizing haptic devices and robots.

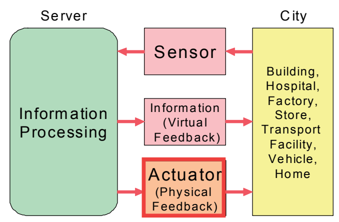
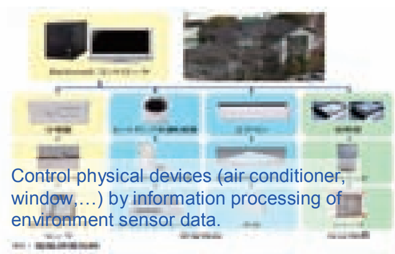


Fig. 1: Virtual and Physical Feedback



http://www.toshiba.co.jp/tech/review/2010/03/65_03pdf/01.pdf

Fig. 2: Example: Physical Feedback Home (Smart Energy-saving Home)

ALPS Final Report 2010

Group 8

PROJECT TITLE:
"SMART PHYSICAL FEEDBACK CITY"

Theme:
"Smart Physical Feedback City"

Proposer Organization: Toshiba Corporation with Shimizu Corporation

Proposer Organization's Supporter: Naoshi Uchihira

Keio Mentor: Yasutoshi Makino

Members:
KISOU, KIYOTO
YOSHINAGA, ATSUSHI
TANG, HAO
KAWAI, JUN
YAMAGATA, KENJI
YE, QING

Graduate School of System Design and Management
Keio University

Team 8

SMART PHYSICAL FEEDBACK CITY

Kiyoto KISO
Keio University

Jun KAWAI
Keio University

Atsushi YOSHINAGA
Keio University

Hao TANG
Keio University

Qing YE
TU Delft

Kenji YAMAGATA
JAXA

EXECUTIVE SUMMARY

The problem (theme) proposed by Toshiba and Shimizu Corp was to propose an idea for an "active" feedback system for the community (Appendix-1). The purpose of this report is to show how Team 8 came up with a unique solution that met our sponsor's demand, "Bee Box system", to the problem proposed through the use of tools taught during ALPS.

We began from interviewing the proposer as to what he was looking for. From the hearing, we determined some keywords of what the proposer was expecting:

-Not passive unlike the currently existing system/service, but something that is active.
-Houses talking to/sensing each other within the community.

Then, we came up with a vague concept of the system through brainstorming and mind mapping (Appendix 1) based on the keywords, including the ALPS theme "Safety and Security". Next, in order to clarify/narrow down our idea, we created a CVCA (Appendix 2) to find out the stakeholders, followed by scenariographing (Appendix 3) to visualize the activity of the key stakeholder.

From the result of the above tools, we created interview questions to interview the key stakeholders (Appendix 4).

Although the interview result varied among single/married, metropolitan/suburb, a common answer was a "higher demand for mental safeness".

To visualize the demand of the Voice of Customers (Appendix 5), we used QFD I to figure out what kind of components are required to meet the demand (Appendix 6), then used QFD II to create specification of the system (Appendix 7) and to conduct Cost Worth Analysis to be used for prioritizing component (Appendix 8). The information obtained from Cost Worth Analysis also became a factor used for conducting financial analysis (Appendix 9) to create the business model of the system (Appendix 10).

During the course of the workshop, we created several prototypes (Fig. 9 and Fig. 10). Prototyping was useful for the following reasons:

- Commonize team members understanding of the system.
- Physically present sponsor, audience, and customer, what our system looks like.
- Find out weaknesses and/or area for further consideration.

Also, through the comments achieved from the presentation, we also considered non-emergency mode of the system to make the system more attractive for the customers.

Contents

1. PROBLEM STATEMENT

The request posed to us by our sponsor was to come up with a high but not too high 'sky-high' proposal for a physically acting and reacting system to make the community 'safer' and 'smarter', taking into account the theme of ALPS 2010, 'Safety and Security'. Therefore, our team focused on developing a "Community Wide Safety and Security System", a system that covers the defects of currently existing services, as a solution to answering the theme posed by our sponsor and ALPS.

To reach this decision, we conducted several interviews with our sponsor and key stakeholder from our CVCA, learning that 'a unique system where habitat within the community senses each other and acts' and 'a system to provide mental safety' as desired.

For competitive and benchmarking analysis, we conducted various searches. Home level security is provided by SECOM and ALSOK. Also, street corner security camera and security light system provide community based crime suppression, but is provided by different organizations. Regarding safety, there are natural disaster information service provided by some local government (i.e. Tsukuba, Ibaraki), it only provides information via e-mail. In addition, earthquake detection/alarm service provided by companies such as KDDI, NTT Docomo, System & Data Research, Yupiteru etc., only informs the client via e-mail or by specialized device. Tokyo Gas may be a competitor where they have a system which shuts off gas supply actively. As can be seen, although there are various systems to provide 'safety and security', their level of service provision varies and will only be effective only in case of an event.

Our system concept is a solution based on current defect of security services and natural disaster response system of the services described above. We suppose our concept has various advantages over other security services. The following is the reason why we think so.

1.1 Background

Security issue is becoming more and more important in Japan as the Japanese society is turning into an aging society (Ref.1&Fig.1). Also, working couples are increasing due to change in social environment and behavior (Ref.2 & Fig.2). Since 2001, the number of married working couples is increasing. As a result, parents/elder's are left at home from morning to night (average return time of workers, 20:45 (Ref.3)).

Although the crime rate is decreasing over the years, (801,129 cases in 2009 compared to 1,502,108 cases in 2000 (Fig.4 & Ref.4)) people are mentally become more aware of security, resulting in the demand for home security service. The sales for home security service was 389.2 billion yen in 2005 and analyzed to be 837.6billion yen in 2010 (Ref.5).

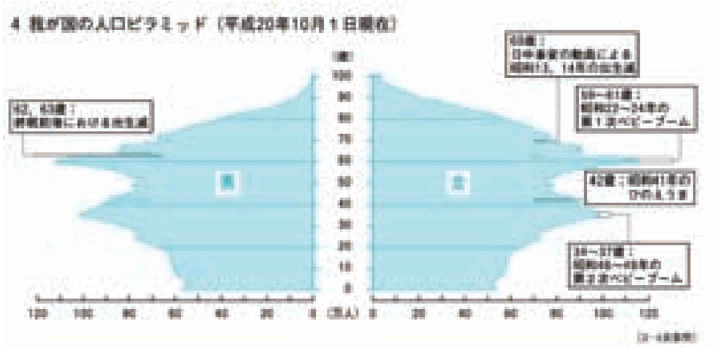


Figure 1 National population pyramid
(Source: http://www.stat.go.jp/data/nihon/g0402.htm)

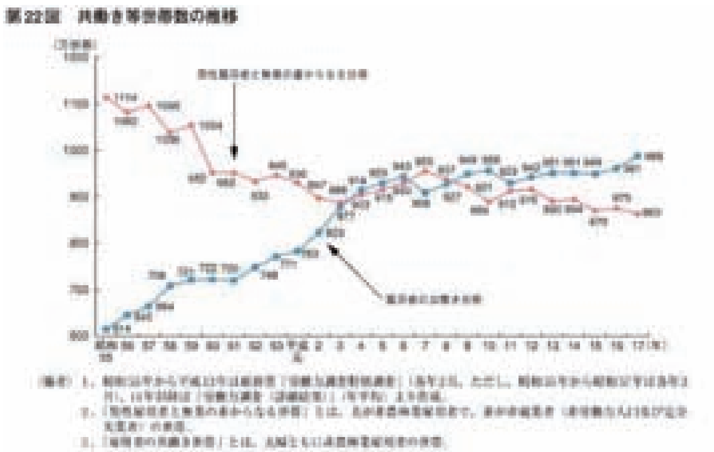


Figure 2 Working couple family statistics
(Source: http://www.gender.go.jp/whitepaper/h18/gaiyou/danjyo/html/zuhyo/G_22.html)

	20代	30代	40代	50代
賃貸	56分	58分	62分	55分
持家	53分	58分	59分	68分

Figure 3 Average commuting time
(Source : http://www.athome.co.jp/news/at-research/vol06/images/at-research-vol06.pdf)

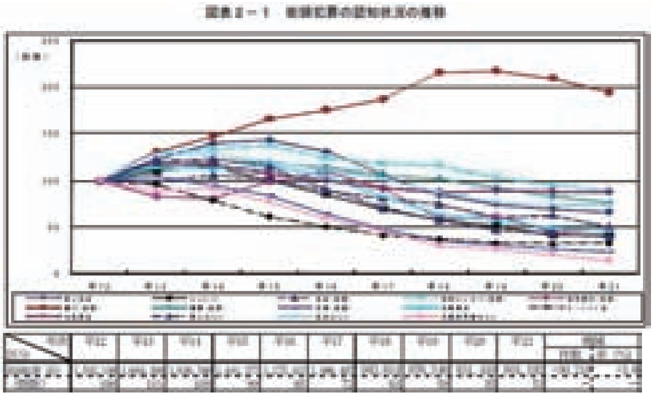


Figure 4 Crime rate from 2000 through 2009
(Source: http://www.npa.go.jp/toukei/seianki8/h21hanzaizyousei.pdf)

Another issue to be considered was the provision of safety against natural disasters. As can be seen from Fig.5 and 6, Japan, although a small island country, sits on 4 plates (Eurasia plate, North American plate, Phillipine plate and Pacific plate) and experiences/will experience lots of earthquake, some resulting in catastrophic damage in the country (Fig.7). Therefore, we assumed that a safety measure for earthquake was another issue that had to be considered.

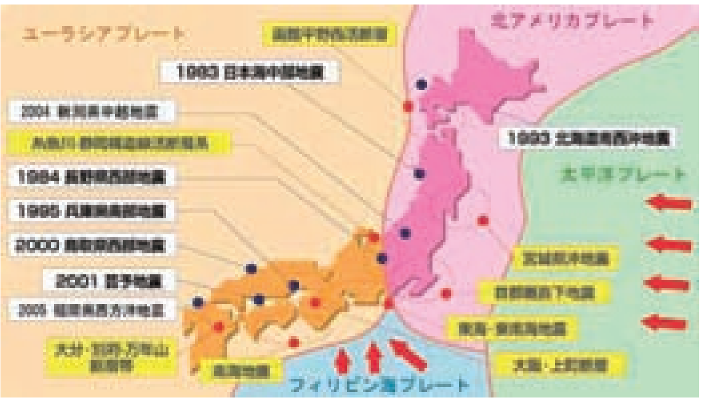


Figure 5 Tectonic plate and past catastrophic earthquakes
(Source: http://blog.heart-land.biz/?eid=639)

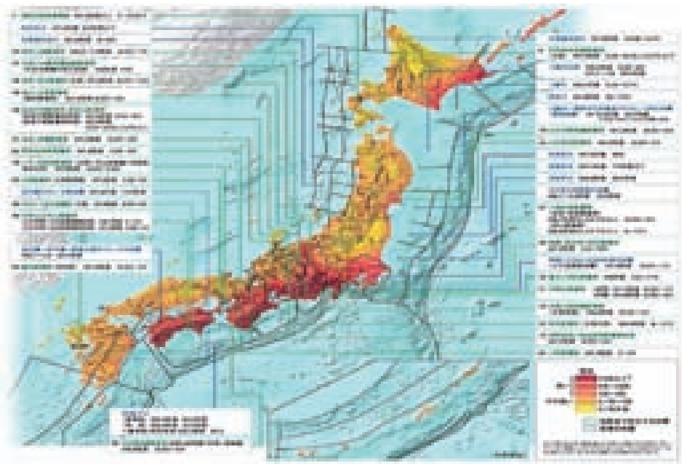


Figure 6 Earthquake occurance probability in the next 30 years
(Source: http://www.mizuho-ir.co.jp/solution/government/policy/city/planning/bousai/zoom/index_01.html)

自然災害の発生状況（地震災害）

順位	地震名	年月日	支払保険金（億円）
1	兵庫県南部地震（阪神・淡路大震災）	[illegible]	783
2	平成13年芸予地震	[illegible]	169
3	福岡県西方沖を震源とする地震	[illegible]	169
4	平成16年新潟県中越地震	[illegible]	149
5	平成19年新潟県中越沖地震	[illegible]	82
6	福岡県西方沖を震源とする地震	[illegible]	64
7	十勝沖地震	[illegible]	60
8	平成20年岩手・宮城内陸地震	[illegible]	52
9	駿河湾を震源とする地震	[illegible]	38
10	岩手県沿岸北部を震源とする地震	[illegible]	37

Figure 7 Insurance fee paid due to damage by earthquake
(Source : http://www.city.takamatsu.kagawa.jp/12854_I12_11.html)

1.2 How to reach the problem

Considering this background, and from the request from our sponsor, we assumed that the first thing to do is to search for a security system that could provide security service to not only individual homes, but also for the community. After making an assumption, we tried researching the existing services. We did this through observation, internet search and interview. From our study, we have found that the currently existing solution is basically at individual building/home level and not community-wide. In other words, it could be safe inside the building/home, but it is does not cover a wide area. Therefore, crimes still happen in real situation even though security service is becoming more common.

1.3 How to reach the decision

From the information we have achieved, we have reached one decision that community wide security service should be provided by each local government. This decision is based on our observation and interview which were gathered from key and non-key stakeholders defined in the CVCA.

The result of observation indicated us the current security service is not sufficient because not all people get advantage from this security service. Namely, these services are essential for the customer even it is costly. However the non-customer said these are too expensive even we need. In short, the customer's safety and security depends on their earning. In addition, a non-key stakeholder mentioned that "such service is not required if our city is safe." From these potential customers' voice, we got two insights; 1) the existing service is too expensive to utilize for everyone, 2) citizens demand is a safe house and a safe community.

After getting these points of views, we generated the concept named Community wide security system which has these following features in the below. The concept of our system is as a solution against the defect of security service.

1. ***Community wide security system is provided by local government.***

This security service is provided as infrastructure of the city. Thereby this service realizes not only individual service but also community wide service. This feature is solution for the defect which was happened due to individual service.

2. ***This system is possible to use as dual purposes.***

On the cost aspect, this system will be more effective because our system is able to utilize both happened crime and disaster. For example, in the usual, it works as a security system, and in the disaster, it works as safety indicator to safe place. Moreover, this system have active part not only safety and security but also information infrastructures because this system consists of equipment which offer signal of internet connections.

As we stated, objective of our project is realizing more suitable for security service which is named community wide security service. Installing this system to a city, the citizen feels more secure and safe.

2. ANALYSIS AND DISCUSSION OF ALPS METHODS

The methods we learned during ALPS were used as shown in Fig. 8.

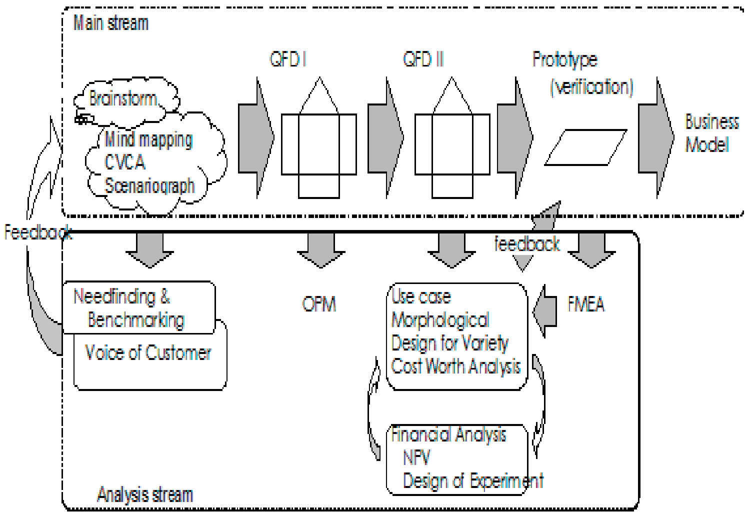


Figure 8 Application of method tools

2.1 Brainstorming

This method helped us in writing out various possible solutions for the smart physical feedback city. We were able to see what each team member imagined after the discussion with the sponsor (Appendix 1).

2.2 Mindmapping

We used this method to further narrow down and clarify what each member thought when talking about safety and security in our daily life. Therefore, each of the team members created their own individual mindmap (Appendix 1).

2.3 CVCA

We used this method to find out the key stakeholder, the one who the service should be provided to (Appendix 2). The method was also used as a basis to create the business model since it shows how money, service and information will flow.

2.4 Scenariographing

We used this method along with the CVCA to figure out what the key stakeholder may want as a service and also to create question to be asked to the key stakeholder for interview. (Appendix 3)

2.5 Needfinding and Benchmarking

We used this method to come up with questions we wanted to ask our key stakeholder (Appendix 4). Through the use of this method, we were able to collect the voice of the customer.

2.6 QFD I

Since we were able to collect the voice of the customer, we used QFD I to figure out what kind of system/device will be required for the system. (Appendix 5)

2.7 OPM

From the system/device list made during QFD I, we used OPM (Appendix 5) to see if the system/device that was listed is feasible.

2.8 QFD II

After assessing the feasibility of the system/device in QFD I, we applied QFD II to list up the device components for our system (Appendix 6).

2.9 Use case

We used this method to prioritize the device component listed in QFD II. In order to come up with better scenario to enhance our idea of "Smart Physical Feedback City (SPFC)," we attempted to do the brainstorming again. Only then we figured that lighting system could also be used to help people evacuate the city safely by estimating the optimum path fro the data taken from each house in the city. From a simple idea, by using the use case scheme, we figured that it was quite realistic to use the lighting system as escape path from the dangerous sites. By listing up the scenario in chorological order, we also found that some important aspects were totally missing from our first idea based scenario. We found that we missed the idea of SPFC sends the overall data to whoever needs to know the overall situation of the city.

2.10 Morphological Analysis

Since there are a variety of device component to create the system, we conducted morphological analysis to select the device suitable for our device.

The information used for this tool was CVCA, scenario graph and prototyping. Our morphological graph is based on function. Firstly, we listed some important function, and then we tried to find the solution of each function by brainstorming.

2.11 Design for variety

This method was used to create a possible design of the device to be used for the system.

2.12 Cost worth analysis

This method was used for assessing the worthiness of components specified in QFD II. The items used for this process was determined from the results of Use case, Morphological analysis and design for variety (Appendix 8).

2.13 Financial Analysis

Then we used the results achieved from Cost worth analysis into financial analysis to seek out the effectiveness of the system as business. NPV (Sec.4.5) and Design of Experiment was implemented during this process.

2.14 Prototype

We created several prototypes (Fig. 9 and Fig.10) to answer questions such as, "How would the community with our system look like?" "Is there any component left out from our consideration?" and "Will it be feasible?"

Figure 9 Team 8 Rapid Prototype

Figure 10 Tangible Prototype

Aside from these physical prototypes, we also developed movie based prototype to see if the flow process of our system is feasible or not.

2.15 FMEA

We used this method to further specify and assess the feasibility of our system. It was a very useful tool, especially for the development of the system.

2.16 Business model

Finally at this step, we were able to create a business model as to how we can make money and new business around our system (Appendix 10).

3. DESIGN RECOMMENDATION

From the result of the data collected, we propose a system with the use of a center-device named "BeeBox".

The unique feature of the system is that it is wireless (self-powered with use of solar panel and rechargeable battery). Also, it is wirelessly connected to other Bee Box creating an ad hoc informational network within the area (Figure 11, 12, 13, 14).

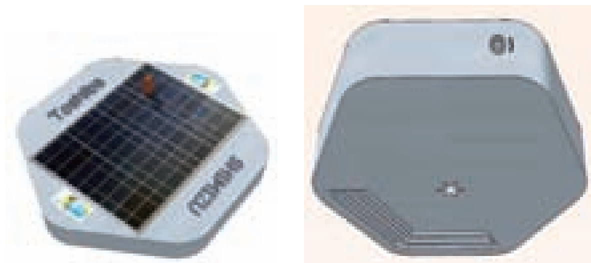


Figure 11 Conceptual Modeo of BeeBox

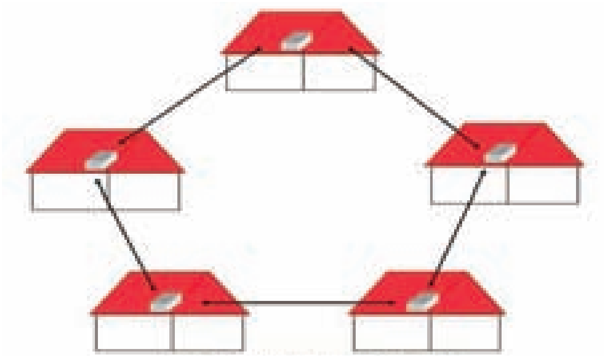


Figure 12 Community Sensor Network: Ring Connected

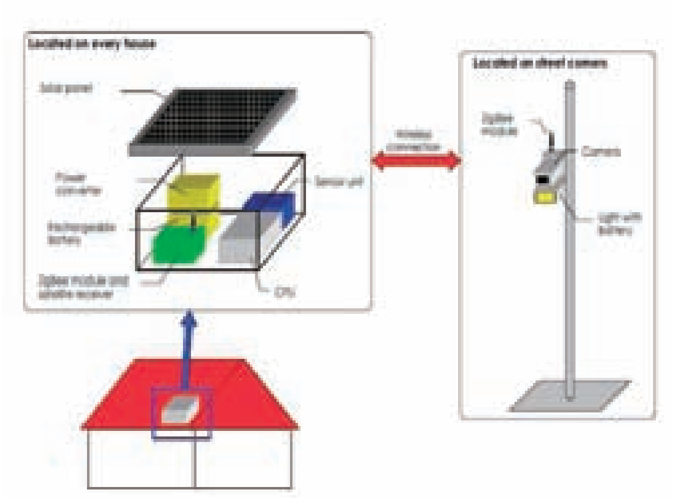


Figure 13 System Concept

Figure 14 BeeBox functioning diagram

First, the system we propose is a device to be used at a community level.

The main function of the device is to provide community safety and security through the use of wireless network communication.

There are three modes to BeeBox (**daily mode**, **urgent mode**, and **after-disaster mode**), where the switching between the modes happen autonomously.

Daily mode – various daily applications of BeeBox:

- "Brain" of Smart Grid Network: ZigBee Network including BeeBox, TV, Air Conditioner, Car and other home appliances: for smart home energy control and information sharing
- Wireless connection and control of lights: community or town illumination (light shows during holidays)
    - "Pin-point" weather sensors (temperature, humidity, ultraviolet radiation intensity, etc.)
    - Visible light communication enabled LED Lamp (optional)
    - Wireless router (optional)

Urgent mode – automatically response to emergencies, and save sufficient lead time for taking measures to prevent or minimize damage:

- Satellite receiver: emergency channel to receive natural disaster broadcast from satellite, for example, volcanic eruptions, earthquakes, landslides, typhoons, etc.
- Smoke sensor for fire detection/alert
- Audio sensor and camera (infrared, high sensibility) for crime detection/alert
- Smart ad-hoc network to locate the crime place and indicate the safest way to nearby evacuation area
- Immediate alert messages sending to mobile phones, TVs or GPS
- Motion detector for home security (optional)

After-disaster mode – saving as many as possible lives after disasters:

- Uninterrupted Power System (UPS): functions even the electric power is off
- Indicate the damage condition of the area
- Probing the signs of life, and sending distress call
- Base station for after-disaster communication
- Solar power supply system (can be used as power source in combination with rechargeable battery during emergency)

BeeBox is a smart, convenient, apian, affordable and customized "magic box" that can take full care of your family and community's safety and security.

Smart: Receiving the natural disaster information from the satellites at the first time, sensing the environment and taking action accordingly and automatically: saving sufficient lead time so that people can take measure to prevent or minimize damage. Powerful data process capability, automatic crime judge (image data from camera) and response (light up the area and alert). Smart ad-hoc network of BeeBoxes among a community: they are working together without a "queen bee" (see more in **Apian**).

Convenient: Easy to install/setup and ready to use. Wireless connection so no more annoyance by the twisted wires. Automatically search and match with other accessories (wireless light & camera & other boxes & other compatible home appliances).

Apian: Bees never work alone, so does our BeeBox. The first detector in the community will also trigger other "companions" to guarantee a first-time alert. More than it, when an uncommon sound is detected, the BeeBoxes work together to locate the accuracy position of the alibi and trigger the camera most nearby. While earthquake or other serious natural disaster happens, they work together to indicate the safest way out of community and to the nearby evacuation area.

Affordable: The price is comparable to the "smoke alarm" in every house. Fully usage in daily life: energy management, daily information and wireless router. House/community base so that the cost is shared. Possible supports from government.

Customized: A variety of optional functions to choose from which allows you to personalize your own magic box. Open source software so that more applications can be developed within the legal boundary.

4. COMPETITIVE ANALYSIS

4.1 Overview of business model and value proposition

In the beginning of our business, Local Government and Households are supposed to be our largest revenue source. Local Government is willing to pay regarding safety, security and prosperity of its citizens, and the improvement of their living condition, while the households will pay for the wireless internet connection service provided by Bee Box. On the other side, Bee Box Corp. has to pay for both Toshiba and Shimizu for device/system production and construction/installment fee, while also contracted with Internet Service Provider. As it is shown in the graph (Appendix 10), fortunately citizens only have to pay a small portion of fee while the larger parts are supported by local government.

After certain years of operation of this system, Toshiba may be able to sell the product and expand their product lines for new products to the other third parties business and make profit out of it.

4.2 Revenue source

- ✓ Initial payment
- ✓ Monthly fee
- ✓ Deposit fee
- ✓ Maintenance fee
- ✓ Payment from government/local government
- ✓ Service fee

4.3 Cost structure

fixed cost	variable cost
• office rent • parking rent • salary • insurance • office equipment lease • car lease	• device production • part-time worker • advertisement

4.4 Assumptions of our forecast (for demand, cost, etc.)

- ✓ Get support from the local governments: government agrees with this system and is willing to fund this business
- ✓ Certain services are available in the target market: Internet/telecom operators, satellite service, etc.
- ✓ Other home appliances are compatible with our system (ZigBee network)

4.5 Net Present Value Calculation

NPV is calculated by the sum of free cash flow discounted by discount rate, and then minus initial investment. So to calculate Net Present Value, first we should find out free cash flow about these 10 years, and then we used revenue, depreciation, account receivable and account payable to calculate FCF out. About discount rate, because our project is normal business, so we assumed it is 10%.according calculated FCF and discount rate; we can use the function of Excel to calculate NPV (the details about calculation, please check the appendix).

4.6 Development Time/Risk

Our strategy is that try to use as many COTS as possible and focus on interface, integrating and programming of the whole system. The development time is probably around one year, regarding current amount of researchers and resources. However, after prototyping, there should be a testing phase to validate our system's robust under real condition, which may lead to redesign certain parts or rewrite some programs. The whole development period (including validation phase) may cost 2-3 years in total.

One of the biggest risks we face is that we choose to use ZigBee standard for our wireless connection, however, after several years, it may turn out that ZigBee fails to be the standard of Smart Grid Network, which will make our system incompatible with other home appliances and need to redesign. The other risk is that the system should be robust enough to work under its three working modes. Last but not the least, it should also be secured enough to prevent hacking for illegal usages.

4.7 Protection strategy against competition

We have some strategy against current competition and future competition .For example, first we would apply for a patent for our overall system within Japan and international. This would create many patents, to mention one, function of our system BeeBox.

In fact, standardizing unit of Smart Grid is able to apply to every appliance both at home and outside.

We are not only focusing on the function of our system, but also pay attention to the service part. We can provide enough service and machines something like devices, controlling schemes, and 24hours standby and so on.

Besides, we also regard how to promotion our system. Through try our system for free first, and then by the power of word of mouth, let more and more people to know our safety and security system.

5. ALPS ROADMAP AND REFLECTIONS

5.1 Explanation on documents

We basically followed the tools learned according to what we learned during each workshop. We made use of mind mapping as we did our brainstorming since our idea kept on growing due to the numerous options that could be considered for this project.

5.2 Aha: Insight moments

The first "Aha!" of this project was during brainstorming. We brought our individual mind maps. We set some rules for brainstorming such as "be stupid, do not deny other's ideas, etc... We came up with lots of unique idea such as "city which automatically shoot criminal, self moving bending machine like 'Transformer'" and so on. However, we recognize this tool as a first key point of our project, because the base idea of our final product which was shown at the last workshop came from this tool and that is why we put "Aha!" here.

The second and final "Aha!" appears at the time of score carding. The main point to be emphasized here is that we were forced to think deeply about transfer function of our system and to figure out how we can make our wireless network system. We searched several technological options and came up with "FON" which became the key technology of our final product. Accordingly, we put in "Aha!" here.

5.3 Oops: Times of failures or correction of wrong assumptions

The first "Oops!" we faced was at the very beginning of the project where we just sat down and began brainstorming and was lost by the expansion of possibilities to the problem. That is why we put "Oops!" here.

The second "Oops!" we faced was during "prototyping rapidly". The first prototype we made here seemed feasible to us, winning 2nd prize during the workshop. But we noticed that although we wanted to show two ways for safety and security (natural induced disaster and human induced disaster), our prototype did not fully show that. We adjusted our system later, but we thought we should put "Oops!" here.

The last "Oops!" was at the phase of FMEA. We learned that our system heavily relied on sensors. Thus we focused on simplifying the system. This is why we put "Oops" here.

5.4 Eureka: Breakthrough moments for your teams

The first "Eureka!" appeared at CVCA. We tried to figure out connections between each stakeholders of existing solution and found its defect. The key factor here was so-called "security company" such as SECOM or ALSOK, and they profited by making their product as a service for the rich. Therefore, we set our goal to override the service provided by these companies. Thus, we put "Eureka!" here.

Secondly, we put "Eureka!" at the phase of Pugh selection. We put several possible choices of our project into this tool and got the key one scenario which stands for our final product. That is why we marked "Eureka!" here.

Thirdly, we made "Tangible Prototyping" with insights we got from FMEA and attempted to make it simple by adding plain sensors and functions. Our main focus on this prototyping was to test our conceptual system design by simple structure. We believe that it was successful, and therefore, added "Eureka" in this phase.

The last "Eureka!" we had was while creating the business model. At this phase, we finally came up with the idea of "BeeBox" which contains wireless network and sensing modules that could be used as Wi-Fi network hub during non-emergency period. This became the final product of our project. Since our proposer from Toshiba also said this is an excellent idea, and this is why we put last "Eureka!".

5.5 If you could do the project again from the beginning, what kind of roadmap would you like to take? Why?

We think the entire roadmap we walked through was quite smooth, but guess there might be other ways to get other solution. As mentioned previously, we followed the order from the lecturers almost all the time on our project, and believe if we switch the orders there might be other solution.

For example, if we switched VOC and EM's before making tangible prototyping, we could make more users or customer oriented prototyping and the final solution and product was probably changed.

5.6 Other constructive feedback or comments for the teaching staff, mentors, volunteers and support staff

We thought the roadmap of the ALPS teaching staffs drew was quite reasonable, because we followed their orders and believed that our ALPS journey was full of success. However, the only thing we want to convince is that the first tool the students use might not be brainstorming. We felt difficulty to settle down the discussion, furthermore it grew forever. Actually, we saw that a lot of groups had this kind of problem at the begging of the project. Thus, let us emphasize about the importance of the initial requirement analysis tool such as mind mapping.

6. CONCLUSION AND FUTURE WORK

The system we have proposed involves area in which Toshiba does not possess as a company (i.e. wireless network system). Therefore, in order to develop the system, Toshiba will have to collaborate with internet providing company for network infrastructure construction. We recommend that Toshiba, through the use of the research fund from NEDO and the Yokohama Smart City Project, demonstrate the system and demonstrate the effectiveness of the system although natural disaster may be difficult to simulate in the community. Observing the roadmap for the Yokohama Smart City Project, if it might be difficult to implement.

7. ACKNOWLEDGMENTS

We would like to thank Sun Kim for the coordination of the ALPS course. We would like to thank Professor Shinichiro Haruyama, Professor Tetsuya Toma, Professor Naohiko Kohtake and Assistant Professor Nobuaki Minato of Keio University SDM for teaching us various system design tools. We would also like to thank Professor Gerard Dijkema from Delft University, Professor Kurt Beiter from Stanford University, Professor Takuto Ishimatsu from MIT and Professor Olivier Dewek for their time to travel from abroad to teach at ALPS (ここの名前と所属要確認).

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9. APPENDIX

Appendix 1 Brainstorming and Mind Mapping

Appendix 2 CVCA

Appendix 3 Scenariographing

Appendix 4 Interview Questions to Key Stakeholders

Appendix 5 Voice of X

Appendix 6 QFD I and OPM

Appendix 7 QFD II

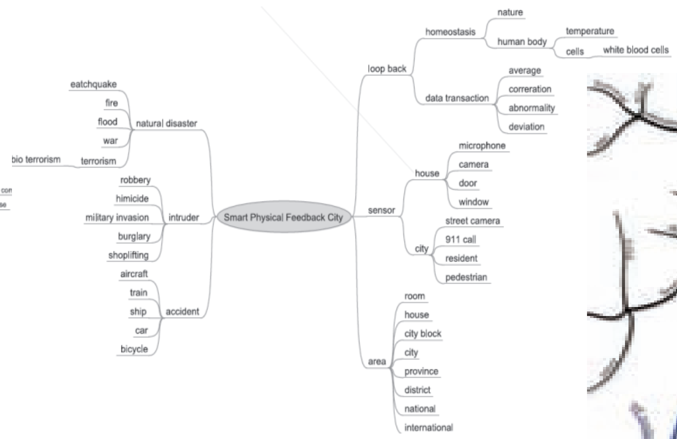
Appendix 8 Cost Worth Analysis

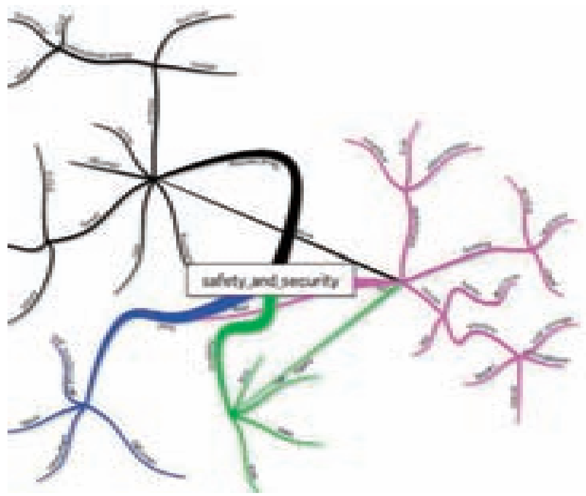
Appendix 9 Financial Analysis

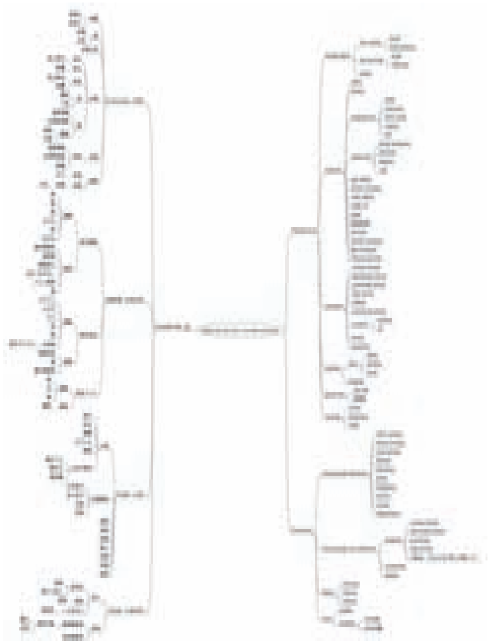
Appendix 10 Business Model

Appendix 11 ALPS Roadmap and Reflections

Appendix 1 Brainstorming and Mind Mapping







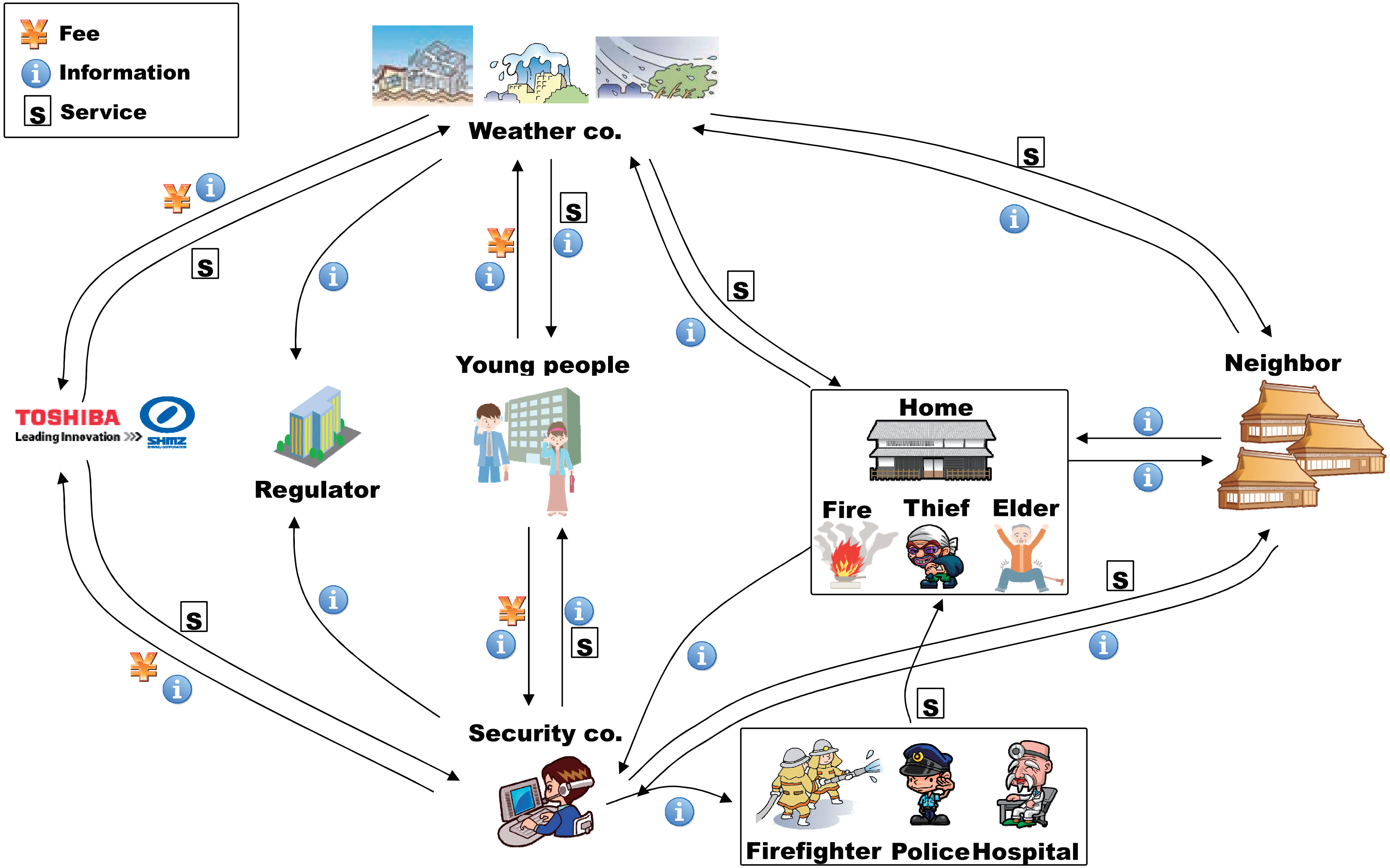
Common Keywords

- House
- City
- transportation
- natural disaster
- intruder
- accidents
- environment

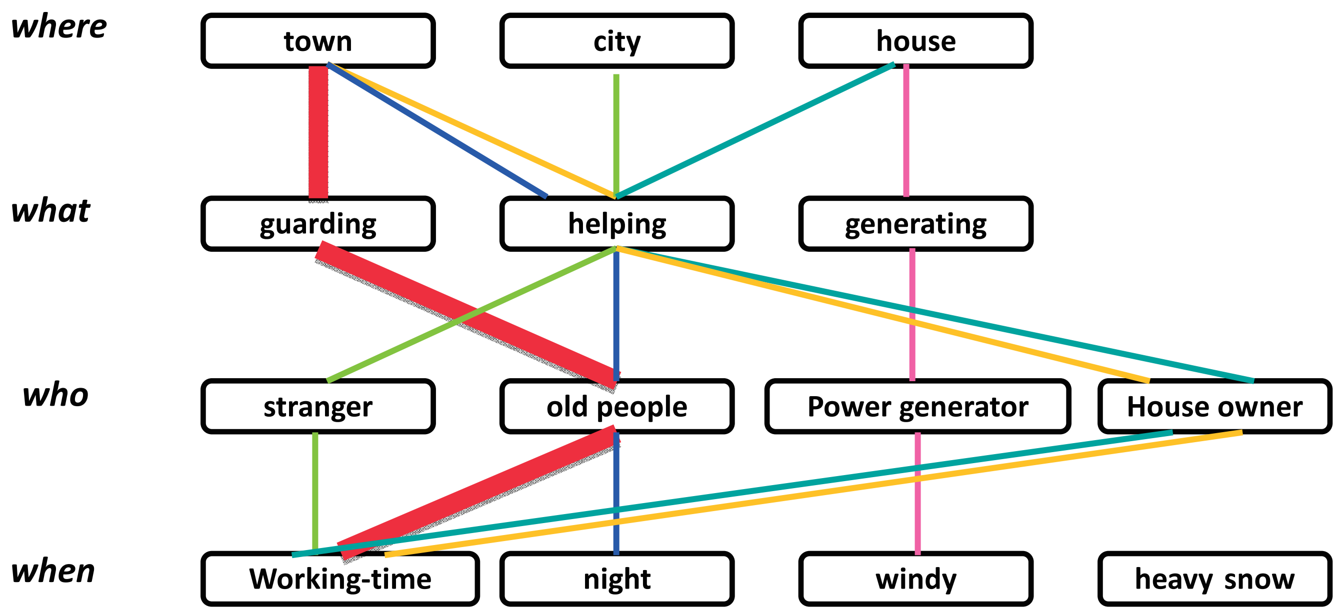
11

Appendix 2 CVCA

- Situation: daytime
- Commuting distance: 70km (1.5hr-2hr) from business district
- 2-3 generation family



Appendix 3 Scenariographing



Appendix 4 Interview question and result

Genre	Questions	Answer 1	Answer 2	Answer 3	Answer 4
Family	Are you living alone or by family? If by family, could you please mention the family members you are living with (parents, grandparents, children, etc.)?	I'm living with my parents	alone	Alone	I live alone
Family	Are the elders in your family living alone or together with some other family members?	Both of my grandparents live alone.	alone	Together	The rest of my family, except for my oldest sister, lives together with the three of them.
Family	In your family, who is going out for work during the daytime? And how long? Who is staying at home (if any)?	My mum works 8 hours a day, while dad just stays at home, working 2~3 hours per day on average.	everybody	Father and mother, 8 hours per day.	My mom, 40 hours per week. Little brother and sister both go to school during the week for about 32 hours per week.
Family	Do you worry about the safety of family staying elders and/or children (if any)? Why?	No, they are so healthy, and it seems that there is no any problems about this.	no	Yes, in order to keep a healthy environment.	No, our policy is quite strict at home, lock the door if you are alone, just in case.
Residence	Do you have any feeling about insecurity or fear when stay in your house in daily life?	No.	no	Sometimes. Some strange people are always passing around.	Nope, not at all.
Region	Which country are you from? Which town are you living in?	China. I'm living in Chengdu now.	Kazakhstan, Almaty	Brazil, Delft, The Netherlands	The Netherlands The rest of the family in Apeldoorn, I am living in Delft.
Region	Is your town safe? If you have any unsafe experience, when is it?	My town is very safe, no unsafe cases happened to me.	yes	Yes	Apeldoorn and Delft are both quite safe; I have had no experience of unsafe situations.
Region	Does your town do anything for safety and security?	Yes, they do much about that.	yes	Yes, a lot of policemen	Police cars drive by several times per night, because in both cities we/I live nearby the centre.
Security	Have you ever felt any possibility of being rolled in crime when you are at home?	NO.	no	No	Once, that was on the 1st of September in 2005, my brother was at home watching TV when several robbers came inside our house, stole the key of my moms bike and stole it from the garage, along with some contents of the freezer which is placed there too.
Security	Have you ever thought about the possibility of being robbed or sneaked?	Sometimes I will think about that, for dangerous is everywhere :)	no	Yes, in my building where I live. There have been some burglaries	Yes I have, but I'm quite careful for valuable things I'm carrying with me. I have watched several movies on how pickpocketing works, hope that helps me to prevent it from happening.
Security	How much will you spend for safety for your house per month?	I have never think about it, sorry.	Limited amount of money	It's included in the rent I pay per month.	10 Euros now, but in the future that might change (this is for my student housing, for a real house I would pay more, about 30-50 Euro per month

Appendix 5 Voice of X

To gather Voice of X, we firstly did several searches to get the tendency of Japanese consumer, market, technology, competitor, and so on.

Secondly, we seek VOX from non-Japanese customer, market and technology by Mr. Ye's interview which is held in the European region.

We decided to separate VOX several aspects, as we learned at ALPS WS#2.
And the results are below.

○***Voice of Society***

・Market Trends

➜Recession in Japan. People tend to buy cheaper ones.
However in Europe, the rich is going to buy expensive ones.

・Sources of Change

➜Internet is available everywhere. Smart phone is becoming popular.

・Societal Changes

➜Elder population is increasing in Japan. Thus, they live alone while young people leave sub-urban area.
Crime rate is getting higher.
However, there is a tendency that the elders live alone and help themselves in Europe. In addition, hiring a part-time nurse is very common there.

○***Voice of Technology***

・Scientific Research

➜Cloud computing is a hot issue these days.
Accuracy of sensor system is improving.

○***Voice of Competition***

・Competitive Landscape

➜Gas company has autonomous switching-off system.
Mobile-phone company has auto-alarming system.
Hiring a part-time nurse is already common in the European region.

○***Voice of Business***

・Mission & Vision

➜Want to integrate community-wide safety and security system.
We have to create the system which is much cheaper than existing system.

・Target Markets & Customers

➜Young people who have elder parents might be our target customer.
People who have children and women live alone also can be our important customer.
Sub-urban city or town is able to be a crucial area for our system.

・Differentiation & Positioning

➜Physical feedback. No need to pay much money for security companies such as ALSOK, SECOM or some like that.

・Core Competencies

➜Physical feedback.

・Business Model

➜Improve sales.

Appendix 6 QFD I and OPM

PHASE I QFD Smart Physical Feedback System

Correlation Codes	
+	Positive
-	Negative

	Community server (TBD ch)	House server (TBD ch)	Motion sensing	Temp sensing	Audio sensing	Regulating	Actuating	Power source	Transmitting	0	0	0	0	0	0	0	0
Community server (TBD ch)																	
House server (TBD ch)																	
Motion sensing		+															
Temp sensing																	
Audio sensing	-		-														
Regulating	+			+	-												
Actuating				+		+											
Power source																	
Transmitting																	
0																	
0																	
0																	
0																	
0																	
0																	
0																	
0																	
Preferred	nom	nom	dwn	dwn	up												

NO INPUT IN THIS AREA

Engineering Metrics

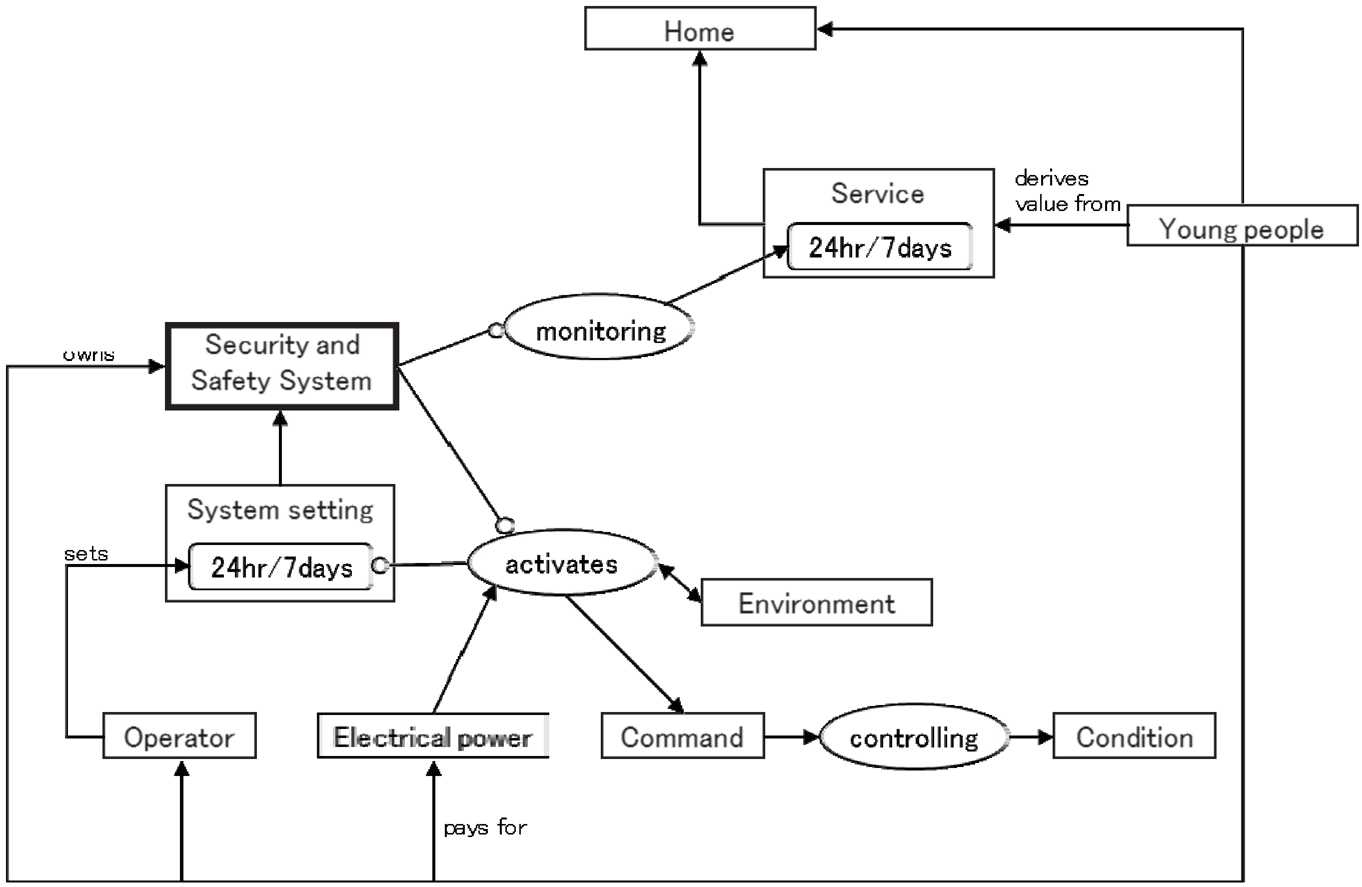
	Customer Requirements	Customer Weights	Community server (TBD ch)	House server (TBD ch)	Motion sensing	Temp sensing	Audio sensing	Regulating	Actuating	Power source	Transmitting								
1	Informs situation	9	9	9	3	3	3				9								
2	Closes shutter	3	1	9	3			9	3	9									
3	Shuts off gas	9		9	9	1		3	3	3									
4	Lights up community	3	3				9		3	3									
5	Opens window	1	1	1	3	3	1	3	1	1									
6	Turns on TV	1					1		1	1									
7	Cheap to Operate	3	3	9						3									
8	Portable	1								3									
9	Operates Easily	1	3	3					1		3								
10	24hours 7days a week	9	9	9	9	9	9	9	9	9	9								
11																			
12																			
13																			
14																			
15																			
	Technical Targets		100 channels	20 channels	0	20*C<30*C	> 65dB			100W									
	Technical Benchmarking	*Better* 5					A												
		4	Ab	b	b	b	b												
		3		c	c	c	c												
		2		A	A	A													
		Worse 1																	
		Raw score	187	301	201	120	137	138	129	158	165	0	0	0	0	0	0	0	0
		Relative Weight	12%	20%	13%	8%	9%	9%	8%	10%	11%	0%	0%	0%	0%	0%	0%	0%	0%

Customer Perception

	1 *Worse*	2	3	4	5 *Better*
1				b	A
2		A	c	b	
3		A		b	
4	c	A		b	
5			Ac	b	
6			c	bA	
7			A	bc	
8		c	Ab		
9		c	Ab		
10					
11					
12					
13					
14					
15					

Existing System or Competition
A: SECOM
b: Tokyo gas
c: NTT communications

Appendix 6 QFD I and OPM



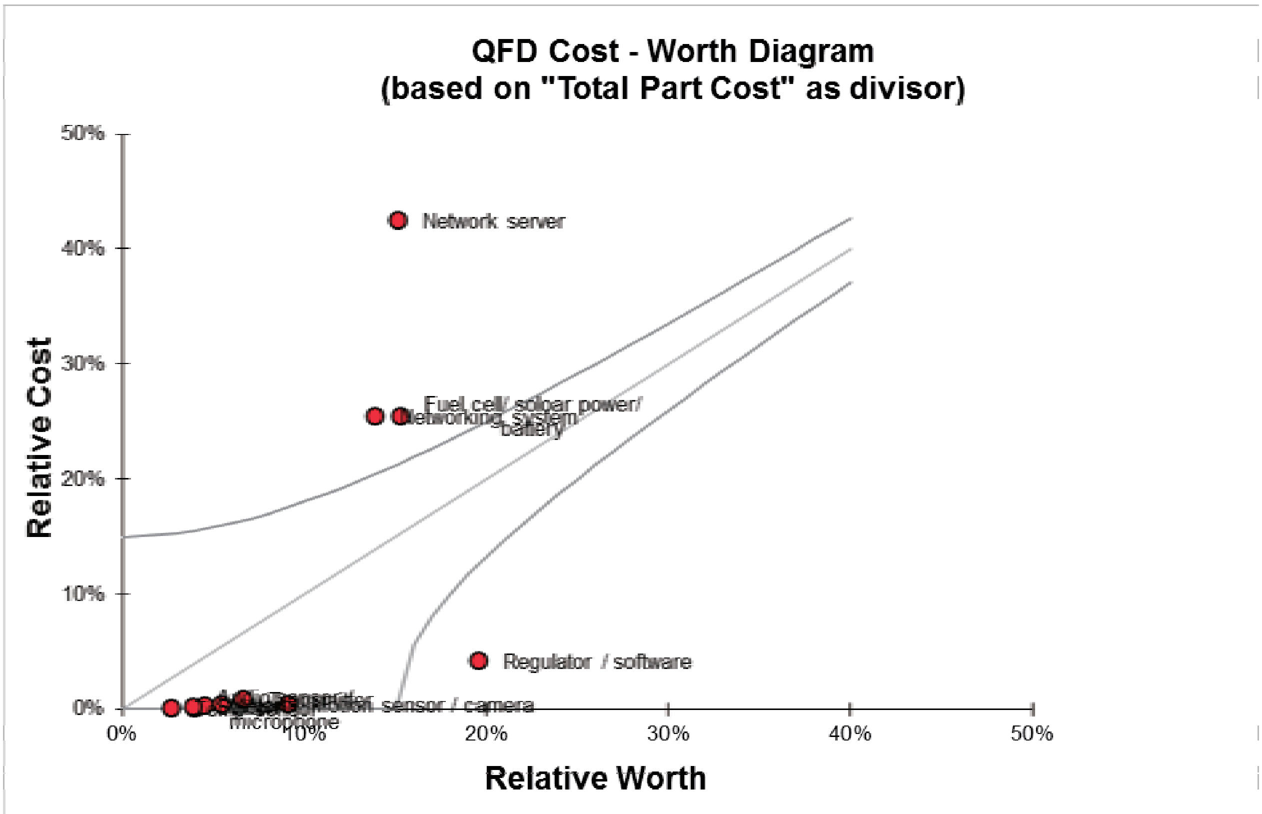
Appendix 7 QFD II

PHASE II QFD ***Smart Physical Feedback System***

		Solution Elements or Enabling Functions																
Engineering Metrics	**Phase I Relative Weights**	Network server	Networking system	Motion sensor / camera	Temp sensor	Audio sensor / microphone	Regulator / software	Motor	Fuel cell/ soloar power/ battery	Transmitter	Alarm	Switch						
Community server (TBD ch)	12%	9	9	3		3	9		9	3	1	1						
House server (TBD ch)	20%	9	9	9	1	1	9		9	3	3	1						
Motion sensing	13%	3	3	9			9		3	3	3							
Temp sensing	8%	9	3		9		9		3	1	3							
Audio sensing	9%	3	3			9	9		3	1	3							
Regulating	9%	9	9				9		3			3						
Actuating	8%							9	9			9						
Power source	10%	3	3	1	1	1		9	9		1	1						
Transmitting	11%	3	3				9			9	3							
0	0%																	
0	0%																	
0	0%																	
0	0%																	
0	0%																	
0	0%																	
0	0%																	
0	0%																	
	Raw score	5,7	5,2	3,4	1,0	1,5	7,3	1,7	5,7	2,5	2,0	1,4	0,0	0,0	0,0	0,0	0,0	0,0
	Relative Weight	15%	14%	9%	3%	4%	20%	4%	15%	7%	5%	4%	0%	0%	0%	0%	0%	0%

Appendix 8 Cost Worth Analysis

Part #	Solution Element	Cost	Relative Worth * * From QFD Phase II	Relative Cost	Cost / Worth
1	*Network server*	$50.000,00	*15%*	42%	2,81
2	*Networking system*	$30.000,00	*14%*	25%	1,84
3	*Aotion sensor / camera*	$500,00	*9%*	0%	0,05
4	*Temp sensor*	$100,00	*3%*	0%	0,03
5	*io sensor / microphone*	$50,00	*4%*	0%	0,01
6	*Regulator / software*	$5.000,00	*20%*	4%	0,22
7	*Motor*	$300,00	*4%*	0%	0,06
8	*/ soloar power/ battery*	$30.000,00	*15%*	25%	1,67
9	*Transmitter*	$1.000,00	*7%*	1%	0,13
10	*Alarm*	$500,00	*5%*	0%	0,08
11	*Switch*	$200,00	*4%*	0%	0,04
12	*0*	$0,00	*0%*	#N/A	#N/A
13	*0*	$0,00	*0%*	#N/A	#N/A
15	*0*	$0,00	*0%*	#N/A	#N/A
15	*0*	$0,00	*0%*	#N/A	#N/A
16	*0*	$0,00	*0%*	#N/A	#N/A
17	*0*	$0,00	*0%*	#N/A	#N/A
	Total Cost	$117.650,00	100%	100%	



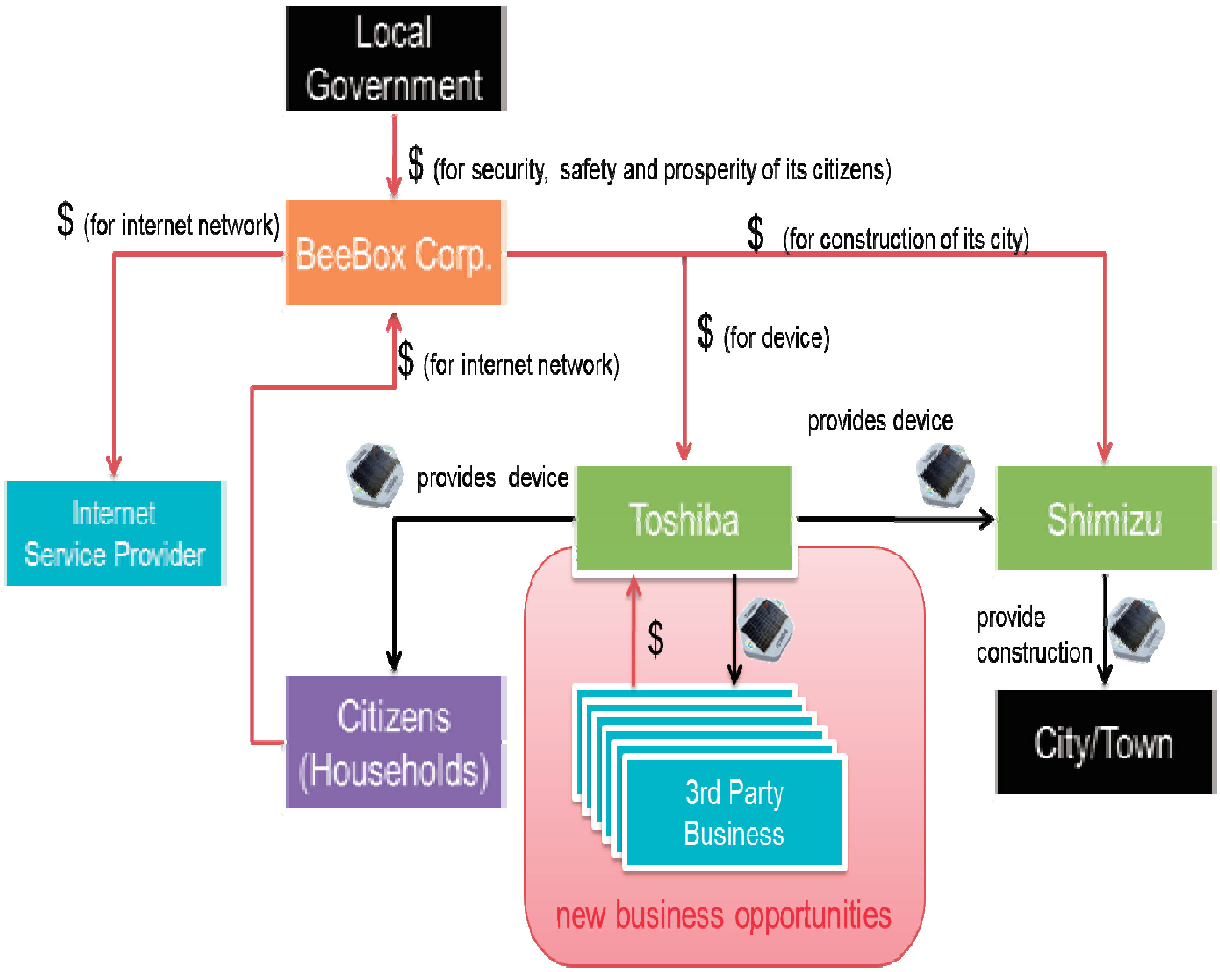
Appendix 9 Financial Analysis

Project Period	10	Year
Discount Rate	10%	%
Initial Investment	$10.000.000,00	$

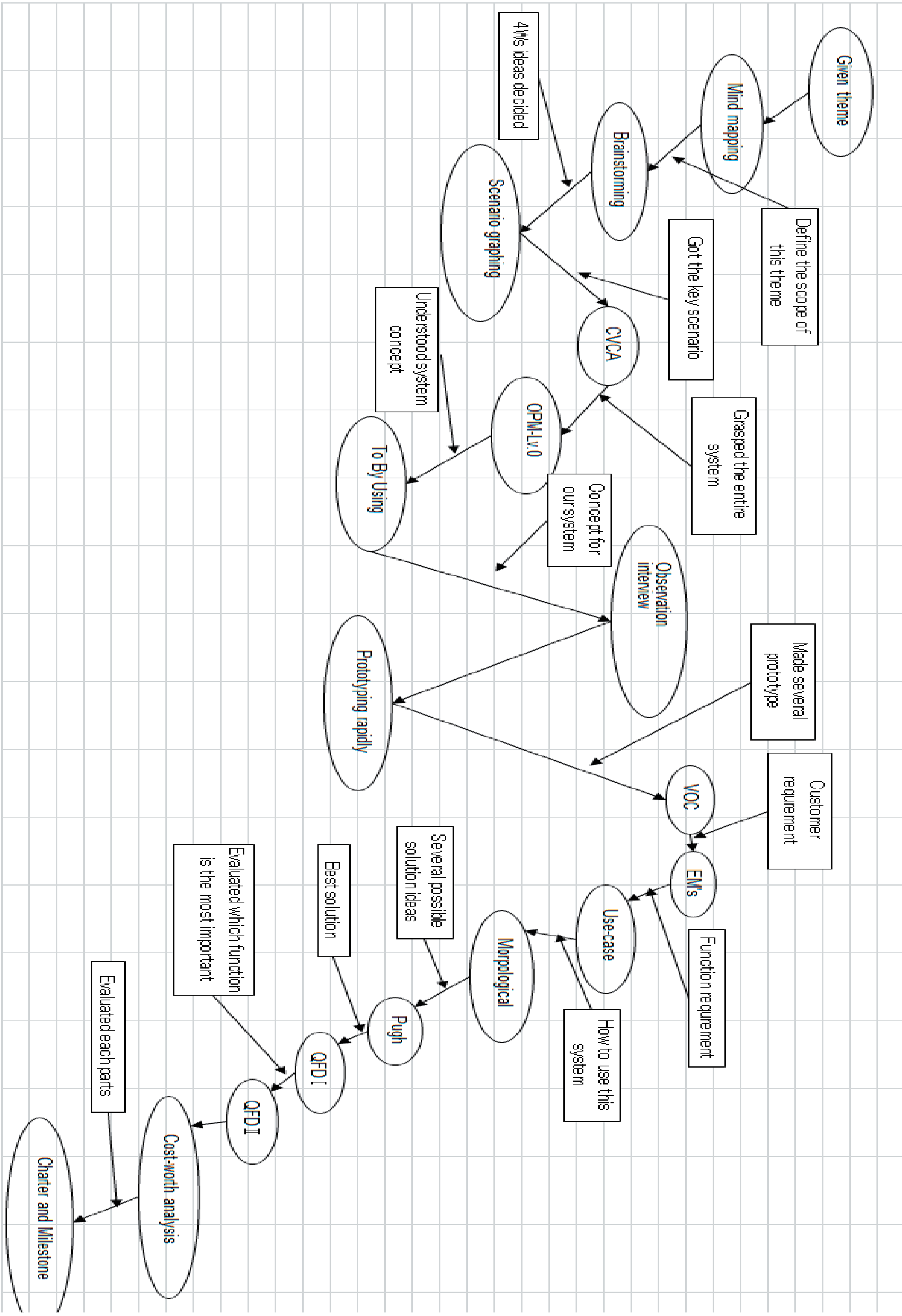
	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Revenue…A		$827.322,00	$591.192,00	$1.418.514,00	$1.182.384,00	$2.837.028,00	$2.364.768,00	$4.019.412,00	$3.547.152,00	$5.201.796,00	$4.729.536,00
Cost…B		$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08	$3.462.445,08
Profit…A-B		-$2.635.123,08	-$2.871.253,08	-$2.043.931,08	-$2.280.061,08	-$625.417,08	-$1.097.677,08	$556.966,92	$84.706,92	$1.739.350,92	$1.267.090,92
Tax		5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Depreciation (Declining)		$692.489,02	$553.991,21	$443.192,97	$354.554,38	$283.643,50	$226.914,80	$181.531,84	$145.225,47	$116.180,38	$92.944,30
Investment	$10.000.000,00										
Δ Working Capital		-$497.556,00	-$497.556,00	($995.112,00)	($995.112,00)	($1.990.224,00)	($1.990.224,00)	($2.985.336,00)	($2.985.336,00)	($3.980.448,00)	($3.980.448,00)
Free Cash Flow		-$1.313.321,91	-$1.676.143,21	-$503.429,56	-$816.391,65	$1.679.721,27	$1.174.345,57	$3.695.986,41	$3.211.033,05	$5.749.011,75	$5.277.128,68
Discount Factor	1,00	0,91	0,83	0,75	0,68	0,62	0,56	0,51	0,47	0,42	0,39
Present Value		-$1.444.654,10	-$2.028.133,29	-$670.064,74	-$1.195.279,01	$2.705.207,91	$2.080.424,82	$7.202.431,93	$6.883.134,51	$13.555.868,99	$13.687.512,72

Net Present Value	$6.058.150,11	
Internal Rate of Return	31%	
Payback Period	1st year	

Appendix 10 Business Model



Appendix 11 ALPS Roadmap and Reflections



Group 8’s Final Presentation Slides

Theme 12:

ALPS "safety and security" theme title: **Smart Physical Feedback City**

Proposer Organization's Name: **Toshiba Corporation with Shimizu Corporation**

Supporter Name and contact info: Naoshi Uchihira (naoshi.uchihira@toshiba.co.jp)

Abstract of your project theme :

How do Mono-zukuri companies survive competing against Google? Physical feedback is the key issue!

Recently, cyber-physical systems are becoming very important which gather information with the sensor network, process them, and then give useful information (*virtual feedback*). However, few systems give useful physical services with actuators (*physical feedback*). In this project, future vision, concept, and application of smart physical feedback city are requested to make cities safer and smarter with physical feedback. Moreover, service business strategy for Mono-zukuri companies to compete against Google in the future virtual and physical feedback world is very interesting. ***This project supported by a physical device company (Toshiba) with a construction company (Shimizu).***

Examples:

- Smart energy-saving facilities in which controls air conditioners, lighting, window shades, etc. using environment sensor data (e.g. weather information) and human behavior modeling.
- Transportation scheduling system in which control commuter vehicles, elevators, robots, movable space, etc. utilizing real-time traffic flow information.
- Smart operation, maintenance and patrol of city facilities utilizing haptic devices and robots.

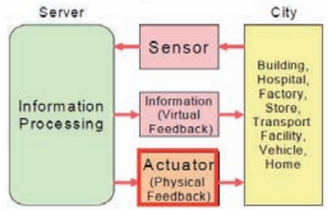


Fig. 1: Virtual and Physical Feedback

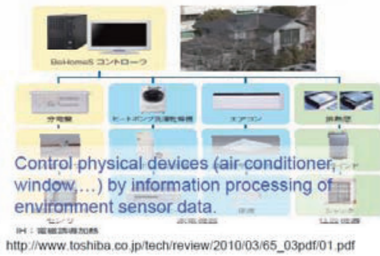
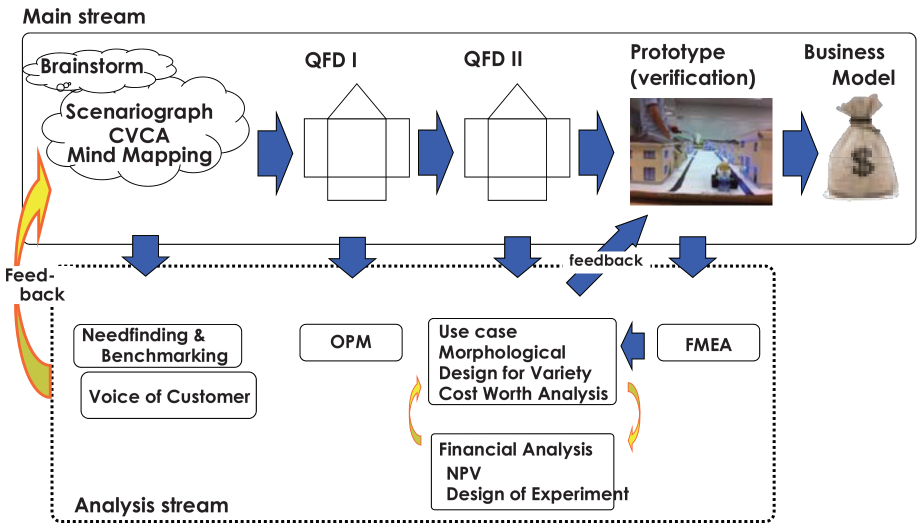


Fig. 2: Example: Physical Feedback Home (Smart Energy-saving Home)

2

How we reached the solution –work flow



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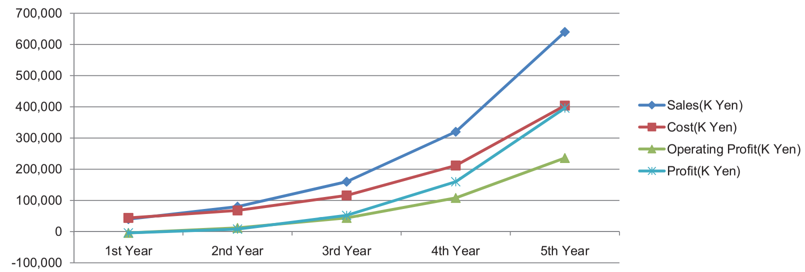
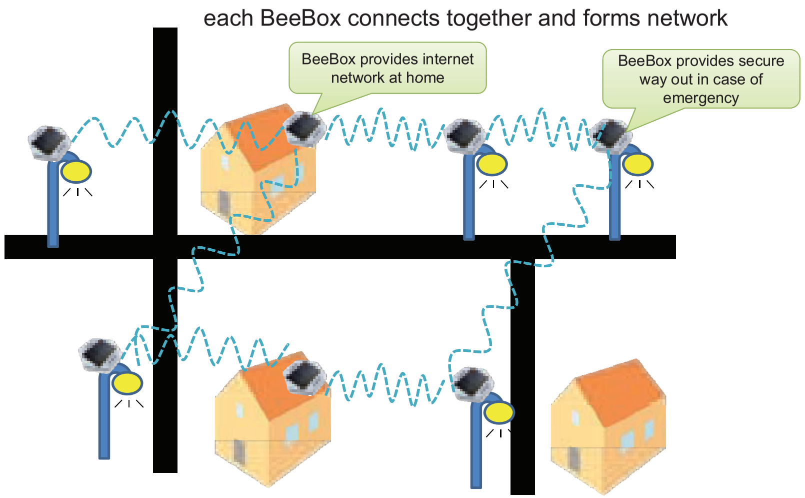
Business model



	1st Year	2nd Year	3rd Year	4th Year	5th Year
Sales(K Yen)	40,000	80,000	160,000	320,000	640,000
Cost(K Yen)	44,000	68,000	116,000	212,000	404,000
Operating Profit(K Yen)	-4,000	12,000	44,000	108,000	236,000
Operating Profit Percentile	-10.00%	15.00%	27.50%	33.75%	36.88%
Profit(K Yen)	-4,000	8,000	52,000	160,000	396,000
device sales num	200	400	800	1600	3200

6

Architecture (initial phase)



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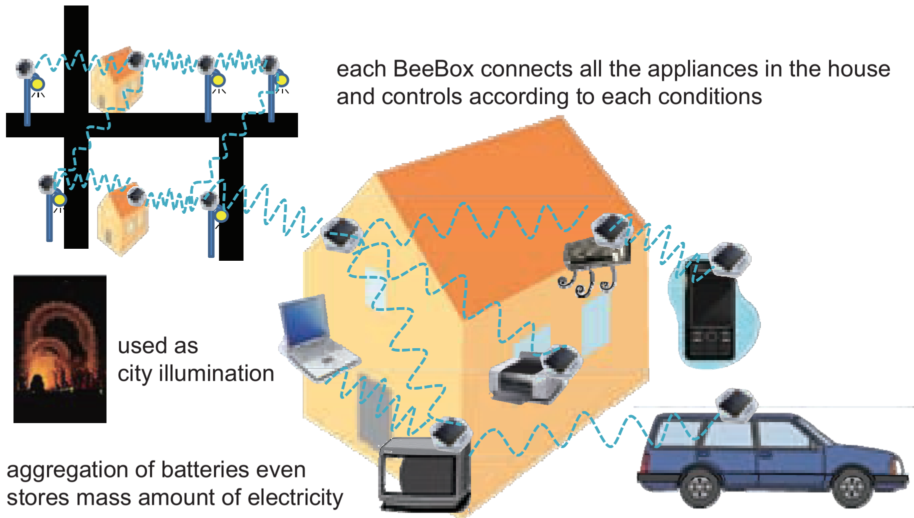
Architecture (future phase)



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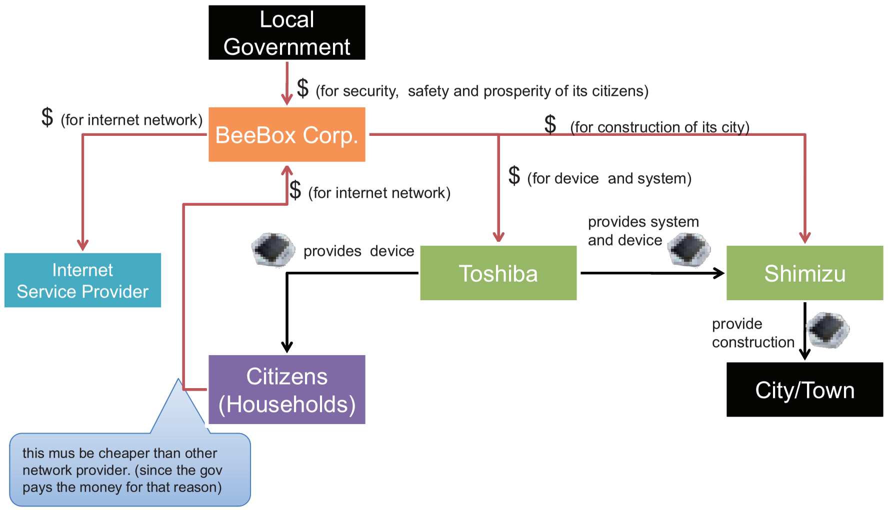
Business Flow (initial phase)



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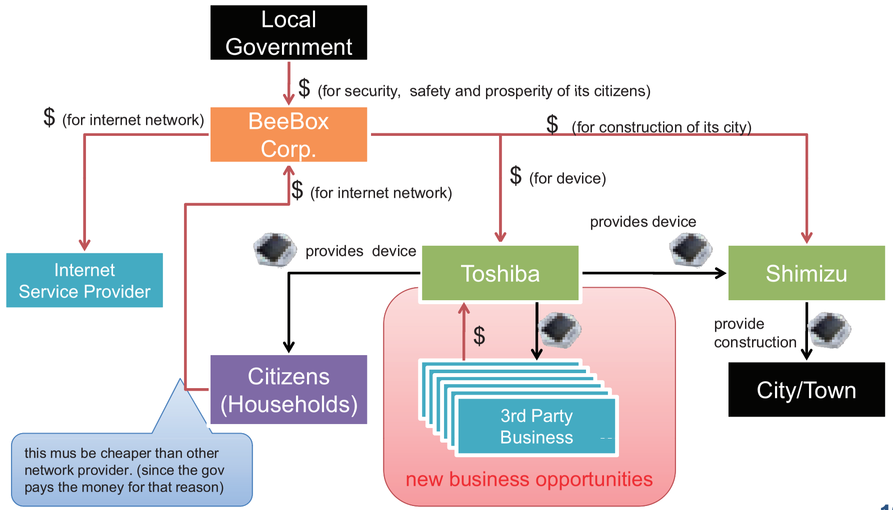
Business Flow (future phase)



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Summary

System, device and a business plan.

[System]

-"Community level" Safety and Security

-"Informational Device" during non-emergency

[Device]

-"Self Powered"

-"Wireless"

-"Device-Device" comm

[Business Plan]

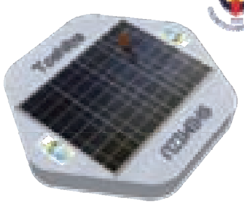
-"Local government based"

-Mass sales (w/ Toshiba home re-chargeable power source)

-Infrastructure construction

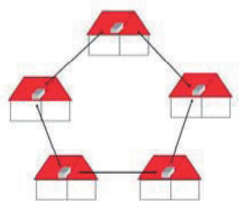
-"New business opportunity"

-i.e. Bee-box based operating device



powered!!

Wireless!!



Talks to each other!!

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Thank you very much for your interest

ALPS TEAM-8

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