Tourism Information System from Integration Viewpoint: A Constructive Case Study

University of Oulu
Department of Information Processing
Science
Master’s Thesis
Xiaori Hu
30th April, 2013
## List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>AR</td>
<td>Augmented Reality</td>
</tr>
<tr>
<td>B2C</td>
<td>Business-to-Consumer</td>
</tr>
<tr>
<td>CBD</td>
<td>Component-Based Development</td>
</tr>
<tr>
<td>COM</td>
<td>Component Object Modeling</td>
</tr>
<tr>
<td>C2C</td>
<td>Consumer-to-Consumer</td>
</tr>
<tr>
<td>DDMS</td>
<td>Destination Decision Making System</td>
</tr>
<tr>
<td>DDM</td>
<td>Dynamic Decision Making</td>
</tr>
<tr>
<td>EJB</td>
<td>Enterprise JavaBeans</td>
</tr>
<tr>
<td>ESS</td>
<td>Emergency Solution System</td>
</tr>
<tr>
<td>FAQ</td>
<td>Frequently Asked Question</td>
</tr>
<tr>
<td>GIS</td>
<td>Geographical Information System</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communications Technology</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol</td>
</tr>
<tr>
<td>IS</td>
<td>Information System</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>STIS</td>
<td>Smart Tourism Information System</td>
</tr>
<tr>
<td>TIS</td>
<td>Tourism Information System</td>
</tr>
<tr>
<td>TRcS</td>
<td>Tourism Recommendation System</td>
</tr>
<tr>
<td>TRsS</td>
<td>Tourism Reservation System</td>
</tr>
<tr>
<td>3D</td>
<td>Three-Dimension</td>
</tr>
<tr>
<td>2D</td>
<td>Two-Dimension</td>
</tr>
</tbody>
</table>
Abstract

As the rapid economic development of tourism industry in recent years, and gradually increasing user needs to tourism products and services, a variety of Tourism Information Systems (TISs) have been available. However, less attention is focused on these TISs from integration viewpoint, since currently most TISs are independent or isolated from the user’s perspective, tourists have to enter separately into different TISs in order to make a complete travel plan and get related tourism services. Advanced, Smart Tourism Information Systems (STISs) provide all tourism-related products and services in the unified system environment.

This constructive case study proposes a framework for STIS including theoretical analyses of the core elements and components of the systems, and provides several potential development approaches to and recognized challenges as developing STISs. Interview-based scenarios with potential users are used to demonstrate the needs of independent travellers and in showing for which purposes the different systems should be integrated. The results show that the developed framework of STIS is promising and can be useful when integrating the systems as offering one-stop services for independent tourists. More research with a wider empirical sample is still required to generalize the results and test the framework in practice.

Keywords
Information systems development, TIS, STIS, integrated system, constructive approach
Foreword

This Master’s thesis is focused in proposing a framework of Smart Tourism Information System. The initial charting of the subject for this thesis was started in October 2012. The subject took its final form in November 2012. The study and writing work started in December 2012, and continued from January to March. The thesis was finalised in April 2013.

First of all, I would like to thank my supervisor, University Lecturer Anna-Liisa Syrjänen, and opponent, Adjunct Professor Tero Vartiainen from the University of Oulu, for their guidance and feedback given during the thesis process. I also thank the interviewees for their participation in the empirical study. I want to thank all the friends I have made during my university studies in Oulu. And finally I want to thank my loving mother and father, my lovely girlfriend, thanks for your support and encouragement. You are very dear to me and this thesis is dedicated to you.

Oulu, 30th April, 2013

Xiaori Hu
# Contents

List of Abbreviations .............................................................................................................. 2
Abstract ........................................................................................................................................ 3
Foreword ........................................................................................................................................ 4
Contents ....................................................................................................................................... 5
1. Introduction ............................................................................................................................... 6
   1.1 Research goals, questions and methods ............................................................................ 6
   1.2 Structure of the thesis ....................................................................................................... 7
2. Analysing Integration Viewpoints for STIS ............................................................................... 8
   2.1 Defining smart tourist information systems .................................................................... 8
   2.2 Components of STIS ....................................................................................................... 10
   2.3 Development approaches to STIS .................................................................................. 12
   2.4 Challenges for future development of STIS ..................................................................... 18
   2.5 Summary ......................................................................................................................... 19
3. Framework for the Integrated STIS ......................................................................................... 20
   3.1 Identification of a tourist .................................................................................................. 20
   3.2 Social network ................................................................................................................ 21
   3.3 Self configuration ............................................................................................................. 22
   3.4 Value-added service ........................................................................................................ 23
   3.5 Simple interactive operation ........................................................................................... 26
   3.6 Dynamicity ...................................................................................................................... 27
   3.7 Summary ......................................................................................................................... 28
4. Constructive Case Study ............................................................................................................ 30
   4.1 Research process .............................................................................................................. 30
   4.2 Analysis of scenario with trip contexts ........................................................................... 36
   4.3 Analysis results for developing STIS framework ............................................................... 37
5. Discussion ................................................................................................................................. 47
   5.1 Evaluation of the STIS framework .................................................................................... 47
   5.2 Evaluation of the construction process ............................................................................. 47
   5.3 Future research ................................................................................................................ 49
6. Conclusions ............................................................................................................................... 50
Reference ....................................................................................................................................... 51
1. Introduction

According to the report of World Tourism Organization (UNWTO), international tourism receipts surpassed US $ 1 trillion in 2011, up from US $928 billion in 2010, receipts grew by 3.8%. Tourism industry as a third industry for a country, it can serve as the main source of generating revenue, offering more employment opportunities, and boosting the infrastructure development (Buhalis & Law, 2008). Thus most countries place the development of tourism industry into national economic development strategy. Along with the increased importance of tourism industry development for a country's economic development, the research concerning how to develop a new generation smart tourism information system becomes a hot research topic and also is worth to do in-depth research.

One relevant development trend for development of Smart Tourism Information System (STIS) should be how to take into account the tourists who want to search travel-related information and plan their trips by themselves instead of relying on the travel agency. It is considered that a number of independent travelers are increasing along with advance in Internet and travel planning systems (Morrison, Jing, O'Leary, & Lipping, 2001). However, the current tourism information systems (TISs) have many problems. One of the greatest challenges with current TISs is that they do not support the needs of independent travelers. Current existing TISs tend to require the tourists spend much time to search various tourism information due to the independence/isolation of TISs.

Although in practice there exists some e-Commerce websites, such as eDreams and Hotels.com providing reservation services for hotel or/and flight together, or people can select that option with the reservation they are interested in the first place, these services offered are just a small part in a whole trip. This may reduce the search cost, energy and time at least to some extent but cannot support comprehensively the needs of independent travels or tourists who look for special services. According to Büyüközkan and Ergün (2011) and Staab and others (2002), the advantage of using the more integrated, smart TIS would be that tourist can achieve one-stop services covering all travel-related things in whole trip without the annoyed process of searching tourism-related information in different e-tourism systems and get the intend results based on the reorganization of tourist identity, configuration of information filter and individual preferences, and recommendations from system and other tourists.

In addition, through the development history of software industry, the trend of shifting from standard products to customized products has been recognized and considered being a common strategy also in development of in-house Information Systems (ISs) (Friedman & Cornford, 1989). On the other hand, in the field of tourism industry that focuses on mass tourists, there has been noticed the importance of personalized services (Campbell, Maglio & Davis, 2011).

1.1 Research goals, questions and methods

The goals of this paper are to explore the field of Information Systems, including tourism and consumer information systems, for STIS which can provide ideas for how to
construct such a system and suggestions which elements and components are needed when developing STIS with one-stop services offered to independent tourists.

In this paper, the research question required to answer is: what are the core elements for the development of STIS and the components of STIS? The questions can be divided into several sub-questions: how an STIS can be defined, what are the components of STIS, which kinds of approaches can be applied to STIS development, and what are the main challenges for development of STIS.

My research approach is constructive and is adopted by following ideas of Tuunanen and others (2010) who have represented a case study based research setup and the conceptual framework for IS development. The research process in this paper involves

- Recognize the boundary of STIS, and define an STIS with its end-users.
- Outline the architecture and characteristics of STIS based on the theoretical review of TISs.
- Collect end-user requirements in real life settings by using interviews and creating scenarios as representing the viewpoint of potential STIS uses.
- Validate proposed STIS framework through analyzing scenarios and evaluating existing tools used by end-user both based on qualitative content analysis method.

1.2 Structure of the thesis

This paper describes the framework of STIS in two dimensions: core elements and components. Core elements actually are the principles of developing STIS while the components are the architecture of STIS. The whole structure of this paper is presented:

Section 1 introduces the background of current TISs, the motivation of writing this paper, research -goals, -questions and –method.

Section 2 presents STIS from the perspective of components and explores in detail the questions in the order given in the previous section.

Section 3 proposes six core elements of STIS, they are also the development principles for STIS.

Section 4 validate the framework of STIS by analyzing scenarios collected and evaluating existing tools mentioned by end-user in scenarios.

Finally, conclusions and future work are given in section 5.
2. Analysing Integration Viewpoints for STIS

This section will present some existing researches in the field of TIS. However, less attention is focused on these TISs from the perspective of integration viewpoint. Currently most TISs are independent or isolated from the user’s perspective. In order to make a complete travel plan which includes several sectors such as destination decision-making, transport and accommodation etc, the tourists should separately finish each sector in various TISs. STIS, an intelligent tourism information system providing tourists services in a unified environment by integrating various TISs, assists tourists to accomplish all travel-related things. This section also elaborates the demarcation of independent tourist, characteristics in STIS, essential components and potential development approaches of STIS.

2.1 Defining smart tourist information systems

Traditionally an information system is seen as consisting of data structures, tools for inputting and processing data, and organizational arrangements (Hirschheim, Klein & Lyytinen, 1995) including more or less informal user groups, from Information Technology (IT) departments to systems management and individual end users. In the context of TISs, one group of end users is independent tourists, who on the other hand can be seen as the major target group for STIS.

*Independent tourist*

In general, *tourism* can be classified into mass tourism and alternative tourism from the perspective of tourism products (Christou, 2012). Package tour, a common form of mass tourism, refers to transport, accommodation and other related tourism services provided by tour operators. Some travel agents, employees of tour operators, will make the fixed sightseeing route and timetable of visiting tourism attraction, usually these kinds of arrangements are not flexible for the independent tourists who are the major target customers of STIS and want to participate in deciding and making most things related to tourism independently. It should be noted that tourist mentioned in this paper is indicated to independent tourist if there is no special explanation in this paper.

*Definition*

According to Morrison and others (2001), a STIS is a subset of Information Systems; it primarily is the combination of people’s activity and information technology in the field of tourism industry. This paper will describe the STIS in two dimensions: core elements of STIS development and components of STIS. In this paper core elements, characteristics and principles of developing STIS are treated as synonyms, also components, sub-systems and composition of STIS are treated as synonyms.

From the perspective of system’s characteristics, the STIS can be defined as follows:
• STIS, an intelligent tourism information system, can recognize the tourist’s identification via collecting the user’s basic data regarding profile, preference, and other related personal details (Moore, Smallman, Wilson and Simmons, 2012; Staab et al., 2002).

• It is a social network information system where the tourists can interact with tour information providers and other tourists to get more useful information (Kraut, Maher, Olson, Malone, Pirolli & Thomas, 2010; Tuunanen, Myers & Cassab, 2010).

• It allows tourist self-configuration for individual requirements and information filters (Newman et al., 2002).

• Value-added services such as recommendation services based on tourist’s identification and navigation based on GIS are available (Nysveen & Lexhagen, 2001).

• All interactive operations with terminal devices of STIS and human are required to be simple and easy-understand by different-levels tourists (Malaka & Zipf, 2000).

• It can respond to dynamic user’s requirement (Daramola, 2009).

From the perspective of system structure, STIS is an integrated system; it includes several components or sub-systems such as Destination Decision Making System (DDMS), Emergency Solution System (ESS), Geographic Information System (GIS), Tourism Planning System (TPS), Tourism Recommendation System (TRcS), Tourism Reservation System (TRsS). These components are the architecture of STIS, and the core elements of the framework of STIS will be applied into the development of components. In addition, the component of ESS is added based on the findings after analyzing scenarios of independent tourists and some related literatures concerning emergency service systems. The scenarios will be elaborated in section 4. (Camacho, Borracho & Molina, 2001; Giles, 2003; Hanlan, Fuller & Wilde, 2005; Hinze & Junmanee, 2005; Larson, 1975; Moore et al., 2012; Morrison et al., 2001; Nair & Katiyar, 2011; Schulz, 1996.)

Based on above articles, Figure 1 represents the idea of integrated STIS, and more detailed description of components will be given later.
2.2 Components of STIS

Based on the definition and the integrated structure given earlier, individual components of STIS can be classified into:

- Destination Decision Making System (DDMS)
- Emergency Solution System (EES)
- Geographical Information System (GIS)
- Tourism Planning System (TPS)
- Tourism Recommendation System (TRcS)
- Tourism Reservation System (TRsS)

They can be seen as cooperating with each other as the travel agencies are offering services for independent tourists and functions based on tourist’s current stages in whole trip. (Camacho et al., 2001; Giles, 2003; Hanlan et al., 2005; Hinze & Junmanee, 2005; Larson, 1975; Moore et al., 2012; Morrison et al., 2001; Nair & Katiyar, 2011; Schulz, 1996.)

Destination Decision Making System (DDMS) refers to the system which primarily is used to help tourists make the decision in terms of destination, places of interest, when tourist has his or her own idea concerning where to go, he/she can ignore this step of setting destination and directly go to the step of reserving online in the whole process of making travel plan (Fesenmaier, Werthner & Wober, 2003, p. 19; Hanlan et al., 2005). Moore et al. (2012) indicated current tourism destination-decision made based on the naturalistic decision-making process. It emphasizes to understand how person make a dynamic and complex decision when confronting a task in the naturalistic settings, and also addresses that in practice tourists seldom make a fixed decision before trip and they
may adjust their plan or change decision during trip. It should be noted that the DDMS, a component of STIS, is also based on the naturalistic decision-making process.

**Emergency Solution System (ESS)** provides several solutions to possible and predictable emergency occurring in whole trip, and it mainly functions in the stages of before- and during- trip (Larson, 1975). For example, a tourist arranges all things related to tourism well before trip, but he is informed and required to cancel his trip due to emergency in the business, then the tourist has no choice but to give up the trip, if he has booked several tickets such as airline, hotel, museum etc, a series of work regarding canceling the reservation should be done, it is usually for a careless tourist to forget cancel some reservations, which finally lead to loss in the finance. In this case, ESS can remind tourists the reservations which they should cancel in time in order to refund, it helps tourist reduce the loss to some extents at least.

**Geographic information system (GIS)** is a computer-based tool designed to capture, store, operate, manage, analyze, and present all sorts of geographic data, also is a valuable tool especially used to local and regional planning activities (Giles, 2003; Nair & Katiyar, 2011). In the STIS, GIS will serve TPS, TRsS and TRcS, for example, tourist use the TPS make travel plans, when he/she reserves hotel whose information of location and surroundings is available and is presented to tourist in the way of 3D view, similar with the Google street view. Besides, in the destination, he/she can visit the tourism attractions in the order of sightseeing route with the help of GIS navigation.

**Tourism Planning System (TPS)** is one component of STIS, it assists tourist to make a complete travel plan, especially for beginners without any travel experiences. TPS can act as a guide to help tourists to make their individual plan step by step. The general process of making travel plan can be divided into following several steps, first of all, the tourist should decide where to travel, namely make sure the destination; then determine how to reach the destination and return home, choose transport type (e.g., airline, train, bus, car, cruises) based on budget; after finishing pervious step, the tourist have to solve the problem where to stay overnight during trip, that is, accommodation; the last step but also the most important step is to design the sightseeing route and distribute the time slots based on individual favorites or recommendations. Besides, the TPS can also help to check whether the travel plan is integrity or not, if not, TPS will remind the tourist the missing segments, for example, if the careless tourist forget to book the return airline tickets or tickets of some museums where the online reservation is mandatory and also he/she plans to go, then a prompt will be arisen. In this sense, TPS can make the plan more perfect to some extents at least. (Camacho et al., 2001.)

**Tourism Recommendation System (TRcS)** refers to recommendation system whose fundamental data mainly comes from tourism information provider/organization, travel agencies and tourists’ feedback/comments and serves tourists in the whole trip. TRcS primarily supports DDMS, TRsS and TPS by providing sufficient tourism information based on tourist’s current stage of trip, current location or individual favorites. (Camacho et al., 2001; Hinze & Junmanee, 2005.)

**Tourism Reservation System (TRsS)** is used to help tourists make the online reservation in terms of tickets (transport type to destination), hotel and some places of interest which require tourist do so because of limitation of open hours or visit amount. With the support of TRcS, the tourists can quickly choose the suitable services based on their individual requirements such as price, time, location, environment, value-added service, all these output information of TRsS will be stored and used in the other components based on the
actual needs, for example, the hotel information of online reservation will be applied in TPS to help form the travel plan. (Schulz, 1996.)

2.3 Development approaches to STIS

Several development approaches to STIS are presented based on the related literature, and they involve customer-centered approach, social network approach, software engineering approach and component-based approach (Daramola, 2009; Iivari and Iivari, 2011; Kopetz and Suri, 2003; Kraut et al., 2010; Newman & Landay, 2000; Newman et al., 2002; Papatsoutsos, 2001; Zarikas, Papatzanis & Stephanidis, 2001). According to aforementioned articles, custom-centered approach focuses on the user involvement, and the method of scenario-based representation that can be used for gathering and analyzing the STIS user’s requirements. Social network approach emphasizes the social participation and interaction between tourists in social network, and it may be applied to extract valuable comments from social network of tourists and assist tourists to interact with others. Software engineering approach is typically used in the implementation of computer systems involving to consider how an STIS can be designed so that it is doable in practice. Component-based approach highlights the development of architecture of STIS. In the whole development of STIS, several development approaches will be partly introduced based on different advantages themselves.

Customer-centered approach

According to Iivari and Iivari (2011), four common user-centered system development methods consist: goal directed interaction design, contextual design, scenario-based design and human-centered systems development life cycle. The scenario-based design method includes six phases: requirements analysis, activity design, information design, interaction design, prototyping, usability evaluation and documentation design, and it specially focuses on the empirical user profiles and strongly suggests the user involvement which can facilitate developers and users mutual learning and growing, but personalization is recognized as an issue for scenario-based method.

Scenario is a story about person carrying out an activity. Problem scenario is a story focuses on the problem domain, and it usually is used to describe important characteristics of users, significant task, tools frequently used and context of use. Design scenario focuses on description of new vision, and it can be divided into activity-, information-, and interactive-design scenario. Activity design scenario is narrative of critical services which users want to get from the system; information design scenario elaborates activity or information provided; interactive design scenario describes human-computer interaction in detail. (Iivari & Iivari, 2011; Rosson & Carroll, 2002, p.2.)

In order to demonstrate the viewpoint of independent tourists, Figure 3 shows the trip process by using a scenario combine based on both real cases and fictive but possible, naturalistic real-life situations. Thus, as the purpose is to develop and understand the actual needs of independent tourists, and more detailed description of Figure 3 and scenario are available in section 4.
**Navigation approach**

According to Newman and Landay (2000) navigation design refers to the design of method which is used to find certain way or process around information structure, while information design means to identify the problem regarding structuring information into a coherent whole. Navigation design and information design outlines information architecture. Newman et al. (2002) proposed an idea of supporting end-user configuration in ubiquitous computing environment. Allowing end-users configuration based on their own needs can make the configuration more customized, but also is a challenge in ubiquitous computing environment because of high-level dynamic objects of users’ control. For instance, the component of information filtering cannot update itself contextual information and its organization also could not be responsive to user’s current context. In this paper, the navigation approach used in development of STIS will navigate independent tourist to prepare the tourism-related things, and allow they configure information filter based on their own preferences such as location, duration of trip and price priority, to get the more accurate results required. Generally in different phases of trip, a tourist will use different components or sub-systems which are in unified technology environment. Figure 2 shows an example of how this activity happens in practice, and will be described in detail as follows:

- **Navigation before a trip**

  Before a trip the independent tourist should make sure the destination where he wants to go, also he can seek help from DDMS if he has no idea where to spend his trip, then he needs decide the duration of trip, choose the transport how to reach destination and return home, and reserve tickets of corresponding transport online. If the destination is composed of several cities, he also should make the travel route, namely the sequence of visiting cities. When he visits a city, also the sightseeing route should be considered in order to make a complete travel plan. Finally he should book the hotels. After above several steps, the tourist basically accomplishes the essential things which should be prepared in whole trip. All aforementioned information related to travel plan are presented in the order of timeline.

- **Navigation during a trip**

  During the trip, the independent tourist can use the GIS integrated in STIS to navigate, and get more information concerning value-added or special services recommended by TRcS. The main advantages of using the GIS integrated in STIS are the followings:

  1) All information made before the trip is stored in the STIS, thus they can be easily reused in the GIS and independent tourists can skip the operation of repeatedly input geographical location information.

  2) It enables the user to change easily the language marked in the map and no longer to worry about the language barrier in the situation of searching the same place in two different language version maps.

- **Navigation after a trip**

  After the trip, some independent tourists would like to post their photos taken during the trip and their comments or share stories occur in the trip. At the same time, these experiences shared, comments or stories are useful for other tourists who are planning to go or on the way to the same destination. It is indeed a good way to let the potential
customer have direct perceived to the tourism attraction, which is much better and persuasive than simply push recommendation services with functional terms (Staab et al., 2002). The comments to tourism products and error corrections of geographical information due to change in real world require social participation, especially the contributions from users (Kraut et al., 2010).

**Social network approach**

According to Kraut et al. (2010) Technology-Mediated Social-Participation Theory can be applied in the field where systems development needs a vast user base to collaborate as solving problems. Current social system and network technology allows Internet users to communicate, collaborate, and interact at anytime, anyplace. The form of social interaction from online to offline makes it possible to adequately utilize social capital which includes benefit and common ground that influence and improve social efficiency. Tuunanen et al. (2010) have indicated that customers tend to use consume information systems within social networks rather than the isolated systems and without interacting with others, and developers hardly cannot foresee all possible needs of users when implementing systems.

According to Barcelona Field Study Centre (BFSC) independent tourists can be classified into various types based on location preference, activity, duration and purpose etc, it is difficult to completely know their needs in such big customer population and also to offer enough personalized services to satisfy all tourists’ demand. In this sense, the social participation or social network method is applicable to STIS development to some extent at least, since it is better to allow one tourist to seek help from other tourists than to require developers to consider all possible requirements before developing STIS.

In the context of STIS, there are two main user groups: tourists and information providers. Figure 2 shows that tourist can search the tourism information provided by information providers and also interact with other tourists. TReS pushes the recommendations to tourists by extracting information with similar session in social network of tourists (Staab et al., 2002). This means that TReS will sift the cases and comments of other tourists based on the similar situation, tastes with target customer.
Figure 2. A STIS work diagram comprising the whole trip (based on the systems and viewpoints adapted as following the authors Brenner & Elias, 2003; Chen and Shibasaki, 1999; Hanlan et al., 2005; Kuhlthau, 1991; Newman et al., 2002; Tuunanen et al., 2010).
Software engineering approach

Traditional software engineering and web engineering approaches cannot satisfy modern tourist’s fast changing demands and fit dynamic business environment, hence it is essential to find better development approaches that would sufficiently enable the ability of TIS to adapt to more complex functional requirements (Daramola, 2010). Daramola (2010) indicated the expected next generation of TIS should enable semantics-based information processing and capability of dealing with natural language, facilitate the information of inner organization exchange in a seamless way, and rapidly respond to dynamic user requirements.

The architecture of the PALIO system, it means the framework of personalized access to local Information and services for tourists, and focuses on the support for extensive adaptation. The framework provides a location-aware information system for tourists, and also is able to deliver proper information to a wide range of devices. It means the tourism information will be delivered to different terminal devices in a self-adaptation way. Due to open and expandable architecture, PALIO system is capable of aggregating a variety of pre-existing or upcoming services and retrieve information from a collection of different databases. (Zarikas et al., 2001.)

Product Line for Ontology-based Tourism Recommendation (PLONTOREC), a special approach focusing on the creation of variants of TIS products within a product line. To the issues of TIS development such as dynamic user’s requirement management, this approach tackles them in an engineering way which blends the concepts of software product line engineering and ontology engineering. The approach is a systematic process model based on product line management, ontology engineering, domain engineering, and application engineering and it allows to define common TIS product requirements, plan the product variants of commonalities and differences of content in TIS, and create variant TIS products based on a construction specification. (Daramola, 2009.)

Component-based approach

According to Szyperski (1998, p. 3, 475 & 548) component is an executable unit which is allowed to be deployed and composed during the system run-time. On the other hand, according to Kopetz and Suri (2003) component can be seen as a sub-contained sub-system, and the component-based software development method can be seen as applicable for a larger and aggregate system. The expected component is functional cohesion and autonomy which can be flexibly aggregated and also limit complexity on the level of system, and it can be reused after one-time development, or allow end-user configuration to reuse.

The interactions between component and its environment rely on the interface, the interface can be distinguished at the level of function: 1) service providing Linking interface, 2) service requesting linking interface, 3) configuration planning interface, 4) diagnostic and management interface. Service providing interface is the fundamental interface which receives the request from service requesting linking interface. Service requesting linking interface receive requests from users. Configuration planning interface used to manage configuration of global resource. Diagnostic and management interface provide the access to diagnose and monitor the internals of component. Based on the relationship between components and natural environment, the component can be divided into open component and closed component. Open component means that it can own
several service providing linking interfaces to outside, but closed component only has single service providing linking interface to interact with outside. (Kopetz & Suri, 2003.)

According to Papatsoutsos (2001) and Owaied, Farhan, Al-Hawamdeh and Al-Okialy (2011) who all have shown similar viewpoints, different components combined with respective interfaces based on unified system environment to make connection between components seamless. For instance, COM and EJB implement the communication between objects and components by providing proper and standardized interfaces. Crnkovic (2005) have indicated that the components can be classified to software components and system components. A system component can be viewed as an independent subsystem, and various system components compose a whole integrated system. Software components refer to the meta-component in given software, and it can be presented in the form of software package, model. Based on Crnkovic’s viewpoint to component, the components of STIS are system components while the software component means the specific component which encapsulates a set of functions or data. For instance, TPS -a system component- needs to make the itinerary also to calculate budget of whole trip, then a budget calculation component -required to complete the work of budget computation- is software component.

The common system development approaches involves a waterfall model, where prototyping, incremental spirals, rapid application development (RAD), object-oriented development etc (Centers for Medicare & Medicaid Service, 2008) are usually involved. In this work, the component-based approach is suggested to be used with STISs because it uses components as the fundamental unit blocks, giving thus support for the integration perspective. In addition, it can be seen as useful because it inherits the successful IS development concept of existing paradigms, such as object-oriented design, but on the other side can be seen as capable of overcoming their inherent weaknesses. The advantages of using component-based approach to STISs are

- Divide whole system development task into several components, allow different developers focus on respective component development, and leave the system assembly task to other developers.

- Allow the companies dynamically change their business strategy or process according to actual demands by replacing old component with new one. (Papatsoutsos, 2001.)

To enjoy the advantage of component-based approach, at the same time the disadvantages and risk to Component-Based Development (CBD) should be recognized:

- Time and effort required for the development of component, it means the time and effort cost in developing reusable unit for a specific function is much more than only develop the unit.

- Unclear or unpredictable requirements, since the component are intended to be reuse in different application in the future, thus some of requirement can be predicted.

- Conflict between reusability and usability, it refers to reusable component should be general for various application, but it may too general to complete a specific purpose.
• Reliability and sensitivity to change, it means some concealed characteristics for application-level developer, in this case, some changes introduced may cause the system failure. (Crnkovic, 2003.)

In addition, the CBD is also different from traditional software development, and it focuses on the identification of reusable entities and the rations between them. The general process of CBD is 1) find candidate components can be used in the system, 2) select the proper component or create a new one, 3) adapt selected component to fit specific requirements, 4) test the compatibility and usability of component, 5) deploy components, 6) and replace earlier with later version component. (Crnkovic, 2003.)

2.4 Challenges for future development of STIS

The challenges of developing and implementing STIS can be summarized: components integration in unified system environment, semantic-based information processing, respond to dynamic user’s requirement, enable full autonomy of the respective participants, self-adaptation information to various devices including mobile one. (Ananthapadmanaban, Srimathi & Srivatsa, 2012; Crnkovi, 2003; Daramola, 2009; Hinze and Buchanan, 2005; Moore et al., 2012; Pröll & Retschitzegger, 2000; Staab et al., 2002; Zarikas et al., 2001)

Since STIS is an aggregated system, a proper architecture of CBD is required. The architecture emphasizes component aspect of software development and how these components are integrated in the unified system environment. (Crnkovi, 2003.)

In practices, most general search engines retrieve the information by predefined keywords, only when users input the same or similar keywords and they can get the intended information, which obviously impacts the accuracy of retrieving information based on the customer’s own thinking habit of retrieving and current situation/condition. For example, a passenger want to refund an airline ticket but do not know whether the airline company’s clauses of refunding are applicable his condition or not, and it is also difficult for the passenger to describe the conditions and capture the predefined keywords which is the index of intended information. In this case, the application of a semantic-based information processing model makes it possible to offer better services for independent tourists, for instance, to retrieving tourism information in a more accurate way based on individual thinking habits. However, it is also a challenge to implement semantically appropriate user-driven solutions in STISs. (Daramola, 2009.)

Hence, STIS has several limitations. One of them is that a tourist is supposed to make a fixed travel plan before a trip. In practice, it may happen that the tourist want to change his/her sightseeing route in the situation where there are not too strict limitations regarding open time for some tourism attractions, but it is still not flexible enough when tourist intend to change the travel route during trip. Thus the function of dynamic decision making in destination becomes more important in order to satisfy the requirements for changing needs and frequently changeable preferences (Daramola, 2009; Moore et al., 2012). Besides, the challenges of enabling the autonomy of participants and the mobile communication in STIS also cannot be ignored (Staab et al., 2002).

Self-adaptation information was delivered based on user and context characteristics in a proper means (Zarikas et al., 2001). According to Hinze and Buchanan (2005), they indicated the notion of context should be open and extensible when the system support context adaptation or context awareness in various application environments, and
normally the changes in terms of user’s devices and context of use is not directly predictable variables.

2.5 Summary

In this section summary, the demarcation of needs of independent tourists will be gathered and STIS illustrated from the perspectives of core elements and components discussed earlier, namely the principles of developing STIS and the architecture of STIS. In addition, several potential development approaches will be proposed and several challenges that may be confronted in the process of developing STIS are recognized.

For the development approaches to STIS, the component-based development approach is proposed, and several other development approaches can be combined with component-based development approach in the integrated development process for STIS. For instance, the scenario-based method, one of the user-centered approaches, can be used to collect user requirement for STIS. Social network approach can be applied to the part of STIS where the social participation and interaction of tourists in social network are required. Navigation approach emphasizes to assist tourists to make a complete travel plan, and it can provide different solutions to different-levels tourists. According to development approaches of STIS mentioned earlier, the summarization of these approaches is available in Table 1.

Table 1. Potential development approaches to STIS.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Viewpoint</th>
<th>Use purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>User-centered</td>
<td>It focuses on the empirical user profiles and strongly suggests the user involvement</td>
<td>Collect end-user’s requirement</td>
</tr>
<tr>
<td>Navigation</td>
<td>It focuses on user-driven navigation between and within several systems</td>
<td>Support for self configuration needs of inexperienced users</td>
</tr>
<tr>
<td>Social network</td>
<td>It emphasizes social participation and interactivity in social network based on ICT</td>
<td>Objectives for user requirement</td>
</tr>
<tr>
<td>Software engineering</td>
<td>It concentrates on specific feasible solutions for the implementation of systems</td>
<td>Implement STIS in an engineering way</td>
</tr>
<tr>
<td>Component-based</td>
<td>It focuses on implementing the system piece by piece</td>
<td>Special suitable to aggregated system</td>
</tr>
</tbody>
</table>
3. Framework for the Integrated STIS

This section primarily illustrates the core elements in the framework for integrated Smart Tourism information system (STIS). The core elements are composed of the following:

1. Identification of tourist
2. Social network
3. Self configuration
4. Value-added services
5. Simple interactive operations
6. Dynamicity.

The first five elements are achieved by reviewing literatures related to research on tourism industry while the last element, namely dynamicity, is proposed to be included in the framework after analyzing the scenarios collected from narratives of independent tourists. All these core elements can also be treated as the principles of developing STIS in the real life context, and the core elements of varying quantity will be recruited in any components or sub-systems mentioned in section 2. (Brenner & Elias, 2003; Camacho et al., 2001; Cavada, Mirzadeh, Ricci & Venturini, 2003; Chen and Shibasaki, 1999; Ho, Lin and Chen, 2012; Kraut et al., 2010; Kuhlthau, 1991; Li and Kurt, 2000; Moore et al., 2012; Newman et al., 2002, Nysveen & Lexhagen, 2001; Schafer, Konstan and Riedl, 2001; Staab et al., 2002; Tuunanen et al., 2010; Werthner & Klein, 1999, p.10.)

3.1 Identification of a tourist

The content of identification of a tourist primarily includes:

1. Tourist categories
2. Trip types
3. Individual preferences of tourists.

The identifications of independent tourists related to the itinerary type, transport type, length of trip, accommodation type, travel group composition etc are useful and valuable data for tourism recommendation system and destination decision making system in STIS. In brief, the identification of independent tourists provides the essential data for the TRcS and DDMS. (Moore et al., 2012; Staab et al., 2002.)

According to the tourist classification (BFSC), in general, the categories of tourist are composed of:

- Tourism product, e.g., mass tourist and alternative tourist.
• Nature of the activity, e.g., active and passive.

• Location preference, e.g., rural, city, mountains, lake and coastal.

• Duration of trip and distant traveled, e.g., day trip for local-level, weekend break for national-level and annual holiday for international-level.

• Purpose, e.g., business travel and pleasure travel.

In this paper, the main end-user of STIS is the independent tourist mentioned in section 2. Mass tourist emphasizes large tourist groups, fixed programs directed by tour operators and travel agencies, while alternative tourist focuses on small tourist groups or singles and the tourist program directed by tourists themselves (Christou, 2012). Although the distinction between alternative tourist and independent tourist is ambiguous, in the categories of tourist based on the tourism product, the mass tourist and alternative tourist are ignored in this paper. And the rest categories of tourist mentioned above are also applicable for independent tourist.

According to Moore et al. (2012) the types of trip identified are: sightseeing, visiting friends and family, holiday/family, working holiday and ‘round-the-world’. It was possible for more than one of these categories of trip type to apply to each travel group. The Type of trip impacted on a number of other characteristics of travel including the length of stay, type of transport used and itinerary taken.

In order to better understand and satisfy the consumer's actual requirements and their preferences, the STIS should collect the customer's travel-related data as possible. Normally the whole process of collecting customer's data, especially for the consumption data before- and during- trip, can be identified to three stages: before trip, during trip or on site, after trip (Staab et al., 2002; Werthner, 2003). In the first stage, the data collected mainly includes profile of tourist such as age, gender and hobbies, historical data concerning general duration of trip and reservation information such as accommodation type and transport type; in the second stage, namely during trip, tourists tend to choose the local popular restaurants, attractions or rent a car/bicycle, so collecting such data is the aim of this stage; the last stage focuses on the feedback/comments of tourist, which can give insight to tourist personal habit and preference in order to provide more accurate recommendation services in the future.

### 3.2 Social network

The concept of social network proposed in STIS is based on two concerns:

• The needs of users who want to use the system allowing they interact with others.

• The data of feedbacks/comments of tourists requires the collaboration and contribution of vast groups of users not only in the STIS but also in other systems.

In brief, the social participation from both STIS and other social network system is required. (Kraut et al., 2010; Tuunanen et al., 2010.)
Tuunanen and others (2010) indicated the system users tend to use the system which includes social network and can allow they interactive with other users. Most tourists are willing to share their mood and experience with their friends or other tourists during trip or after trip, and these experience or comments -related to some products or services which are not easily described in functional terms or expressed as monetary values- are useful for other tourist to some extents (Staab et al., 2002). The scope of social network is not only limited to the tourist groups in STIS, the users in other social network system are also included, it means the users in STIS can also interact with other users in other social network systems. For example, the users in STIS write blogs to describe their experiences of visiting cities, and they are allowed to disseminate the blogs into their other social network systems such as Facebook, then their friends of Facebook can also see their experiences shared and do not need have an account in STIS.

According to Kraut et al. (2010) social participation is applicable in the system which requires a large and diverse user base to provide information, insight and tackle problems. Social participation creates advantages for individuals and groups, since it can facilitate they create the massive intellectual products and the new technology makes it possible for they to collaborate in anytime, anyplace. For instance, Wikipedia is the intellectual product created based on social participation. In addition, a deep scientific understand of current and emerging TISs and tourists behavior around these systems is the essential pre-condition of designing a powerful architectures for social participation. Also it is important to develop relevant theories supporting the development of effective and positive software application in the field of tourism industry.

### 3.3 Self configuration

In STIS, self configuration mainly involves:

- Allow end-user to configure for the personalized requirements or value-added services.
- Configure for filters of searching related tourism information such as hotels and airline tickets (Newman et al., 2002).

The general tourism information search process (Kuhlthau, 1991) can be divided into several stages:

- Users use the search engines such as Google, Bing to get generic information, in this stage, they begin to recognize and identify the information searched.
- Then they use keywords to get related information which is closer to what the users want, and gradually try to use special website for tourism information. For instance, eDreams is e-Commerce website providing reservation services of hotel and flight, and qiongyou, a third-part provider of tourism information, is popular among Chinese students who studies in abroad, the scenario regarding using it to make a simple travel plan and book hotel etc will be mentioned later. In this stage, the users start to learn how to explore related information and formulate the ideology of accurately retrieve the information desired.
- Finally they compare the results retrieved and focus on the information which is actual need for themselves. In last stage, users will gather and compare the results in order to get the optimal result or accurate information.
The scene is common to be seen in real life: in order to get the same-level service at lower price, some tourists spend much time to search tourism information in various TISs, open many websites and compare the differences among various solutions. Ho and others (2012) mentioned the comparable strategy as one of online search strategy was frequently used in practice when tourists search tourism information, thus it is better to rank tourism information based on the configuration of end-user’s requirement. For example, listing out the top 10 popular hotels every month/season after the TIS receives the requirements of searching hotel, if tourist cares more about other conditions such as locations, internet service, in-house environment, then TIS should allow end-users to configure their own requirements or value-added services. In this senses, it can make the process of searching tourism information more efficient by allowing end-user configuration.

Newman et al. (2002) also agreed on the viewpoint of making the configuration for end-user more customized, and they indicted it was also a challenge to implement one-time end-user configuration reused in ubiquitous TISs environment, one of possible solutions for this problem is that all TISs are integrated in unified TIS environment.

3.4 Value-added service

Value-added service refers to the extra services - compared with the standard service, which can support consumer decision making and better fit the tourist’s individual actual requirements such as limited budget, length of trip etc (Nysveen & Lexhagen, 2001). Except the common value-added services such as search engine, maps, FAQ, and feedback processing etc, the STIS should also contains the value-added services:

- Itinerary making (Camacho et al., 2001; Li and Kurt, 2000).
- Budget calculation (Nysveen & Lexhagen, 2001).
- Recommendation service (Daramola, 2009; Staab et al. 2001).
- 3D-view navigation (Brenner & Elias, 2003; Chen & Shibasaki, 1999; Malaka & Zipf, 2000).

Itinerary making is used to arrange the all travel-related things and record them in the format of calendar, similar with the Google calendar. The travel-related things involve transport between home and destination (home — airport/wharf/train station (home context) — airport/wharf/train station (destination context) — hotel), accommodation in the destination, restaurants, attractions, sightseeing path in destination etc. (Camacho et al., 2001.)

According to Li and Kurt (2000) the basic content of itinerary covers a wide range of categories such as travel routes, sightseeing routes, schedules, fares etc. these information are employed to support the itinerary making, and make the optimal solution/decisions based on composite conditions such as goal of trip, constraints and tourist’s preferences.

Itinerary making is a process of making decision with multiple objectives, due to its nature of multi-objective, conflicts in stratifying multiply criteria and uncertainty, it is possible to get a set of potential solutions rather than a single optimal solution, thus tourist should make some compromises based on requirements of priority in order to select the best and suitable solution. For example, a tourist plan to travel from Helsinki to Pairs by airplane, he/she uses the schedule making tool to set the start place and destination, also
the departure and return date, the recommendation service will provide the flights info based on his/her preference (e.g. Low price airline ticket), he/her just select the flight and these data will be stored in a data set which also includes the hotel, transport between hotel to airport in destination etc. After the tourist finish all travel-related things, the itinerary making tool will generate a form of itinerary based on the data set. In addition, this tool can check the time conflict which is easy ignored by tourist and also difficult to find in a complex travel schedule without some applications help. (Li & Kurt, 2000.)

Budget calculation, a decision-making support tool, should combine the schedule making to use, it is used to calculate the fare on the transport between home and destination, accommodation in destination, attractions etc to get a preliminary budget. Some travel agencies tailor the trip based on the tourist's budget to better satisfy customer's actual requirement and some employees in the travel agency has the travel experience to the destination where tourists want to visit. Comparing with the package tour sold by tour operator, the budget calculation tool maybe not like tour operator who can provide a fixed fare before trip, but it has already calculated the most part fare of trip in the situation of ignoring invisible fare or uncertainty cost such as purchasing in shopping mall of destination, thus the actual cost in the trip will be close to the result of budget calculation when tourist don not spend much money on luxury. In this sense, it helps less-experiences tourists to get a basic knowledge concerning tourism-fare before trip to some extents at least and encourages them pay an action to their travel plan. (Nysveen & Lexhagen, 2001.)

Recommendation service suggests the services based on the tourist's preferences, objective requirements and suggestions/feedback collected from other tourists in social network are provided by STIS. The reasons why need recommendation services in STIS are:

1. Intangible nature of tourism product
2. And can also get the objective evaluations before practice experience. (Daramola, 2009).

The common definition of Recommendation system is the application extensively used in e-Commerce sites to suggest products and information services etc to assist tourist's decision-making process (Schafer et al., 2001). And Staab et al. (2001) indicated that the recommendation system should sift the related products and services experienced by other users who have the similar behavior with the target user and show their reviews or comments to the target user.

According to Staab et al. (2002) traditional recommendation process refers to the linear process of moving from needs to products explanations, and the aim of recommendation system is struggle to catch user needs without too much user-input even no user-input by recognizing user's identity. For example, Amazon.com, it can directly recognize the user's identity and recommend the books that customers interested in prior to any user-input. Besides, they indicated that the easy-understanding or suitable language for different-levels tourists is also important in the recommendation system.

In the study of Moore et al. (2012) related to dynamic decision-making in destination, they indicated that tourists are tend to seek out personal advices from the immediately available person such as other tourists, local residents, accommodation personnel, front-line staff at certain website of travel agency. While the aim of seeking out these advices involves two concerns:
To be informed about activities or accommodation.

To ensure a premade decision was indeed good by receiving objective suggestion or comments.

Recommendation system should also support multi-decision styles (Fesenmaier, Ricci, Schaumlechner, Wöber & Zanella, 2003), and it means the recommendation system should have different solutions for different-levels tourists. For example, DieToRecs recommender, a case-based travel planning system, respectively provides a solution for experienced tourists, common tourists and inexperienced tourists:

- Iterative single-item selection refers to allow experienced tourism to select any products and services that he or she likes, and efficiently navigate he or she complete this process of decision-making for tourism products or services.

- Complete travel selection means that the recommendation system recognize the tourist's identity, and provide available bundles items based on the same products and services accepted by other tourists who has the similar travel-behavior and preferences. This solution focuses on the group of tourists who have several times trip experiences but not enough to be experienced traveler.

- Inspiration-driven selection focuses on the green-hand or inexperienced travelers who tend to accept a complete trip plan in a way of simple user interface and simple interactive operation. (Staab et al., 2002).

The challenge of pushing recommendations based on tourist's preferences, since these preferences are not easily translated into characteristics of product, and ultimately into recommendations (Cavada et al., 2003). Besides, the definition of tourism products has not been standardized due to their complex structure (Werthner & Klein, 1999, p.10).

In addition, the suggestions/feedback from other tourists are tend to be accepted by tourists easier than the suggestions directly comes from tour operators, since they believe other tourists' feedback is more objective and valuable for their destination decision making. For the same reason, another practical case can also support this viewpoint: most Chinese shopping on taobao.com (a e-Commerce website for C2C and B2C), they tend to choose the product with many other customer's comments, the more comments for a product, the more objective information of product can be presented to customers. In this case, recommendation service obviously needs the cooperation of social network.

**3D-view navigation** refers to tourist can get the 3D-view navigation service based on GIS, and the navigation interface is similar with the 3D street view of Google. With the rapid development in the field of GIS, the GIS has shifted from 2D to 3D and extensively applied into outdoor mobile devices from the early era of indoor workstation, desktop application. (Brenner & Elias, 2003; Chen & Shibasaki, 1999; Malaka & Zipf, 2000.)

According to Chen and Shibasaki (1999) the technology of GPS has already can determine position accurately on the level of cm, but the performance of GPS in urban areas is not good since the signals of GPS satellite usually disturbed by high-moving objects and blocked by high buildings etc. The algorithms of image sequence analysis based on landmark lines applied in the AR Type 3D Mobile GIS developed by Chen and Shibasaki can solve the problem mentioned above, and the AR Type 3D mobile GIS is potentially applicable for personal navigation. However, the challenge of 3D-view GIS based on image Navigation technology involves:
1. Detect the position with tiny deviation

2. Collect massive data of 3D spatial models covering the real world image

3. Dynamically renew these data based on the change of the real world. (Chen and Shibasaki, 1999)

According to Brenner and Elias (2003), they also indicated that landmark-based navigation is potentially to be applied in personal navigation system and it will navigate the users by identifying appropriate landmarks. This solution for personal navigation system also confronted the same problem as Chen and Shibasaki met, and it is also difficult to gather huge quantity of information overlapping the real world images, thus they approached the problem by extracting landmark from existing GIS databases and replenishing missing segments uncontained in GIS database by laser scanning data.

The motivation of recruiting 3D-view navigation in STIS is based on the consideration that some cities has complex structure streets where tourists are easy to get lost on the way from one attraction to another, of course they can directly use map of city, but at least the tourists should identify the current place where they are, what's worse if the tourist cannot speak local language or English to communicate with passerby, in the situation mentioned above, the STIS can help the tourist to get the 3D-view navigation directly without repeated user-input since all premade travel-related information can be reused in the context of STIS. In this sense, it is also meet the principle of simple interactive operation.

3.5 Simple interactive operation

The principles of simple interactive operation are composed of: 1) user-input as less as possible, 2) succinct user interface with easy-understanding language (Malaka and Zipf, 2000). According to Winograd (1994) it was also essential to develop and facilitate the standardization for language of interaction, which enable the operation to more simple and easy-understand.

According to research of the challenge for HCI, Soloway, Guzdial and Hay (1994) proposed two design methods for HCI:

1. User-centered design

2. Learner-centered design.

The differences between them are: 1) user-centered design should focus on user needs, it involves what task should be implemented, what tools are used to deal with task, what interfaces are applied to these tools; 2) while learn-centered design concentrates on the understanding of learner to what extent, whether it can be popularized to all potential learners or not. In addition, if the system focuses on the needs of users, then the interaction should be designed based on ease of use, if it focuses on the needs of learners, then the interaction should be designed based on the understanding, performance. The above viewpoint can also address that the interactive operation for green-hand tourists can apply the learner-centered design, for the experienced tourists the interactive operation can be apply the user-centered design. (Soloway et al., 1994.)

Garrison, Mountford and Thomas (1994) thought that the product design should be conducted in conjunction with real people and real task. In real life, when users access to
most tourism information systems for the first time, generally the system requires users to register for a new account, although the whole process just costs you several minutes, most users resist the process of signing up, even they give up to use this system if there are other replaceable systems or applications provide the same service. From the perspective of system design, the aim of requiring user sign up before access to system is to collect some customer basic information. In this situation, it may be one of potential solutions to apply the method of third-part account authorization. For example, STIS gives the users another way to sign up a new account via Google account, Facebook account etc, thus the personal basic information required can also be achieved from Google or Facebook. Besides, the user can also share his or her blog, comments or events in STIS via external link to other social network system. All these tasks will be undertaken by clicking one or several button. Simple interactive operation aims to reduce unnecessary process and make the interactive operation more simple and efficient.

3.6 Dynamicity

The motivations of recruiting dynamicity in STIS are

1. The dynamic nature of user’s requirements

2. New technology such as semantic web, mobile computing makes the implementation for management of dynamic user’s requirement to be possible. (Daramola, 2009).

Dynamicity as one of core elements applied in STIS suggests that not only the data of tourism information is required to be renewed up-to-date or up-to-the-minutes, but also STIS be able to respond to tourists’ dynamic demands or emergency happened in the whole trip, it means the STIS should support the dynamic decision making (DDM) and can tackle the emergency.

In the model of DDM, the DDM frequently utilized to what extent by tourists relies on the levels of tourist.

According to Fesenmaier et al. (2003) the independent tourists can also be divided into

1. Highly pre-prepare tourists

2. Price-oriented tourists

3. Recommendation-oriented tourists

4. Accommodation-oriented tourist

5. Geography-oriented tourists.

For highly pre-prepare tourists, they seldom need to change their plans, and this group of tourists usually is the experienced one. For price-oriented, recommendation-oriented, accommodation-oriented and geography-oriented tourist may be tend to make decision in-destination if other perfect selections are available. In addition, the length of stay in destination or the length of flexible time can also induce the dynamic decision-making for tourists.


3.7 Summary

These six core elements are the principles of developing STIS, and different components rely on different core elements. For the element of identification of tourist, it will be employed into TRcS and DDMS, since STIS supports the identification prior to pushing recommendations to tourist, and also the destination decision-making process will influenced by recommendations from TRcS to some extents. Hereby TRcS and DDMS will recruit the identification of tourist contained in framework of STIS. The element of social network consists of social participation and interaction with other tourists in social network. TRcS and GIS obviously require social participation, since vast of data concerning the comments or suggestions to some tourism products which are not easy to be expressed in the functional terms need the contribution of tourists, also the errors information existing in GIS can be corrected by users. The self configuration involves the configuration for individual requirements and information filters, when tourists make the destination decision and reservation online and receive the value-added services related to their tastes, it also need tourist to configure for their requirements and preferences. Therefore, the element of self configuration should be introduced in the development of DDMS, TRcS and TRsS. There is no doubt that Recommendation system will offer the value-added services, and GIS will navigate tourists in the destination via presenting the paths in 3D-view. The simple interactive operation emphasize interact with computer and other users based on ICT in an easier way, hereby it is welcome by all components in STIS. Dynamicity is applicable for development of DDMS, ESS, TPS and TRcS, because such components should respond to dynamic user’s requirements. Figure 4 clearly presents the relationships between the components and core elements.

Figure 4. The relationship between components and core elements in the context of STIS.

In addition, according to the relationships between components and core elements shown in Figure 4, TRcS employs all core elements in its development, all core elements except social network and value-added services are introduced into the development of DDMS, GIS recruits Social network, value-added service, simple interactive operation during the
development, both TPS and ESS import simple interactive operation and dynamicity as the principles of development, simple interactive and self configuration are applicable for the development of TRsS. Table 2 shows the statistics of core elements employed in components, the *Number* shown in the third column of table refers to the amount of core elements employed in corresponding component. Since all core elements are required in the development of TRcS, the work of developing TRcS becomes more significant and complicated in the whole development of STIS.

**Table 2.** The statistics of core elements employed in components.

<table>
<thead>
<tr>
<th>Component</th>
<th>Core elements employed</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRcS</td>
<td>Identification of tourist, social network, self-configuration, value-added service, simple interactive operation, dynamicity.</td>
<td>6</td>
</tr>
<tr>
<td>DDMS</td>
<td>Identification of tourist, self-configuration, simple interactive operation, dynamicity.</td>
<td>4</td>
</tr>
<tr>
<td>GIS</td>
<td>Social network, value-added service, simple interactive operation.</td>
<td>3</td>
</tr>
<tr>
<td>TPS</td>
<td>Simple interactive operation, dynamicity.</td>
<td>2</td>
</tr>
<tr>
<td>ESS</td>
<td>Simple interactive operation, dynamicity.</td>
<td>2</td>
</tr>
<tr>
<td>TRsS</td>
<td>Simple interactive operation, Self configuration.</td>
<td>2</td>
</tr>
</tbody>
</table>
4. Constructive Case Study

This section will introduce how the research process is conducted, analysis of scenarios with trip contexts, and analysis of results for developing STIS framework. The research process involves four phases, the first two phases aim to sketch an early-version framework of STIS based on theoretical review, the third phase focuses on the collection of information in real life that can present tourists’ needs to TISs, the last phase is to validate STIS framework achieved in the first two phases based on qualitative content analysis to collection information from interviewees and evaluation of TISs mentioned by interviewees.

4.1 Research process

My research approach is constructive and is adopted by the ideas of Tuunanen et al. (2010) who have represented a case study based research setup and their conceptual framework for IS development. The research process applied in this case has contained the following phases:

1. Recognize the boundary of STIS, it means the definition of STIS and its end-user.
2. Outline the architecture and characteristics of STIS based on the theoretical review of TISs. This phase aims to increase the understanding of STIS in the first phase of research, so a mass of theoretical review in the field of TISs is essential and the initial knowledge structure of STIS forms in this phase.
3. Collect end-user requirements in real life based on scenario combined method. Since the understanding of STIS should not be only limited in the literatures and the actual requirements of end-user still are not recognized.
4. Validate the framework of STIS by analyzing scenarios and evaluating existing tools mentioned in scenario both based on qualitative content analysis.

Through the first two phases of research process, an early version framework of STIS is sketched based on theoretical review and its core elements include 1) identification of tourist, 2) social network, 3) self-configuration, 4) value-added service, 5) simple interactive operation. And its components consist of 1) DDMS, 2) GIS, 3) TPS, 4) TRcS and 5) TRsS. In order to validate this framework, several interviews to potential independent tourist are conducted and the records of interviews are presented in the form of scenario. The last phase focuses on the analysis of scenarios and evaluation of tools used by interviewees based on the early version of framework of STIS. Some findings were revealed in the last phase, and they thus facilitate the evolution of early version framework of STIS.

Several thematic interviews (totally eleven interviewees) were conducted by this means informants’ narratives of trips were collected. Most interviewees were students aged between 20 to 35 years and covered four regions: the mainland of China, Finland, Hong Kong, and Italy (for the further research in this topic, questionnaires will be used to
collect data from actual intended independent tourist and the quantitative method used to analyze such data will be employed).

Based on and using the general process of trip (Figure 3) as a model, the questions for the interviewees in this case were:

1) What kinds of things related to the trip you usually do in these three stages?
2) What kinds of tools related to the trip you use in the different phases of trip?
3) Any suggestions or comments to the tools you use during the whole trip?

Interviews were recorded by writing down the primary narratives of their trips, and based on qualitative content analysis of this empirical material the result presented in the form of trip scenarios. Since some interviewees have repeated the similar kinds of trip requirements and commented quite similarly their needs for tools needed during their trips, hereby, only four scenarios – which show most typical features and cover all the requirements or comments mentioned in interview – are presented in this work.

Figure 3 shows the contexts of trip process from home to destination. To simplify the trip process, we in this case suppose that tourist only take one type transport from home to destination. For example, an independent tourist lives in Oulu, he wants to travel to Paris by air, he has two solutions, one is that he can take plane directly from Oulu to Paris (one stop in Helsinki airport), the other one is that he can take train to Tampere and then take plane to Paris, if the total fare of latter solution is much cheaper than former one, and his time of trip is enough, he may select the latter solution. Such situation, he changes different types of transport on his way to destination, is not considered here. In addition, if the destination includes several cities, treat current city as home and next city as destination, then to follow the same process from home to destination. And the way how to return home from destination also can follow this means, treat the last city in the tourism destination as home and home as destination. Some symbols in Figure 3 should be explained clearly, and the contexts of trip process from home to destination contain

- **Home context**

At the home context of use the independent tourist need to decide the destination, make a travel plan, book the tickets of transport, reserve hotels in destination, and calculate an approximate budget etc. The blue dotted line refers to the area of home where the tourist can complete above tasks with the help of STIS. Black full line with arrow refers to travel route, and it also appears in on the way context and destination context. Travel route contains the round-trip route between home and destination, and if the destination consists several cities, then travel route also should include all routes between each city in the destination. In other words, the travel route is the whole route of trip except sightseeing route mentioned later.

- **On the way context**

On the way context, if the destination includes several cities, tourist just needs to check the transport connecting to city with the help of STIS. If the destination is composed of a single city, usually tourists enjoy their time in plane, train or cruises on the way. The green dotted line represents the context of on the way which concerns the transport selected.

- **The destination context**
As arriving to the destination tourists use GIS integrated in STIS to navigate in the city and check the reservation information and recommendations with the assistance of STIS. Also they can record anything via mobile phone installed end-user application of STIS and share these to their social network. The red dotted line is the context of destination where tourists visit and get services from TPS and TRcS. Black dotted line represents sightseeing route which is the path of connecting several places such as hotel, restaurant, tourism attractions and shop mall. In addition, the destination is supposed to a place where there are infrastructures such as hotels, restaurants and the transport can reach, for example, the tourism concerning filed trip is not considered in this work.

**Figure 3.** Contexts of trip process from home to destination (Inspired by Camacho et al., 2001).
Scenario-based method in the user-centered approach (Iivari & Iivari, 2011) is employed to collect the information regarding the needs of independent tourists and the tools they frequently use. The tools frequently used are actually the components of STIS framework which are used to assist tourism make a complete travel plan and to provide services in different phases of trip. The needs of independent tourists and the service desired to be improved will be concluded to the core elements of STIS framework. In this work, several interviews are undertaken in informal way, and interviewees all meet the definition of independent tourist in this paper.

**Scenario 1:**

Interviewee 1, male, an Italians who I met at a train to airport of Barcelona, and also a software engineer, was having a business trip in Barcelona. He told me about how he made his business trip generally. He said: “Since most of his business trips are short-term, actually there are not so many things need to be prepared. For example, before this trip I just booked the flight tickets and hotel online and did not need care more about the expenses. Because the budget of this trip, my company will pay for it late, is enough to afford these expenses. After finishing my work in Barcelona, I have two days to have a short rest there, basically when I reach a city where I have never been before, I will take the city sightseeing bus to roughly see the tourism attractions and read a guide book related to local tourism, then go to the interest places where I think they are. Actually I have no idea regarding make an exact sightseeing route, just go the interest places randomly, and maybe sometimes depends on my temporal mind. Of course, sometimes I maybe accept some recommendations from other warm-hearted tourists. If there are some sandy beaches in surrounding, I would like to rent a sand-beach chair to enjoy the sunshine.”

**Scenario 2:**

Interviewee 2, female, a student from Chinese university of Hong Kong, studies in University of Oulu for half a year. Likes other exchange students from Asia, she spends most time to travel around the countries in Europe after she finishes the courses in university of Oulu. She shares the experience how to prepare her trip.

Before trip, she usually spends much time in some forums or websites, for example, a website of tourism information named qiongyou where lots of Chinese tourists share their stories and experience to some tourism attractions. Based on aforementioned information to make decision of destination, she usually selects several cities in a trip, make a rough travel route, then she reserves tickets and hotels online and collects the more detailed information of tourism attraction where she think it is interesting. After she makes all things well, she will record these in the Google calendar, thus the itinerary is also available in her mobile phone application based on the information synchronization function with the same user account. Besides, she would like to select the Chinese family hotel, not only for its low price but also she can meet some other Chinese tourists there and enjoy the time to talk about the funny events with them.

During trip, she said: “if I lost my way in certain city, I usually asked the way from the passerby, and can get the current location where I was by showing the maps to passerby. But there are several problems, for example, last time I visited a small city in Italy, most local citizens cannot speak English, what’s worse, when I showed a map marked in English, they could not tell the accurate position, although
sometimes it is luck enough that some passersby can speak English and know the position where I wanted to go, but finally I found that actually I walked on a longer way to there by following the passerby’s instruction. Maybe you will say I can ask help from GPS, but most of time in some remote places, the signal of GPS is very weak, it almost did not work correctly.”

After trip, she would like to post her photos of the trip via Facebook and share them to her friends and also like to write some micro-blogs which usually attracts her friends to comment.

Scenario 3:

Interviewee 3, male, a Finnish student in university of Oulu, told me about how he makes his trip. He thinks the time spent in searching information of tourism attractions and cheap airline tickets is huge, but now there are some websites combined information filter tools can assist tourists to get the expected results. For example, the website named eDreams is very good. He usually searches cheap airline tickets in eDreams when he cannot find any cheap tickets in his familiar websites such as Norwegian and Ryanair, although it is not always can help him find the best price. When he plans to go a destination, he said: “it is better to pay a visit to friends and can also sleep overnight in friend’s house for several days, if there are not any friends there, I will choose the youth hotels, besides couch surfing also is a good choice.”

During trip, he is used to get a map of local city, mark out the places where he wants to go in a few days. If he loses the way he will try to find whether there is any street map in street corner or not, if not, then he asks help from passerby. Actually he does not like to ask way from passerby, because most passersby asked maybe also do not know the accurate position except he or she is a citizen living in that city for a long time. One thing he remembers clearly is that during the trip to Rome he wanted to visit an art museum but forgot to make reservation online. Since the limitation of visitor amount, he had to wait until the next week if he began to reserve that day, however it may disrupt his premade travel plan. For this event, he said: “the reason why I forget to book online is that I totally do not know it is mandatory. Suppose I can afford the annoyed and complex work of remaking or adjusting the rest part of travel plan, but the whole cost of trip will increase because of the change fee of the unused tickets, normally I book the tickets with discount which are not changeable. In this situation, it is not a good idea to change my current travel plan leading to the extra added cost of time, energy and money, but if there are some intelligent software applications or tools can help to dynamically make or adjust travel plan and calculate the approximate loss caused by adjusting premade travel plan, maybe I will consider to do it.”

After trip, he likes to talk about the trip with his friends in leisure time, if they have the same plan to go the place where they had never gone before, he would like to share travel experiences and recommend some interesting places which he found in the trip, it is better to listen to the other’s stories and recommendations than spend much time in Internet to collect tourism information, in addition, the recent comments and/or suggestions for tourism products such as hotel, restaurant and interesting places from your friends are more believable, realistic than from information providers who has the aim of promotion.
Scenario 4:

Interviewee 4, male, a Chinese student studying in the University of Oulu, shares his experience of trip. In his trip, the destination usually includes several cities, the preparations before trip is a complex work, thus a complete travel plan is essential.

Before trip, he spent much time in forums of tourism and then made decision of destination. He tended to travel outside in the holiday, since the time of trip can be more flexible. Also he is a price-oriented tourist, the decision of days of staying in certain city will be impacted by the air ticket to some extents. He said: “The tool I frequently use is the assistant of travel plan in the qiongyou. I use this tool to make a travel plan which consists of general itinerary, approximate budget list etc. Besides, the electronic guide book of destination can be download from qiongyou, the service I highly appreciate in qiongyou is the social network of tourist group, many people communicate in this social network based ICT, they comment for attractions, local delicious food, the things what they saw and heard during trip. In this way I can better understand destination from various aspects. Some tourists will share their travel plans in qiongyou, if you are an inexperienced traveler, you can directly reuse certain travel plan similar with yours and modify some details based on your own situation and taste, it can reduce the cost of time in making a travel plan to some extents. Comparing with other airlines companies, I usually choose the Norwegian, Ryanair (they are airline companies that are famous with cheap flight) as my primary selection, if there are not available air lines to destination, then I decide to search in internet for cheap flight. I prefer to Chinese family hotel, if there is not any family hotel available in destination, then I select the youth hostel. After several steps, basically the essential preparations before trip are ready.”

During trip, normally he enjoy the trip by following his travel plan, but the problems he also met as other interviewees, for instance, lost the way in some places and GPS embedded in mobile phone is useless in the place where satellite signal is blocked and disturbed. The conflict between dynamic requirements in destination and fixed travel plan gave him a deep impression. He told: “Last summer I have traveled to Italy and visit several cities there, because I did not spend enough time to make travel plan, the time distribution in different cities has some problems. In my travel plan, I distribute five days in Rome, four days in Florence, four days in Venice, three days in Milan, after the trip, I found that the city of Florence and Milan don not need too much time to visit and these two city are boring compared with Roma and Venice, but the length of stay in Roma and Venice are too short, especially in Venice, it is a really beautiful city and half of month is still not enough to visit, during the days in Venice, I have ever wanted to adjust my plan, but finally gave up this idea due to the cost of time, money and energy, if there are some applications can assist me to automatically adjust travel plan, cancel, change or rebook the ticket, and calculate the cost of adjusting travel plan, I guess I will consider to try.”

After trip, he likes to share his photos taken during trip and the experience to other tourists, and records all these things in my blog. The system of qiongyou also supports the blog to be shared to other social network, so his friends in other social network based on ICT can also see his experience of trip and the interactive operation is very simple.
4.2 Analysis of scenario with trip contexts

The characteristic of interviewees and their needs to TISs will be extracted from four scenarios mentioned earlier. These results will be shown in the following means:

- Home context
- On the way context
- Destination context

And the results will be used in the analysis for developing STIS framework mentioned later. Following is the analysis of scenarios with trip contexts

**Scenario 1**

Home context: Use the reservation system in terms of flight and hotel;

On the way: no mentioned;

Destination: dynamically decide the sightseeing route, preference of sandy beach, tend to accept the recommendation from others.

**Scenario 2**

Home context: search information related to destination in some forums, reserve flight ticket and hotel online, make an itinerary, Preference of living in Chinese family hotel;

On the way: no mentioned;

Destination: hope to get the service of navigation in the situation of losing way in some cities. Share trip experiences to social network both in real world and visual world based on ICT.

**Scenario 3**

Home context: search information related to destination and cheap flight ticket, reserve flight ticket and hotel online, prefer to sleep in the hours of friends in the destination or live in youth hotel;

On the way: no mentioned;

Destination context: need the navigation service, need to adjust travel plan due to unpredictable event. Share his experience and recommend tips to friends, need cost calculating tool.

**Scenario 4**

Home context: make a travel plan, search information related to destination in a social network with many Chinese tourists, price-oriented, reuse tourism strategy of other tourists and modify it based on preferences, reserve ticket online, tend to live in Chinese family hotel;

On the way context: no mentioned;
Destination context: need navigation service, hope to dynamically adjust his travel plan, share the experience of trip to different social network based on ICT in a simple way.

4.3 Analysis results for developing STIS framework

The STIS framework (it is an early-version framework of STIS mentioned earlier, not the final version of framework of STIS proposed in this paper) will be validated based on the qualitative content analysis to the results of analysis of scenario with trip contexts and evaluations of TISs mentioned in scenarios. Followings are the qualitative content analysis to the results of analysis of each scenario.

In scenario 1, dynamically decision in destination refers to dynamicity, preference of sandy beach indicates he should configure his preference, or recommendation can be push to him based on the identification of tourist including preference. Recommendation from others is the presentation of value-added services and social network. The characteristics presented involve 1) identification of tourist, 2) social network, 3) value-added service, 4) dynamicity. The components presented include TRsS, TRcS.

In scenario 2, hope to get the service of navigation and should make a itinerary indicate value-added service, preference of Chinese hotel refers to identification of tourist or self-configuration, share experiences of trip is the presentation of social network, Searching information of destination can help user to make decision of destination. The characteristics involve 1) identification of tourist, 2) social network, 3) self configuration and 4) value-added service. The components presented include TRsS, TRcS, TPS, GIS and DDMS.

In scenario 3, search information of destination can support the process of destination-decision making. Searching cheap flight ticket indicates the preference of price-oriented, namely the presentation of self configuration or identification of tourist. Need navigation service refers to value-added service. Share trip experiences and recommend tips to others are the presentation of social network. Dynamically adjust travel plan indicates dynamicity. The characteristics involve 1) identification of tourist, 2) social network, 3) self configuration and 4) value-added service, 5) dynamicity. The components presented include TRsS, TRcS, TPS, GIS and DDMS.

In scenario 4, search information of destination in social network of tourist group, it indicates social network. Price-oriented, tend to live in Chinese family hotel are the presentation of self configuration or identification of tourist. Price-oriented tourist will be impacted by recommender to some extents, and travel plan assistant tool can support the process of travel plan making, thereby they refer to value-added service. Dynamically adjust plan indicates dynamicity, show trip experience in social network in simple way are the presentation of social network and simply interactive operation. The characteristics involve 1) identification of tourist, 2) social network, 3) self configuration and 4) value-added service, 5) simple interactive operation, 6) dynamicity. The components presented include TRsS, TRcS, TPS, GIS and DDMS.

Table 3 shows varying amount of core elements and components contained in STIS framework have been presented in each scenario. Especially in scenario 4, all core elements and components are presented in the interviewees’ needs to TISs. In addition, the results of analysis of scenario 3 and scenario 4 both show another new core element mentioned later which is not included in STIS framework.
Table 3. Validate STIS framework based on qualitative content analysis to results of Scenarios

<table>
<thead>
<tr>
<th>Characteristic or component</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
<th>Scenario 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of tourist</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Social network</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Self configuration</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Value-added service</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Simple interactive operation</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>DDMS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GIS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TPS</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TRcS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TRsS</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Above is the validation of STIS framework from the perspective of users’ needs to TISs. In order to further validate STIS framework, the experience-based evaluation of system from the perspective of existing TISs is employed and this evaluation method emphases the understanding of users' experience affected by their motivation and expectations (Roto, Obrist & Väänänen -V. -M., 2009). In this work eDreams and qiongyou are selected as the TISs evaluated, evaluations of two systems are achieved based on the author’s experience of using them and results will be also analyzed based on the qualitative content analysis.

eDreams

In Figure 5, the interface of system is shown in a way of succinct and easy-understand. In the navigation bar of website, it shows the services included, for example, flight reservation, vacation packages, hotel reservation and car rental. This simple interface is the presentation of simple interactive operation in terms of HCI. In the process of searching fights, this reservation system supports the configuration of individual requirement and information filter, for example, the configuration of lowest fare. It is the presentation of self configuration.
Figure 5. The front page of flight reservation in eDreams.

In Figure 6, below, there is the navigation bar which shows whole purchase process and current phase. This easy-understand navigation approach also is the presentation of simple interactive operation.

Figure 6. The processing page of flight reservation in eDreams.

The top right corner of Figure 6 and Figure 7 shows that eDreams supports the connection to social network via external link, but it only has the function of sharing information from eDreams to social network, and its social network rely on Facebook and Twitter. These are presentation of social network interactive and simple interactive operation.
Figure 7. External link connecting to social network in eDreams.

Figures 8, 9 and 10 focus on the evaluation of hotel reservation service in eDreams. Figure 8 shows that the website is accessed in Oulu, English is selected, the city recommended (see big image at right side) is Helsinki, the list of “recommender for you” (see small image at lower left corner) begins with Barcelona. Figure 9 shows that the website is accessed in Oulu, Chinese is selected, the city recommended (see big image at right side) is still Helsinki, but the list of “recommender for you” (see small image at lower left corner) begins with Roma. Figure 10 shows that the website is accessed in Shanghai, English is selected, the city recommended (see big image at right side) is Hong Kong. In addition, the position of hotel will be marked in the map based on the technology of Google map. Table 4 shows the summary of the contents shown in Figure 8, Figure 9 and Figure 10 in a direct and simple way.

Figure 8. Access hotel reservation of eDreams with English in Oulu.
Figure 9. Access hotel reservation of eDreams with Chinese in Oulu.

Figure 10. Access hotel reservation of eDreams with English in Shanghai.

The Recommender in eDreams shows the capability of context-awareness based on the IP address of current users, since the different locations of accessing website of eDreams (see Figures 8 & 10 in Table 4) lead to different result of city recommended. Focusing attention to “recommended for you” (see Figures 8 & 9 in Table 4), you will find the cities recommended are different, Figure 8 shows the first city recommended is Barcelona, Figure 9 shows the first city recommended is Roma, the differences are caused by language selected. One of possible reasons is that different recommendations are pushed to different culture background tourists and these tourists are supposed to primarily select their native language. It shows the recommendations are pushed based on identification of user’s preference of language and current context of use. These are the presentation of identification of tourist and value-added service.
Table 4. Summary of the contents in Figures 8, 9 and 10.

<table>
<thead>
<tr>
<th>Condition</th>
<th>location of accessing website</th>
<th>Language selected</th>
<th>City recommended</th>
<th>First city in the “recommender to you”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 8</td>
<td>Oulu</td>
<td>English</td>
<td>Helsinki</td>
<td>Barcelona</td>
</tr>
<tr>
<td>Figure 9</td>
<td>Oulu</td>
<td>Chinese</td>
<td>Helsinki</td>
<td>Roma</td>
</tr>
<tr>
<td>Figure 10</td>
<td>Shanghai</td>
<td>English</td>
<td>Hong Kong</td>
<td></td>
</tr>
</tbody>
</table>

Qiongyou

In the evaluation of qiongyou, it focuses on the evaluation to tool of travel plan. In Figure 11, the navigation bar of website shows that the services offered involve destination information, travel strategies, forums, hotel reservation, flight reservation, car rental etc. At the bottom of Figure 11, the system provides third-part account authorization, it means if end-user does not want to sign up for a new account in the system of qiongyou, it allow users to sign in the system with third-part account allowed such as micro-blog of Xinlang and QQ, these are top two social networks based on ICT in China, like the Facebook, twitter. It is the presentation of simple interactive operation.

Figure 11. Front page of website of qiongyou.

In Figure 12, it presents a tool used to make travel plan, the tool covers schedule of each day in the trip, travel route (see Figure 13) made based on Google map. Although the tool does not assist user to generate a sightseeing route, it provides travel map combined recommender in destination (see Figure 14). Figure 15 shows the tool used for budget calculation, it requires user-input and does not directly reuses the fare data in the reservation information such as hotel and flight ticket. Figure 16 presents the tool for preparations before trip, the tool guides users to prepare the essential things before trip. If
the trip belongs to the outbound tourism and the tourist is the first time to travel outbound, the general process (see Figure 17) involves 1) apply for a passport, 2) make a complete travel plan, 3) book flight tickets online, 4) reserve hotel in destination and purchase insurance of tourism, 5) apply for a visa in the destination, 6) apply for credit card used in destination, and 7) prepare baggage before trip, it is very useful for inexperience tourists. Figure 18 presents the tool used for travel strategy. The travel strategies of tourists mostly are travel diaries or blogs, and they include itinerary and comments to some attractions attached with photos etc. Besides, these travel strategies are allowed to share to other social networks. Electronic guide book of destination is also available and made based on the FAQ and some tips. Related travel strategies will be recommended based on the destination inputted in travel plan, it shows that the recommender is context-awareness to some extents at least. The ideal tool of travel plan should 1) generate the travel route and sightseeing route based on the user’s configuration in terms of requirements, time and budget etc, 2) atomically input reservation information regarding flight ticket and hotel etc 3) and recommend the optimal solution. Although the tool of travel plan exist some weaknesses in qiongyou, it has already facilitated the development of tool for making travel plan.

Figure 12. Tool for travel plan.

Figure 13. Travel route generated by tool for travel plan.
Figure 14. Travel map combined recommender in destination.

Figure 15. Tool for budget calculation.

Figure 16. Tool for preparations before trip.
Figure 17. General process of preparations for outbound tourism.

Figure 18. Tool for travel strategy.

Table 5 shows the results of qualitative content analysis to evaluations of eDreams and qiongyou. In eDreams, simple interface of system, share information to other social network via external link are the presentation of simple interactive operation and social network. Reservation system supports end-users to configure their requirement and information filter, it is the presentation of self configuration. Recommender combined context-awareness is the presentation of identification of tourist and value-added service. Based on the services and tools contained in eDreams, it actually is an integrated TIS containing GIS, TRcS and TRsS.

In the system of qiongyou, it supports end-user sign in system via third-part account. It is the presentation of simple interactive operation. Travel strategies as recommendations shared by other tourists who really experience services or products in destination are useful for destination-decision making of tourist. These are presentation of value-added services and social network. Besides, the travel strategies will be pushed to end-users based on the destination inputted in their travel plans, it the presentation of identification of tourist. Qiongyou provides a tool of travel plan, with the help of this tool tourists can configure their travel plan based on needs. Tourist can also configure flight and hotel reservation information. These are presentation of self configuration. Based on the services provided such as flight reservation, travel strategies and travel map combined
recommender and tools such as travel plan and budget calculation, qiongyou is an aggregated TIS combined several sub-systems such as DDMS, GIS, TRcS, TRsS and TPS.

Table 5. Validate STIS framework based on qualitative content analysis to evaluations of TISs.

<table>
<thead>
<tr>
<th>System or component</th>
<th>eDreams</th>
<th>Qiongyou</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification of tourist</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Social network</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Self configuration</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Value-added service</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Simple interactive operation</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>DDMS</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>GIS</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TPS</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>TRcS</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TRsS</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
5. Discussion

This section introduces the evaluation of STIS framework, the evaluation of construction process and future research. Based on the qualitative content analysis to results of interview-based scenarios and experience-based evaluation of example TISs, some findings are uncovered, a new core elements and a component are adopted into STIS framework. The evaluation of construction process is undertaken based on the design science research guidelines mentioned later, and based on results of evaluation of construction process, some new design problems are recognized in the further research.

5.1 Evaluation of the STIS framework

The early version framework of STIS is achieved based on the theoretical review in the field of TISs and intelligent system development, and it is presented in two dimensions: core elements and components. In order to validate it, several interviews and evaluation to some existing TISs are conducted, it means to validate the framework of STIS from the user’s actual needs to TISs and functions or service provided in existing TISs. After analyzing the scenarios collected in interviews and evaluation to example systems, we find the core elements, namely identification of tourist, social network, self configuration, value-added service and simple interactive operation, are mentioned in the interviewees’ needs to STIS, and varying amount of components are applied in the existing TISs although these TISs do not perform perfectly like what mentioned in STIS framework and still have some weaknesses. Besides, current TISs cannot respond to dynamic user’ requirements and provide solutions to emergency that occurs in the trip, also there is no related component used to solve this problem, Emergency Solution System mentioned earlier can fill the void. Hereby dynamicity as the sixth core element and ESS will be added into STIS framework. The new version framework of STIS, also is the framework of STIS proposed in this paper, is composed of six core elements and six components.

5.2 Evaluation of the construction process

According to Hevner and others (2004) design science research guidelines involves 1) design as artifact, 2) problem relevance, 3) design evaluation, 4) research contributions, 5) research rigor, 6) design as a search process, and 7) communication of research. These guidelines emphasize the understanding of a design problem and its solutions in the building and application of an artifact. The evaluation of construction process in this paper is undertaken based on above guidelines of design science research.

Design as an artifact, it refers to the result of design-science research is a viable artifact such as construct, model, method and instantiation, and the artifact can enable its implementation and application in an appropriate domain (Hevner et al., 2004). STIS framework proposed in this work will be presented from the perspective of principles of developing STIS and architecture of STIS, namely core elements and components both mentioned earlier. Besides, both the boundary and end-user of STIS are defined.
Problem Relevance, it means to develop technology-based solutions or innovative artifact to relevant business problems (Hevner et al., 2004). The business problems mentioned are that less attention is focused on TISs from integration viewpoint, current most TISs are independent or isolated, and tourists have to enter separately into different TISs in order to make a complete travel plan and get related tourism services. Hereby a framework of STIS is urgently needed to be developed.

Design Evaluation refers to the evaluation method used to validate a design artifact in terms of utility, quality and efficacy (Hevner et al., 2004). In this work several interview-based scenarios are conducted, these scenarios present interviewee's needs and expectations to TISs. Results acquired through qualitative content analysis to scenarios will be used to validate STIS framework. In addition, the results of experience-based evaluation of example TISs will be used in the validation of STIS framework. However, these methods are only applicable to validate STIS framework in terms of utility. In addition, the STIS framework developed in this work should be tested by implementing a functional paper or software prototype. However, within limits of available human recourses (the author) such prototyping was not possible in this case but earlier the initial idea has been tested during Interaction Design course. The course was operated by the supervisor of this thesis, and the initial idea involved a software prototype comprising components such as flight reservation, hotel reservation and car rental integrated in unified system environment.

Research contribution means that clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies should be provided (Hevner et al., 2004). This paper aims to propose a STIS framework which enables STIS development from integrated viewpoint, some potential development approaches are suggested in the whole STIS development where several approaches aforementioned will partly be introduced based on different advantages themselves.

Research rigor emphasizes appropriate techniques to develop or construct a theory or artifact and appropriate means to justify the theory or evaluate the artifact (Hevner et al., 2004). In this work, the proposed STIS framework is sketched through theoretical review of TISs and evaluation of framework based on qualitative content analysis to interview-based scenarios and experience-based evaluation of example TISs. The qualitative content analysis method is conceptually on appropriate and comparable levels, but it is not a mathematical formalism method of describing construction which is often required in design-science research. Regarding the methods used in the interviews, the questions asked from the informants were too general as they could not completely and accurately describe their requirements to STIS. Beside, the amount of interviewees was eleven, the most interviewees were students aged between 20 and 35 years, the destinations of their trips are the cities in Europe, and their cultural background only covered four regions: mainland of China, Finland, Hong Kong, and Italy.

Design as a search process focuses on the process of searching an effective artifact which requires using available means to reach desired ends while meeting the constraints in problem domain, and it often simplifies a problem by explicitly representing only a subset of the relevant means, goals, and constraints or by dividing a problem into simpler sub-problems (Hevner et al., 2004). The research question of this work is decomposed into several sub-questions. An early-version STIS framework is sketched based on initial idea of STIS framework mentioned earlier and the theoretical review of TISs. The proposed STIS framework is the result derived from the evaluation of early-version STIS framework based on qualitative content analysis to interview-based scenarios and evaluation of examples TISs. In the STIS framework, the destination is supposed to be a
place where there might be a hotel, satellite or radio signal coverage, public transport etc. The future research of STIS framework will consider the field that lacks of aforementioned infrastructure. Therefore the progress of developing STIS framework is made iteratively as the scope of the design problem is expanded.

Communication of research puts stress on the presentation of research both to technology-oriented and management-oriented audience (Hevner et al., 2004). Although this paper mentions some potential development approaches for STIS development, it only describe their notions, advantages and/or weaknesses on conceptual level, not sufficient detail to describe how artifact to be constructed. Besides, this paper also does not consider whether STIS framework is feasible in realistic organizational context, but it addresses the framework from the perspectives of development principles and architecture, these can enable managers to understand the profile of STIS and benefits it brings.

5.3 Future research

For the future research purposes, the questionnaire could be used to collect the end-user’s requirements and be designed by a more systematic method, as some of the previous case studies (Tuunanen et al., 2010) have done. Such methods can help informants to describe their expectations and requirements to STIS in a heuristic way. Also the informants invited should be representative enough in relation to the intended users, the typical independent tourist groups. It means that the selection of informants should consider several factors such as the range of age, culture background based on regions, position, gender and the amount of participator. Also, in the first place, there should be a research on what kinds of people prefer independent travelling. Besides, with questionnaire data, quantitative analysis methods used and results presented by using statistical representations, which could be essential in the context of wide samples.

Although some potential approaches are suggested in the STIS development and the benefits of using STIS are described from the perspective of end-user, the STIS framework still does not provide detailed description regarding how STIS to be constructed and its feasible analysis in the realistic organization context. Hereby the future research will also include these new design problems.
6. Conclusions

In this paper, a concept of Smart Tourism Information System (STIS) is put forward, intelligent system for tourism and STIS are synonymous. In STIS, tourists can enjoy the one-stop services related to tourism, it means that tourists will no longer need to search tourism information and services etc in various TISs, since these TISs will be integrated in unified system environment.

This study aims to propose a framework of STIS, the framework of STIS is elaborated from the perspectives of core element of STIS development and component of STIS. Core elements of STIS are applied as the principles of STIS development and components of STIS is the architecture of STIS.

In the research, the framework of STIS is achieved through several phases: 1) recognize the boundary of STIS and identify the end-users of STIS, 2) sketch the framework of STIS based on theoretical review in the field of TISs and intelligent system, 3) collect user’ requirements to STIS in means of interview and evaluate several existing TISs, 4) validate the framework of STIS through qualitative content analysis to the results of analysis of interview-based scenarios and experience-based evaluation of example TISs.

The framework of STIS proposed in this paper is expected to give some suggestions to the STIS development to some extents, although several potential development approaches suggested in this paper may not be able to support the implementation of STIS in practice. In addition, the challenges of STIS development, the limitation of research process in this work and new design problems of further research are recognized.

As conclusions this constructive case study proposes a STIS framework based on theoretical analyses of the core elements and components of the systems, and provides several potential development approaches and recognized challenges in STIS development. Interview-based scenarios with potential users are used to demonstrate the needs of independent travellers and in showing for which purposes the different systems should be integrated. Experience-based evaluations of example TISs are applied to certify user’s needs from the perspective of systems developed based on demand-oriented. The results show that the developed framework of STIS is promising and can be useful when integrating the systems as offering one-stop services for independent tourists. More research with a wider empirical sample is still required to generalize the results and test the framework in practice.
Reference


