Ideation Method for Satellite Image Applications with Three Axes Data Representation and Cause-Effect Chains

Review of Integrative Business & Economics Research

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ABSTRACT

This study aims at proposing a method to support generating satellite image utilization ideas. Recently, expectations for potential values of satellite image utilization have been increasing. However, the use of satellite images is still limited to specific fields. One of the reasons is the difficulty in generating utilization ideas, but none of the ideation methods previously developed addresses the difficulties involved in creating satellite images application ideas. Therefore, the authors developed a method consisting of four sub methods; supporting clarification of what can be seen from satellite images, supporting extraction of what can be understood from satellite images, supporting identification of potential users and supporting consideration of potential users' issues to be solved. To evaluate the method, the author conducted experiments of idea generation with the method. The result indicates that the method is effective to generate novel ideas with unobvious connection between satellite images and addressed issue.

Keywords: Satellite images, Idea generation, Ideation method.

Received 1 February 2019 | Revised 5 May 2019 | Accepted 1 June 2019.

1. INTRODUCTION

Recently, expectations for potential values of satellite image utilization have been increasing. For example, the World Bank (European Space Agency, and the World Bank, 2013) and the United Nations Statistical Commission (Australian Bureau of Statistics, 2016) have been trying to utilize satellite images to facilitate the achievement of Sustainable Development Goals (SDGs). Cabinet Office of Japan (CAO) also states the importance of promoting satellite image utilization as space industry including services utilizing satellite images is strong driving force to increase productivities of other sectors (Space Policy Commission, 2017).

However, the use of satellite images is still limited to specific fields. According to the study by National Space Policy Secretariat, CAO, the size of a global market for services using satellite images is only 4% of that for services using positioning satellites (location and time data) and moreover only 2% of that for services using communication satellites (National Space Policy Secretariat, 2016).

There are several reasons for the limited use of satellite images. They are inadequacy of continuously observed satellite images, difficulty in accessing satellite images, skills

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

required to analyze satellite images and difficulty in creating satellite utilization ideas (Space Policy Commission, 2017).

Among those factors mentioned above, difficulty in creating utilization ideas needs to be addressed. This is because it is expected that other factors will be improved. For instance, with respect to the insufficient data, development of small satellites is currently active globally, and it is believed that the data volume will rapidly increase. Also, with regard to expertise and cost required for analysis, artificial intelligence has been utilized to analyze satellite images recently, which will make the analysis of satellite images easier in the future. In this situation, it is necessary to support creation of satellite image utilization ideas to promote satellite image utilization.

One of the reasons for the difficulty in creating ideas is that information extracted directly from satellite images is not directly related to the issues to be solved. The authors analyzed cases where satellite images are utilized to solve social or business issues and found out that there is no direct connection between what can be seen directly from satellite images and addressed issues and that issues are rather solved by what can be understood from the things directly seen from satellite images and further, what can be understood from that. Accordingly, it is difficult to search for potential issues which can be solved by satellite images, and this makes it difficult to create ideas of satellite image utilization.

There have been many researches about ideation methods. Takahashi (2001) categorizes ideation methods into four types; divergent method, convergent method, combined method and attitudinal method. For the purpose of creating satellite image utilization ideas, firstly, one needs to generate ideas, and thus divergent method or combined method (combination of divergent and convergent methods) are suitable. However, none of divergent and combined method developed before addresses difficulties in creating satellite images utilization ideas mentioned previously. Brainstorming (Osborn, 1953), one of divergent method is useful to expand solution areas for one theme. This method would be suitable when one tries to come up with many ideas of what can be known from a certain thing seen from satellite images, but it is difficult to think from satellite images to issues to be solved. Input-output method (Takahashi, 2001), one of combined methods can support considering solutions to certain issues step by step, but as issues need to be set for ideation, this method is not suitable for generating ideas of satellite image utilization. Ideation methods utilizing analogy thinking such as TRIZ (Altshuller, 1984) and WordTree (Linsey and Wood, 2012) are also difficult to be applied as there is not so much practices of satellite image utilization. Therefore, the authors decided to develop an ideation method which can address the difficulties in creating satellite image utilization ideas needs to be developed.

This paper consists of four chapters. The first chapter explained background and the purpose of this research. The second chapter will explain the method developed in this research. The third chapter will explain evaluation of the developed method. Lastly, chapter 4 will explain conclusion of this paper.

2. PROPOSED METHOD

2.1. Development of method

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2.1.1. Extraction of functions

To extract functions necessary to facilitate generating satellite image utilization ideas, the authors analyzed cases where satellite images are utilized to solve social or business issues. Cases were collected from good practices introduced on Eurisy and Japan Aerospace Exploration Agency (JAXA) and applications awarded from Copernicus Masters held by European Space Agency (ESA). We extracted constituent elements of collected cases and analyzed how they are connected each other to extract required functions.

As a result of the analysis, four elements that make up satellite image applications were extracted; what can be seen from satellite images, what can be understood from that, users utilize the information and addressed issues (Figure 1). For example, in the case of improving the efficiency of poverty mitigation measures, the height of houses and the material of roofs which can be viewed from satellite images are used to detect areas to be prioritized for poverty mitigation measures. The height of houses and the material of roofs change depending on the economic situation of families living there (poor households tend to have straw roofs, while families with certain income have metal roofs), so from the height of houses and the material of roofs one can understand economic situations of households. Accordingly, economic situations of households tell the mitigation measures implementers where households in need are located and where they should put priority (Figure 2).

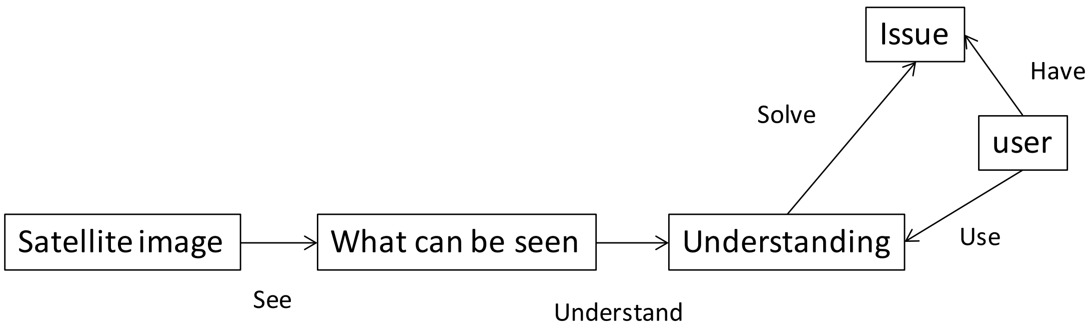

Figure 1 Elements in satellite image application

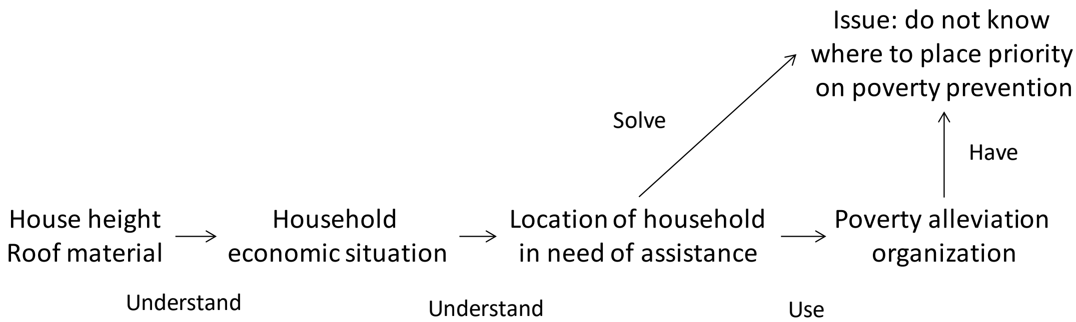

Figure 2 Analysis result of improving the efficiency of poverty mitigation measures

In malaria risk monitoring case, vegetation distribution extracted from satellite images is used to address the need by governments or organizations taking malaria preventing

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

measures to know places to distribute mosquito net for malaria control with priority. From vegetation coverage, one can know places with good condition for mosquitoes to breed. As mosquitoes transmit malaria, mosquito breeding sites can be malaria prone areas. Then, by providing information on places where malaria is likely to occur, the issues the governments or organizations have will be solved (Figure 3).

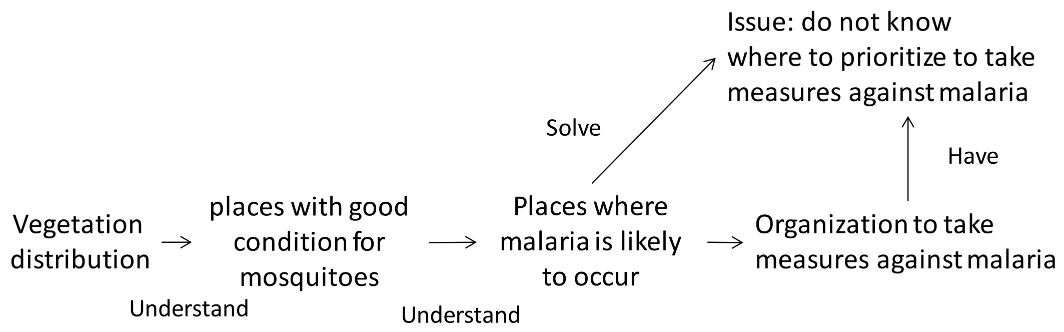

Figure 3 Analysis result of malaria risk monitoring

Based on the result of case studies, the authors decided to develop a method with the following four functions. In order to extract what can be understood from what can be seen from satellite images, it is necessary to clarify what can be seen from satellite images beforehand. However, it is difficult to understand what can be seen from satellite images for non-experts on satellite image analysis. Therefore, making it easier to clarify what is visible from satellite images is added as a function.

- Function 1: supporting clarification of what can be seen from satellite images
- Function 2: supporting extraction of what can be understood from what can be seen from satellite images
- Function 3: supporting identification of users who use extracted information
- Function 4: supporting consideration of issues held by the users and to be solved by the extracted information

Figure 4 shows the overall picture of the functions of the proposed method.

2.1.2. Construction of methods

To construct methods to realize the four functions extracted in the previous section, the authors further analyzed examples used for function extraction. The result of analysis shows that what can be seen from satellite images can be expressed in three axes; objects, states of objects and changes in states (Figure 5) and that there is cause-effect relationships between what can be seen from satellite images, what can be understood from that and users of the information. Therefore, expressing what can be seen from satellite images in three axes is adopted as a method for function 1, and listing up causes and effects of what can be seen from satellite images and what can be understood from that are adopted as methods for function 2 and 3. Regarding function 4, no common relationship between users and addressed issues was found from the result of case studies. Thus, the authors decided to adopt associating issues from combination of extracted information and users as a method for function 4. Table 1 summarizes the functions and methods of the proposed method. As the developed method utilizes three axes to represent what can be seen from satellite images and cause-effect to extract what can be understood from satellite images and potential users, the authors named the method

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"ideation method for satellite image applications with three axes data representation and cause-effect chains (hereinafter, the method).

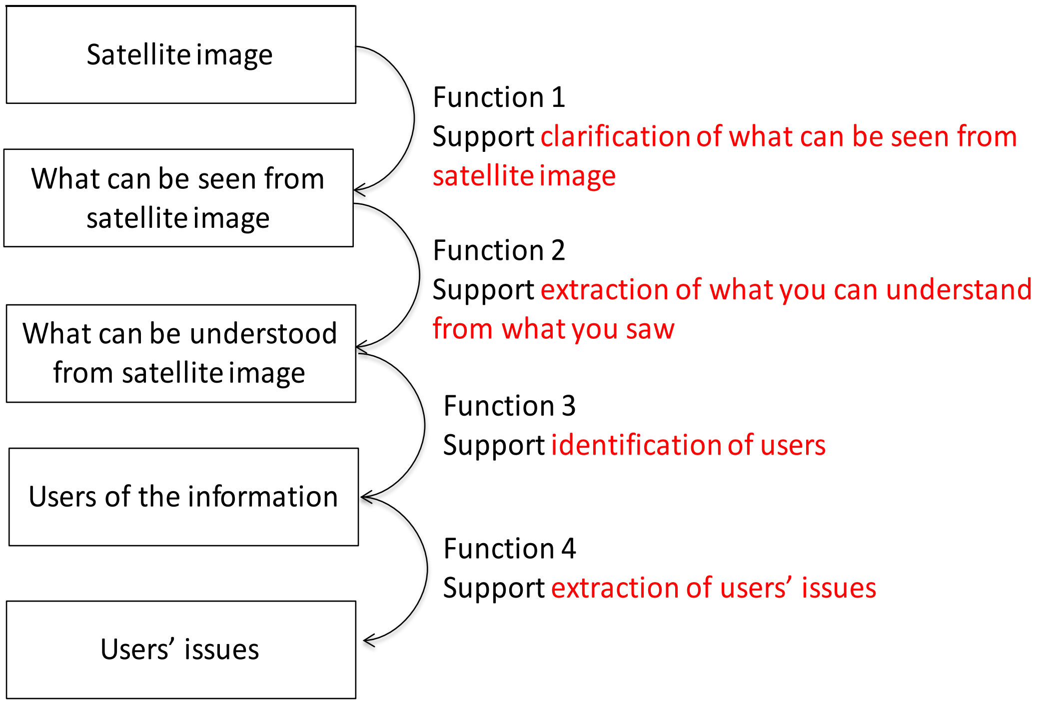

Figure 4 Four functions of the proposed method

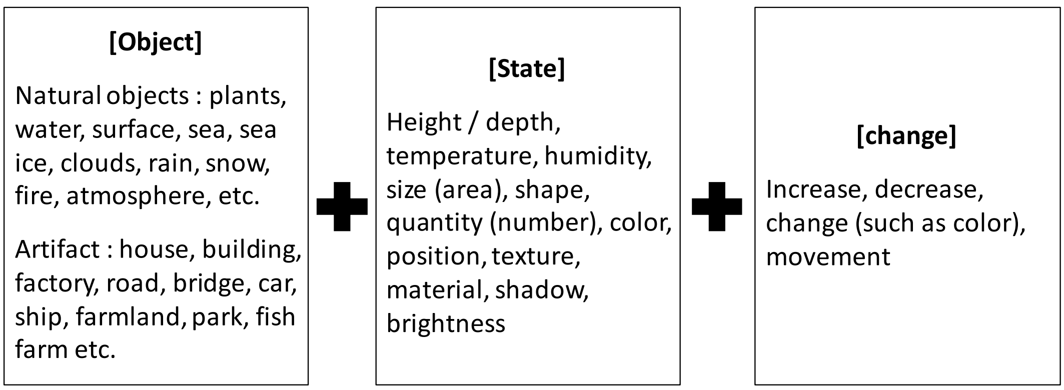

Figure 5 Method to represent what can be seen from satellite images

2.2. How to create ideas with the method

In this section, how to use the proposed method to generate satellite image utilization ideas will be described. First, one selects an object seen from satellite images and write out the selected object, the states of the object and the changes in the states (step 1). Next, one lists up causes and effects of states of the object and changes in states as indicated in Figure 6 (step 2). Causes of states are things or events that affect the state of the object, and effects of states are things or events affected by states of the object. Causes of changes in states are factors causing changes, and effects of changes are things or events

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brought about by changes. By writing out these items, it becomes possible to extract what is known from satellite images.

Table 1 Summary of the proposed method

No.	Function	Methods to realize functions
1	Support clarification of what can be seen from satellite images	Represent in object + state + change
2	Support extraction of what can be understood from satellite images	Identify the causes and effects of what can be seen from satellite images
3	Support identification of users	Identify people and organizations affected by what you can see
4	Support extraction of users' issues	Associate with the combination of users and what can be understood from satellite images

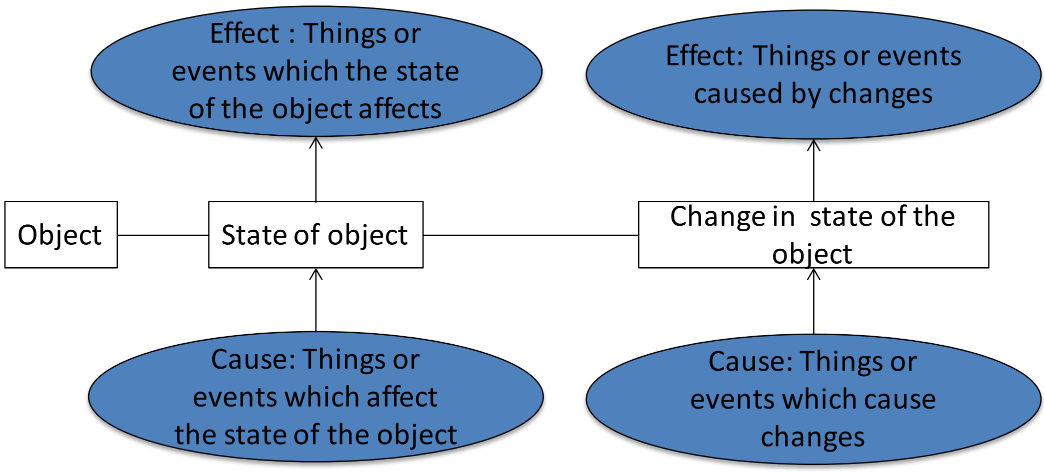

Figure 6 How to extract what can be understood from satellite images

Thirdly, as shown in Figure 7, one lists up persons and organizations that affect or are affected by the things or events listed up in step 2 (step 3). By writing out persons and organizations from these two points of view, it becomes possible to extract possible users of information extracted in step 2. An example of the description of steps 1 to 3 is shown in Figure 8.

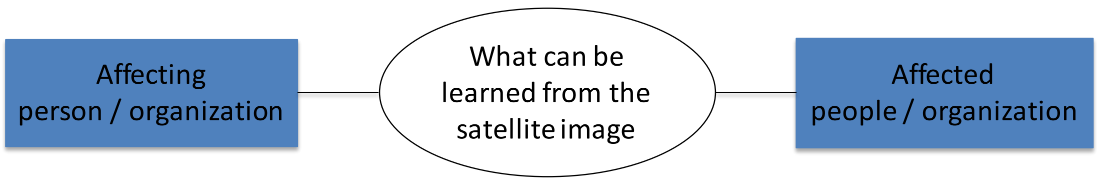

Figure 7 How to extract users

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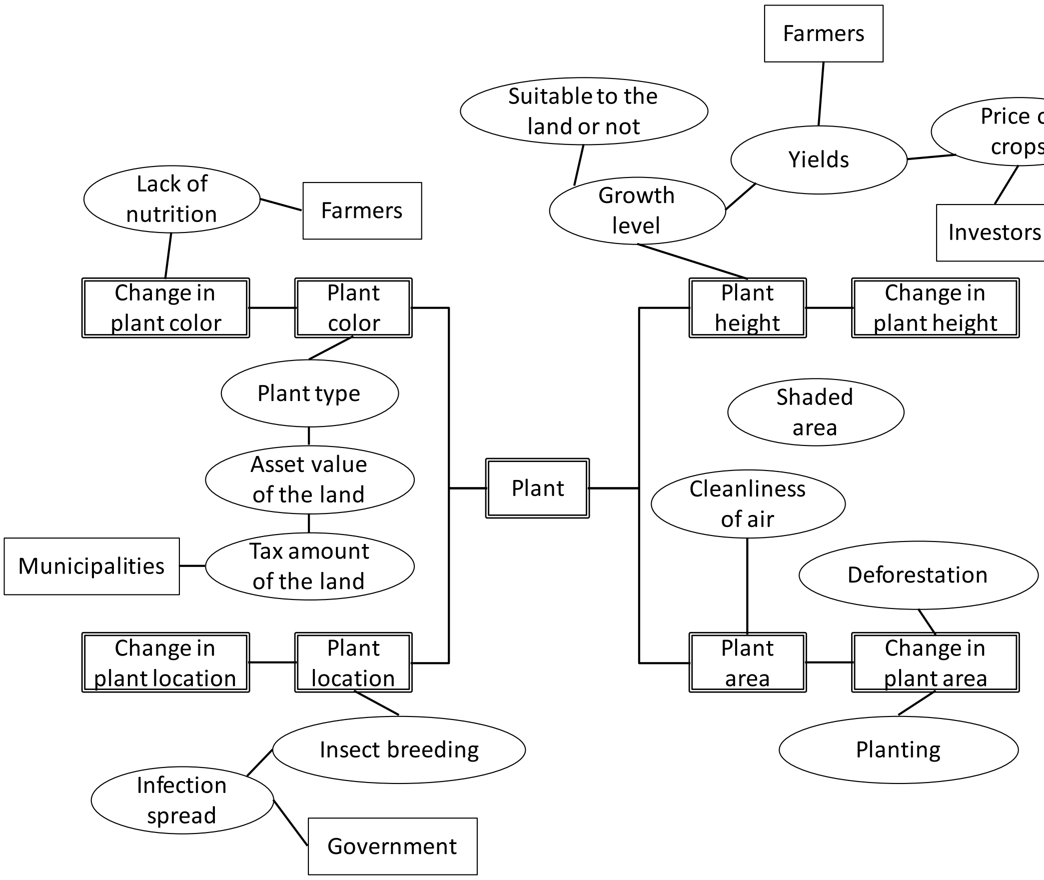

Figure 8 Example of the description of steps 1 to 3

Lastly, one picks up combination of 1) what can be seen from satellite images, 2) what can be understood from 1) and, 3) potential users of 2) and associate issues from the three elements. An example is described in Figure 9. This example is an idea to solve the problem of a municipality that wants to know whether tax is appropriately collected or not by estimating tax amount on land from colors of trees as types of trees planted in lands may affect the value of lands.

1. What can be seen from satellite image	2. What can be understood from 1	3. User that is likely to use 2	4. Issues of users (3) which is likely to be solved by 2
Plant color	Tax on land	municipalities	want to check if the tax is appropriately collected

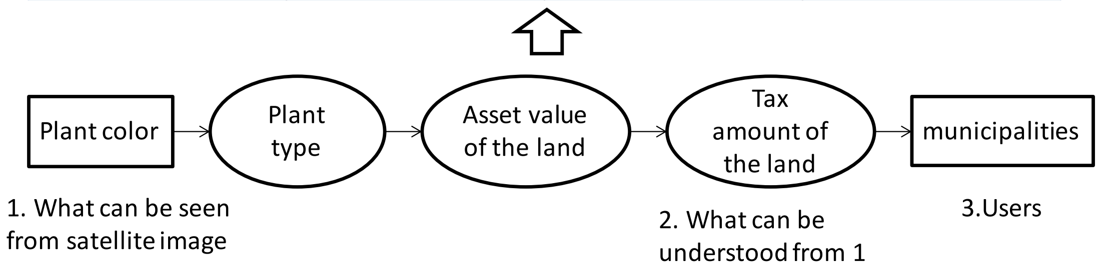

Figure 9 Example of step 4

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3. EVALUATION

3.1. Evaluation method

To evaluate the proposed method, the authors conducted experiments of idea generation with individual and group works. In individual work, subjects generated ideas with and without the proposed method, and in group work, subjects generated ideas only with the proposed method. evaluation criteria are understandability, usability and effectiveness of the method (Nakada and Ioki 2019). The authors evaluated those three criteria based on the result of questionnaire answered by subjects after experiments and the third party's evaluation of ideas generated in individual work. The evaluation method is summarized in Table 2.

Table 2 Evaluation method

<table>
<tr><th>Evaluation criteria</th><th>Evaluation method</th></tr>
<tr><td>Understandability</td><td rowspan="4">Questionnaires by participants (individual and group works)</td></tr>
<tr><td>Usability</td></tr>
<tr><td>Effectiveness of four functions</td></tr>
<tr><td rowspan="2">Effectiveness of the whole method</td></tr>
<tr><td>Ideas evaluation by the third party (individual work)</td></tr>
</table>

In individual work experiment, 12 subjects generated satellite image utilization ideas both with and without the proposed method. Subjects were divided into two groups; A and B. Subjects in group A generated ideas with the method first and then generated ideas again without the method. Subjects in group B generated ideas without the method and then with the method. The theme of ideas was the same for group A and B but changed after the first work; houses for the first work and cars for the second work. Individual work experiment is summarized in Table 3.

Table 3 Experiment method of individual work

Item	First work	Second work
With or without the method (group A)	With the method	Without the method
With or without the method (group B)	Without the method	With the method
Theme	House	Car
Work time	50 mins	50 mins

22 subjects participated in group work experiment. Subjects were divided into groups with 3 to 4 members, and each group generated satellite image utilization ideas. The theme of ideas was houses for all groups.

3.2. Result

3.2.1. Understandability

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After experiments with individual and group works, participants answered questions of whether it was easy to understand four functions and the whole method. There were six options to answer the questions; 1. Strongly disagree, 2. Disagree, 3. Rather disagree, 4. Rather agree, 5. Agree, 6. Strongly agree. Table 4 shows questions about understandability.

Table 4 Questions about understandability

No.	Questions
1	Did you easily understand function 1 of the proposed method?
2	Did you easily understand function 2 of the proposed method?
3	Did you easily understand function 3 of the proposed method?
4	Did you easily understand function 4 of the proposed method?
5	Did you easily understand the whole method of the proposed method?

The result of questionnaire is shown in Table 5. Although there was a slight difference between individual and group works, more than 90% of answers were positive. In other words, almost all participants evaluated that the proposed method was easy to understand.

Table 5 Result of questions about understandability

Evaluation object	Work type	Percentage of answers					
		1	2	3	4	5	6
Function1	Individual	0%	0%	0%	17%	25%	58%
	Group	0%	0%	0%	0%	47%	53%
Function2	Individual	0%	0%	8%	8%	42%	42%
	Group	0%	0%	0%	18%	55%	27%
Function3	Individual	0%	0%	0%	8%	50%	42%
	Group	0%	0%	0%	27%	36%	37%
Function4	Individual	0%	0%	0%	25%	33%	42%
	Group	0%	0%	9%	14%	45%	32%
Whole	Individual	0%	0%	0%	17%	58%	25%
	Group	0%	0%	0%	14%	53%	33%

3.2.2. Usability

After experiments with individual and group works, participants answered questions of whether it was easy to use four functions and the whole method. There were six options to answer the questions; 1. Strongly disagree, 2. Disagree, 3. Rather disagree, 4. Rather agree, 5. Agree, 6. Strongly agree. Table 6 shows questions about usability.

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Table 6 Questions about usability

No.	Questions
1	Was the function 1 of the proposed method easy to use?
2	Was the function 2 of the proposed method easy to use?
3	Was the function 3 of the proposed method easy to use?
4	Was the function 4 of the proposed method easy to use?
5	Was the entire method of the proposed method easy to use?

The result of questionnaire is shown in Table 7. Although there was a slight difference between individual and group works, more than 85% of answers were positive. In other words, almost all participants evaluated that the proposed method was easy to use.

Table 7 Result of questions about usability

Evaluation object	Work type	Percentage of answers					
		1	2	3	4	5	6
Function1	Individual	0%	0%	0%	25%	33%	42%
	Group	0%	0%	0%	0%	44%	56%
Function2	Individual	0%	0%	0%	25%	50%	25%
	Group	0%	0%	0%	14%	41%	45%
Function3	Individual	0%	0%	0%	25%	42%	33%
	Group	0%	0%	5%	9%	50%	36%
Function4	Individual	0%	0%	0%	25%	33%	42%
	Group	0%	5%	9%	14%	45%	27%
Whole	Individual	0%	0%	0%	8%	58%	34%
	Group	0%	4%	0%	14%	41%	41%

3.2.3. Effectiveness of four functions

After experiments with individual and group works, participants answered questions of whether four functions of the proposed method have the intended effects. There were six options to answer the questions; 1. Strongly disagree, 2. Disagree, 3. Rather disagree, 4. Rather agree, 5. Agree, 6. Strongly agree. Table 3-3 shows questions about effectiveness of four functions.

Table 8 Questions about effectiveness of four functions

No.	Questions
1	Do you think function 1 of the proposed method has the intended effect?
2	Do you think function 2 of the proposed method has the intended effect?
3	Do you think function 3 of the proposed method has the intended effect?
4	Do you think function 4 of the proposed method has the intended effect?

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The result of questionnaire is shown in Table 9. Although there was a slight difference between individual and group works, more than 85% of answers were positive. In other words, almost all participants evaluated that the proposed method has the intended effects.

Table 9 Result of questions about effectiveness of four functions

Evaluation object	Work type	Percentage of answers					
		1	2	3	4	5	6
Function1	Individual	0%	0%	0%	8%	33%	59%
	Group	0%	0%	11%	10%	26%	53%
Function2	Individual	0%	0%	0%	17%	33%	50%
	Group	0%	0%	5%	19%	33%	43%
Function3	Individual	0%	0%	0%	25%	33%	42%
	Group	0%	5%	9%	14%	48%	24%
Function4	Individual	0%	0%	0%	33%	25%	42%
	Group	0%	0%	14%	29%	38%	19%

3.2.4. Effectiveness of the method as a whole

The object of the method is to support searching potential users or issues connected to what can be seen from satellite images (easiness to find connections) and to support generating ideas of satellite image utilization (easiness to generate ideas). To evaluate the effectiveness of the whole method, participants were asked to evaluate the two points. To compare with easiness without the method, the same questions were asked after work with and without the method in individual work. In group work which generated ideas only with the method, the participants with the experience to generate satellite image utilization ideas were asked to evaluate the easiness by comparing their own experience. There were six options to answer the questions; 1. Strongly disagree, 2. Disagree, 3. Rather disagree, 4. Rather agree, 5. Agree, 6. Strongly agree. Table 10 shows questions about effectiveness of the whole method.

Table 10 Questions about effectiveness of the whole method

No.	Questions
1	Using the method, was it easy to find potential users and issues to be solved which have connections with what can be seen from satellite images?
2	Using the method, was it easy to generate ideas of satellite image utilization?
3	Without the method, was it easy to find potential users and issues to be solved which have connections with what can be seen from satellite images?
4	Without the method, was it easy to generate ideas of satellite image utilization?

Firstly, the result of individual work will be explained. Table 11 shows the result of questionnaire of participants of individual work. Regarding easiness to find connections,

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the average point of work with the method was 5.08 and work without the method was 2.42. Regarding easiness to generate ideas, the average point of work with the method was 4.92 and work without the method was 2.42.

In order to verify whether there is a significant difference between the evaluation result of with and without the method, the authors conducted two tailed t-test with significant level of 5 %. Regarding the easiness to find connections, significance value of Levene's test was 0.140 (not significant), and thus the variances can be treated as equal. Since significance level of equal variance is 0.000 (1% significant), there is a significant difference in the evaluation of easiness to find connections between with and without the method. In addition, since the average point is 5.08 for the former and 2.42 for the latter, the authors conclude that the connections are easier to find with the method than without the method.

Regarding the easiness to generate ideas, significance value of Levene's test was 0.221 (not significant), and thus the variances can be treated as equal. Since significance level of equal variance is 0.000 (1% significant), there is a significant difference in the evaluation of easiness to generate ideas between with and without the method. In addition, since the average point is 4.92 for the former and 2.42 for the latter, the authors conclude that ideas are easier to generate with the method than without the method. The results of t-test are summarized in Table 12.

Table 11 Result questions about effectiveness of the whole method (individual work)

Evaluation object	Work type	Percentage of answers					
		1	2	3	4	5	6
Easiness to find connections	With the method	0%	0%	0%	25%	42%	33%
	Without the method	25%	25%	33%	17%	0%	0%
Easiness to generate ideas	With the method	0%	0%	8%	17%	50%	25%
	Without the method	25%	25%	33%	17%	0%	0%

Table 12 Result of t-test

Evaluation object	Average (with method)	Average (without method)	Significance value
Easiness to find connections	5.08	2.42	0.000 (1% significant)
Easiness to generate ideas	4.92	2.42	0.000 (% significant)

The questionnaire results of group work are shown in Table 13. For both easiness to find connections and easiness to generate ideas, more than 90% of answers was positive. Almost all participants evaluated that the method makes it easy to find connections and generate ideas compared to their own experience.

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Table 13 Result questions about effectiveness of the whole method (group work)

Evaluation object	Percentage of answers					
	1	2	3	4	5	6
Easiness to find connections	0%	0%	0%	25%	38%	37%
Easiness to generate ideas	0%	0%	6%	18%	53%	23%

From the results of questionnaires of individual and group works, the authors conclude that the method makes it easier to find connections between satellite images and issues to be solved and to generate ideas of satellite image utilization.

3.2.5. Quality of ideas

Ideas generated in individual work experiment were evaluated in three terms; novelty, technical feasibility and distance between what can be seen from satellite images and addressed issues (whether the connections between them can be directly associated). Three experts engaged in satellite image business evaluated ideas without knowing whether ideas were generated with or without the method. Table 14 shows the options of evaluation.

In order to verify whether there is a significant difference between the evaluation result of ideas generated with and without the method, the authors conducted two tailed t-test with significant level of 5%. Regarding the distance between satellite image and addressed issue, the average points of ideas with the method was 3.56, and that without the method was 2.88. Significance value of Levene's test was 0.372 (not significant), and thus the variances can be treated as equal. Since significance level of equal variance is 0.000 (1% significant), there is a significant difference in the evaluation of distance of relationships between ideas with and without the method. In addition, since the average point is 3.56 for the former and 2.88 for the latter, the authors conclude that the ideas created using the method have indirect connections between satellite images and addressed issues.

Regarding novelty, the average points of ideas with the method was 2.53, and that without the method was 2.10. Significance value of Levene's test was 0.000 (1% significant), and thus the variances cannot be treated as equal. Since significance level of unequal variance is 0.016 (5% significant), there is a significant difference in the evaluation of novelty between ideas with and without the method. In addition, since the average point is 2.53 for the former and 2.10 for the latter, the authors conclude that the ideas created using the method are more novel than the others.

Regarding technical feasibility, the average points of ideas with the method was 2.55, and that without the method was 3.30. Significance value of Levene's test was 0.818 (not significant), and thus the variances can be treated as equal. Since significance level of equal variance is 0.000 (1% significant), there is a significant difference in the evaluation of technical feasibility between ideas with and without the method. In addition, since the average point is 2.55 for the former and 3.30 for the latter, the authors conclude that the ideas created without the method are more technically feasible than the others. The test results are summarized in Table 15.

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Table 14 Evaluation criteria of generated ideas

Evaluation object	Questions	Options
Distance between what can be seen from satellite images and addressed issues	The addressed issue is easy to associate from what can be seen from satellite images.	1. Agree 2. Rather agree 3. Neither agree or disagree 4. Rather disagree 5. Disagree
Novelty	The idea is novel.	1. Disagree 2. Rather disagree 3. Neither agree or disagree 4. Rather agree 5. Agree
Technical feasibility	The ideas is technical feasible.	1. Disagree 2. Rather disagree 3. Neither agree or disagree 4. Rather agree 5. Agree

Table 15 Result of t-test of idea quality evaluation

Evaluation object	Average (with the method)	Average (without the method)	Significance value
Distance	3.56	2.88	0.000 (1% significant)
Novelty	2.53	2.10	0.016 (5% significant)
Technical feasibility	2.55	3.30	0.000 (1% significant)

3.3. Consideration

In this section, consideration on the evaluation result explained in the previous section will be discussed. Firstly, in order for the method to fully demonstrate its intended effects, the method must be easy to be understood and used. Analysis of the questionnaire result indicated that the proposed method is easy to understand and use. Therefore, it can be said that the proposed method has no particular problem in understandability and usability to demonstrate the intended effects. Next, the effectiveness of four functions will be discussed. More than 85% of responses were positive, and thus, it can be concluded that the methods designed for four functions work well to realize the four functions.

Regarding the effectiveness of the method as a whole, the questionnaire result indicated that it was easier to find connections between satellite images and issues to be solved and to generate satellite image utilization ideas when using the method than when not using

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the method. Therefore, the authors conclude that the proposed method achieves its purpose.

The result of evaluation of generated ideas also led to the same conclusion. As the evaluation of generated ideas, three perspectives were evaluated; distance of satellite image and addressed issue, novelty and technical feasibility. For distance between satellite image and addressed issues and novelty, ideas generated with the method were evaluated higher. Therefore, it is considered that the method makes it easier to find unobvious connections. Furthermore, with such connections, it becomes easier to generate novel ideas.

On the other hand, the technical feasibility was lower for the ideas created using the method. In the proposed method, one considers causes and effects of what can be seen from satellite images when he or she extracts what can be understood from that. By listing up causes and effects not directly extracting what can be understood, one can remove restrictions on his or her thinking as he or she does not need to consider if things or events can be really known from satellite images or not. It is considered that this led to lower technical feasibility of ideas generated with the method.

However, considering that removing the limitation of thinking makes it possible to find unobvious connections and moreover to generate more novel ideas, there is trade-off between novelty and technical feasibility. Therefore, the authors consider that it is preferable to generate many novel ideas and to select ideas with high technical feasibility rather than modifying the method to generate ideas higher technical feasibility.

4. CONCLUSION AND FUTURE WORK

In this research, the authors developed the method to support finding connections between satellite images and issues to be solved and generating satellite image utilization ideas. To develop the method, the authors analyzed satellite image applications and extracted four functions necessary to realize the objectives. Furthermore, the authors constructed the methods for four functions; supporting clarification of what can be seen from satellite images, supporting extraction of what can be understood from what can be seen from satellite images, supporting identification of users who use extracted information and supporting consideration of issues held by the users and to be solved by the extracted information. The authors then constructed the methods to realize the four functions by analyzing the applications again; representing what can be seen from satellite in three axes and connecting from that to addressed issues using cause-effect relationships.

In addition, the author evaluated if the method can realize four functions and the objectives of this research. Evaluation was done by individual and group work experiments in which participants generated satellite image utilization ideas. Understandability, usability and effectiveness of the method were evaluated based on the result questionnaires and the third party evaluation of generated ideas. The result shows that the proposed method is effective for the purpose of facilitating finding the potential connection between satellite images and issues, and for supporting the idea creation utilizing satellite images.

ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)

While the result of evaluation indicates that the developed method is effective, there is room for improvement on this method. Firstly, some of issues addressed in ideas generated with the method can be solved by other means, and utilization of satellite image does not have advantages. Secondly, the method does not support creating ideas with the combination of multiple kinds of information derived from satellite images. Future works should improve the method in these regards.

ACKNOWLEDGEMENTS

We would like to express sincere appreciation to Mr. Tuyoshi Hirose, Mr. Fumihito Oura, Ms. Kii Iizawa, and Mr Ryoya Inomata.

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ISSN: 2304-1013 (Online); 2304-1269 (CDROM); 2414-6722 (Print)