Introducing Human-Centered Design Approach in Transportation Planning Process: A Scenario Method and A Concept Model of Stakeholders

Kiko YAMADA-KAWAI

Graduate School of Science and Engineering, Tokyo Institute of Technology,
2-12-1-M1-20 O-okayama, Meguro, Tokyo, 152-8552, Japan;
E-mail: kiko.yamada@plan.cv.titech.ac.jp

Abstract: User-involvement and consensus building are thought to be a key process to achieve high satisfaction in planning and implementing social infrastructures and related services and plans. In products and information system development, an iterative Human-centered Design process starting from observing users behavior are applied, but not implemented in the areas above is known to provide effective results. The author has proposed a scenario-based method employ statements of speakers into conceptual planning process and introduced a case example of a mid-term plan. Another reason for HCD not to be implemented in infrastructures is infrastructure’s characteristics “external diseconomy,” and proposed a concept model that describes each infrastructure or plan and three stakeholders. With the model, it was well understood that certain pattern of relationship may prohibit implementing Human-centered Design process while some patterns are similar to products and information systems; this implies that in certain infrastructure and services can take the benefit of Human-centered design process.

Keywords: Human-centered Design, User Involvement, Scenario based design, Stakeholder Analysis, Consensus Building, Social Infrastructure

1. INTRODUCTION

Planning and implementing social infrastructures including transportation facilities and services are done to satisfy stakeholders; the motivation does not differ from the ones of commodity product designs.

Japanese government has issued guidelines to have residents involved in the very early phase of planning. Yai (2006) assumed the purposed of the process so called “public involvement” is the justification of procedures realizing smooth communication with the residents; with this assumption, the quality of the plan and implementation are collateral effects. Tomari et al. (2010) surveyed the guidelines and they allow the planners, in this case the government, to have variation of interpretation, which may lose viability of the required process stated in the guidelines. A type of public involvement is organized as workshops and discussion sessions to obtain consensus among stakeholders. Studies are done to analyze discussion record estimate the progress on consensus building (eg. Sakakibara and Chosokabe, 2010; Namba et al., 2011; Jeong et al., 2009.) The author proposed a method to analyze speech transcript and written records and transform them into scenarios of stakeholders at target timeframe; the concept of scenario is employed from Human-centered Design (HCD) approach (Yamada-Kawai, 2014). The method showed a way to implement an HCD viewpoint in conceptual design phase of infrastructure projects.

In the more tangible design phase of infrastructures, HCD approach has not been much employed yet. Yamada-Kawai (2015) focuses on the characteristics of processes that are required for the government sponsored projects; laws and regulations set certain procedures
regardless of wants to suit for user needs; pointed out that points should be considered when applying HCD approach to infrastructure planning, implementing and operating.

The purpose of this study is to consider introducing HCD approach into transportation related planning and projects, in focusing the characteristics of stakeholder of infrastructure related plans and projects which may be specific to the fields and different from conventional targets of HCD approach: products and information systems.

Section 1 described motivation and purposes of the study. Section 2 briefly goes through HCD approach and processes employed for Japan’s infrastructures’ planning and projects. Section 3 introduces an HCD approach method to help understand and reflect stakeholders’ statements to early phases of infrastructure planning. This section is summary of the author’s previous works published in Japanese. In Section 4, a model is proposed to understand stakeholders focusing on transportation related projects and services and case examples are discussed in Section 5. Section 6 is discussion followed by Section 7 as conclusion.

2. HCD & TRANSPORTATION PLANNING

2.1 Human-centered Design Approach

In this study, the Human-centered Design (HCD) approach is referred as to the one stated in “ISO 9241-210: Ergonomics of human systems interaction – Part 210: Human-centered Design for interactive systems (ISO 9241-210, 2010).” The target of this approach is set for “products”, “systems” and “services”, and it is executed in purpose of designing useable targets. The approach is interactive (Fig. 1) and consists of four processes:

1) Understand and specify context of use,
2) Specify user requirements,
3) Produce design solution to meet user requirements, and
4) Evaluate design against requirements.

Numerous methodologies are core of the HCD approach such as: interviews, fieldwork to observe users’ tasks, personas and scenarios to describe present and target user experiences, prototypes for design and evaluation, usability tests, etc. The approach has been implemented to products and user-involvevment design, organizational changes, websites, ICT systems, business plans (some examples are introduced in Righi and James (2013) a selection from Righi and James (2007).)
2.2 Infrastructure Planning Process in Japan

The national and local governments sponsor majority of infrastructure planning and implement projects in Japan. Yamada-Kawai (2014) summarizes the project process and stakeholders (Fig. 2.)

Five processes are described as:
1) Planning: Abstract plans such as concept, master development and implementation plans are compiled in accordance of the progress of the project.
2) Survey & design: Surveys on natural and social environments are done in this process. Obtained data and design specification are handed in to the implementation process.
3) Implementation: Detailed design and implementation plan are compiled followed by construction work.
4) Operate & maintenance: Completed facilities are then operated. Duration of this process lasts several decades to sometimes over a century, and during the term, maintenance is also done.
5) Disposal: Either replacing, rerouting, or terminating is decided, the facility is disposed.

To complete each process, five stakeholders groups are described. Those are:
1) Intellectuals: Scholars and experts are assigned as members of committees that audit or involve in each process. They are supposed to be independent from the sponsors.
2) Users: Those who actually use the facilities and services. Part of them is a resident and/or taxpayer.
3) Taxpayers & residents: Those who live near by or in the influenced range of the projects. They are usually taxpayers thus can be called as sponsors of the project. In some cases they are also users.
4) Governments: They are sponsors of the projects. As they are run by tax, they owe
taxpayers the accountability or the duty to explain and to obtain consensus. They order companies and institutions for compiling survey, plans, implementation and operations.

5) Consultants, construction companies and operators: Those who execute each process. Most of them are private institutions, which are commissioned by the sponsors of the project, the government.

The Ministry of Land, Infrastructure, Transportation and Tourism of Japan (MLIT) published process guidelines (MLIT 2008) for governments to conduct resident-involvement procedures to get consensus. The guideline state that infrastructures including transportation planning are advised to include a process to have residents involved (called “public involvement process (PI)”) to ensure bi-directionally communication between the residents and the government. But it does not precisely states the procedures; Tomari et al. (2010) states that it may not be effectively operated.

Figure 2. Process and stakeholders of infrastructure projects in Japan (Yamada-Kawai, 2014)

3. EARLIER PLANNING PROCESS

3.1 Scenario Approach in Planning Process

The author (Yamada-Kawai, 2014) has proposed a method to reflect residents’ and experts’ (or intellectuals’) opinions into planning process by transforming transcripts into “scenarios.” The scenarios in this context are based on the ones introduced by Carroll (2000), which is to describes the way of actors or users using computer systems in natural sentences: scenarios. Carroll explains that the scenarios enable users’ view in system developing process and they are to be referred when developing design specification as well as evaluation of implementation.

Scenarios have four common elements, such as:
1) agents or actors (or users),
2) settings of the agents and agents themselves,
3) goals or objectives, and
4) sequences of actions and events.

The method proposed by the author is to utilize scenarios in summarizing transcripts and/or articles of interviews and discussions, which is performed at early stage of planning process such as long term plans or concept, and applied it into some case examples described in this section. With the method, various form and volume of records can be standardized in a form “scenario,”

- the volume of scenario is larger than that of usual “summaries” (articles or itemized short sentences), but shorter than the original records that also helps readers of scenario better understand the contents, and
- keywords extracted from the scenarios can be sorted into groups that also help analysts understand the concepts which should be included in the plan.

At the same time, the quality of the records and the background of the analysts (who write scenarios from the records) seem to affect the volume and number of scenarios. The background knowledge are human-centered point of view and the fields of the topics.

3.2 Method

The method proposed by the author consists of six steps (a) to (f) (Fig.3):

- [Step a] Collect records,
- [Step b] Specify timeframes and stakeholders,
- [Step c] Separate the records into as short as sentences,
- [Step d] Flag each separated records with the timeframes and stakeholders,
- [Step e] Write scenarios with each set of a timeframe and stakeholder, and
- [Step f] Choose keywords and sort them into groups.

Figure 2. Steps of writing scenarios

(1) Step a: Collect records
The raw data in this case is audio record of conversation and a speech. This raw data are to be
transcribed into text data, so articles and transcriptions are also the target of the collection.

(2) Step b: Specify time frames and stakeholders
Time frames or exact dates and stakeholders are defined from the plan that is being worked on. If the plan’s target date is 10 years from today, the time frame can be today, one year later, five years later, and 10 years later, which is the target year. Stakeholders are also be defined from the plan. In the case of transportation planning, stakeholders may include users, residents, operators, local and national governments.

Maximum number of scenarios is calculated by multiplying the number of time frames by that of stakeholders, and it greatly affect the workload of the analysts.

(3) Step c: Separate records into fragments
The third step is to separate the original record into fragments that are as small as sentences. Note that the length of each fragment should be as long as to be able to contain at least one subject and verb. In handling languages like Japanese where the subjects are often omitted, consider complimenting appropriate ones.

(4) Step d: Label fragments
Then label each fragment which time frame and stakeholder that is related to. One fragment can be related to multiple time frames or stakeholders.

(5) Step e: Sort fragments and write scenarios
Sort and read the fragments of the records by pair of time frame and stakeholder, and write scenarios of the stakeholder at the specific time frame. The scenario becomes a story of the stakeholder at certain time frame.

(6) Step f: Extract and sort keywords
Extract keywords from scenarios and sort them into groups that describe the discussion.

3.3 Application on Planning of a Mid-term Plan

An application was performed when Japan Society of Civil Engineers (JSCE, an academic society with 30 thousand members) made its mid term plan. When developing JSCE’s five-year-plan, JSCE decided to take advantage from the board of intellectuals with its former president as chairman, and a series of interviews performed a year before, to leaders of local governments, NPOs and industries. The method was employed in order for the members in charge of the planning to understand and share the fruits of the records.

(1) Records
Two sets of records were collected: 1) discussion session of 11 intellectuals, and 2) nine interview records. (Table 2)

Eleven intellectuals were asked to give their opinions on the role of civil engineers in the aftermath of a disaster and economic depression. The speakers consisted of the former presidents of academic societies, scholars in various fields, journalists. Each speaker handed in a one-page abstract of his speech followed by discussion session. Thus 10 abstracts and one transcription of a two-hour discussion were obtained. The form of abstracts varied from lists of phrases, one full page abstracts and presentation slides. Summary of the discussion was published as a two-page report at JSCE journal.

For the interviews, nine records were generated by each interviewer; the forms also vary
from lists of phrases to full sentences, but none of them were in spoken Japanese.

<table>
<thead>
<tr>
<th># of Speakers</th>
<th>Discussion</th>
<th>Interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Background of speakers</strong></td>
<td>Scholars related to engineering and journalists</td>
<td>Leaders of local governments, NPOs and chambers of commerce</td>
</tr>
<tr>
<td><strong>Types of record</strong></td>
<td>Transcription and abstracts written by the speakers</td>
<td>Written records by interviewers and an executive summary by the project leader</td>
</tr>
<tr>
<td></td>
<td>Japanese</td>
<td>Japanese</td>
</tr>
<tr>
<td><strong>Date</strong></td>
<td>December 11, 2011</td>
<td>December 2011 – February 2012</td>
</tr>
</tbody>
</table>

(2) Analysts

Two researchers with more than 20 years of civil engineering experience analyzed the record and wrote scenarios. One of them has knowledge of HCD approach, especially scenarios.

(3) Timeframe and stakeholders

The target year of the JSCE 2015 was set 2018 and the head of the planning committee decided to work on the plan in consideration of 100 years ahead. At the same time the discussion records showed that certain amount of statements were made on the past and present. Thus four timeframe was set: the past, the present, 10 years later, and 100 years later. The planners chose four stakeholders as: civil engineers, JSCE, the industry of civil engineering, and the society.

(4) Scenarios

From the discussion of 11 speakers, 97 scenarios were generated, from the original records 28,862 characters were summarized into 16,964 characters or 58.8% of the originals (Table 2). Examples of scenarios are shown in Table 3.

In the case of interview records, 38 scenarios of 2,219 characters were written from the records of 18,525 characters, which was 12.0% of the source (Table 2). Note that most of the original records were roughly summarized by the interviewers into lists of requests from the interviewee; the analysts decided to write demanding stories to each stakeholders.
Table 2. Numbers of scenarios

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Civil engineers</th>
<th>JSCE</th>
<th>Industry</th>
<th>Society</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past</td>
<td>7</td>
<td>2</td>
<td>9</td>
<td>5</td>
<td>23</td>
</tr>
<tr>
<td>Present</td>
<td>9</td>
<td>3</td>
<td>10</td>
<td>9</td>
<td>31</td>
</tr>
<tr>
<td>10 years from now</td>
<td>10</td>
<td>3</td>
<td>10</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>100 years from now</td>
<td>4</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>30</strong></td>
<td><strong>8</strong></td>
<td><strong>34</strong></td>
<td><strong>25</strong></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>

b) Interviews

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Civil engineers</th>
<th>JSCE</th>
<th>Industry</th>
<th>Society</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Past</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Present</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>17</td>
</tr>
<tr>
<td>10 years from now</td>
<td>2</td>
<td>8</td>
<td>7</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>100 years from now</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>7</strong></td>
<td><strong>2</strong></td>
<td><strong>12</strong></td>
<td><strong>7</strong></td>
<td><strong>38</strong></td>
</tr>
</tbody>
</table>

Table 3. Part of scenarios

<table>
<thead>
<tr>
<th>Timeframe and stakeholders</th>
<th>Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 years from now civil engineers</td>
<td>Civil engineers need to regain the trust from the Japanese society. Firstly civil engineers need to understand the pain that the engineers could not save the society from the disaster (Great East Japan Earth Quake in 2011); explain the development and examination of the course; and take enough time to regain the public’s trust. In explaining to the public, the civil engineers need to be aware of the possibility as the nuclear power plant sector so called “the nuclear party” lost motivation to pay efforts on explaining and discussing with the society when they felt discussion is useless.</td>
</tr>
<tr>
<td>100 years from now the industry</td>
<td>The social infrastructures that the industry works on last from some decades to sometimes a century or more, and the distinction or malfunction greatly affects the society. Thus building disaster proof national land with global competitiveness is indispensable to the country. Otherwise the industry may weaken the country.</td>
</tr>
</tbody>
</table>

(5) Keywords

Keywords were extracted and grouped by one analyst and an engineer who has background of software engineering. The purpose of the analysis were described as:

- to help planners understand the speakers statements,
- to help planners define the region of civil engineering included in the JSCE 2015, and
- to have the speakers validate the scenarios.

The analyst who wrote the scenario with HCD background picked up keywords from the scenarios of the discussion, and grouped them with the engineer. In total 174 keywords were picked up and grouped into three layers; five for top, 26 for the middle and 90 for bottom layers. (Fig. 3)
(6) Validations and implementation

The scenarios with the figure of layers (including Fig. 3) were presented to each speaker for validation. Then the planners share the scenarios and the figure before writing the plan. The planners pointed that the identical format of scenario enabled them to easily read through all of them, to figure out the characteristics of each one and obtained enough understanding with discussing with speakers.

(7) Discussion

Some discussion was left with the method and application. They are:
- The purpose of the scenario may not just summarize to understand. Schema and other theories in cognitive science may be applied to position the meaning of scenarios.
- In the application, quality of record and the analysts seemed to affect the quality or amount of scenarios produced.
- What are the “good records” and “good scenarios”?

4. LATER PLANNING PROCESS

4.1 Characteristics of Infrastructure Planning

In planning of later stages like designing specifications of the facilities and services, for example, Jonsson speaks in a dialogue with Grøendal (2014) points out in planning bike lanes there are not much for the user researchers can do because the specification of the lanes are strictly stated by regulations and laws. Yamada-Kawai (2015) reviewed and Human-centered Design (HCD) and resident-involvement of Japanese governments’ infrastructure planning process, and pointed out that when applying HCD into infrastructure planning process, four characteristics of infrastructure may be prohibiting HCD processes to be implemented in such
cases: distinction of infrastructures different from products, systems and services, numbers of stakeholders including sponsors requirement of accountability, established and often law-designated development processes, relatively longer lifecycle of the development and artifacts.

In this section, focus is set on the stakeholders of artifacts and analysis is practiced to find the difference or specific characteristics of infrastructures and related services, especially those related to transportation.

4.2 Stakeholders

We employ a hypothesis that consists of four elements:
- To simplify the model, there assumed to be four groups of stakeholders that are residents, taxpayers, users and the engineers.
- The residents are those who live in the vicinity of the infrastructure.
- The taxpayers are those who live in the area where the sponsor of the project governs. Hence they are also sponsors of the projects.

From the definition of Yamada-Kawai (2015), residents are divided in two stakeholders, residents and taxpayers, as they are not the same when discussing on a smaller scale projects.

4.3 Model

We are discussing on the design of an artifact. The stakeholders can be classified into three groups. A stakeholder can be classified into one or more groups: users, taxpayer and residents. Users have direct contact with the artifact; they use it or they visit it, the frequency is depend on the characteristics of the artifact and the users. An artifact has always users, but the interaction of between the artifact and the users may not be identical depending on the types of the artifact.

At the same time, a taxpayer can be a stakeholder even he/she does not use the artifact. So the whole set of stakeholders $S_{all}$ is described as a sum of users, residents and taxpayers as equation (1):

$$S_{all} = S_u \cup S_r \cup S_t$$  \hspace{1cm} (1)

where,
- $S_u$ : users of the target infrastructure and
- $S_r$ : residents of the target infrastructure, and
- $S_t$ : taxpayer of the target infrastructure.

Other stakeholders such as the sponsor of the artifact, planners and engineers (Yamada-Kawai, 2015), but they do not directly affect the specification or design of the artifact and neglected in this model. The equation (1) is described in Fig. 4.
Table 4. Combinations of the stakeholders

<table>
<thead>
<tr>
<th>#</th>
<th>Artifact</th>
<th>Users ($S_u$)</th>
<th>Residents ($S_r$)</th>
<th>Taxpayers ($S_t$)</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>*</td>
<td>*</td>
<td>---</td>
<td>---</td>
<td>The artifact and user has closed interface.</td>
</tr>
<tr>
<td>2</td>
<td>*</td>
<td>---</td>
<td>*</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>*</td>
<td>---</td>
<td>---</td>
<td>*</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>---</td>
<td>The artifact has some external influence, and is sponsored by something but tax.</td>
</tr>
<tr>
<td>5</td>
<td>*</td>
<td>*</td>
<td>---</td>
<td>*</td>
<td>The artifact has little external influence but sponsored by tax.</td>
</tr>
<tr>
<td>6</td>
<td>*</td>
<td>---</td>
<td>*</td>
<td>*</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>Most likely the case of social infrastructures.</td>
</tr>
</tbody>
</table>

*: Involvement exists.
---: No such case is found in the social infrastructure.

Assuming the existence of three groups of stakeholders derives seven combinations (Table 4). The artifact and only the users involves in the combination #1. Personal products such as personal computer, clothes, websites and other artifacts are classified in this combination. In this case, the interaction of the artifact between stakeholders is very dense, where user-interface plays great role. Patterns # 2, 3, 6 are the cases where no users exists; they are out of the scope. Pattern #4 is the case where users and residents involve with the artifacts. In
this case, the artifact causes external influences including costs thus the residents are the stakeholders, but the sponsors of the artifact are not taxpayers; it is a limited setting as social infrastructures where the artifact is sponsored not by tax but other funding. Pattern #5 is the case with users and taxpayers but not residents. No tangible (sometimes conventional) infrastructure can be categorized in this pattern, but computer systems or web systems can be. Pattern #7 is the case where all three stakeholders groups are involved in the artifacts.

We are now able to choose four typical patterns (Fig. 5) out of seven in considering the effects of the Human-centered approach. Those four patterns are described in equations as:

\[
S_1 = S_u, \quad \quad (2)
\]

\[
S_4 = S_u \cup S_t, \quad \quad (3)
\]

\[
S_5 = S_u \cup S_r \quad \text{and} \quad (4)
\]

\[
S_7 = S_u \cup S_r \cup S_t. \quad \quad (5)
\]

5. CASE EXAMPLES

In this section, we compare various types of infrastructures by the model proposed in the previous section.

5.1 Conventional Targets of HCD
If we apply the model to the products let’s say a smartphone or a website that are conventional targets of Human-centered Design approach. It is easily understood that the case falls into Pattern #1 where only the artifact and a user involves. There are usually no resident $S_r$ or taxpayer $S_t$ in the groups of stakeholders. The interaction between the artifact and human is limited only to the user and human-centered approach means user-centered approach. An example of Pattern #4 include a privately owned and run facility such as an amusement park, house and company, where few tax or public funding is spent but has an influence outside of the artifact and users.

This consideration suggests that conventional approach does not have much experience in patterns like #6, and #7 but a lot of them in #1, and #4; social infrastructures categorized into these two patterns can be somewhat easier to be implemented where others not and may require some specification of the Human-centered Design approach.

### 5.2 Transportation Facilities and Services

In this section, some subjects in transportation field are analyzed from a viewpoint of suitability to HCD approach regarding stakeholders. These examples are typical projects in transportation planning but not sufficient enough to cover all the fields.

**1\(^{st}\) Information provision service and systems**

Sign boards, maps and route maps at the railway stations, airports, highways are designed and operated at certain geographical points to help users decide their route choice or avoiding congestions. The artifacts in this case affect only to users ($S_u$). Especially in case of web-based systems, they are already included in the conventional targets of HCD approaches.

**2\(^{nd}\) Interior of buildings**

Arrangements inside of building, such as railway stations, airport passenger buildings, and public space around station or road are in this category. When the facility is restricted to the users of the transportation, then the stakeholders include only the users ($S_u$). But following cases include the residents ($S_r$) as well:

- a railway station whose main corridor connects areas divided by the railway and used as a street,
- a railway station, airport building and service areas of expressway (with entrance other than from the expressway) that have facilities as restaurants, shops and others for vicinity residents.

In cases where tax is put into buildings themselves, taxpayers ($S_t$) are also considered to be the stakeholders. It is usually the case in Japan that some half of the building costs is filled with local and national governments.

**3\(^{rd}\) Buildings**

Even though a building only allows its users ($S_u$) to be visited, the building itself affects the residents ($S_r$) around; when implementing by noise, traffic; when operated by the visitors. If the government paying a part of the building cost, the taxpayers ($S_t$) cannot be neglected.

**4\(^{th}\) Roads and railways**

Typical example of “external influence” arises around road and railways. During and after the implementation, users ($S_u$) as well as the residents ($S_r$) along the routes are somehow
affected. The affects include costs (ex) nose, air pollution) as well as benefit (ex) increase in convenience, land price.) If the government funds the road or railway and it is usually the case in Japan, especially the size of the project is relatively large, the tax payers ($S_t$) also become the stakeholders.

### 5.3 Discussion

Conventional targets of the HCD approach were products and ICT systems where the stakeholders are only the users of the artifacts. Thus the approach may have evolved assuming the circumstances that only group ($S_u$) exist as stakeholders, the Pattern #1. Cases of social infrastructures are regarded to have “external influences” which derives both positive and negative affects to other than users but the residents ($S_r$), the Pattern #4 and #7 and that the author has thought as one of the reasons that preventing the HCD approach to be implemented.

Closely examining with the proposed concept, transportation fields also have facilities in which only the users are counted as stakeholders. In these areas, the HCD approach can be applied improve usability of the system. Other cases where residents and taxpayers involve, modifications to the process are necessary to suit the characteristics of the infrastructure projects that are having residents and taxpayers as stakeholders, and the original project process described in Section 2.

### 6. CONCLUSION

To obtain higher satisfaction of stakeholders is an objective of implementing infrastructure including transportation services. In this study, the process guideline by the MLIT of Japan was introduced to confirm the motivation and then a method that can be applied to the earlier planning process was introduced from the author’s previous works published only in Japanese.

Transforming speakers’ statements into stakeholders’ scenarios helps planers understand the contents. A conceptual model that describes target artifacts’ involvement of stakeholders was proposed. The model was used to understand the difference of transportation services and systems from that of conventional HCD approach. The case examples revealed that some of the targets like information provision systems have the same stakeholder patterns which is the users; only regarding these patterns HCD can be applied. In other examples where residents and/or taxpayers involve, the HCD approach requires some modifications as author has previously discussed (Yamada-Kawai, 2015).

Further study is to be done on increasing the suitability of the HCD approach as well as accumulating analysis case examples in the transportation fields.

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