CT-Planner5: a Computer-Aided Tour Planning Service Which Profits Both Tourists and Destinations

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ABSTRACT
CT-Planner is a web-based tour planning service, which promotes the collaborative design of tour plans by a user and the system. Its remarkable feature is its interactive and cyclic process of tour planning, in which the user provides his/her requests in a stepwise manner and the system keeps revising the plan until he/she gets satisfied. Such interface design fits service domains where users are not well-aware of their interests/requests at the beginning, such as tour planning. This paper reports its latest version, CT-Planner5, which supports 25 destinations in Japan at this moment. CT-Planner5 makes it possible to generate tour plans which use public transportation when it is efficient. We explain the mechanism of plan generation, as well as the process of authoring destination data. We also introduce our future plan to use the user log of CT-Planner5 for destination marketing in collaboration with travel agencies, DMOs, and communities, as the collected user log allows us to know the demand and emerging trend of tourists for each destination without cost.

Categories and Subject Descriptors
H.3.5 **[Information Storage and retrieval]**: online Information – *web-based services*.

General Terms
Design, Human Factors.

Keywords
computer-aided tour planning, personalization, critiquing-based recommender system, user log, marketing analysis

1. INTRODUCTION
Making a tour plan is an exciting process of travel, but sometimes people feel hard to do it, especially when they are visiting unfamiliar destinations on a tight schedule. In order to relieve people from such difficulty, researchers have developed *tour recommenders* that generate personalized tour plans (e.g., [7][17][19]; See [26] for a review). Early systems typically aim at generating an optimal plan in a single step, asking users to give all tour conditions/requests in advance. This interface makes their users feel lack of participation [24]. In order to realize more user-centered planning, some systems introduced *customization phase*, in which the users are allowed to modify recommended plans [6][23]. Furthermore, we developed *CT-Planner* in pursuit for realizing system-user collaboration of tour planning [12]. In CT-Planner, the users can provide their requests in a stepwise manner and the system keeps revising the plan until they get satisfied. We confirmed that this interactive interface helps the users to clarify their requests and eventually leads to higher user satisfaction [15]. CT-Planner's interaction model is similar to that of *critiquing-based recommender systems* [5][18] in the sense that the users are requested to give feedbacks to the system about its recommendations. However, the requested feedback in CT-Planner is not the evaluation of each recommended plan, but pieces of requests which come up to the users' mind while examining the recommended plans.

This paper introduces the latest version of CT-Planner, called *CT-Planner5*. CT-Planner5 is available online at http://ctplanner.jp. CT-Planner5 succeeds the following features from its previous versions: collaborative planning approach, online accessibility, and use of a genetic algorithm for generating plans. In addition, CT-Planner5 now supports the generation of tour plans which use public transportation, and equips with two family tools, namely *plan viewer for smartphones* and *log analyzer*.

Our CT-Planner5 has two goals. The apparent goal is to provide a useful planning service to tourists on the Web. With CT-Planner5, people can consult on their plan from anywhere at any time, as much as they want. Another implicit goal is to collect log data from a large number of users, which can be eventually utilized as a resource for marketing analysis.

The remainder of this paper is structured as follows: Section 2 consider general requirements of computer-aided tour planning services. Section 3 looks back the history of CT-Planner. Section 4 describes the outline of CT-Planner5's service, including *plan viewer for smartphones*. Section 5 briefly explains how CT-Planner5 generates tour plans. Section 6 discusses the applicability of CT-Planner5's user log for marketing analysis, together with the introduction of our *log analyzer*'s prototype. Section 7 explains the process of data authoring in CT-Planner5. Finally, Section 8 concludes with a discussion of future work.

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2. GENERAL REQUIREMENTS OF TOUR PLANNING SERVICES

Before introducing CT-Planner5, we discuss general requirements of tour planning service from a viewpoint of design engineering.

2.1 Design Perspective: Configuration Design by User

Thanks to advancement of ICT, the design and the use phases have become strongly and inseparably related. In some forms of design, users attend to the development process [3][22][28] and simultaneously design and use products/services. Many approaches have been used for achieving it, such as user-centered design [1], participatory design [21], lead-user innovation [10], and reinvention [4]. Hara *et al*. have introduced a model for combining design activities by the product/service provider, individual user, and user community [8]. They also explained engineering processes that involve and do not involve users. The importance of design by users is explained from the difference between these two processes. The discussion here does not distinguish between physical products and non-physical services.

Figure 1 shows such a general engineering process that does not involve users. The design process includes concept design and detailed design, and the production process includes production, manufacture, and quality control. In this entire process, users attend only to the use phase. In other words, users simply consume the products/services designed and produced by providers. In the design process, users only appear as the Voice of Customer (VoC), and their characteristics and behaviors are not considered.

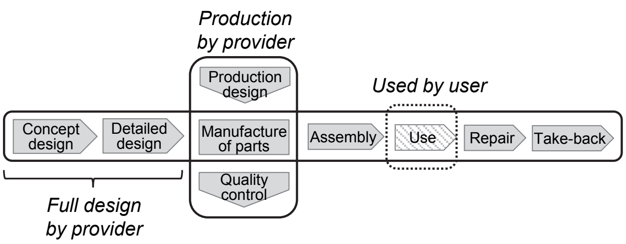

Figure 1. General engineering processes of a product/service (modified from [8])

On the other hand, Figure 2 shows an engineering process involving high user participation [8]. User participation is used as an approach to respond to each customer [22]. The main feature of this process is the processes of configuration and adaptation by the user. The process of full design by the provider is changed to that of preparatory design. In this process, providers design the basis of products/services and prepare for configuration by a user. In this situation, users not only use products/services but configure and adapt the parts prepared by the provider. Thus, they become co-designers of products/services. By providing users with more freedom for developing products/services, they can make these products/services more fit to their requirements and the conditions in the use phase. Preparatory design by the provider includes formulating the PFA (Product Family Architecture) [27] and preparing the configurator. Next, the process of configuration by the user is carried out as assembly and configuration in the configuration design of use. Interactive design methods have been proposed to support these user's processes (e.g., [29]). In the use phase, users use and adapt a product/service to the environment in the use phase.

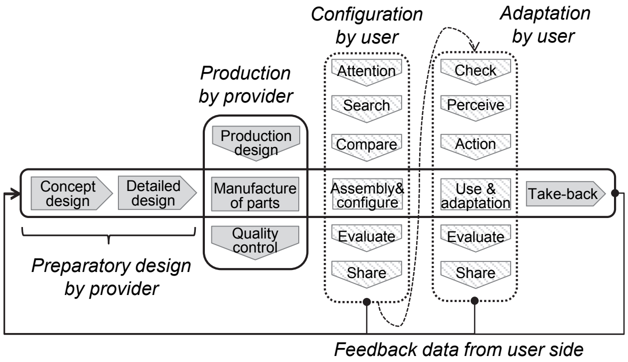

Figure 2. Engineering processes of a product/service involving high user participation (modified from [8])

2.2 Tour Planning Assistance

According to the above design perspective, tour planning is viewed as a configuration design activity of a service, in which tour components, mainly point of interests (*POIs*), are selected from numerous candidates and combined as into series, such that the plan maximizes the expected satisfaction of its users (i.e., tourists) under such constraints as total time, budget, start/goal point, mode of transportation.

Mathematically speaking, it is modeled as a combinatory optimization problem (Section 5). A unique feature of this design activity is that, not like product design, the design is conducted not only by experts, but often by ordinary users (in other words, people often make their tour plans by themselves). However, each user usually has insufficient knowledge about the destination and, accordingly, he/she is forced to estimate the value of each component and time necessary for enjoying it, as well as the travel time between these components, based on the limited amount of knowledge and experience. This task may be acceptable if the destination has only a small number of POIs within a walkable distance, but rapidly becomes difficult as the destination has larger number of POIs in a broader area. For instance, making the best one-day tour plan in Tokyo is an extremely difficult problem with countless number of possibilities. This justifies the significance of assistance service of tour planning by experts.

Of course, human experts, such as staffs at tourist information offices and hotel concierges, can assist individual tourists for tour planning. However, human resources of these experts are limited, especially during such busy hours as morning, and open hours of such services are also limited. In addition, people may feel reluctance to communicate with these human experts in foreign languages. Such situations motivate the development of computer-aided tour planning service, as it is expected to support tourists at any time at anywhere in the world without human cost.

Another unique feature of tour planning as a design activity is that users are often not well-aware of their own interests/requests at the beginning. This is simply because tourism is an activity that usually takes place at unfamiliar environments and people do not know what they can do at the destination. In this sense, tour planning should be distinguished from such online services as shortest-path finders and transit search tools where the users usually recognize their own interests/requests before use. Thus, we consider that tour planning service should have a certain *educational* aspect, providing appropriate amount of knowledge about the destination and promoting the users to find their own requests. Such knowledge enlightenment may also help the users at the destination if they want to rearrange their tour plan.

3. HISTORY OF CT-PLANNER

CT-Planner has a long history of improvement. It has its root on Kurata's preference-based tour planner [11], which asks its user to answer fifteen pairwise comparison questions to deduce his tour preference, and derives the best-scored personalized plan using a greedy optimization algorithm. In this system, however, the user is not allowed to modify the recommended plan. Thus, in order to achieve interactive tour planning, the first CT-Planner was developed [12]. The first CT-Planner allows such user requests as POI addition/removal. In addition, it has a *plan-comparing* function—it simultaneously shows two tour plans with different focuses, asks the user to select a preferable plan, and deduces his/her preference in a stepwise manner.

CT-Planner2 [13] has both a plan-comparing mode and a single-plan mode. In addition, it provides a manipulatable radar chart which represents preference model. In its user test, most users actually preferred the single-plan mode and manipulated his preference model by themselves. Thus, the plan-comparing function is no longer succeeded to the later versions.

CT-Planner became a web-based application since CT-Planner3 [14]. CT-Planner3 adopted a genetic algorithm for plan generation. Since we expected that this algorithm requires heavier computation than our previous greedy algorithm, we made two versions for experiment: a server-client version in which the plan generation is conducted on the server side, and a client-alone version. In our experiment, the response speed of the client-alone version was unexpectedly better than that of server-client version, even on mobile devices with low computation power. Thus, the client-alone model is succeeded to the later versions.

CT-Planner4 [15] supported multiple destinations and multiple languages. In order to increase the number of our destinations, we developed a macro-enhanced Excel template for authoring destination data.

In addition to the above versions, there were also several extended experimental versions of CT-Planner. For instance, Shimada *et al*. [25] revised CT-Planner4, such that it suggests the modification of user preference parameters based on his/her POI requests (Figure 3). Nakamura *et al*. [20] developed another extension of CT-Planner4, in which the user is proposed an alternative route in the last one-third part of his trip (Figure 4). This idea is motivated by our finding that people often deviate from their original plan made with CT-Planner, especially at the last part of their tour.

Figure 3. Proposal of modification of a user preference model based on his POI requests [25]

Figure 4. Proposal of an alternative route in the last part of the trip [20]

4. CT-PLANNER5

This section introduces the latest version of CT-Planner (CT-planner5) from a viewpoint of its user interface.

Figure 3 shows the initial screen of CT-Planner5. Here you are asked to select your destination and your favorite travel style. Currently CT-Planner supports 23 destinations in Japan, among which six has English contents as well. These destinations include i) large cities, which presumes the use of public transportations for sightseeing (e.g, *Sapporo*, *Yokohama*, *Nagoya*, *Kobe*, and *Fukuoka*), ii) subparts of Tokyo megalopolis, such as *Shinjuku* and *Shibuya*, which are typical units of a day trip in Tokyo, iii) walkable-size rural destinations such as *Shikine-jima Island* and *Ikaho Hot Springs*, and iv) even facility-scale destinations such as *Hongo Campus, University of Tokyo*. The favorite travel styles you can select are the following five: *anything welcome*, *city stroller*, *relaxed traveler*, *locality-oriented*, and *with children*. We adopted these five styles based on the result of our previous GPS-assisted survey on foreign tourists visiting Tokyo [2].

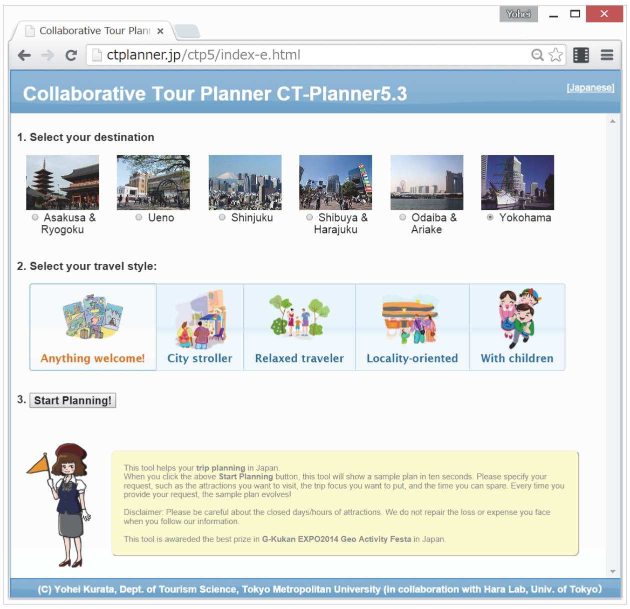

Figure 5. Initial screen (English version)

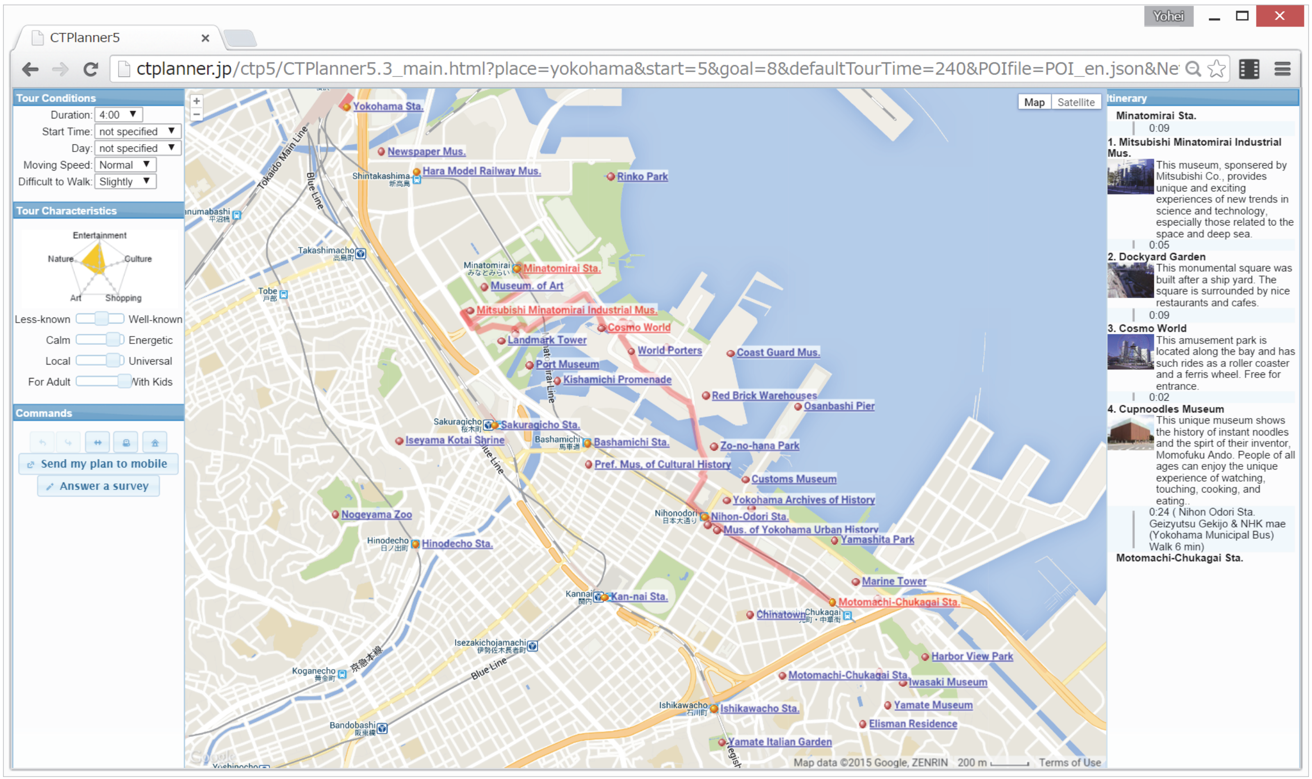

Figure 6. Main screen

Imagine that you select *Yokohama* and *With Children* as your destination and travel style, respectively. When you click the *Start Planning* button, you will see the main screen like Figure 6 in a few seconds. The main screen shows the route of an initial plan on the map, together with its itinerary on the right end. The initial plan is generated based on the travel style you have selected and typical tour conditions among Yokohama visitors (four-hour stay, starting from a west-side station, and ending at an east-side station).

The left end of the main screen shows your tour conditions and tour characteristics (see Figure 7 for detail). When you update any element on them, the displayed tour plan is revised immediately. The tour conditions consist of five items: *duration*, *start time*, *day of the week*, *walking speed*, and *degree of difficulty to walk*. The tour characteristics represent a model of user preference and consists of two parts: *focus* and *taste*. *Focus* refers to the tour's functional features that the user wants. It is represented by a manipulatable radar chart with five axes: *entertainment*, *culture*, *shopping*, *art*, and *nature*. If you put more weight on culture, for instance, your tour plan will visit more museums. *Taste* refers to the tour's emotional characteristics that the user wants. We considered four types of taste, each represented by two poles; *less-known* or *well-known*, *calm* or *energetic*, *local* or *universal*, and *for adult* or *with kids*. If you move the top slider to the right end (labeled *well-known*), for instance, your plan will visit popular places more likely. Note that the initial value of each parameter is determined based on your initial selection of favorite travel styles, such that the user do not worry about the settings of these parameters at the beginning. These initial values are predetermined by us.

Figure 7. Tour conditions and characteristics

The map shown on the center (Figure 6) is depicted with the aid of Google Maps JavaScript API. Accordingly, you can zoom/scroll the map and even see the isometric view of satellite images, which is nice to understand the tour route (Figure 8). If you click the name tag of a POI on the map or the satellite image, an information window opens (Figure 9). This window shows the

POI's name, estimated value for the user, description, hyperlinks to the related websites (if available), open hours/days, staying time, photo, scores on the five items, and several buttons. If you click *Visit* button, the system generates tour plans which visit this POI as long as possible. Conversely, once you click *Avoid* button, the system no longer shows the plans that visit this POI. *Start*/*Goal* button allows you to set this POI as the tour's start/goal location. Finally, *+10*/*-10* button allows you to adjust the staying time of this POI. Note that CT-Planner5 does not force the users to select all POIs they want to visit—instead, they can entrust the selection of POIs to the system other than those with their visit requests.

Figure 8. The route of a recommended tour plan displayed over an isometric satellite image

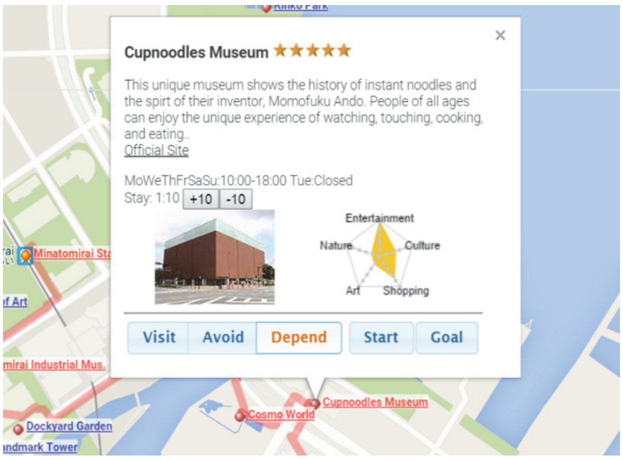

Figure 9. An example of information window

The design of CT-Planner5 presumes the following interaction cycle between the user and the system:

1. the user examines the displayed tour plan, as well as the POIs on/off the route,
2. the user gives certain feedback to the system (modification of tour conditions, modification of tour characteristics, or visit/avoid request), and
3. the system revises the plan accordingly and displays it.

This cycle is repeated until the user gets satisfied with the displayed plan. This cyclic interface relieves its user from the burden of specifying their requests at the beginning of planning [12].

When you get satisfied with your plan, you can print it or send it to your smartphone via a two-dimensional barcode (Figure 10). Our *plan viewer for smartphones* shows your plan and your current location on the screen. In addition, this viewer can show you the latest transportation schedule with the aid of Yahoo Transit.

Figure 10. Linkage to our plan viewer for smartphones

5. UNDERLYING MECHANISM

CT-Planner5's mechanism for generating tour plans is similar to that of CT-Planner4 [15]. Here we briefly describe its essence. Basically, CT-Planner5 estimates the value of individual POIs for each user, and calculates the most efficient plan under given constraints that maximizes the sum of the estimated values of the POIs to be visited in the tour.

The value of each POI is estimated from the matching between the POI's characteristics and the current setting of the tour characteristics that the user wants. The previous versions of CT-Planner considers simple weighted sum of the scores in five *focus* categories (i.e., *culture*, *entertainment*, *nature*, *art*, and *shopping*), but this method is advantageous to the POIs with balanced scores. Thus, CT-Planner5 modifies this method, such that the POI with a high score in a specific category is highly evaluated if it matches with the user's interest. Note that the estimated value of a POI is replaced to *zero* if the user wants to avoid this POI, and to a very high value if he wants to visit it.

The calculation of the most efficient plan under given time and start/goal constraints is formalized as a selective traveling salesman problem [16]. Since this is a NP-hard combinatory optimization problem, we adopt a genetic algorithm (GA) for deriving semi-optimal solutions in a short time. In this algorithm, each tour plan is regarded as a gene (i.e., a series of symbols, each representing a POI). We randomly generate thousands of initial genes and then simulate evolution (crossover and mutation) and survival competition over a large number of generations. In each competition, the plans with higher evaluation survive more likely (but not always). This process eventually leads to the generation of superior plans, although the optimality of the final plan is not guaranteed. A nice point of this algorithm is that we can easily support open/close hours of POIs, and even temporally-changing values of POIs, only by adjusting the evaluation function of each plan.

Of course, the above method still has a room for improvement. In reality, the plan's value may be affected by the combination and order of POIs to be visited. We should also consider reciprocal effects—if people visit similar POIs repeatedly, they may get bored, or conversely, they may get more satisfaction. How to incorporate such effects into the model is our future question.

6. USE OF LOG DATA

CT-Planner5 records all operations and plans by each user. This log will be useful for navigating the same user at the destination. Our previous experiment shows that our users often deviate from the plan they have made, because the interaction with CT-Planner helps them to identify the interesting POIs near their route. This implies that not only the final plan they have made, but also the list of the POIs they have checked are useful for a smart on-site navigation.

The user log of CT-Planner5 is also useful from a viewpoint of destination marketing, if it is analyzed statistically. We are developing *CT-Planner5 log analyzer* powered by Google Analytics (Figure 11) to examine the following statistics:

- the number of accesses,
- average tour durations,
- viewing rate of each POI (i.e., how much percentage of users have opened its info-window),
- adopting rate of each POI (i.e., how much percentage of users have made the tour plans that visit it), and
- appearance of POI pairs (i.e., which POIs are often listed together in user-generated tour plans),

as well as conducting data-mining analyses for discovering unique tour plans. A nice point is that we can examine such statistics for each user group (genders, ages, countries, languages, and interests) and compare them with the aid of Google Analytics. Such information will help DMOs to examine their promotion strategies, as well as travel agencies to design their package tours [9]. Another nice point is that, not like ordinary questionnaire-based tourists surveys, we do not have to pay any extra cost to collect data from customers.

Figure 11. Prototype of CT-Planner5 Log Analyzer

7. AUTHORING DESTINATION DATA

We made a macro-enhanced Excel template with which people can easily make a destination data for CT-Planner (Figure 12). On this template the user input for each POI the name, description, type, URLs of related websites, URL of photo data, open days/hours, and scores for the nine criteria (Section 4). It normally takes a few hours to complete the table for a typical destination with thirty to sixty POIs.

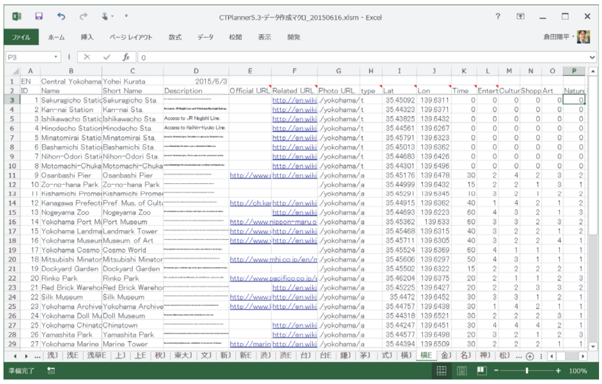

Figure 12. CT-Planner5's template for destination data

Once the table is completed, its macro program computes the route between every pair of the POIs listed in the table, in order for CT-Planner5's main program to reduce the time for generating tour plans. Our template has several modes for the route calculation. In *walking-only mode* and *driving mode*, the user can select either Google Directions API or Map Quest API (using OpenStreetMap data) as a route calculating engine, considering the coverage area of these two services. In *public transportation mode*, the program uses both Google Directions API and Yahoo Transit, because Google Directions API does not provide the routes that use public transportations in Japan, while Japanese version of Yahoo Transit provides such routes together with their average travel time, but not with their geometrical shapes. In *public transportation mode*, the walking route between a pair of POIs is calculated only if the straight distance between them is less than 1.5 km, while the possibility of public transportation use is sought if the distance is more than 1km. By this mechanism, the number of API requests is considerably reduced. Normally this route calculation process takes about ten minute to one hour.

We have tested the above macro-enhanced template with several groups, including students, professionals, and local people. Through the collaboration with them, we learnt that the involvement of various people in data creation is effective not only for expanding CT-Planner's coverage, but also for enriching the diversity of our service. We are, therefore, seeking further possibility of user participation, by introducing a web-based *CT-Planner's data editor*, with which people can create destination data in a collaborative manner.

8. CONCLUSION AND FUTURE WORK

This paper reports the latest version of our web-based tour planning service, CT-Planner5. It promotes the collaborative design of tour plans by the user and the system through its cyclic interaction. In addition, this system now equips with sub-systems for viewing the plans for smartphones, and analyzing user logs.

In Japan, the number of tourists from abroad increases rapidly due to the nation's policy toward a tourism-oriented country, as well as rapid economic growth in East Asia. The interests of visitors to Japan are much more diversified than those of domestic tourists who have dominated our market for long. As a result, Japanese tourism industry is facing two critical problems: how to know the interest of inbound visitors and how to serve them appropriately and efficiently based on such knowledge. We expect that CT-Planner will contribute to the tourism industry under this situation. Firstly, CT-Planner serves as a virtual consultant of tour planning.

Since CT-Planner is an online service, it allows inbound tourists to consult their tour plans at any time at anywhere, without paying human cost. Secondly, CT-Planner will serve as a survey tool, with which we can know the interest of inbound tourists. In order to achieve these two goals, we are now working on the translation of contents into English, Chinese, and Korean languages, as well as the enrichment of destinations supported by CT-Planner5.

Figure 13 shows our future vision. We expect that CT-Planner basically serves individual tourists who are relatively advanced in the sense that they actively collect tourist information by themselves. In exchange for providing planning service to them, we will obtain their planning log, from which we can analyze their demand and emerging trend. We will provide the result of our analyses to travel agencies and DMOs. This information will be useful for providing more attractive tour merchandise and/or information service to tourists in general. This will motivate those organizations to cooperate with us and provide their destination data. To realize this virtuous cycle is our future challenge.

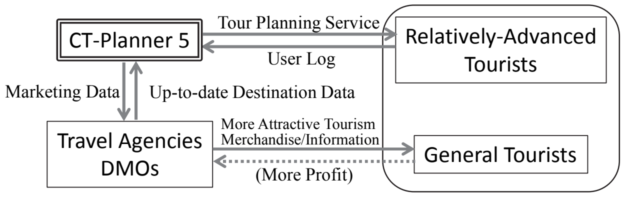

Figure 13. Future vision of CT-Planner

Furthermore, we envision the application of CT-Planner to tourism-oriented community design. Tourism is a key to achieve a sustainable community development in both economic and cultural aspects. Meanwhile, it has been difficult for local people to know how visitors evaluate their region and what the community should improve it from the viewpoint of tourism. Now the user log of CT-Planner, as well as user-posted contents in such SNSs as Trip Advisor, Twitter, and Flickr, are available for the visualization of visitors' activities and evaluations. Such visualization will serve as a useful material for the local people to discuss the future of their community by themselves. In order to demonstrate its potential, we are currently working with several local communities in Japan, where we have created CT-Planner's destination data with local people, started planning service online (and eventually offline at information kiosks), and kept collecting the log data from various users for future analysis.

Another future challenge for us is to develop a smart on-site navigation tool, which works in combination with CT-Planner. We consider not a virtual tour conductor, as seen in [19], which controls the user to follow his tour plan, but the one that supports his flexible trip, taking his original plan and planning activity into account. Then, by analyzing the difference between the original plan and the actual behaviors recorded by this tool, we want to pursue deeper understanding of tourists.

9. ACKNOWLEDGMENTS

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10. REFERENCES

[1] Abras, C., Maloney-Krichmar, D., Preece, J., 2004. User-Centered Design, *Encyclopedia of Human-Computer Interaction*, Thousand Oaks: Sage Publications.

[2] Aratani, K., Shimada, S., Ota, J. and Hara, T. 2012. Classification of inbound tourist activities using GPS log data toward service innovation. *12th Japan-Korea Design Engineering Workshop*, 28-31

[3] Barki, H., Hartwick, J. 1994. User Participation, Conflict, and Conflict Resolution: The Mediating Roles of Influence. *Information System Research*, 5, 4, 422-4384.

[4] Carroll, J. 2004. Completing Design in Use: Closing the Appropriation Cycle. *European Conference on Information Systems* (Turku, Finland, June 14-16, 2004). CD-ROM.

[5] Chen, L., and Pu, P. 2009. Interaction Design Guidelines on Critiquing-Based Recommender Systems. *User Modeling and User-Adapted Interaction*, 19, 3, 167-206.

[6] Garcia, A., Arbelaitz, O., Linaza, M., Vansteenwegen, P., and Souffriau, W. 2010. Personalized Tourist Route Generation. *Current Trends in Web Engineering* (Vienna, Austria, July 5-6, 2010), CWE 2010 Workshops, Lecture Notes in Computer Science 6385, 486-497.

[7] Goy, A., and Magro, D. 2004. STAR: a Smart Tourist Agenda Recommender. *Workshop on Configuration* (Valencia, Spain, Aug. 2004). *ECAI 2004*, 8/1-8/7

[8] Hara, T., and Arai, T. 2013. Design-of-use and design-in-use by customers in differentiating value creation. *CIRP Annals - Manufacturing Technology*, 62/1 (ISSN 1660-2773), 103-106.

[9] Hara, T., Shimada, S., Yabe, N., Kurata, Y., Aoyama, K. and Hompo, Y. 2012. Value Co-Creation in Tourism: Incorporating Non-Expert's Design into Expert's Design Activities. *1st International Conference on Human Side of Service Engineering* (San Francisco, CA, July 21-15, 2012).

[10] Hippel, V. E. 2005. *Democratizing Innovation*, London: MIT Press.

[11] Kurata, Y., Sadahiro, Y., and Okunuki, K. 2000. Development of a Preference-Based Tour Planning System. *9th Conf. of GISA Japan* (Tokyo, Japan, Oct 2000). 199-202 (in Japanese).

[12] Kurata, Y. 2010. Interactive Assistance for Tour Planning. *Spatial Cognition VII* (Mt. Hood, OR, Aug. 15-19, 2010). Lecture Notes in Artificial Intelligence 6222, 289-302.

[13] Kurata, Y. 2011. CT-Planner2: More Flexible and Interactive Assistance for Day Tour Planning. *ENTER 2011* (Innsbruck, Austria, Jan. 26-28,2011). 25-37.

[14] Kurata, Y. 2012. CT-Planer 3: An Interactive Support Tool for Tour Planning on the Web. *International Journal of Tourism Science* 5, 159-165 (in Japanese).

[15] Kurata, Y. and Hara, T. 2014. CT-Planner4: Toward a More User-Friendly Interactive Day-Tour Planner. *ENTER 2014* (Dublin, Ireland, Jan. 21-24, 2014), 73-86, Dublin, Ireland.

[16] Laporte, G., and Martello, S. (1990). The Selective Travelling Salesman Problem. *Discrete Applied Mathematics*, 26, 2, 193-207.

[17] Lee, J., Kang, E., and Park, G. 2007. Design and Implementation of a Tour Planning System for Telematics Users. *ICCSA 2007* (Kuala Lumpur, Malaysia, Aug. 26-29, 2007). Lecture Notes in Computer Science 4707, 179-189.

[18] Linden, G., Hanks, S., and Lesh, N. 1997. Interactive Assessment of User Preference Models: The Automated Travel Assistant. *6th Intl. Conf. on User Modelling* (Chia Laguna, Sardinia, Italy, June 2-5, 1997), 67-78.

[19] Maruyama, A., Shibata, N., Murata, Y., Yasumoto, K., and Ito, M. 2004. A Personal Tourism Navigation System to Support Traveling Multiple Destinations with Time Restrictions. *Advanced Information Networking and Applications 2004* (Fukuoka, Japan, Mar. 29-31, 2004). 2, 18-21.

[20] Nakamura, Y., Shimada, S., Ogata, T., Kurata, Y., Ota, J. and Hara, T. 2014. An Interactive Tool for Tour Planning Considering Adaptive Behaviors. *JSPE Spring Conference 2014* (Tokyo, Japan, Mar. 18-20, 2014). CD-ROM (in Japanese).

[21] Pilemalm, S., Timpka, T. 2008. Third generation participatory design in health informatics--making user participation applicable to large-scale information system projects, *Journal of Biomedical Informatics*, doi:10.1016/j.jbi.2007.09.004, April 2008.

[22] Robey, D., Farrow, D., 1982. User Involvement in Information System Development: A Conflict Model and Empirical Test. *Management Science*, 28, 1, 73-85.

[23] Schaller, R. 2011. Planning and Navigational Assistance for Distributed Events. *2nd Workshop on Context Aware Intelligent Assistance* (Berlin, Germany, Oct. 2011) 44-56.

[24] Seifert, I. 2008. Collaborative Assistance with Spatio-temporal Planning Problems. *Spatial Cognition V* (Freiburg, Germany, Sep. 15-19, 2008). Lecture Notes in Computer Science 4387, 90-106.

[25] Shimada, S., Ogata, T., Ota, J., Hara, T., and Kurata, Y. 2014. A Support for Design of Use in Consideration of Use Phase. *13th International Design Conference* (Dubrovnik, Croatia, May 19-22, 2014). 995-1004.

[26] Souffriau, W. and Vansteenwegen, P. (2010) Tourist Trip Planning Functionalities: State-of-the-Art and Fitire. *Current Trends in Web Engineering* (Vienna, Austria, July 5-6, 2010). ICWE 2010 Workshops, Lecture Notes in Computer Science 6385, 474-485.

[27] Tseng, M. M., J. Jiao and M. E. Merchant 1996. Design for Mass Customization. *CIRP Annals - Manufacturing Technology*, 45, 1, 153-156.

[28] Yang, B., and Burns, N. 2003. Implications of postponement for the supply chain. *International Journal of Production Research*, 41, 9, 2075-2090.

[29] Yanagisawa, H., Fukuda, S., 2003, Interactive Design Support System by Customer Evaluation and Genetic Evolution: Application to Eye Glass Frame. *7th International Conference on Knowledge-Based Intelligent Information & Engineering Systems* (Oxford, UK, Sep. 3-5, 2003), Lecture Notes in Computer Science 2774, 481-487.