Introduction of Seifu Nankai Jr. & Sr. High School

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Introduction

Seifu Nankai High School was established in Takaishi City in Osaka in 1963. It used to be an all-boys school, but in 1999 it became coeducational. Our school's education is based on our three core values of trustworthiness, respect and reliability. We have been able to maintain a high level of education that enables our students to pass entrance examinations at prestigious universities.

Buddhism and a Global Perspective

One thing that makes our school special is that education at Seifu Nankai aims to balance a global orientation with Buddhist ethics in order to foster the development of young people with a well-rounded personality, able to make a difference in the world.

Toho Hiraoka, the founder of our school, put great emphasis on developing a spirit of 'jiririta', which means a spirit striving to take actions that, while benefiting oneself, also serve others. In order to create a win-win situation, self-benefit and altruism have to go hand in hand.

For the development of a stable mind, the whole school chants the Heart Sutra at each morning assembly, and in addition, our high school students practice sitting meditation on a weekly basis.
In this way, we strive to develop a calm and stable, altruistic mind.

In order to apply such a mind to the benefit of the whole, it is necessary to have a thorough understanding of the dynamics of our globalized world. To gain such an understanding, our school has joined the Super Global High School project initiated by the Japanese government. Super Global High Schools aim to foster global leadership skills in their students' by raising awareness and deep knowledge of social issues, and by developing their communicative abilities, as well as their problem-solving skills.

At our school we employ two tools widely used in business: the STEP Analysis to identify the societal, technological, economic and political changes that are influencing the issue we are analyzing, and the Scenario Planning method to develop possible scenarios for the future that are based on crucial factors we have identified in the STEP analysis.

To hone the skills that we have acquired in the classroom, we strive to present our work outside of school to receive feedback on our performance whenever we are given the opportunity. We also join competitions where we have the chance to challenge ourselves and to learn from observing other schools presentations. If the quality of our work is good enough and we win, we can move up to the next stage and, for example, take part in an international conference like this.

For the reasons given here, we can be ambitious, gain valuable experiences and develop the skill sets indispensable for the kind of leaders our world needs to initiate change that can move us all in the right direction.

Scenario Planning "Smart House in 2030"

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What is Scenario Planning?

First, we will explain what Scenario Planning is. Scenario Planning (SP) is a way to logically create scenarios, considering the trends at the time, to prepare for the future.

Seven Steps of Scenario Planning

STEP1: We set up the theme. (e.g. energy)

STEP2: We set up the topic according to the theme. (e.g. solar generation)

STEP3: We brainstorm and enumerate as many driving forces as possible that might affect the future of the topic we chose. We have to be very careful not to leave out major driving forces, because it would limit scenarios.

STEP4: We set Uncertainty for the X axis and Impact for the Y axis. We apply the driving forces we enumerated in STEP3 to this IU (Impact and Uncertainty) matrix.

STEP5: From the matrix we made in STEP4, we select two factors (high impact and high uncertainty), and set these two factors as the two axes for the SP matrix.

STEP6: We consider how each driving force will be affected in the four quadrants.

STEP7: Analyzing driving forces, we logically make scenarios for each quadrant.

The Theme and Topic of Our Scenario Planning

Theme: House Topic: Smart House

There are four reasons why we chose "House" as the theme and "Smart House" as the topic of our Scenario Planning.

Firstly, houses are one of the most important and familiar things in our life. Therefore, we can collect a lot of information on them. Secondly, the situation surrounding houses will have greatly changed in 10 years, which will surely have a huge impact on our lives. Thirdly, smart houses are now attracting considerable attention because they can decrease energy consumption. Lastly, smart house technology is rapidly developing day by day, so it will also have a strong influence on our daily lives in the near future. These are the reasons why we chose our theme and topic.

Our scenario planning will help us read the future of 2030 and understand what we should do by 2030 to make a contribution to realizing a more eco-friendly society.

The Two Axes of Our SP Matrix

We brainstormed and enumerated as many factors as possible. Then, we chose the following two factors as axes for our SP matrix.

X-axis: The population concentrates in Tokyo.
⇔ The population disperses to many cities.

Y-axis: The economy is on an upward trend.
⇔ The economy is on a downward trend.

Both these factors definitely have a very strong impact on "Smart House," and at the same time, nobody can tell how these factors will change. That is why we chose these as the two axes of our Scenario Planning.

The Trends

Trends: Declining Population
Development of Smart House
The Changes of Jobs or Working Style

Advances of Artificial Intelligence

Deterioration of Infrastructure

These are some of the factors we have thought of as "Trends." Here "Trends" means the factors that are most likely to take place and, at the same time, have a huge effect on the future.

Four Quadrants

1st Quadrant

When the population concentrates in Tokyo and Japan's economy is on an upward trend.

2nd Quadrant

When the population disperses to many cities and Japan's economy is on an upward trend.

3rd Quadrant

When the population disperses to many cities and Japan's economy is on a downward trend.

4th Quadrant

When the population concentrates in Tokyo and Japan's economy is on a downward trend.

Four Scenarios

1st Quadrant: "The Super Big City of Tokyo"

In this scenario, smart houses are widely spread only in Tokyo. This is because concentrating population makes Tokyo City still bigger and the disparity of people living there also becomes larger. That means wealthy people in Tokyo can afford smart houses. However, the gap between Tokyo and other cities becomes larger, so in those cities smart houses may spread, but to a certain extent.

2nd Quadrant: "Self-Sufficient Cities"

In this scenario, smart houses are widely spread in the cities, including Tokyo. This is because many people in Tokyo can afford them because of the strong economy. Other cities become a compact city and the Japanese government encourages this tendency by providing subsidies, which helps people living there introduce smart houses.

3rd Quadrant: "The Unique Cities"

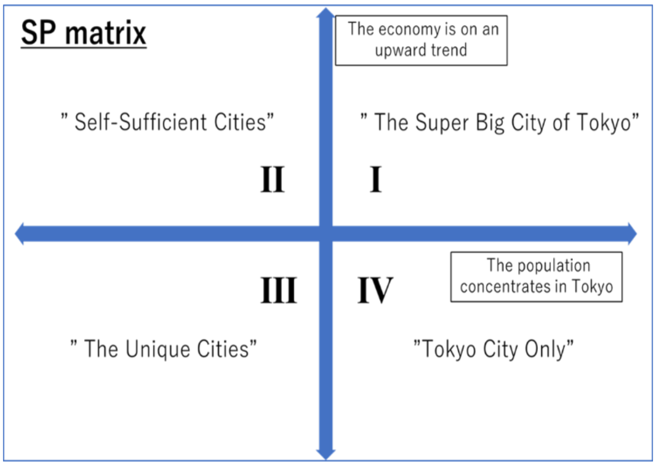
In this scenario, few smart houses are introduced. This is because many people cannot afford them due to the weak economy, though many cities become a compact city. Since each city needs to improve the efficient use of energy, it employs unique policies to stimulate the economy.

4th Quadrant: "Tokyo City Only"

In this scenario, smart houses are not widely spread. This is because the number of people who can afford smart houses has decreased due to the recession, even in Tokyo. In other cities, too, a smaller population and the weak economy have a negative effect on the sales of smart houses.

Conclusion

We must promote the sales of smart houses. This is because the widespread of smart houses will change the working style, which will lead to the dispersion of people. If this happens, many cities are likely to become a compact city. Besides, if smart houses are widely introduced, related technology will develop. This will surely help build a more eco-friendly society in 2030.



Perovskite Solar Cells
-The New Star of Our Future-

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Abstract

As one of the solutions to solve the global warming, we are going to introduce the study of "perovskite solar cells". They have a lot of advantages and traits which other solar cells do not have. At this poster session, we will tell the audience our perspective on the future utility of perovskite solar cells, including the story of our fieldwork experience at Kyoto University.

Introduction

Nowadays global warming becomes issue all over the world. One of the way to solve this issue is solar power generation. And we focused on the perovskite solar cells. They have three benefits; cheapness, lightness, and flexibility.

Perovskite solar cells can be fabricated by solution-printable process, and thus are expected to e cheaper than the previously developed conventional photovoltaics, such as silicon-based solar cells, so many people can afford them. Also, the previous solar cells have been set on horizontal surfaces such as grounds because they were too heavy. On the other hand, these perovskite solar cells are so light that they will be able to be equipped even on the walls of buildings. Furthermore, since they are flexible, they will be available on curved surfaces such as on the sides of airplanes and cars.

The Experiment at Kyoto University

On December 16th, we visited Kyoto University in Uji city. The experience is actually one of the reasons why we are interested in this technology. We fabricated several perovskite solar cells with 2.5 cm x 2.5 cm under the guidance of Prof. Wakamiya. The fabrication protocol for these cells consists on following five steps; [1]

1. Deposition of SnO_2 layer on ITO substrate as an electron transporting layer by spin-coating, followed by annealing
2. Deposition of $MAPbI_3$ (methyl ammonium lead iodide) layer with PbI_2 + MAI (methyl ammonium lead iodide) in DMF/DMSO* by spin-coating, during which toluene was added dropwise on the substrate, followed by annealing
3. Deposition of Spiro-OMeTAD (N2,N2,N2',N2',N7,N7,N7',N7'-octakis(4-methoxyphenyl)-9,9'-spirobi[9H-fluorene]-,2',7,7'-tetramine/$C_{81}H_{68}N_4O_8$ layer as a hole transporting layer by spin-coating, followed by annealing
4. Thermal evaporation of Au as an electrode
5. Soldering

According this protocol, we fabricated up 9 cells, and measured the photon-to-current conversion efficiency (PCE) of each nine perovskite solar cells under 1 Sun (AM 1.5) condition. The result ranged from 0.8% to 13.5%.

This time, we focused on the way to drop toluene as anti-solvent during spin-coating. We dropped toluene at 8-9 seconds after the cell started spinning. And there are quite large differences in the dropping way. As a result, generating efficiencies are 0.8%-13.5%. Compared to the optimized perovskite solar cells at Dr. Wakamiya's group showing the efficiency more than 18%, the performances obtained in these experiments are all less. First, we examine No.1, that had the lowest generating efficiency. We dripped toluene vigorously onto the board. So there is a possibility its layers were broken. We also surmise that the electrode was damaged when we dropped the solar cell by mistake. This result suggests that perovskite solar cells have low durability. On No.2 solar cell, there is a mark of swirl in the center. This is because solvents started to be vaporized to grow crystals of perovskite precursor materials before the cell stopped spinning. This is why a mark of a swirl appeared on the cell. The last one is No.3 panel. The rainbow color on the substrate most likely corresponds to the interference color of the crystal of formed perovskite, and this rough surface of perovskite layer might lower the generating efficiency. However, the surface of the cells (No.2 and No.3) look more uniform color and indeed these cells gave the better efficiencies with over 10%. These results suggest that the flat perovskite layer formation highly depend on how to drop toluene, and their optimization would be indispensable for the fabrication of perovskite solar cells with high power conversion efficiency.

Fig. 1.Pictorial representation of the solar cells (No. 1–No.3)

Practical use of perovskite solar cells in the future

Because they are flexible and inexpensive, they are expected to be used in many ways. For example, perovskite solar cells can be placed in the roof of a car and they can provide enough energy for it to run. Another example is that a part of a plastic greenhouse will be covered with perovskite solar cells. This will help farmers make their energy consumption much smaller. Taking advantage of perovskite solar cells, solar power generation will become more familiar in our lives.

Conclusions

According to the results of our experiment, if we can find how to drop toluene and fabricate homogeneous films at the most desirable speed and timing, companies can produce perovskite solar cells in large quantities in the future.

In addition, as we mentioned above, the technology of perovskite solar cells is so incredible and infinite that a number of scientists have been trying to invent more efficient ones and they must be available in considerable ways. Finally, this technology is expected to be one of the best solutions to global warming.

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References

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