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Abstract	When a disaster occurs, it is difficult to predict where they occur, the damage occurs is very serious. Especially in urban areas as electricity, gas, and make daily life difficult to break in a water supply infrastructure, human damage is increased by the building collapse and fire. Been evacuated or displaced temporarily under a long-term scale of the disaster are forced to live against a very stressful daily life. Japan's large-scale natural disasters since 1947 (typhoons, volcanoes, tsunami, torrential rain, earthquake) and see the number of occurrences of the situation amounts to 52 times. The earthquake 33 times in 17% of the total life of 14,619 names is taken away, the 15th typhoon in 29 percent of the 17,455 names have been deprived of life. In recent years, the typhoon is the modernization of the building due to fewer deaths. It should be noted in the Great Hanshin Earthquake that occurred in 1995, 6,437 deceased after 1960. We initially conducted a brainstorming, Natural Hazard and Natural Disaster, Effect Damage extracted, and thought it might be able to supply power to set up the school grounds and parks that shelter the renewable energy. By creating charts and graphs during a power failure scenario earthquake scenarios, lighting and television, enables access to information through radio, led can ensure a safe and secure living in shelters. What we learned in interviews with people who experienced the Kobe earthquake was that the power is restored sooner than we thought. From power after this disaster, gas, or to recover research performed at the time how much of the infrastructure, water could get very interesting data. -The top priority should be a haven for power restoration. 75% 24 hours after restoration is done in the area of emergency power in the 7 days have ended. - Gas and water has to be buried underground, and recovery can take 85-95 days. To recover in this case is the highest priority evacuation. Renewable energy uses a natural resource that doesn't dry up the resource, and the force of the wind, sunlight, and water power are typical. When our idea was spoken to the person in charge of disaster prevention of the municipality, it was obtained that the certainty of 100% was requested in the energy used in a time of disaster. However, they are required to ensure reliability during disasters that greatly depends on the weather and the environment will inevitably grow in size very much. When the global perspective, the world has a non-power region, a disaster occurred in the world doing. I tried to work on an emergency hearing of the disaster, and later finding the victims, it was found that some interesting process. - First stage: "surgical" - The second stage: "Infection" - The third stage: "Mental Care" Prevention of infection, vaccines and drugs that require temperature control, for it was found that these global needs. And we produced a prototype of Portable battery system versatile in the world, showed the potential for the use of renewable energy in the disaster.
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Group 4

Group 4's Theme Proposed by Kokusai Kogyo group Infrastructure Innovation Institute, Inc.

Theme 9:

ALPS theme title: **Disaster prevention system using renewable energy**

Proposer Organization's Name: Kokusai Kogyo group Infrastructure Innovation Institute, Inc.

Energy security in an afflicted area

The security of energy is important in our safe life, and emergency too. At present, disaster prevention system is settled on only using conventional fossil fuel as a most reliable way.

At present emergency electric power system

However, In case of emergency, is there a positive proof where it works?

Risk factor

- **Running out of the fuel stuck due to the collapse of supply system**
- **Absence of an engineer to be able to operate the electric power system**
- **Lack of alternative energy sources**

The characteristic of renewable energy straighten out that problem !?

Point

- **Not only for emergency, but for everyday**
- **Analysis of beneficiary's demand and renewable energy**
- **Operating risk and risk management**
- **Development of anti disaster city with Community Participation**

For reference

- **An assumption field ex. a urban like a ward of Tokyo ,Yokohama**
- **Observation of a real case ex. MEGA-solar power plant**

・URL: http://www.kk-grp.jp/

Fig. 1: stakeholder

Characteristics of renewable energy	Period for recovery			
	short-term		long-term	
	conventional	Renewable	conventional	Renewable
operational performance	△	○	△	○
adjustment capacity	○	×	○	×
logistics of fuel or resource	○	○	×	○
running cost	×	○	×	○
initial cost	○	△	○	△
emission	×	○	×	○
CO2 emission	×	○	×	○

Fig. 2: Characteristics of renewable energy and period for recovery

Keyword： **Renewable energy, Energy efficiency, Environmental analysis, Overseas Development**

ALPS Final Report 2010

Group 4

PROJECT TITLE:
“DISASTER PREVENTION SYSTEM USING RENEWABLE ENERGY”

Theme:
“Disaster prevention system using renewable energy”

Proposer Organization: Kokusai Kogyo group Infrastructure Innovation Institute, Inc.

Proposer Organization’s Supporter: Naomi Sawada

Keio Mentor: Yoshiaki Ohkami

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HAMADA, DAISUKE
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Team No. Four

DISASTER PREVENTION SYSTEM USING RENEWABLE ENERGY

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1. EXECUTIVE SUMMARY

When a disaster occurs, it is difficult to predict where they occur, the damage occurs is very serious.
Especially in urban areas as electricity, gas, and make daily life difficult to break in a water supply infrastructure, human damage is increased by the building collapse and fire.
Been evacuated or displaced temporarily under a long-term scale of the disaster are forced to live against a very stressful daily life.
Japan's large-scale natural disasters since 1947 (typhoons, volcanoes, tsunami, torrential rain, earthquake) and see the number of occurrences of the situation amounts to 52 times. The earthquake 33 times in 17% of the total life of 14,619 names is taken away, the 15th typhoon in 29 percent of the 17,455 names have been deprived of life. In recent years, the typhoon is the modernization of the building due to fewer deaths.
It should be noted in the Great Hanshin Earthquake that occurred in 1995, 6,437 deceased after 1960.

We initially conducted a brainstorming, Natural Hazard and Natural Disaster, Effect & Damage extracted, and thought it might be able to supply power to set up the school grounds and parks that shelter the renewable energy. By creating charts and graphs during a power failure scenario earthquake scenarios, lighting and television, enables access to information through radio, led can ensure a safe and secure living in shelters.

What we learned in interviews with people who experienced the Kobe earthquake was that the power is restored sooner than we thought. From power after this disaster, gas, or to recover research performed at the time how much of the infrastructure, water could get very interesting data.
-The top priority should be a haven for power restoration. 75% 24 hours after restoration is done in the area of emergency power in the 7 days have ended.
- Gas and water has to be buried underground, and recovery can take 85-95 days. To recover in this case is the highest priority evacuation.

Renewable energy uses a natural resource that doesn't dry up the resource, and the force of the wind, sunlight, and water power are typical.
When our idea was spoken to the person in charge of disaster prevention of the municipality, it was obtained that the certainty of 100% was requested in the energy used in a time of disaster.
However, they are required to ensure reliability during disasters that greatly depends on the weather and the environment will inevitably grow in size very much.

When the global perspective, the world has a non-power region, a disaster occurred in the world doing. I tried to work on an emergency hearing of the disaster, and later finding the victims, it was found that some interesting process.
- First stage: "surgical"
- The second stage: "Infection"
- The third stage: "Mental Care"
Prevention of infection, vaccines and drugs that require temperature control, for it was found that these global needs.
And we produced a prototype of Portable battery system versatile in the world, showed the potential for the use of renewable energy in the disaster.

Key word: disaster, renewable energy, earthquake, Infection

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3. PROBLEM STATEMENT

Renewable energy uses a natural resource that doesn't dry up the resource, and the photovoltaic generation, the solar heat utilization, wind power generation, the geothermal power generation, and the biomass energy, etc. are given as previously stated.
It is a photovoltaic generation, a solar heat utilization, and a force of the wind that it is widespread in these.
However, the output changes according to natural environment and the weather condition. It is necessary to use the battery etc. to level this output.
It is very difficult to imagine damage due to the disaster.
Therefore, when the renewable energy system is set up while securing robust, the construction cost grows.
It was pointed out that the certainty of 100% was requested by the person in charge of the municipality of the disaster measures for the energy used in a time of disaster, and the portability was requested and.

In the Hanshin-Awaji (Kobe) Earthquake in 1995, the restoration construction of the electric power to the evacuation site starts in top priority immediately after generation of the disaster, and the stricken area region whole will be restored in a very short term (seven days).

4. ANALYSES AND DISCUSSION OF ALPS METHODS

4.1 Mind Map

The mind map is a tool that arranges the relating item, and brings it together plainly.
Figure 4.2 (see Appendix) is one about "safe and security" we made.
It is divided into eight groups roughly.
It is health and is life, and it is environmental problems, a disaster it, people it, economy, and SDM government.
The matter that related further was connected from each the item and the mind map was made.
It was understood that this mind map was a tool that brought the matter with the relation concerning the theme together.

4.2 Project Priority Matrix

PPM is about features, cost, and time. It evaluates constrain, optimize, and acceptable.

It is evaluated by time series of three patterns.
The curve is assumed to be a maturity level of the prototype that changes with the time axis.

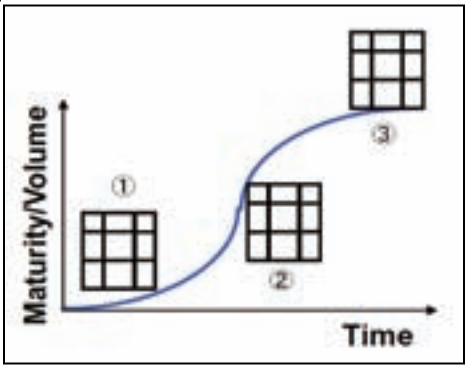

Figure 4.2.1

It changes flexibly according to the desire of the market the cost a little beginning came into the market the prototype. However, the improvement is done repeatedly according to the user's desire when limiting it to features. The prototype doesn't spread to the market if the improvement is not done repeatedly.

	constrain	optimize	accept
Features			●
Cost		●	
Time	●		

Figure 4.2.2

When the prototype begins to sell in the market, the cost is limited a little.

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However, the improvement is done repeatedly according to the user's desire when limiting it to features.

	constrain	optimize	accept
Features			●
Cost		●	
Time		●	

Figure 4.2.3

When time passes, too and the prototype is established to the market, the cost is limited. However, it flexibly thinks about the change for the user's desire when limiting it to features.

	constrain	optimize	accept
Features		●	
Cost	●		
Time			●

Figure 4.2.4

4.3 Scenario Graph

Scenario Graph is about When, Where, Who, What, Why and How. The necessary key word for the theme is picked up from 5W1H. This keyword of concrete case described clearly. This is tool that relativity is shown.

This tool is that the necessary keyword of relativity can understand theme of 5W1H.

This purpose of theme is that to use the prototype from the renewable energy rescues the victim. The keyword that relates from Scenario Graph to the purpose is shown in a red line. The purpose can understand part seen from the whole. Exactly, "The forest sees and the tree sees."

Or 5W1H pick up and the keyword concerning this theme pick up. There is an advantage that the purpose of the directionality of the project becomes clear.

(See Appendix 4.3.1/4.3.2)

4.4 CVCA

CVCA（Customer Value Chain Analysis）is tool that the relating stake-holder adjust and the flow of fortune and information is shown.

I consider CVCA. The stake-holder who made the prototype pick up the idea. The outline of the prototype show in Figure 4.4.1.

First, the prototype is made from PV, Battery, Cooler box, and LED-Spot Light Maker. Next, the made prototype sold to Fire Station, Hospital, and Local Government. When prototype sell, information of the disaster receive. The flow is Figure 4.4.2.

[Summary]

・To understand the stake-holder, The flow of the fortune and the thing can understand.

・This flow that buy the thing from Maker, make the prototype, and sold. It could understood.

・If the price etc. confirmed, in addition, it can understand concretely.

4.5 Interview, Observation

According to CVCA, we decided to visit some of our main stakeholders such as victims who really experienced disasters, staffs working with a hospital, local government clerks and so on. There actually are 3 interviews that changed our ideas.

The first one is a person-to-person talk with the chief of Disaster Prevention Section in the city of Toshima—Mr. Sato. From his points of view, the prevention system we have been using now is extremely unreliable, so to build a strong one is at emergency. Plus, if we can use renewable energy like photovoltaic generation and locate them in community parks or schools, it will become a natural place for the green education besides having a trustworthy electronic providing system. Finally he suggested us to have a visit to gas station since they have the most reliable disaster prevention system, unexpectedly.

Therefore we organized an interview to the person who is not on our list of stakeholders at the beginning. Mr. Masukawa—Deputy General Manager from Showa Shell Sekiyu K.K. guided us a trip to a gas station. What surprised us is some of the gas station did not damage at all during either the Hanshin-Awaji (Kobe) Earthquake in 1995 or the Mid Niigata Prefecture Earthquake in 2006. The amazing system includes a 2-meter-high firewall, water saved in advance device, and the solar photovoltaic system.

Then, we went to Hospital of Kyorin University where we met Ph.D. Kobayashi who is an infectious disease physician. He told us the most horrible things for them after disaster is the Infectious Diseases due to the bad environments, dense populations and so forth.

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Those valuable conversations told us that the person we should focus on after disaster is the “helpers” instead of “victims”, which makes us begin to think about what they can do and what they need during the process of saving others. In addition, since we already had a perfect prevention system which adopted by gas station successfully and their availability (gas station can be found everywhere within a community), the gas station became our main customer which is out of our expectation.

4.6 Scenario Prototyping Rapidly

In order to know the gap between the ideas we had and the real customer’s requirements, we made our rapid prototype according to scenario revised after interviews.

This is the original version of our prototyping. You can tell we were going to build a system for the community as whole, and this is a part of our system which is positioned at school.

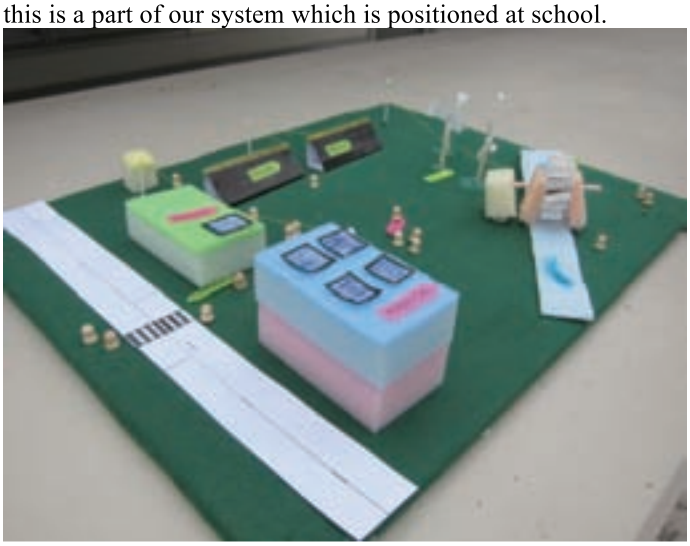

Figure 4.6.1

It showed some insights of our idea to combine several types of renewable energy. However, it’s impossible for any individual company to build this without obtaining sponsor from government. That’s why we changed our ideas later but still a very good try we guess.

4.7 Value graph

Combining CVCA and VoX we find the most important element for our system would be “Reliable”. To support that, our system should be available and provide electronics continuously even after disaster. By using this method we’ve learned that the system we provide should be maintenance in a certain time and care about running out of batteries.

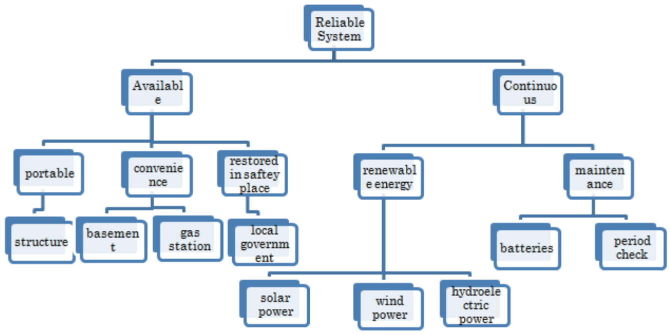

Figure 4.6.2

Also, it reminds us how important the availability of a system is. Given there is a reliable system, and only can be used by a certain area, the system is meaningless to the society as a whole.

4.8 Function-Structure map

Function-Structure map is tool that showed relation horizontal axis and spindle based on QFD. The relation do not understood in the table. So, to use Function-Structure map confirm causal relation

・QFD1

To strong between the user requirement and the function “Want to electric power” can understand. Another, To strong between “Want to electric power” and “Can use anywhere and the price are low” can understand.

・QFD2

To strong between “Can use anywhere” and “Can use anywhere” can understand. Another, strong “Can use anywhere and the price are low” can understand.

・Summary

This tool can understand the relation of user requirement, function and physical design. To use tool, When you product design, understood what keyword of necessity.

4.9 QFD I・II

QFD is a tool which will help to meet the customer’s requirements, ensure the quality, and let them feel satisfied with it during the whole project, because it can prevent big mistakes.

For example, in this project QFD helped us to making a decision on using photovoltaic energy among renewable energies since it is the most suitable tool for our customer and the most appropriate product would be ruck style.

Therefore by using QFD we can tell the orientation of our solution. But to make a product with a low cost and to maintain its minimum durability, certain kind of materials should be founded. This would be matters should be continued after QFD.

4.10 Complexity Cost Worth Analysis

In the Cost Worth Analysis, each part can be analyzed whether it is a proper cost distribution according to the importance. It

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can be judged that it is a proper cost distribution because each part exists from this figure in a proper range.

Figure 4.10.1

4.11 FMEA

The red line in the following graph shows the prototype we want to provide.

There is the possible unconventional failure modes we concluded according to Figure 4.11.1.

According to Table 4.11.1, our system won't work well in certain conditions like the so called bad weather, which means days we don't have solar or heavy wind or no wind at all, and not to mention the broken of the devices which generate electricity.

In the graph if the object which has a high point means it is a dangerous one and under this situation we hardly can use electricity power, vice versa, if it gets a low point that means it will affect generating little or not at all.

Table 4.11.2 is based on Figure 4.11.2&3.
As we can see if RPN got a high number, that means people are injured or not have enough information. Otherwise, it is due to the weather.

4.12 Design for Variety

At first, the connection with the electric power company would be cut off due to disasters. So we proposed a dependent social system which can provide electronics by itself. However, it was understood that the proposal was not requested while interviewing, and shifted to the product proposal.

It was a power supply that was actually requested because the electric power came to supply in about one week as for the clarification by the interview even if the power supply was cut off in Japan due to the disaster immediately after struck. Therefore, it is a large amount of electric power. Became the product proposal of "Portable multi energy backpack system" to which electricity was able to be generated anywhere though electricity was not able to be generated.

There is especially no design change after it thinks about this product.

4.13 Environmental Complexity Recyclability

This tool is not suitable for our project, so very sorry we cannot use it.

4.14 Serviceability

Something was discussed, "Disaster", and the flow to which the disaster occurred was confirmed in the beginning. All members were able to recognize that they returned to the state in daily life after timing for which the electric power was needed had occurred the disaster by having confirmed the flow.
Next, the method of generating the most efficient renewable energy discussed something. Moreover, not only to discuss the power generation method but also to deepen the more understanding, it visited an actual site. It went to Ashikaga Institute of Technology for the visit for the small water power citizen power plant and wind power generation for the photovoltaic generation including the Kashiwazaki Kariwa nuclear plant of Tokyo Electric Power Company for the mega-solar site and the hydro-power of the north grove city. Especially, it was able to know there was a demand of wanting to cool the vaccine for those who injured in the stricken area and to preserve it in the Ashikaga industry. As for the method of each power generation, the summary is Table 4.14.1.

The power supply the request actually because the electric power comes to supplied in about one week even if the power supply is cut off in Japan as other interviews are done due to the disaster immediately after struck. Therefore, it is a large amount of electric power. To be the product proposal of "Portable multi energy backpack system" to which electricity was able to be generated anywhere though electricity was not able to be generated.

	Source	Output	Infra	Municipality	House	Personal
Photovoltaic	Sun	Electric	○	○	○	○
Wind power	Wind	Electric	○	○	○	---
Biomass	Plant	Electric, Gas, Hot water	○	○	---	---
Solar energy	Sun	Heat, Hot water	----	△	○	○
Hydropower	water	Electric	○	○	---	---
Geothermal	Geo-Heat	Electric, Hot water	○	---	---	---

Table 4.14.1

4.15 Quality Score-carding

①Control Factor : About providing the electronic

The prototype can control power supply from the solar panel and the battery. The solar panel can adjust the angle of light. The battery can control the output of electric energy to be made renewable energy.

②Noise Factor : Besides sunny day , For example , rain , snow , cloud , strong wind

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The prototype can charge the cellular phone, warm the drink, cool the drink from the renewable energy. The renewable energy consists of natural energy. Natural energy is controlled by the weather. Human cannot control the weather.

As a result, Noise Factors is weather.

How did you arrive at your transfer function?

●Transfer Function

For example

Y＝Necessary amount of energy for helping others

X1＝size of battery, X2＝solar panel

V1＝rain , V2＝snow , V3＝cloud , V4＝strong wind

⇒ "Y＝(X2(if, -V1 -V2 -V3 -V4) →X1)"

Purpose of prototype supplies what electric power from renewable energy. And when you use Y, the electric power was requirement.

4.16 Net Present Value Analysis

Following is the main structure of our business model.

Figure 4.16.1

The parameters showed in Graph 4.16.2 (see Appendix).

*Total Admin Cost including Staff Cost, Office rental fee, CM cost, transportation cost and so on.

Then, we set our tax rate as 4% referencing to www.nta.go.jp; the discount rate as 10% which is the average number; and assume we can get 86,000,000 yen as our initial investment. It will take us for 3 years to get the payback.

Detail prices are included in Figure 4.16.3 (see Appendix). According to that our Net Present Value would be 26,576,000 yen. It is quite a good deal for our investors.

4.17 Design Structure Matrix

This tool is not suitable for our project, so very sorry we cannot use it.

4.18 Design of Experiment

●Design Variables:

A Kind of battery : A1. Lead-acid storage battery A2. Lithium-ion battery

A3. Nickel and hydrogen storage battery

B Kind of solar panel : B1. Fold B2. Fixed mount

C Style of cooler bag : C1. Circle C2. Square C3. Triangle

NO	Battery	PV	CoolerBag
1	A1	B1	C1
2	A1	B2	C1
3	A2	B1	C1
4	A2	B2	C1
5	A3	B1	C1
6	A3	B2	C1
7	A1	B1	C2
8	A1	B2	C2
9	A2	B1	C2
10	A2	B2	C2
11	A3	B1	C2
12	A3	B2	C2
13	A1	B1	C3
14	A1	B2	C3
15	A2	B1	C3
16	A2	B2	C3
17	A3	B1	C3
18	A3	B2	C3

Table 4.18.1

The electric power is supplied to put the battery on the rucksack, and to cool the one from the sunlight energy in the cooler, and it shines on with the light.

- What are your factors (= design "knobs")

  Battery, Solar panel, and Cooler bag

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Figure 4.18.1

- What are your levels?

Answer is nothing. Because our prototype is not numerical target.

A lot of prototypes are sold to the local government, hospital and fire station.

- How can you conduct experiments with your prototypes
- · Physical Experiments?

Actually, The user uses the prototype.

<u>4.19 Object-Process Methodology</u>

To combine the ideas of our group and visualize the structure of our system, OPM did help us a lot. Especially at first, all of us only have am ambiguous vision of it. Figure 4.19.1 (Appendix) shows the level-0 of our system.

We were trying to build a back-up system which also could be used in usual times due to the depletion of conventional resources. Therefore, the system looks like a transition one between only using fuel nowadays and only using renewable energy in the future.

5. DESIGN RECOMMENDATION

According to the priority, we designed our system more suitable for the person who can help others.

Figure 5.1

As showed in the above picture, there are four basic parts in our system: solar panel, generator, light and ice-bag. The solar panel and generator work together to provide continuously electronics, and lights would be an extraordinary element due to the high frequencies disaster happens in night and the dim in the underground. In the saving process, ice bag would be a very useful tool to conserve medicines. We considered it as a key element of our system. Also, we can offer other parts such as rice-cooker according to customer's requirements.

Figure 5.2

Use-cases (Figure 5.3) and Scenario Graph (Figure 5.4) attached (see Appendix) explained our main concern on the mid-term of our system design.

We are planning to provide our products to local governments and gas stations and some families. Once they find their products are in bad condition they can call us and we'll go there for checking and repairing. The changing of batteries will be held interval 2 years. Additionally, we'll teach them how to use it and how to keep it at first time they get the products.

In terms of partnerships, we may cooperate with companies who are doing researches on renewable energies and alike.

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6. COMPETITIVE ANALYSIS

Our business model would be a model product mixed with and service. We will purchase solar panels, generators, ice bags from our suppliers, and assemble them according to our customer's requirements. At the same time, for our patrons we will provide after sales service such as one free regular check within 2 years, batteries changing or system repairing within 24 hours after customer calls.

The following graph shows the detail of our business model.

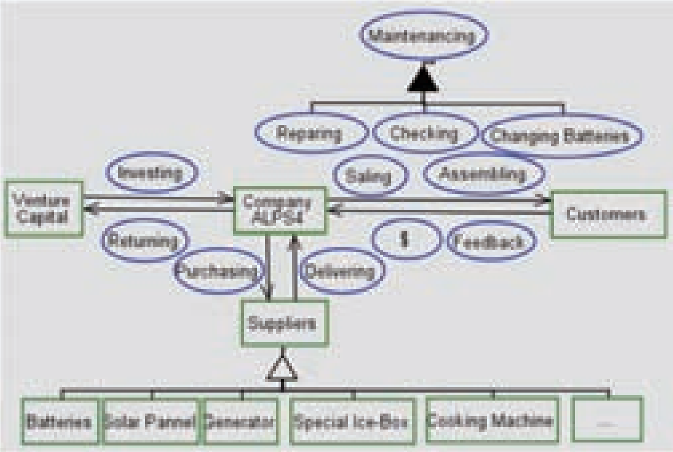

Figure 6.1

Due to the expensive administration cost of warehouse in the big Tokyo area, we gave up the plan of rental and least model. And we also didn't include the service revenue because at the first 3 years it would be too little to be taken into account.

Here is our cost structure, and we assumed the Minimum, Likeliest and Maximum prices respectively. In addition, the total administration cost is made up of the office rental fee, CM, staff and so on. We did a rough calculation as well. (see Appendix Figure 6.2/6.3)

According to National Tax Agency of Japan, we set our taxation as 4%; since the average discount rate is between 4~12, so we set it to 10%; and we assumed we could get an initial investment at least 86,000,000 yen. Then, we got the graph showed us we can make money from the third year which means our company will enter into a development phase after 2 years hard working. And the Net Present Value of our product would be 26,576,000 yen. (see Appendix Figure 6.4)

Apparently, the model of assemble corporation is the easiest one to be imitated. However, we'll focus our main concern on integrations but not only simply assembling or repairing.

7. ALPS ROADMAP AND REFLECTIONS

At first we brainstormed on the concept of "disaster" and "renewable energy". According to that we made our own Scenario Graph. Referring to the specialty of our system, our scenario is made in three different situations which are the three phases during disaster. That is before disaster, just after disaster and the recovery phase. Then, we listed almost all stakeholders, and interviewed some. After group discussion, we decided to choose the key routine for our project and made CVCA, OPM.

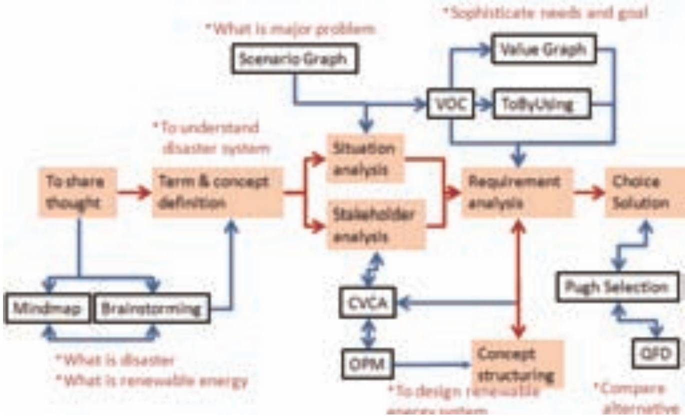

Figure 7.1

As a matter of fact, we interviewed some key person after second ALPS lecture because of their time table. And the latter interview actually changed our ideas, which can be called Aha. During the third period of ALPS, we actually made a real prototype and this is the Eureka I guess. We also had many Oops, especially at first, second phases since we want to build a very huge system for a community which seems impossible later.

If we could do the project again from the beginning, we'd like to use it again. At least, it is a suitable tool for our team.

We wish Japanese would be also available. The advantage of which is it will improve the quality of ALPS.

8. CONCLUSION AND FUTURE WORK

In order to build the electronics providing system, we solved three main problems which related to the reliability, availability, and sustainability respectively.

First of all, our system must be a reliable one because it will be used even after disaster happened. After a casual visiting to a gas station, we began to consider it as our best place to restore electronic generators because the strong construction system they had. Plus, since gas stations are located at every corner of cities, it is very convenient to be reached for citizens.

Secondly, the electronic power should be provided at some place where may be experienced a huge damage. In a word, a portable one is required. On this point we should thanks to the tool of VOC and CVCA. At first we didn't include hospital when we selected our key scenario, but it showed in CVCA. In order to understand our customers' requirements completely,

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we decided to have a visit to the hospital as well, which changed our idea totally.

Lastly but not least importantly, our system should be sustainable since we don't have much resources left in the earth. Therefore, we chose to use renewable energy in case the fuel is depleted. Besides, in terms of the technique problem (reference to Pugh Selection) we only use solar power in this phase but will add more in the future which will be discussed later.

Figure 8.1/8.2/8.3 (see Appendix) showed our processes in using almost all important tools learned during ALPS lectures.

To sum up, during the whole project VOC helped us a lot in making the key decisions, so we reckoned that it is extremely vital to listen to your customer or other stakeholders frequently and observe/analyze their behavior maybe a vital points in system designing.

Apparently, there is not a 100% perfect system in the world, not to mention our system. There are at least 3 things we should do in the near future.

Firstly, due to the characteristic of portable, we don't think our system can last a long time if the batteries couldn't be recharged on time. In another words, our system at a large part depends on the weather. Therefore, next year we should be developed another one such as wind power or geothermal energy to make it up.

Then, given several types of electronic generators we need a standard interface for recharge. This would be taken into account within 3 years.

Furthermore, our customers currently are gas station and local government since they had safer places. However, if you surf on Google map and take a look at their locations, it's not difficult to find that there are still lots of blind areas. As a result, next step would be very instinct, that is to provide it to ordinary families and help them to find a safety place to store. This would also become our core business—to provide an integrated solution for electronics either after disaster or in their ordinary lives.

In order to do those things, a deep knowledge on renewable energy is required. Professional engineers who are familiar with electronics and construction and of course certain amount of investment are musts.

9. ACKNOWLEDGMENTS

We would like to thank Taniya-san, Sawada-san and Nakajima-san from Kokusai Group Corporation, the research center of inflation and innovation for the kind sponsor and thoughtful care from the first day we know each other till now, without them we do not think we can accomplish the whole project.

During ALPS, our mentor—Prof. Okami gave us lots of ideas and comments especially on the making of prototype (COTS) which really enlightened us. We really appreciate his great help and feel very lucky to have him on this project.

Last but not the least important, we want to give our sincere thanks to Prof. Kim Sun, Prof. Kurt and all the professors who taught us a lot on everything. We have really learnt a lot.

Many thanks to who helped us during the project and forgive us not listed here one by one.

10. REFERENCES

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[5] http://www.mlit.go.jp/saigai/index.html

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ANNEX A

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Figure 4.1

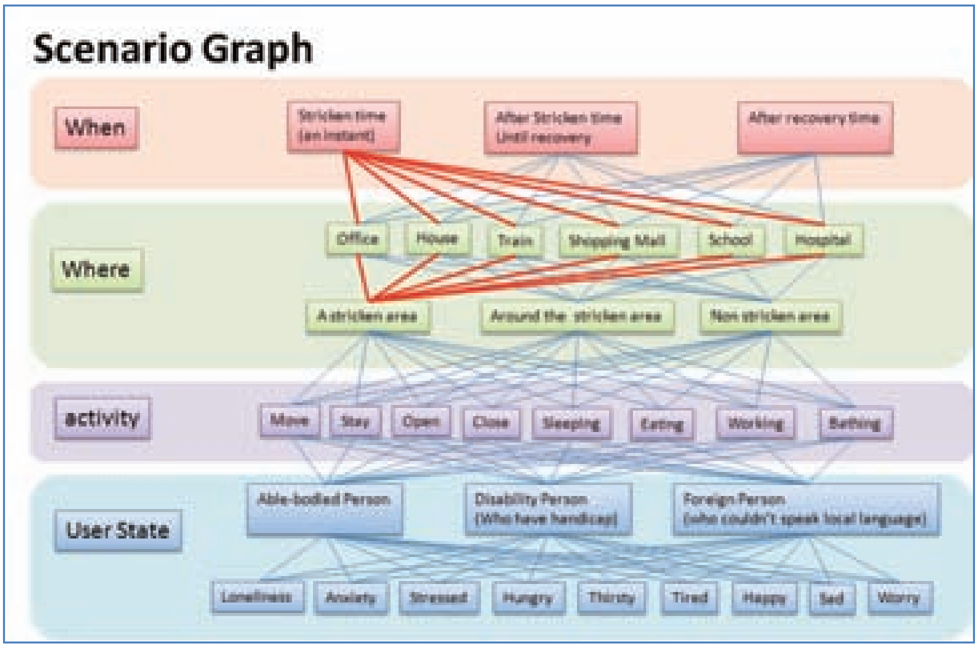

Figure 4.3.1

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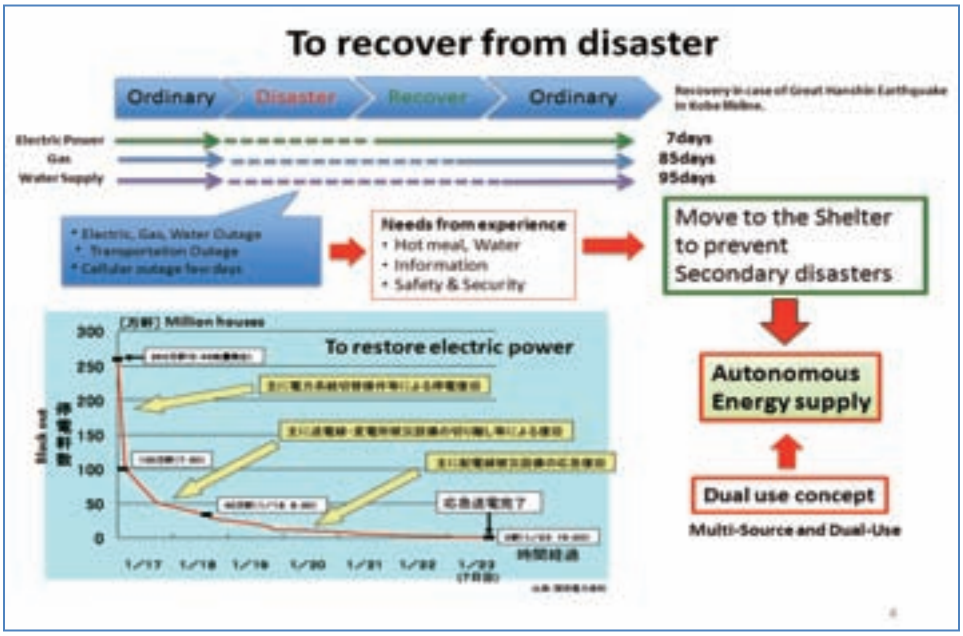

Figure 4.3.2

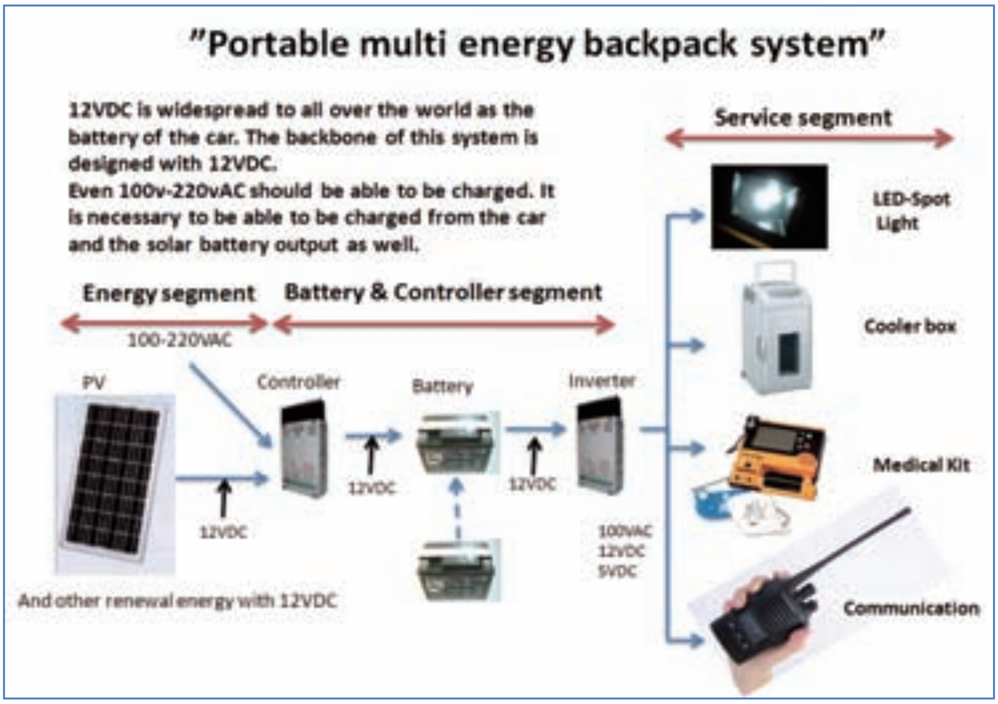

Figure 4.4.1

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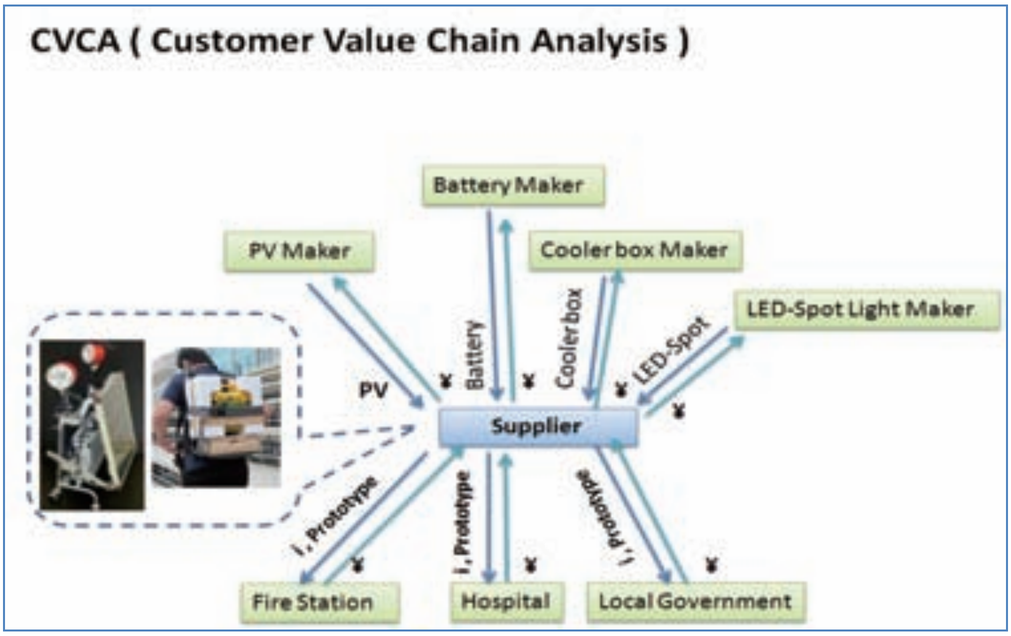

Figure 4.4.2

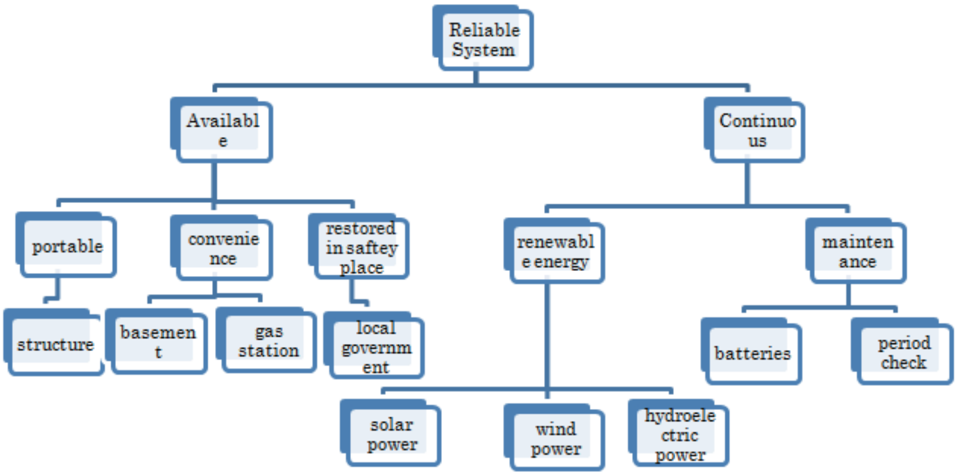

Figure 4.6.2

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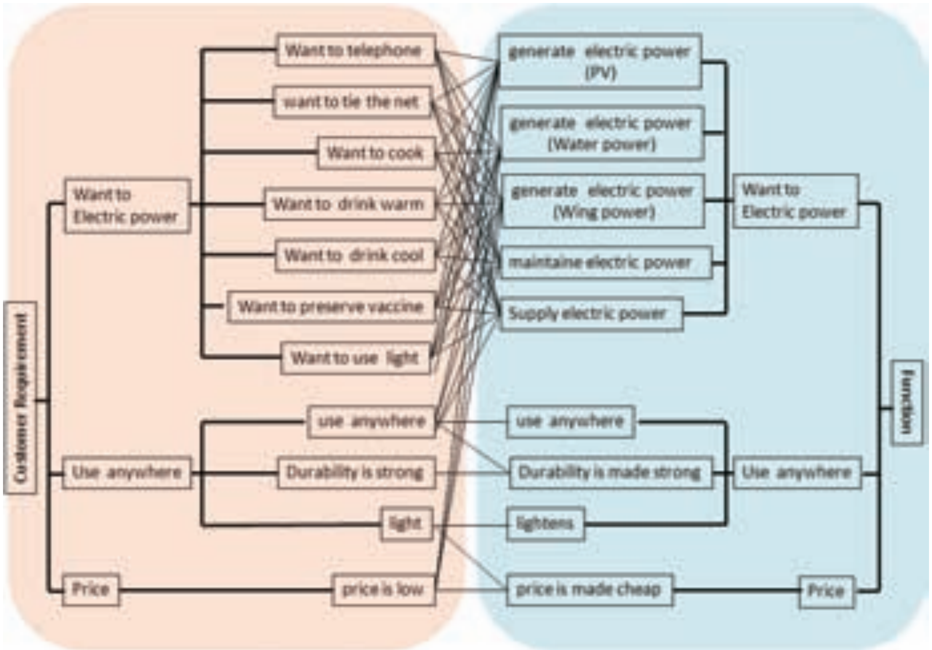

Figure 4.8.1

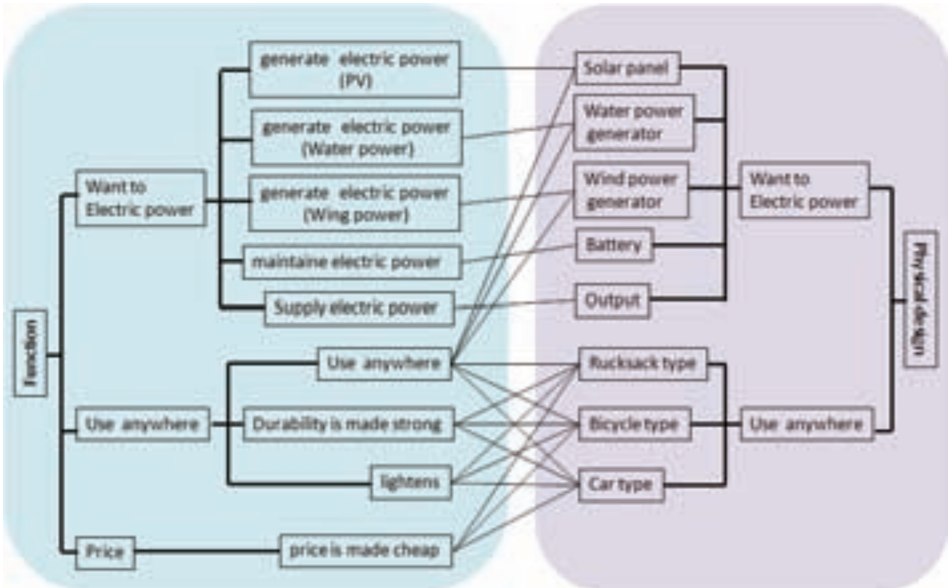

Figure 4.8.2

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Customer Requirement		Weight(%)	generate electric power (PV)	Generate electric power (Water power)	generate electric power (Wing power)	Maintaine electric power	Supply electric power	Use anywhere	Lightens	Durability is made strong	price is made cheap
		Function	Want to Electric power					Use anywhere			Price
Want to Electric power	Want to telephone	5%	3	3	3	3	3				
	Want to tie the net	10%	3	3	3	3	3				
	Want to cook	5%	3	3	3	3	3				
	Want to drink warm	10%	3	3	3	3	3				
	Want to drink cool	5%	3	3	3	3	3				
	Want to preserve vaccine	15%	3	3	3	3	3				
	Want to use light	15%	3	3	3	3	3				
Use anywhere	Use anywhere	15%	9	1	3	3	3	3		3	
	Durability is strong	10%								3	
	Light	5%							3		3
Price	Price is low	5%	3	3	3						3

Table 4.9.1

Function		Solar panel	Water power generator	Wind power generator	Battery	Output	Rucksack type	Bicycle type	Car type
	Physical design	Want to Electric power					Use anywhere		
Want to Electric power	Generate electric power (PV)	3							
	Generate electric power (Water power)		3						
	Generate electric power (Wing power)			3					
	Maintaine electric power				6				
	Supply electric power					6			
Use anywhere	Use anywhere	9	3	3			9	3	1
	Lightens						9	3	1
	Durability is made strong						3	3	3
Price	Price is made cheap	9	3	3			9	3	1

Table 4.9.2

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Function or Requirement	Potential Failure Modes	Potential Causes of Failure	Occurrence	Local Effects	End Effects on Product, User, Other Systems	Severity	Detection Method/ Current Controls	Detection	RPN	Actions Recommended to Reduce RPN
Generator doesn't work	No Electric generation	Solar panel doesn't start	3	break	No supply electric power	3	human check	2	18	human check
		Generator is short	3	No move		2		3	18	
		Breaker drops	1	No move		2		3	6	
No sunlight		Weather is bad	2	climate stop		2		1	4	
		Night	2	climate stop		2		1	4	
Solar panel doesn't start		Covered dust	2	No move		3		3	18	
		Panel cracks	3	climate stop		2		1	6	
PV doesn't work		drop	3	break		3		2	18	
		PV break	3	break		3		2	18	
Electricity cannot be transmitted		No electric energy	3	No move		2		3	18	
		Leak	3	No move		2		3	18	
		Do not connect	3	No move		2		3	18	
		line cut	3	No move		2		3	18	
		Off	1	break		3		2	6	
Battery breaks		line cut	3	No move		2		3	18	
		line is connected oppositely	1	No move		2		3	6	
		Ground drops	2	break		3		2	12	

Table 4.11.1

Function or Requirement	Potential Failure Modes	Potential Causes of Failure	Occurrence	Local Effects	End Effects on Product, User, Other Systems	Severity	Detection Method/ Current Controls	Detection	RPN
Injury	No work victim	Injury leg	2	No work	No supply electric power	2	human check	2	8
		Bloodsh	3	No work		2		2	12
		Fractures	3	No work		2		2	12
Bad health		Generation of heat	2	No work		2		2	8
Buried in the building		Stay under space	2	No work		2		2	8
No clothes		No shoes	1	Nothing		1		2	2
		No clothes	1	Nothing		1		2	2
Road breaks		No road	1	breaks		1		2	2
		Landslide	1	No work		1		2	2
Bad weather		Rain	1	Climate problem		1		1	1
		Cool	1	Climate problem		1		1	1
No information		Human information	2	No work		3		2	12
		Place information	2	No work		3		2	12
		Food information	2	No work		3		2	12
		Disaster information	2	No work		3		2	12

Table 4.11.2

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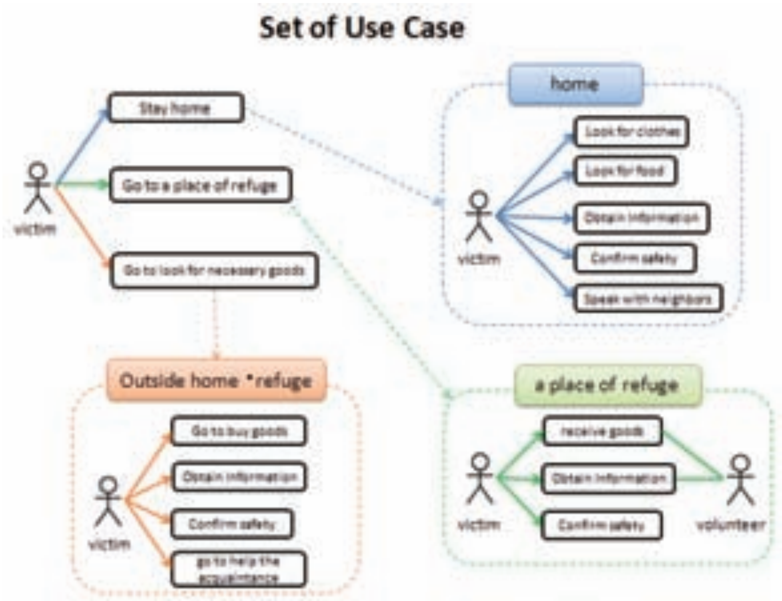

Figure 4.11.2/5.3

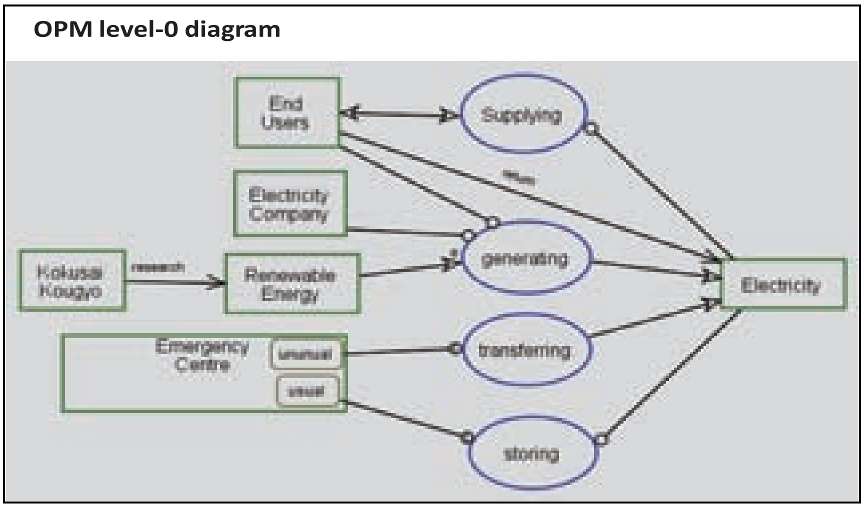

Figure 4.11.3/4.19.1

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	Minimun	Likeliest	Maximun
Unit Price	1,500,000	2,000,000	2,500,000
Sales Volume	10	20	30
Battery Cost	250,000	375,000	500,000
Body Machine Cost	750,000	1,125,000	1,500,000
Delivery Cost	1,000	5,500	10,000
Total Admin Cost	49,300,000	74,650,000	100,000,000

Figure 4.16.2/6.2

Staff Cost	30,000,000	45,000,000	60,000,000
Office Rental Fee	6,000,000	8,000,000	10,000,000
Office Other Fee	1,200,000	1,600,000	2,000,000
CM Cost	12,000,000	16,000,000	20,000,000
Transportation Fee	100,000	4,050,000	8,000,000
Total Admin Cost	49,300,000	74,650,000	100,000,000

Figure 6.3

Year	0	1	2	3	4
Revenue		40,000,000	80,000,000	120,000,000	160,000,000
Cost		104,760,000	104,760,000	104,760,000	104,760,000
Profit		−64,760,000	−24,760,000	15,240,000	55,240,000
Investment	86,000,000	0	0	0	0
Free Cash Flow		23,830,400	60,800	14,691,200	67,721,600
Discount Factor	1.00	0.91	0.83	0.75	0.68
Present Value		21,664,000	50,248	11,037,716	46,254,764

Figure 4.16.3/6.4

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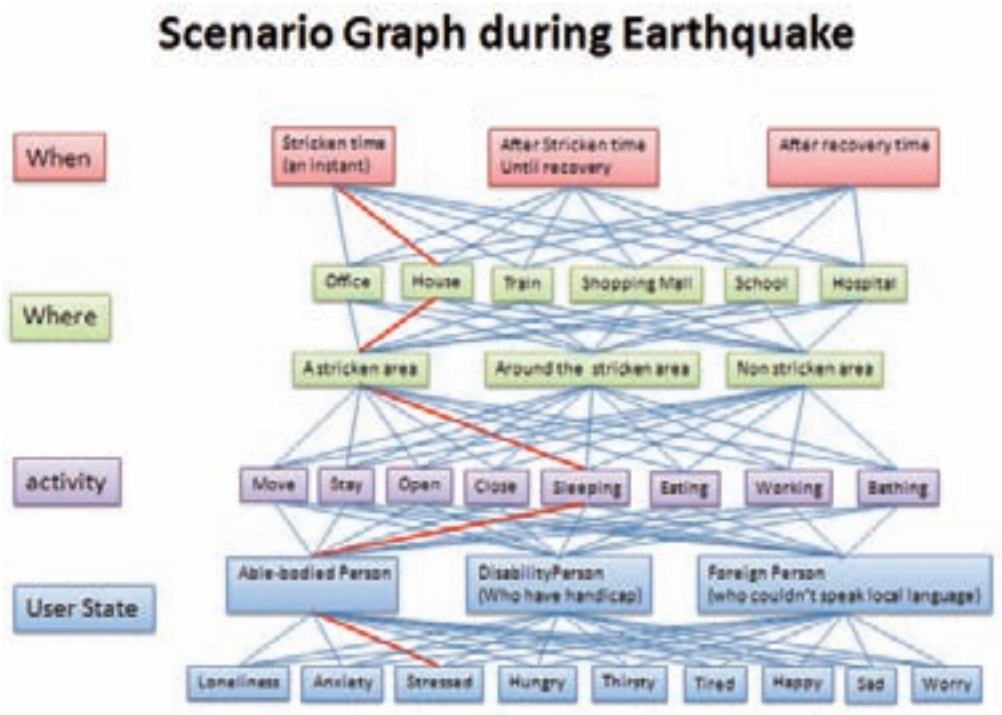

Figure 5.4

o	Project Name	ALPS4			
o	Project Description	Disaster Prevention System Using Renewable Energy			
o	Project Length	6 months			
o	Start Date	10-May-10	◉	End Date	30-Nov-10
			○	Number of Weeks	30
o	Working Days	Monday – Sunday			

Figure 8.1

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Level	Task	PIC	Start Date	Finish Date	WD	DC	DR
1	Problem Definition	Sakurai/Kinoshita	10-May-10	23-Jun-10	45	205	-160
1.1	Topic Choosing	Sakurai	10-May-10	14-May-10	5	205	-200
1.2	Brainstorming	Shimokawa	14-May-10	18-May-10	5	201	-196
1.3	Senario Graph	Shimokawa/Nikaido	14-May-10	20-Jun-10	38	201	-163
1.4	CVCA	Kinoshita	14-May-10	1-Jun-10	19	201	-182
1.5	VOX	Sakurai/Hamada	18-May-10	1-Sep-10	107	197	-90
1.6	OPM	Shu	1-Jun-10	10-Jun-10	10	183	-173
2	Development	Kinoshita/Shimokawa	24-Jun-10	5-Aug-10	43	160	-117
2.1	Roadmap	Kinoshita/Shu	24-Jun-10	2-Jul-10	9	160	-151
2.2	QFD	Hamada/Shu	24-Jun-10	1-Aug-10	39	160	-121
2.3	Pugh	Shimokawa/Knoshita	20-Jul-10	2-Aug-10	14	134	-120
2.4	Morph	Shimokawa/Knoshita	20-Jul-10	2-Aug-10	14	134	-120
2.5	Prototyping Rapidly	Sakurai	24-Jun-10	2-Aug-10	40	160	-120
2.6	STAMP STPA	Shu	24-Jun-10	10-Jul-10	17	160	-143
2.7	Use Case	Shimokawa/Knoshita	1-Jul-10	20-Jul-10	20	153	-133
3	Prototyping	Sakurai/Hamada	5-Aug-10	24-Sep-10	51	118	-67
3.1	DSM	Shimokawa	20-Aug-10	10-Sep-10	22	103	-81
3.2	FMEA	Kinoshita	5-Sep-10	20-Sep-10	16	87	-71
3.3	Real Prototying	Sakurai	5-Aug-10	20-Aug-10	16	118	-102
4	Verification/Validation	Shu/Sakurai	24-Sep-10	30-Nov-10	68	68	0
4.1	Business Modeling	Shu	20-Oct-10	10-Nov-10	22	42	-20
4.2	DOE	Shimokawa/Hamada	10-Oct-10	1-Nov-10	23	52	-29
4.3	Scorecarding	Shimokawa	11-Nov-10	25-Nov-10	15	20	-5
4.3	NPV Analyse	Shu	30-Oct-10	11-Nov-10	13	32	-19
4.3	Final Report	Sakurai/Shu	15-Nov-10	30-Nov-10	16	16	0

Figure 8.2

Figure 8.3

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Group 4's Final Presentation Slides

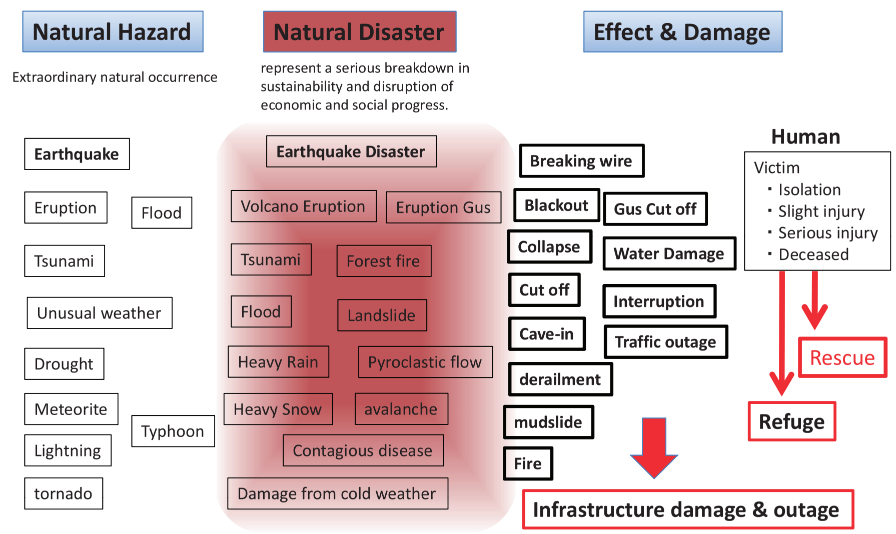
Final presentation

"Disaster prevention system using renewable energy"

ALPS 2010 Group-4
2010.11.19

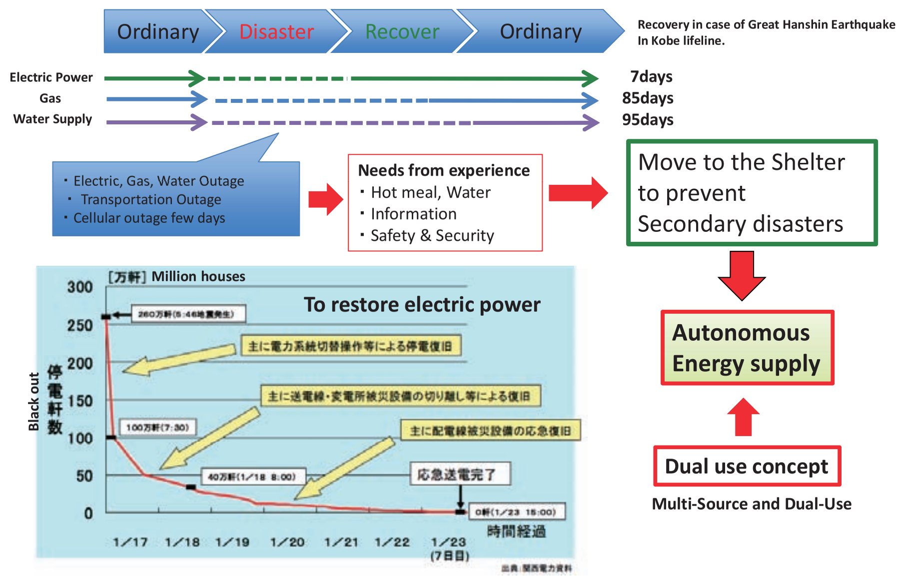
1

Boundary of Natural Disaster from Brain Storming



2

To recover from disaster

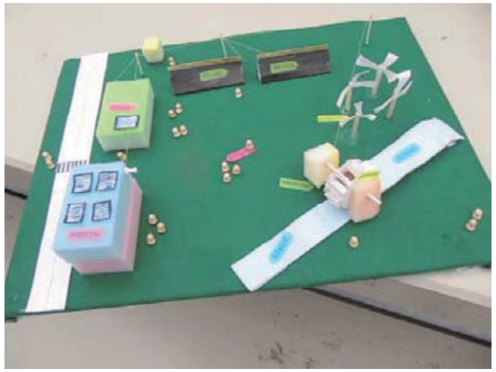


3

Prototype #1

Quick idea and model :-P

4



5

Interview and Observation

6

Interview

- Kyorin Univ. Hospital
  - Infectious Disease Physician
    M.D., Ph.D. Kobayashi
- What should be done after disaster?
  - 3 phases
    - Surgery support
    - Infectious diseases
    - Mental care

7

Aha! from interview and observation

- The disaster is a **global issue**.
- What is necessary in a time of disaster?
- What can we do if we have some energy in disaster?
- Renewable energy can be used even in the world without the electrical power system.
- **Safety and Security** with renewable energy…
- SAVE **LIFE**, HELP PEOPLE ! !

8

Prototype #2

"Portable multi energy backpack system"

9

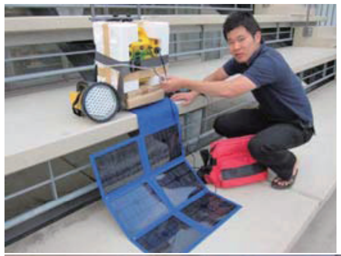
Approach

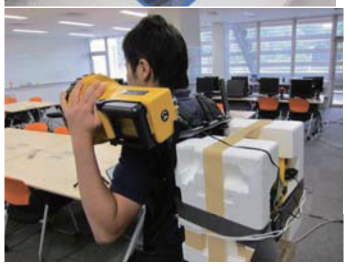
COTS : Commercial off the shelf

Prototype that can be really used

10

"Portable multi energy backpack system" Prototype ALP-G4/S

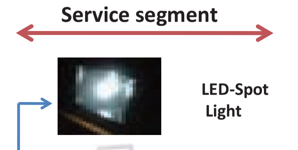


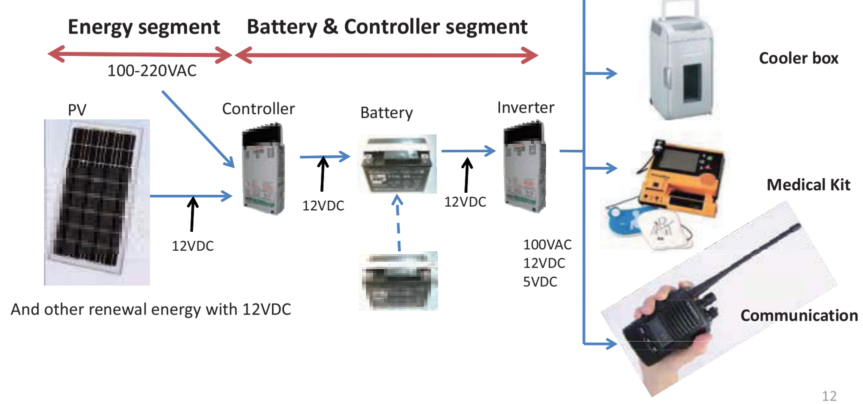


11

"Portable multi energy backpack system"

12VDC is widespread to all over the world as the battery of the car. The backbone of this system is designed with 12VDC.
Even 100v-220vAC should be able to be charged. It is necessary to be able to be charged from the car and the solar battery output as well.





12

Next step for products

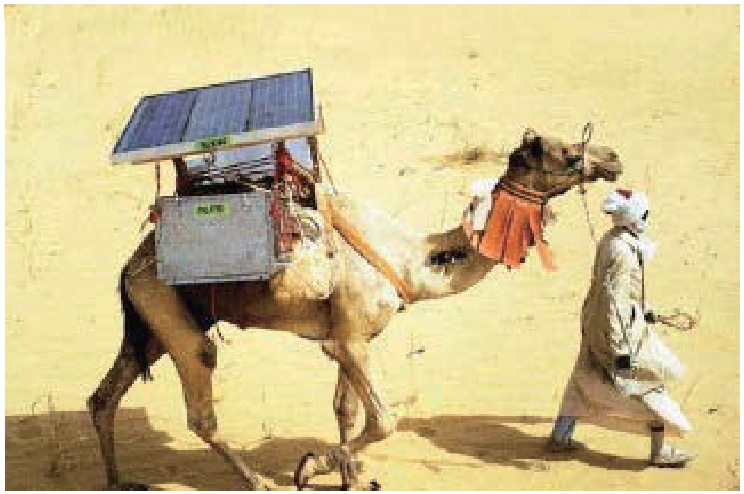
- Battery
  - Weight saving and high energetic density
- Photovoltaic generation
  - Highly efficiency

13

Temperature-controlled vaccine

Medical devices on the field

The actual scene



16

Much longer, much brighter

<

17

insight

- Possible to search for others if there is a **lighting**.
- The **medicine** can be provided if there is an cooler box.
- The **emergency medical equipment** can be used if there is electricity.
- **Telecommunications'** equipment can be used.
- Can be **charged** cellular phone, radio etc.
- If the equipment is portable, it could be used **worldwide**.

18

Special thanks to:

Infrastructure and Innovation Institute, Inc.

President Mr. Taniya, Mr. Nakajima, Ms. Sawada

Thank you

19

Renewable energy types and usage model

Renewable energy is energy which comes from natural resources such as sunlight, Wind, rain, tides, and geothermal heat, which are renewable (naturally replenished).

	Source	Output	Infra	Municipality	House	Personal
Photovoltaic	Sun	Electric	○	○	○	○
Wind power	Wind	Electric	○	○	○	---
Biomass	Plant	Electric, Gas, Hot water	○	○	---	---
Solar energy	Sun	Heat, Hot water	----	△	○	○
Hydropower	water	Electric	○	○	---	---
Geothermal	Geo-Heat	Electric, Hot water	○	---	---	---

21

Interview #1

- City of Toshima
  - Disaster Prevention Section Chief Mr. Satou
- Prevent disaster system must have reliability.
  - It depends on the weather condition in certain degree.
  - If we set up the photovoltaic generation in the park and the school, that will not only do good to disaster prevention but more importantly it will be a good place to have an environmental education.
  - The priority level of energy is low in the phase of disaster prevention.
  - 17% and it assumes it to the electric power damage at magnitude six levels. The evacuation site is supposed to be restored on top priority.

22

Interview #2

- Showa Shell Sekiyu K.K.
  - Deputy General Manager Corporate Planning Division Mr. Masukawa
- About the disaster of the gas station.
  - The gas station did not have damage during the Hanshin-Awaji (Kobe) Earthquake in 1995 and the Mid Niigata Prefecture Earthquake in 2006 either .
  - Spreading of fire was prevented by 2-meter-high firewall.
  - The gas station is considered as a disaster prevention center.
  - Water is saved in advance in case of being stopped. The solar photovoltaic system has been introduced in preparation for the power failure.

23