Collaborative Information Search in Tourism: A Study of User Behavior, User Interface and System Evaluation

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By

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DECLARATION

I certify that the thesis entitled

Collaborative Information Search in Tourism: A Study of User Behavior, User Interface and System Evaluation

Submitted for the degree of

Doctor of Philosophy

does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any university; and that to be the best of my knowledge it does not contain materials previously published or written by another person, except where due reference is made in the text.



Abu Shamim Mohammad Arif

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DEDICATION

This PhD thesis is dedicated to my departed father, *Abdur Razzaque Mollick,* my mother*, Surayia Begum,* my wife *Rozina Akhter and* my daughter *Shasmeen Huma Arisha,* for their love and support.

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ABSTRACT

Collaboration is necessary when a task is too complex and difficult to perform solitary. Many search situations demand people working together to solve a common goal. Tourism information searching is not an exception. Web searching has increasingly become a prevalent channel for tourists to conduct search for information. A group-based traveling information search activity includes preparing a travel plan, dividing the task among the group members, developing different strategies, seeking various information, exchanging views and ideas and decision-making. In addition to these features, communication among collaborators is also important. All these actions demand collaboration among the group members. However, despite its potential appeal and necessity, collaborative tourism information searching on the Web is under-explored. The nature and availability of tourism information and its role in our lives have changed significantly, but the methods and systems that are used to access and share that information in collaborative mode have remained mostly unchanged. This study aims to investigate tourists' collaborative search behavior including collaborative search stages, search strategies, nature of information sharing, and problems encountered during collaborative search. This PhD thesis also attempts to develop a collaborative tourism information search tool.

To achieve the research aims, existing practices for conducting collaborative tourism information search, including motivations and strategies were studied using two carefully designed user studies. The results reveal that most of the users engaged in collaborative activities as they searched for tourism information. Moreover, the results demonstrate that tourists collaborated with their teammates through planning their search strategies, dividing search tasks into sub-tasks and allocating workload, and using search queries and URL links recommended by teammates. Furthermore, tourists encountered various information flow breakdowns in different stages while performing collaborative search. The classification and the effects of information flow breakdowns on collaborative tourism information search were also reported. These investigations and a review of existing collaborative information search (CIS) tools inspired me to develop a CIS tool which is called ColTIS (**Col**laborative **T**ourism **I**nformation **S**earch). The third user study was conducted to evaluate the performance and effectiveness of ColTIS by comparing with a simulated collaborative search tool - Google

Talk-embedded Tripadvisor.com. The results demonstrated that ColTIS performs better than Google Talk-embedded Tripadvisor.com in terms of usability, result satisfaction and result correctness. The third user study also explored gender and cultural differences in collaborative search behavior including collaborative query reformulation and tourism information choice behavior. The findings of this thesis may further help the development or improvement of tourism CIS tools with a more comprehensive understanding of tourism CIS processes.

KEYWORDS

Collaboration, Collaborative Information Search, Collaborative Information Search Tool, Collaborative Query Reformulation, Tourism Information Search Behavior, Web Search

TABLE OF CONTENTS

DECLARATION ii
ACKNOWLEDGEMENTS iii
DEDICATION v
LIST OF PUBLICATIONS vi
ABSTRACT vii
KEYWORDS ix
LIST OF FIGURES xv
LIST OF TABLES xvii
GLOSSARY xix

Chapter 1: Introduction 1

1.1 Background and problem statement 1
1.2 Research questions 6
1.3 Significance of the research 7
1.3.1 Theoretical significance of the research 8
1.3.2 Practical significance of the research 10
1.4 Contributions of the research 11
1.5 Structure of the thesis 12

Chapter 2: Literature Review 14

2.1 Information search behavior models 15
2.2 Collaborative information search behavior 23
2.3 Information search behavior in tourism 29
2.4 Collaborative information search behavior in tourism 32
2.5 Query reformulation and collaborative query reformulation 33
2.6 Gender differences in information search behavior 35
2.7 Cultural differences in information search behavior 36

2.8 Collaborative information search tools 38
2.8.1 C-TORI (Cooperative Task-Oriented Database Retrieval Interface) 39
2.8.2 TeamSearch 40
2.8.3 SearchTogether 41
2.8.4 MUSE and MUST 42
2.8.5 Coagmento 43
2.9 Chapter summary 46

Chapter 3: Research Design……48

3.1 User Study 1: Survey through Questionnaire 50
3.1.1 Questionnaire design 50
3.1.2 Study participants 51
3.1.3 Data collection 53
3.1.4 Data analysis 54
3.2 User Study 2: Simulated tourism CIS with existing tools 54
3.2.1 Study participants 56
3.2.2 Data collection 57
3.2.2.1 Search tasks 57
3.2.2.2 Data collection instruments and procedures 58
3.2.3 Data analysis 59
3.3 Design and implementation of a CIS tool - ColTIS 60
3.4 User Study 3: Tourism CIS with ColTIS 67
3.4.1 Study setting 68
3.4.2 Search tasks 70
3.4.3 Study participants 70
3.4.4 Data collection 72
3.4.5 Data analysis 74
3.5 Chapter summary 75

Chapter 4: Results……77

4.1 Results of User Study 1 77
4.1.1 Questionnaire findings 77
4.1.1.1 Collaborative search pattern 77

4.1.1.2 Frequency and reasons for tourism information searching 78
4.1.1.3 Keywords used in tourism information searching 79
4.1.1.4 Alternative option if desired information not found 80
4.1.1.5 Group search and proximity of users 80
4.1.2 Tourist information search model 81
4.1.3 Summary of results of User Study 1 85
4.2 Results of User Study 2 85
4.2.1 Overview of Web search 85
4.2.1.1 Search systems used by the participants 85
4.2.1.2 Searching keywords used by the participants 86
4.2.2 Useful evidence of searchers' collaboration and types of information exchanged during collaborative search 87
4.2.3 Stages of collaborative search for tourism information 92
4.2.3.1 Stage 1: Collaborative planning 92
4.2.3.2 Stage 2: Collaborative information searching 93
4.2.3.3 Stage 3: Sharing of information 96
4.2.3.4 Stage 4: Collaborative decision-making 97
4.2.4 Collaborative search strategies for tourism information search on the Web 98
4.2.4.1 Collaborative search strategy planning 99
4.2.4.2 Collaboration for the division of search task 99
4.2.4.3 Using search queries recommended by teammate 100
4.2.4.4 Using URL links recommended by teammate 100
4.2.4.5 Observing and discussing search results 101
4.2.5 IFBs and their effects on collaborative tourism information searching 101
4.2.5.1 Types of IFB during tourism CIS 101
4.2.5.2 Effects of IFB on tourism CIS 104
4.2.6 Factors that influence collaborative searches for tourism information 105
4.2.6.1 Budget for the travel 105
4.2.6.2 Prior knowledge and previous visit 105
4.2.6.3 Technology 107
4.2.7 Factors affecting system design 108
4.2.7.1 Technology: Screen sharing 108
4.2.7.2 Division of search task 108
4.2.7.3 Sharing of search results 109
4.2.7.4 Budget (cost) minimization 109
4.2.8 Summary of results of User Study 2 109
4.3 Results of User Study 3 109

4.3.1 Evaluation of ColTIS system 110
4.3.1.1 Evaluation variables 110
4.3.1.2 Findings 111
4.3.1.2.1 Task completion time 111
4.3.1.2.2 Collaboration 112
4.3.1.2.3 Ease of use and usefulness of the system 116
4.3.1.2.4 Result satisfaction 118
4.3.1.2.5 Result correctness 119
4.3.1.2.6 Search usability 119
4.3.1.2.7 Use usability of ColTIS 122
4.3.1.2.8 Users' comparative comments between ColTIS and Google Talk-embedded Tripadvisor.com 122
4.3.1.2.9 Users' suggestions for improving the system 127
4.3.1.3 Summary of Evaluation 129
4.3.2 Collaborative querying architecture 130
4.3.3 Collaborative query reformulation strategy 131
4.3.4 Sources of terms for collaborative queries 132
4.3.5 Operations performed for collaborative query reformulation 133
4.3.6 Impact of individual queries and chat logs on collaborative query reformulation 134
4.3.7 Collaborative query reformulation for tourism information search patterns 135
4.3.8 Query reformulation types and patterns 138
4.3.9 Query reformulation types of male pairs and female pairs 144
4.3.10 Collaborative query reformulation types by Australian pairs and Asian pairs 146
4.3.11 Differences in collaboration query reformulation patterns based on gender and culture 147
4.3.11.1 Male pair versus female pairs 148
4.3.11.2 Australian pairs versus Asian pairs 151
4.3.12 Variables of tourism items choice behavior: Destination, accommodation and budget 154
4.3.13 Choice of tourism items based on gender and culture 155
4.3.13.1 Male pair versus female pairs 155
4.3.13.2 Australian pairs versus Asian pairs 157
4.3.14 Summary of results of User Study 3 158
4.4 Chapter summary 158

Chapter 5: Discussions……..……..160

5.1 Collaborative search stages model 160
5.2 Collaborative search strategies for tourism information 164
5.3 IFBs during collaborative search for tourism information 165
5.4 Supporting collaborative information search for travel planning..... 166
5.5 Effect of gender on collaborative query reformulation 168
5.6 Effect of culture on collaborative query reformulation..... 169
5.7 Effect of gender on collaborative search on tourism items 170
5.8 Effect of culture on collaborative search on tourism items 171
5.9 Implications of this research 171
5.9.1 Collaborative travel planning 171
5.9.2 Distribution of search load 172
5.9.3 Minimization of personal preferences' gap 172
5.9.4 Preventing IFBs 172
5.9.5 Coordination during CIS 173
5.9.6 Modeling CQ reformulation 173
5.9.7 Gender- and culture-based online tourism 174
5.9.8 Improvement of CIS System 176
5.10 Chapter summary 176

Chapter 6: Conclusions and Future Research……..177

6.1 Overall summary of this research..... 177
6.2 Limitations 181
6.3 Future research directions..... 182

References ……....184

Appendices

Appendix A: Survay Questionnare for User Study 1……201
Appendix B: Search Task for User Study 2…….....207
Appendix C: Pre Search Questionnaire for User Study 2……..…….....209
Appendix D: Post Search Questionnaire for User Study 2.....…….....212
Appendix E: Coding Scheme……..……216
Appendix F: Search Task for User Study 3…..……..218
Appendix G: Post Search Questionnaire for User Study 3…..……...…….....219

LIST OF FIGURES

Figure 2.1 Wilson Model ……..……...……...……..15
Figure 2.2 The Krikelas Model ...……..……...……...……..17
Figure 2.3 The Ellis Model….. ...……..……...……...……..19
Figure 2.4 The Kuhlthau Model..……..……...……...……...19
Figure 2.5 Leckie Model ……...……..……...……...……...21
Figure 2.6 Byström and Järvelin ……..……...……...……..22
Figure 3.1 Flow chart of user studies undertaken in this research.……...……...……..49
Figure 3.2 ColTIS interface ……..…63
Figure 3.3 A screenshot of Google Talk-embedded Tripadvisor.com……...69
Figure 3.4 A pair of participants in a study session……..……....……..……..……70
Figure 4.1 Tourist's search behavior model based on User Study 1…...…….…82
Figure 4.2 Tourist's collaborative information search model……..…….….84
Figure 4.3 Number of messages and Web links used in collaboration for search task 1 employed by each pair ……..……..89
Figure 4.4 Number of messages and Web links used in collaboration for search task 2 employed by each pair……..……...89
Figure 4.5 Number of messages and Web links used in collaboration for search task 3 employed by each pair……..…….....90
Figure 4.6 Collaboration on planning, task division and result sharing for task 1…….....……91
Figure 4.7 Collaboration on planning, task division and result sharing for task 2……..……..91
Figure 4.8 Collaboration on planning, task division and result sharing for task 3……..…….91
Figure 4.9 Task completion time using Tripadvisor and ColTIS……..……..112
Figure 4.10 No. of messages exchanged by each pair of participants…….113
Figure 4.11 No. of results shared by collaborators through messaging for Tripadvisor and ColTIS……..……..…..115
Figure 4.12 No. of links shared by collaborators through messaging for Tripadvisor and ColTIS…….....115
Figure 4.13 Users' rating on ease of use for both systems……..116
Figure 4.14 Users' rating on usefulness of both systems…….117
Figure 4.15 Users' rating on results satisfaction……...118
Figure 4.16 Statistics of the search usability…….…..121
Figure 4.17 Statistics of users' choice on ColTIS and Tripadvisor..…….…..127
Figure 4.18 Flow of CQ reformulation…….……...131
Figure 4.19 Percentage of CQ reformulation on tourism information categories employed by participants based on their gender and culture ……...…….……137

Figure 4.20 Occurrence of CQ reformulations…..……..……..140
Figure 4.21 Occurrence of CQ reformulation among male pairs and female pairs…….……...145
Figure 4.22 Query reformulation patterns of Australian pairs and Asian pairs…….……..147
Figure 5.1 Collaborative search stages in tourism CIS……...…….…….…...163

LIST OF TABLES

Table 2.1 Taxonomy for keyword aggregation……31
Table 2.2 Comparison of different CIS tool ……45
Table 3.1 Gender category of respondents……52
Table 3.2 Age group of respondents……52
Table 3.3 Educational background of respondents ……52
Table 3.4 Distribution of respondents' profession……53
Table 3.5 Demographic characteristics of the participants of User Study 3……72
Table 3.6 Summary of data collection and data analysis method for responding to the research questions ……76
Table 4.1 Tourism information search sharing activities……78
Table 4.2 Collaborating tools utilized by user……78
Table 4.3 Frequency of search by the user……78
Table 4.4 Reasons for collaboration when searching for tourism information……79
Table 4.5 No. of keywords used for searching……79
Table 4.6 Highest prioritized (priority 1) search terms for tourism information……80
Table 4.7 Alternatives if information were not found during the Web search……80
Table 4.8 Group search strategy……80
Table 4.9 Statistics for the location of the collaborating people……81
Table 4.10 Major websites visited by the participants and the reasons for visit……86
Table 4.11 Taxonomy of search keywords and information during tourism collaborative search……87
Table 4.12 Number of messages and Web links exchanged during collaboration information search tasks……88
Table 4.13 Types of tourism-related keywords (self-generated and provided by the teammate in the pair) used in collaborative information searching……94
Table 4.14 Overview of sharing of information during collaborative search……96
Table 4.15 Collaborative search strategies for each search task……99
Table 4.16 Types of IFBs during tourism CIS……102
Table 4.17 Statistics for task completion time using Tripadvisor and CloTIS……112
Table 4.18 Statistics of exchanging messages during collaborative search……114
Table 4.19 Results sharing by Tripadvisor and ColTIS… ……114
Table 4.20 Results on use usability……117
Table 4.21 Performance measure of both systems in terms of results satisfaction……118
Table 4.22 Performance measure of both systems in terms of result correctness……119

Table 4.23 Results on search usability……120
Table 4.24 Use usability of ColTIS……..122
Table 4.25 List of users' comparative comments between ColTIS and Tripadvisor.com……...123
Table 4.26 Comparison between ColTIS and Tripadvisor.com based on users' quote regarding these two systems……...126
Table 4.27 Features of both systems those users liked…….…….....127
Table 4.28 Suggestions to improve ColTIS…….....128
Table 4.29 Source of terms for CQ reformulation…….…….….131
Table 4.30 Operations performed during CQ reformulation…….……..134
Table 4.31 Comparison between query and chat for collaboration and CQ reformulation in collaborative information searching……..……...134
Table 4.32 Comparison of self-query versus self-chat and partners-query versus partners-chat as the source for CQ……..…….…….135
Table 4.33 Categories of tourism-related keywords used in CQ reformulation…….…….…136
Table 4.34 Statistics for CQ reformulation on tourism information between male pairs and female pairs……...138
Table 4.35 Statistics for CQ reformulation on tourism information between Australian pairs and Asian pairs ...……138
Table 4.36 Query reformulation types…….…….…...139
Table 4.37 Patterns of CQ reformulation…….…....142
Table 4.38 Details of CQ patterns applied on tourism information…….……....143
Table 4.39 Statistics for CQ reformulation types between male pairs and female pairs ……....146
Table 4.40 Statistics for CQ reformulation types between Australian pairs and Asian pairs ……147
Table 4.41 Summary of high-level CQ patterns based on gender……..…….…….....148
Table 4.42 Significant test on CQ pattern based on gender……..……..…….…….....148
Table 4.43 Gender-based high-level CQ reformulation patterns on tourism information.....149
Table 4.44 Specific CQ reformulation pattern by male pairs and female pairs ..…….……...150
Table 4.45 Summary of CQ patterns based on culture …….....152
Table 4.46 Significant test on CQ pattern based on culture……..……..…….…….....152
Table 4.47 Culture-based high-level CQ reformulation patterns on tourism information.….....152
Table 4.48 Specific CQ reformulation pattern followed by Australian pairs and Asian pairs…...…153
Table 4.49 Tourism information choice of male pairs and female pairs…….....156
Table 4.50 Tourism information choice of Australian pairs and Asian pairs.…….…….....157
Table 4.51 Summary of results integrating research questions and user study ……..…….....158

GLOSSARY

The definitions for some of the terms used in this research are listed below.

Asynchronous Collaboration This collaboration refers to the situations when collaborators work in different times (Golovchinsky, Pickens, & Back, 2009).

Co-located collaboration Co-located collaboration refers to the situations when people work together while located in the same place (Golovchinsky, Pickens, & Back, 2009).

Collaboration It is the process of working together by two or more than two people for a common goal or to solve a common problem (Gaver, 1991).

Collaborative Information Searching It is defined as a task where two or more team members working together to find information for a specific problem or team members looking for information for a specific problem in parallel or sequentially or team members looking for information on the advice of other team members who had found the same or similar information earlier (Hansen & Jarvelin, 2005; Shah, 2010).

Collaborative Query Collaborative query refers to the query that is formulated by more than one user/searcher.

Ease of Use Ease of use refers to the ability of users to perform search task without the need for an advanced explanation and/or the help from others.

External Search External search consists of collecting information from other sources (family, friends, the Web, etc.) rather than memory (Engel, Blackwell, & Miniard, 1990).

Information Behavior Information behavior is the totality of human behavior in relation to sources and channels of information, including both active and passive information seeking, and information use. Thus, it includes face-to-face communication with others, as well as the passive reception of information as in, for example, watching TV advertisements, without any intention to act on the information given (Wilson, 2000).

Information Flow Breakdown It is a real or potential adverse situation where the normal flow of information or information activities are hindered, which may lead to a decline

in the attainment of information and retard the understanding of tasks/information (Galliers, Wilson, & Fone, 2007; Hertzum, 2010).

Information Retrieval It is the process of finding material (usually documents) of an unstructured nature (usually text) that satisfies information need from within large collections (usually stored on computers) (Manning, Raghavan & Schütze, 2008).

Information Searching It refers to the activities that users engage in for gathering information for their work or life, which are associated with a variety of information sources such as people, paper-based documents, information systems, and so on (Li, 2009).

Information Search Behavior The behavior employed by the searcher in interacting with information systems of all kinds. It consists of all the interactions with the system, whether at the level of human computer interaction (for example, use of the mouse and clicks on links) or at the intellectual level (for example, adopting a boolean search strategy or determining the criteria for deciding which of two books selected from adjacent places on a library shelf is most useful), which will also involve mental acts, such as judging the relevance of data or information retrieved (Wilson, 2000).

Interface The layer between the user and the system that facilitates human-computer communication. Interfaces consist of many elements, each of which enables certain actions or interactions

Internal Search Internal search refers to the retrieval of information from the memory (knowledge, experience) (Engel, Blackwell, & Miniard, 1990).

Query Reformulation Query reformulation is the process of modification of the queries to obtain better results during the search (Jansen, Booth, & Spink, 2009).

Remotely Located Collaboration Remotely located collaboration refers to the situations when people work together while located in different places (Golovchinsky, Pickens, & Back, 2009).

Result Correctness Search result correctness refers to the users' perception of the closeness of the retrieved results to users' expected results.

Result Satisfaction Search result satisfaction is a personal belief that users are happy (satisfied) with the search results retrieved by a search system.

Search Engine A program that searches documents for specified keywords and returns a list of the documents where the keywords were found. Although search engine is really a general class of programs, the term is often used to specifically describe systems like Google, Yahoo, Alta Vista and Excite that enable users to search for documents on the World Wide Web.

Search Usability Search usability of a system refers to the evaluation to test whether the system is easy to use.

Synchronous Collaboration This collaboration refers to the situations when collaborators work together in the same time (Golovchinsky, Pickens, & Back, 2009).

Tourism It the travel related activities for recreational, leisure or business purposes. These activities are the sum of the phenomena and relationships arising from the interaction of tourists, business suppliers, host governments and host communities in the process of attracting and hosting these tourists and other visitors.

Tourism Information Searching It is defined as the information search process where individuals use various amounts and types of information sources in order to gather relevant information to facilitate travel planning (Fodness & Murray, 1997).

Usefulness Usefulness refers to the quality of having utility and applicability of any system.

1 Introduction

1.1 Background and problem statement

Traditionally, the common information sources used by tourists or vacation planners have included travel agents, tour brochures, newspaper advertisements, TV/radio, and visitor offices (Ho & Liu, 2005). The development of information technology, especially the Internet, has shaped the way in which travel-related information is organized and distributed as well as the way that people search for traveling information (Beldona, 2005). Nowadays information technology is playing a fundamentally important role in the tourism industry. The Internet has been steadily increasing as an important information source for visitors in recent years. According to the Travel Research Catalog (2012) issued by the U.S. Travel Association, around 162 million American adults used the Internet for trip planning and booking purposes. A recent survey by the Australian Department of Resources, Energy and Tourism indicated that some 62% of international visitors and 37% of domestic visitors relied on the Internet as an information source (Tourism Research Australia, 2011). Searching for information online plays an important role in tourists' travel planning and decision-making (Fodness & Murray, 1998). In recognition of online tourism services' business opportunities (Delgado & Davidson, 2002), specialized destination travel service portals and websites (such as Tripadvisor.com) have been developed and are currently operating to meet travelers' growing interest in online information search and decision-making. These online services organize and present travel information on various topics, including flights, hotels, attractions, and customer reviews. It is believed that understanding travelers' information search behavior is essential for identifying solutions to support online travel planning processes (Pan & Fesenmaier, 2006).

Interaction with a search system will lead to a user's altered state of knowledge, enabling him or her to define, reformulate and re-focus the information need and search strategies, and eventually to contribute to his or her underlying information problem-solving (Belkin, 1980; Du & Spink, 2011). Much of tourism information searching involves the processes of judgment and sense-making: for instance, judging the natural beauty of a place and making a

decision regarding whether to have a certain trip or not. Conversation with others may provide more information about this place. Research shows that when people collaborate they: (1) can accomplish more, (2) benefit from other people's experience and expertise on the given topic, and (3) influence each other and develop a more profound understanding of the subject than when they are isolated (Shah, 2008; Talja, 2002).

Research has shown that people intend to collaborate in various situations (Morris, 2007a). It makes sense to work together to solve certain problems (Denning & Yaholkovsky, 2008) and work successfully (Morris, 2007b; Morris, 2008). Nowadays people like to collaborate through the World Wide Web while searching for information (Shah & Marchionini, 2010). For example, people often desire to collaborate on search tasks (Levy & Marshall, 1994; Shah & Marchionini, 2010; Twidale, Nichols, & Paice, 1997). It is argued that introducing support strategies for collaboration and communication into information retrieval systems would help users to find information more effectively (Shah, 2010; Twidale & Nichols, 1996). Collaboration is the interaction among multiple participants who need to maintain some degree of mutual understanding (Baker, Hansen, Joiner, & Traum, 1999). *Collaborative information search (CIS)* deals with collaboration in searching for information (Fidel, Pejtersen, Cleal, & Bruce, 2004; Hansen & Järvelin, 2005). Studies on CIS have recently appeared in a variety of domains, such as academic research (Talja, 2002), group work command and control (Sonnenwald & Pierce, 2000), design (Bruce et al., 2003), education (Hyldegård, 2006), and healthcare (Reddy & Spence, 2008).

Considering an example in tourism domain, imagine a group of people who live in different places but are known to each other, they want to make a trip to a place during their vacation. Due to busy daily jobs and other activities they may not be able to meet together to plan and search for information for their trip. In such a situation, what can they do for finalizing their travel plan without contacting a travel agent? They share the same goal. The high-level idea of planning and searching information from the Web using tourism information systems or Web portals is required. Following are some of the scenarios that they may encounter.

Scenario 1: Planning the trip

One of the first needs of a prospective tour is that they need a good plan for preparing a search strategy, performing searches and finalizing the tour. A tourist who is planning to travel might look for places and activities and he or she may ask others for some events. The questions are:

how do they conduct these activities as they are not capable of meeting together? What are the current practices for performing these tasks?

Scenario 2: Fixing search strategies

To find information for this group travel, the collaborators need to fix up their search strategies such as dividing the search task. They need to discuss who will search for what. What types of Web portals and search engines they employ for conducting the search?

Scenario 3: Performing the search and communication

After planning the trip and fixing the search strategies collaborators need to perform the search, share the information and communicate to each other. It is important to know whether they perform the search individually or collaboratively, synchronously or asynchronously, how they share search keywords, what types of keywords they utilize for searching tourism information. What is the method of communication? What do collaborators do when they cannot find the information while searching individually? Is there any hindrance for performing these kinds of searches?

Scenario 4: Combining the search results and making changes if necessary

After collecting information individually or collaboratively, how the information is combined for drawing a conclusion on the information retrieved? Is there any way to visualize the results to collaborators? If obtained information does not satisfy everybody's requirements then what next?

This PhD thesis is an attempt to address above mentioned scenarios where collaboration among a group of known people can benefit the collaborators, the tools and methods they use for collaboration and the ways in which appropriate support can be provided for facilitating such collaboration.

There is, however, limited research on CIS in everyday life leisure activities such as in travel. To the best of my knowledge, only a few studies have been published on collaboration in regard to Web information retrieval in the tourism domain. Since enhancing social and interpersonal relations is one of the key tourist motivations (Hsu & Huang, 2008; Pearce, 2005), and tourists most often travel in groups with family, relatives or friends, it is reasonable to argue that tourist information search and retrieval tends to be more collaborative than a completely individual decision-making exercise (Mohammad Arif & Du, 2012;

Mohammad Ari, Du, & Lee, 2012, 2013; Prestipino, 2004). In most such cases, fellow travelers' demands need to be considered concurrently.

There is evidence suggesting that people tend to collaborate with each other for gathering information when information is unavailable, incorrect or incomplete when they seek information alone (Reddy, Jansen and Spence 2010). While information seeking activities are necessary for collaborating actors to acquire new information, these activities are often performed by individual actors or subgroups of actors (Fidel, Pejtersen, Cleal, & Bruce, 2004; Twidale et al., 1997). One of the most challenging parts of CIS is to continuously acquire information while at the same time avoiding a gradual disintegration of the actors' shared understanding (Hertzum, 2010). *Information flow breakdown* (IFB) is a real or potential adverse situation where the normal flow of information or information activities are hindered, which may lead to a decline in the attainment of information and retard the understanding of tasks/information (Galliers, Wilson, & Fone, 2007; Hertzum, 2010).

For example, in the medication process, multiple clinicians/physicians and nurses collaborate for the better treatment of their patients. It happens sometimes, however, that the relevant information such as a patient's allergy information has previously been sought and documented in the records by other clinicians. Yet the clinician who placed the order and the nurse who needed the information failed to consult the records and react on the information, which caused the patient who was allergic to penicillin to receive penicillin (Hertzum, 2010). Various types of information are involved in tourism, consequently, tourists' information search and decision-making processes are usually deemed complex (Proll & Retschitzegger, 2000). Adverse events in such collaborative searching context are a major concern. Investigating the IFBs during collaborative searching for tourism information is important if the continuous flow of CIS and shared understanding between individual tourists is to be achieved.

Gender difference has been found to be an important factor affecting travel information search as well as collaborative Web search behavior and search strategies (Large, Beheshti & Rahman, 2002; Xie, Bao & Morais, 2006). It is evident that there have been gender differences in retrieving information, applying navigational styles and formulating queries (Bowie, 2005; Paul, Berger, Pabon, Osterman, & Thirunarayanan, 2010). These gender differences are found not only in individual search but also in collaborative search (Martin, 1998). For instance, in a collaborative search behavior study in the classroom, Martin (1998)

observed that girl pairs displayed more collaborative work, and seemed more enthusiastic about the task than boys did. Although there are many studies on the effect of gender on information searching, only a few of them have been conducted in tourism information search context.

For example, in a study on tourism information search Ryan, Henley, and Soutar (1998) showed that males and females exhibited their differences in destination information choice. It was also observed that male and female demonstrated different attitudes in searching tourism information on the Web where females spent more time on the Internet and had stronger positive attitudes toward both online and offline travel information sources than males (Kim, Lehto, & Morrison, 2007). Despite these studies on gender-based tourism information search behavior, there are lacks in research on gender-based collaborative tourism information search. As male and female displayed different search behavior and information needs for tourism information (Xie et al., 2006) and these differences cause different behavior, further research needs to be conducted to explore the effects of gender in collaborative search in tourism context.

In addition to gender factor, cultural difference has also been viewed as a notable feature likely to influence travel information search behavior, especially the way a traveler makes a decision and which sources of information he or she utilizes to make that decision (Gursoy & Chen, 2000; Uysal, McDonald, & Reid, 1990). From an international perspective, culture is being treated as a critical factor influencing tourists' choice behavior. Even though the importance of culture on consumers' decision-making processes is well articulated, the role of national cultural characteristics on the travelers' information search behavior has not been given much attention by tourism researchers. Most studies have focused on the information search behavior of travelers from a particular country (Chen & Gursoy, 2000). Quite a few tourism researchers explored the impact of culture on information search behavior of travelers from different countries.

For example, Uysal et al. (1990) studied the information search behavior of German, French, British and Japanese travelers to the United States and discovered that travelers from different countries utilized different types of information with varying frequency. The cultural differences in vocabulary of query terms and query length are also being found during QR process (Spink, Ozmutlu, Ozmutlu, & Jansen, 2002). Previous study suggests that both culture and collaboration influence query reformulation process (Spink et al., 2002;

Mohammad Arif et al., 2014). Understanding the collaborative search behavior of tourists from different culture is critical for the system (search engine or Web portal) development strategy and the delivery of services provided by the system. It is believed that the study on tourists' culture-based information search behavior is one of the more potential areas of marketing research (Gursoy & Chen, 2000). It is therefore needs to expand the concept of collaborative tourism information search behavior of tourists based on their culture.

Since interactions and interpersonal relations are the key components of encouraging group travel (Hsu & Huang, 2008; Pearce, 2005), it is arguable that tourist information searching tends to be more collaborative (Mohammad Arif & Du, 2012; Mohammad Ari et al., 2012, 2013; Prestipino, 2004). However, there is still a significant discrepancy between tourism information searching on the Web and the collaboration process. The research on tourism information search behavior (Fodness & Nurray, 1997, 1998, 1999; Gursoy & McCleary, 2004) and collaborative information search behavior (Mohammad Arif & Du, 2012; Mohammad Ari et al., 2012, 2013; Prestipino, 2004) have been conducted separately. To fill the gap, it needs to study tourists' search behavior and the collaboration process together. This study aims to understand tourists' information search behavior in collaboration on the Web and to develop a CIS model for the tourism domain. A sound CIS model can be a significant milestone for developing collaborative search tools for tourism information.

1.2 Research questions

Imagine a situation where two or more tourists have a common goal of making a better trip plan and they are working together to satisfy their needs in the same timeframe sitting in the same place or different places. We do not want them to repeat each other's efforts, unless it is for verification or training purposes. Given that we successfully distribute a task among the collaborators, how do we distribute the results for their individual judgment? Should we divide the task, execute the requests, and distribute the results based on various aspects of tourism information? How do we evaluate it for commonality and conflicts among several or many people who are working together? How can we facilitate effective communication among the tourists? Many of these questions are often addressed using ad-hoc methods and work-around, such as emails, instant messaging, and meetings, as Morris (2008) showed in her study of knowledge workers. People have been using these general purpose tools to collaborate online (Morris, 2008), and there is an absence of integrated environments that could not only support search and communication, but also help the tourists discover and

learn about the information in collaboration that they may not discover if they work in isolation.

The goal of the work presented here is to understand tourists' collaborative search behavior and the barriers that hinder collaboration and search actions, the stages of collaborative search process, the employed strategies, the factors affecting the collaborative search process and the impact of gender and cultural background of users on collaborative tourism information search. Based on this understanding, a CIS system is built that supports an interactive collaboration during tourism information search. In order to achieve this goal the following primary research questions (RQs) are addressed:

RQ1. What are the characteristics of collaborative search behavior when searching for tourism information?
RQ2. What are the factors affecting collaborative search behavior in tourism?
RQ3. What are the design issues for developing a collaborative information search tool?
RQ4. What are the effects of gender and culture on collaborative tourism information search?
RQ5. How can users collaborate and retrieve information effectively in the tourism domain using a CIS tool?

1.3 Significance of the research

Collaboration is commonly observed in many situations. These situations span age, culture, gender and even task differences. In a gender-based collaborative web search study conducted in a classroom, Large, Beheshti, and Rahman (2002) demonstrated that their participants often desired to collaborate on search tasks. From a survey of knowledge workers, Morris (2008) showed the majority of them wanted to collaborate. It is believed that collaboration in many situations is vital to the success of the process (Morris, 2007b). Twidale and Nichols (1996) argued that introducing support for collaboration into information retrieval systems would help users to learn and use the systems more effectively.

When it comes to searching for tourism information, collaboration is a wise choice. Travel is one of the applications of CIS (Prestipino, 2004; Pröll & Retschitzegger, 2000; Yoo & Gretzel, 2009). Starting with destination choices and itinerary planning, dynamic information needs arise spontaneously during travel. A tourist can extend his or her stay at a particular place or shorten it due to rough weather or other unavoidable but unforeseeable occurrences.

Having communication and feedback will allow for refinement of the information as well as tour plan. Users can acquire information through communities. Communities are the networks of people that can exchange information. This might be personal networks like family, friends and workmates, but can also refer to wider groups of participants on the Internet. Inclusion of collaborative activities in searching for tourism information can produce more effective results.

The question as arises as follows: are these potential benefits enough to inspire people to collaborate even for the search tasks that can be done individually in the tourism domain? Several studies have shown that people want to collaborate in many situations (Morris, 2007a), and that it makes sense to work together to solve certain problems (Denning and Yaholkovsky, 2008). However, either most systems do not support such collaboration explicitly or the users may not realize the value in collaborating (Shah, 2010). It is crucial to identify the situations and issues of collaboration and tourists' collaborative search behavior and provide support so that the tourists can gain the benefits of collaboration during the information search.

Limited research has been conducted into CIS from the community of interactive information retrieval. Fewer studies have modeled the nature of CIS in tourism. Tourists' information searching behavior, type of collaboration, and the nature of retrieval of tourism information from the Web need to be explored. This PhD thesis focuses on identifying user search behavior in collaborative environment for retrieving tourism information and highlighting the importance of communication, collaborative query formulation and developing a collaborative interface for retrieving tourism information. The findings of this research will present an understanding of how collaboration works in retrieving tourism information. In the course of conducting this research, various systems and interfaces are also studied and a new system is developed that can serve as test beds for further research. The theoretical and practical significance of the research is summarized below.

1.3.1 Theoretical significance of the research

A theoretical significance of this study is related to building the collaborative model of tourists' information search behavior. This model will act as the basis for developing the collaborative information search tool for tourism.

Levy and Marshall (1994) noted that support for communication and collaboration is important for information-seeking activities, and support for the former is needed to support the latter. Twidale, Nichols, and Paice (1997) revealed that users often desire to collaborate on search tasks and argued that it makes sense to consider browsing as a collaborative process unlike how it is presented by a majority of search engines. They suggested that a system must acknowledge and support collaborative interactions among users. Collaborative tourism information searching involves searchers' interaction with others directly through vocabulary, phrases, texts or visual displays as information sources in a search task-related tourism information seeking process in an online or offline co-located/remote setting or synchronously/asynchronously.

Travel information seeking activities involve planning, decision-making, and anticipation of the trip with other people. The community may act as a gateway to the information repository, when information seekers are not sure they have the right information. This leads to collaboration in information seeking, although very few researchers discuss the role that collaboration plays in information-seeking activities in the tourism domain. Perhaps collaborative tourism information searching already exists in a certain manner during the process of information search and retrieval. In fact, tourists search for information through their family and friends, travel consultants (Snepenger & Snepenger, 1993) or travel agents (e.g., Kendall & Booms, 1989). Collaborative tourism information search may implicitly be regarded as searchers seeking for tourism information using multiple information channels.

While the issue of collaboration has attained considerable attention, much work is needed to address some of the important issues in tourism domain. This thesis helps in understanding the issues in collaboration for tourism information seeking and provides indications to enhancing user apprehension in a collaborative environment. One of the issues in a collaborative environment is the importance of communication and the ways to provide it. We do not have best practices for implementing and evaluating the impact of collaboration through communications in tourism CIS systems. We also don't have much knowledge about what tourists do during collaborative search, what they share, how they share information, how they distribute the search load, what are the problems they face, what are the steps they need to follow, what types of information they look for and whether they formulate query by oneself or collaboratively. This thesis attempts to address these issues through building a collaborative information search behavior model. The findings of the research presented here will augment our understanding of the way collaboration works in the information seeking in

tourism domain and the behaviors of the users in a collaborative environment. The proposed collaborative model will also enable researchers to develop better tourism CIS systems without burdening the users with unnecessary mental and/or physical load.

1.3.2 Practical significance of the research

With the advances in Internet technology, communication takes place from face-to-face contact to cyberspace. Jeong and Jang (2011) point to the impact of online communication in the travel-related industries. The influence of communication has emerged as an effective marketing tool (Jeong & Jang, 2012) and has driven customers to find tourism information (Okazaki & Hirose, 2009) on the Web.

Within an online environment, people also exchange opinions and critiques regarding travel-related services in the electronic bulletin board system (Ho et al., 2012). Although researchers and practitioners lay emphasis on individual tourism information search behavior in a long run, a few researchers in the field of information science explore tourism collaborative information search behavior by developing and designing associated systems. Prestipino (2004) proposes a community system supporting communication and collaboration in tourism, which is thread and forum-based. In this system, a user discovers his or her information need more explicitly as follows: the community provides accurate and up-to-date information for the individual's information needs, the shared information is accessible without interfering with the community, and this forum-based information is reliable because it is reviewed by many people. Sometimes real-time interaction is necessary for dynamic tourism information search. However, this forum-based collaboration model does not provide such real-time interaction among tourists for situations where they need information instantly because the system takes a longer time to respond. Indeed, chat, voice or video communication for planning search strategy makes the collaboration convenient (Talja, 2002). This thesis is involved in designing and developing a collaborative tourism information search tool supporting communication, collaborative searching and travel planning based on the collaborative tourism information search model.

One practical implication of this research for tourism information seekers who want to collaborate in the information search process is the importance of the sharing of experience or knowledge of tourists; which is vital for finding information for making travel plans. For instance, a person who visited the Taj Mahal in India can provide the best information or the

clue for finding the best information about it for other people who want to visit this famous site.

Another practical significance is that, as more people become involved in the search process for specific information (i.e. tourism information), the more information available about an object (place, accommodation, transportation, food etc.), the more likely are tourists to refine their search terms in their query for finding relevant information. This in turn will reduce search costs and the necessity for extensive external searching and help focus on specific attributes rather than on general information.

1.4 Contributions of the research

There are some works in collaborative information searching in different domains in which collaborative activities made information searching a better experience, including education, industry, healthcare, and military. For example, in healthcare researchers have studied collaborative information seeking behavior and explored how this collaboration influence the effectiveness of information seeking in intensive care units (ICUs) (Gorman, Lavelle, Delcambre, & Maier, 2002; Reddy & Dourish, 2002). The researchers observed that the doctors were curious about what other doctors reacted to a patients' problem and how they negotiated and documented information in relation to the same patient.

Another study of collaborative information seeking in medical settings (Reddy & Dourish, 2002) explored that the collaboration initiated the continual assembly and interpretation of collection of information (Reddy & Dourish, 2002). These activities led to the development of information visualizations, and the creation of common information spaces to get tasks completed in collaborative fashion (Reddy & Dourish, 2002).

Like other domains, this thesis research contributes to the tourism domain in that it makes the collaborative information search effective. This study is an attempt to understand the nature of collaboration among like-minded people and its benefits during the search for tourism information, the tools and strategies they adopt for collaborative search, and the ways in which appropriate support is provided for facilitating such collaboration. In this work, a CIS behavior model and a CIS stages model are presented which explain collaborative processes in information searching in the tourism domain and development of a collaborative information search tool.

This research concentrates mainly on two issues: i) tourists' collaborative search behavior analysis, and ii) collaborative information search interface design and implementation for the tourism domain. The critical part of this study explores the tourists' search behavior model involving various collaborative issues and activities. The contribution of this thesis is the exploration of tourists' collaborative search behavior model including collaborative search stages, search strategies, and information flow breakdown and the development of a CIS interface that creates a channel through which tourists are able to communicate and exchange their ideas and views during collaborative search. Another important contribution of this research is providing the support for CQ reformulation that facilitates collaborating tourists to formulate and reformulate their queries together. Exploring culture and gender-based query reformulation (QR) processes and tourism information choice behaviors are another contribution as well.

In summary, the research contributions include:

1 Exploring tourists' collaborative search behavior.
2 Proposing a model for tourists' collaborative search behavior including search stages, search strategies, search patterns and barriers while doing collaborative search.
3 Proposing an appropriate architecture of an interface for collaborative information search in the tourism domain.
4 Identifying tourists' collaborative QR types and patterns, gender and culture-based QR process and tourism information choice behavior.

1.5 Structure of the thesis

The thesis comprises six chapters. Chapter 1 provides an introduction to the thesis research topic. Chapter 2 presents a review of the literature, with a focus on the information search behavior, collaborative information search behavior, tourism information search behavior, and collaborative search tools. Chapter 3 describes the research design of three user studies (User Study 1, User Study 2 and User Study 3), including data collection instruments, selection of study participants, data analysis techniques, and justification of the methodology. The design issues of developing and implementing a CIS tool are also reported in Chapter 3.

Results of each user study and system evaluation are reported in Chapter 4. Chapter 5 contains a discussion of the key findings. The terms of these findings are guided by the research questions. Finally, in Chapter 6, a conclusion is made which outlines how this

research improves our knowledge of collaborative tourism information search behavior on the Web, the research's limitations and some further research directions.

2 Literature Review

This study focuses on user behavior in collaborative tourism information search. The review includes the study of user search behavior, collaborative information search behavior, tourism information search behavior, collaborative tourism information search behavior, and CQ reformulation behavior for information search. The tools and methods used for performing collaborative search are also reviewed. It is difficult to study the act of collaborative seeking information out of the context in which it is performed. Similarly, it is unrealistic to understand collaboration among users of an information seeking system without characterizing that underlying information seeking process. This perception has led us to study previous analyses from different points of view.

The relevant literature reviewed here is that which has covered the following themes:

- User information search behavior – literature covering the general notion of various user search behavior models.
- Collaborative search behavior – literature covering how users interact with the systems and collaborators while conducting the search in collaboration.
- Tourism information search behavior – literature covering tourists' information search habits and practices, determinants of search behavior and tourists' search behavior model.
- Collaborative tourism information search behavior – literature referring to collaborative information search behavior in tourism domain.
- Gender and cultural influences on information search behavior – literature referring to how gender and culture affect information search behavior in different domains both in the individual and collaborative environments.

- Collaborative information search tools – literature referring to the design of functionalities of collaborative search tools.

2.1 Information search behavior models

The Royal Society of Scientific Information Conference (1948) marked the beginning of the modern study of human information seeking behavior although this subject is older than that. This conference was the starting point for understanding how people used information. Before computer was used to store and retrieve information, the focus was on document use. Most work until early mid-1970s was concerned with system use rather than user behavior. Since the 1980s there has been a shift towards the person-centered approach rather than a system-centered approach. Several investigators are associated with this change and the names of Ellis, Dervin, Kuhlthau and Wilson are regularly associated with both shifts. Some of the information search behavior models are described below.

Wilson Model

Wilson model is based on diagrams published in 1981. His model (Figure 2.1) identifies 12 components (Wilson, 1981).

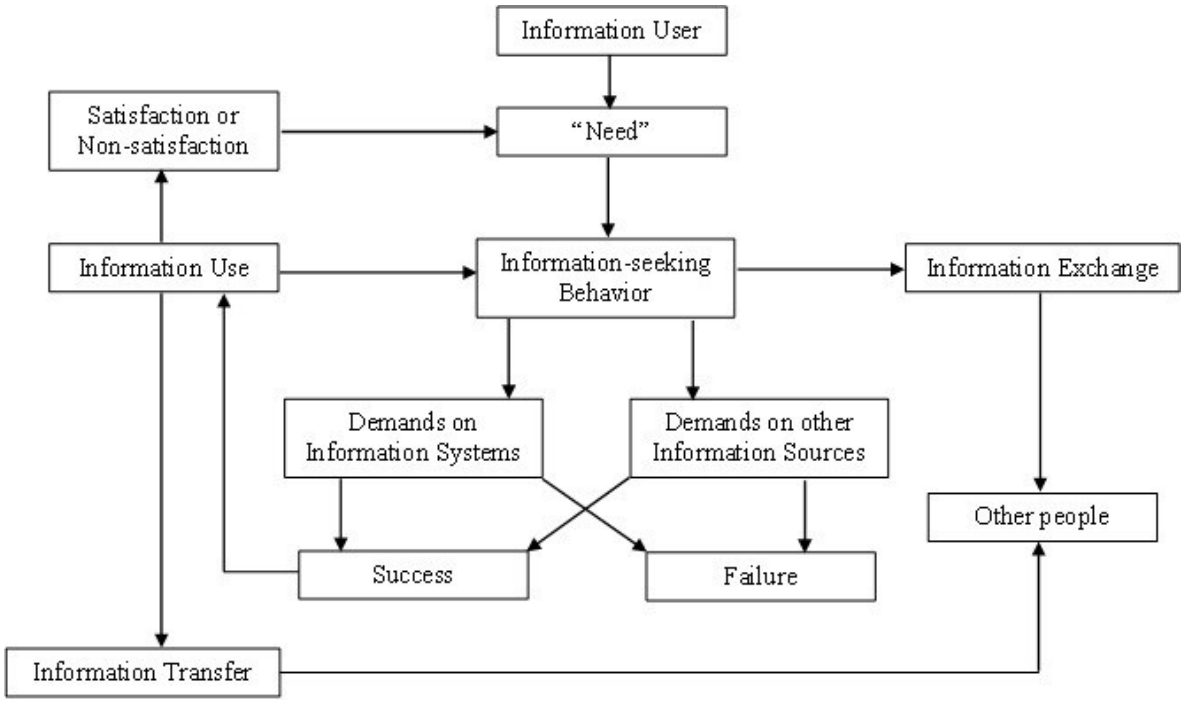


Figure 2.1: Wilson Model (Wilson, 1981)

Wilson's information user has a need, which may (or may not) stem from his or her level of satisfaction (or dissatisfaction) with previously acquired information. Wilson suggests that the perceived need then leads the user into a cluster of activities, the most straightforward of which is to make direct demands on sources or systems of information. The results of these demands lead either to success or to failure, which is presumed to be a dead end, as information that is not found cannot be used. It is odd, however, that "failure'' of "demands on other information sources'' are not depicted as directly feeding back to "need''. An important aspect of Wilson's model is the recognition that information is exchanged with other people (a process he calls information transfer) in the course of information use and seeking behaviors. As he points out, relatively little attention has been paid to informal transfer of information among individuals. But other people are an important source of information in many circumstances, even during direct interaction with a formal system such as a library. This model has some limitations: it does little more than provide a map of the area and draw attention to gaps in research; it provides no suggestion of causative factors in information behavior.

Krikelas Model

Krikelas' (1983) model was prescient in emphasizing both the importance of uncertainty as a motivating factor, and of the potential for an information seeker to retrieve an answer from their own memory or those of nearby persons. The Krikelas model contains 13 components. The causal process generally flows downward, with some provision for feedback loops. In describing his model, Krikelas asks us to imagine a situation in which a person becomes aware of a state of uncertainty about a problem (question, issue) and attempts to reduce that state of uncertainty to an acceptable level. The cause of that uncertainty may be a specific event or simply an ongoing process associated with work, ordinary life, or both. Naturally, for many issues much of the information required would already exist in the individual's memory; only a small part of a person's ongoing needs would produce an outward behavior that we might identify as information seeking. Furthermore the level of "urgency'' and the perceived importance of the problem would influence the pattern of information seeking. The Krikelas model (Figure 2.2) thus claims to be a general one that would apply to "ordinary life''. At the top of the model (implying a beginning), there are twin actions of "information gathering'' and "information giving.'' The activities of information gathering come about in response to deferred needs, which in turn have been stimulated by an event or the general

environment of the seeker. The results of information gathering are directed to memory or, in physical form, to some kind of personal file or other storage mechanism.

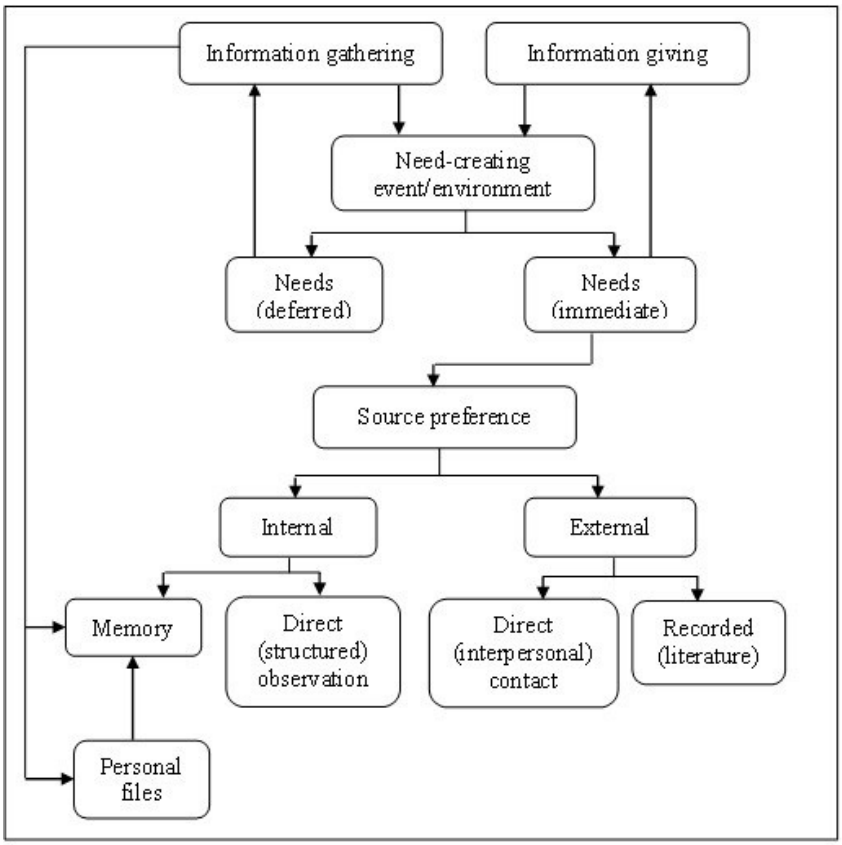


Figure 2.2: Krikelas model (Krikelas, 1983)

Information giving is defined as "the act of disseminating messages which may be communicated in written (graphic), verbal, visual, or tactile forms''. About information giving Krikelas says little, except to point out that individuals are typically both senders and receivers of information, and that neither role is independent of the other. As mentioned earlier, information gathering comes about because of an environment or event that creates needs. Some of these needs can be deferred, which leads to storage in memory and/or physical media, while other needs are immediate, or at least are dealt with as though they were urgent. To meet an information need, the searcher is assumed to consciously select a source. As Krikelas describes in his scenario, the source could be internal (i.e., oneself) or external (other people — communicated with through some kind of medium). Although Krikelas makes a hard distinction between "direct (interpersonal) contact'' and "recorded (literature),'' it is important to realize that today's expanded media environment blurs such boundaries. Although the main and preferred source of information for people is still likely to be face-to-

face conversation, “direct contact’’ could occur over a telephone or a videophone, or by way of e-mail, voicemail, or a videotape as well. Krikelas undoubtedly had in mind the main kind of “recorded’’ material one found in libraries two decades ago (books and journals), but the increased ease of asynchronous interpersonal communication makes the distinction between “recorded’’ and “live’’ difficult. Even the issue of what kind of human communication is truly interactive is a complex one (Durlak, 1987).

Ellis Model

Ellis (1989) did not depict his model as a diagram, but rather describes it in a series of paragraphs. He is careful to point out that it is not meant to indicate a fixed sequence of events, but instead, the order of actions might vary and be iterative as well. Developed using a grounded theory approach, the model first appeared in a study of university-based social scientists. Later it was used in an investigation of physicists and chemists and later applied to engineers and scientists in industry. Others have used in studies of humanities scholars. Ellis model initially featured six types of activities and later added the two final actions described below (Figure 2.3):

- Starting: the initial searches for information in which potentially relevant source are identified.
- Chaining: Following (backwards or forwards) chains of citations or other types of connections among materials.
- Browsing: Semi-directed search areas of potential interest, such as scanning tables of content, indices, and subject headings.
- Differentiating: Assessing and filtering sources of examining differences in nature and quality
- Monitoring: Maintaining awareness of development in a given subject area by regular checking of key sources.
- Extracting: systematic examination of a particular source to extract materials of interest.
- Verifying: Checking that information (.e.g., data and citations) is correct.
- Ending: Additional seeking at the end of a project, e.g., a final search of literature.

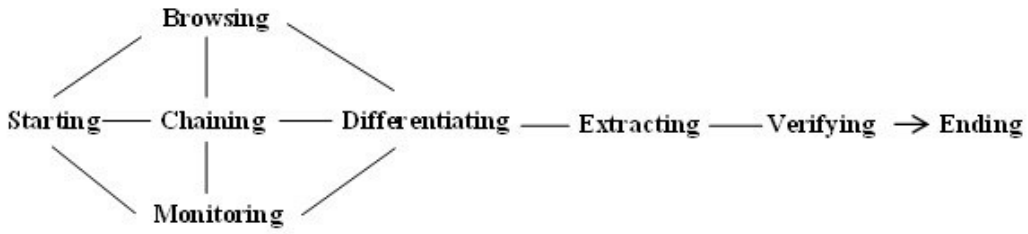


Figure 2.3: Ellis model (Wilson, 1999).

Kuhlthau Model

The model of "Information Search Process" by Carol Kuhlthau (1991) is universally applicable to any domain. Based on theories of learning, it depicts a series of cognitive and affective stages or behaviors through which people are thought to move as they find and evaluate information. Kuhlthau's model attempts a different level of analysis than the other models. Her model does not consider some factors and variables generally considered in information seeking research; or the availability of sources and their characteristics. Her focus is on the feelings, thoughts and actions that follow as a person becomes aware of a gap in their knowledge. The Kuhlthau model (Figure 2.4) includes seven stages, moving from left to right as a time sequence. At the extreme left of the model (the beginning) is the stage of "initiation", in which a person becomes aware of uncertainty or lack of knowledge about something. This is the birth of an information need, as the person identifies what is missing in their knowledge. The stage that follows is "selection" in which users select the topic they are pursuing and how to approach it. At this point one assesses one's own degree of interest, necessary tasks and available resources (time, relevant information), and tends to be optimistic about the process and outcome.

Task	Initiation	Selection	Exploration	Formulation	Collection	Presentation
Feelings (affective)	Uncertainty	Optimism	Confusion, Frustration, Doubt	Clarity	Sense of Direction, Confidence	Satisfaction or Disappointment
Thoughts (cognitive)	Vague →			→ Focussed → Increased Interest →		
Actions (physical)	Seeking relevant information exploring →				Seeking pertinent information, documenting	

Figure 2.4: Kuhlthau model (Kuhlthau, 1991)

In the third stage, “exploration”, feelings of doubt and confusion may arise, as sources are explored and the information search becomes difficult to frame or express to information systems or other persons. At this pint some seekers may abandon their effort to expand their understanding. The fourth stage is “formulation” a time when focus is sharpened and clarity of purpose may be achieved. At this point the search may narrow and confidence in the outcome tends to return. Stage five is “collection”, when effort is focused on gathering, digesting and recording the most relevant information on the topic. At the sixth stage, ‘presentation”, one is able to use the retrieved information to answer the initial question or complete the task (e.g., a report for school or work). Any further searching at this stage is likely to turn up redundant information. Finally, a seventh stage may be “assessment” of what one has accomplished, leading to improved self-awareness and esteem.

This model is distinct from the other models in that it focus on actions, and emotions that take place during a search while not offering a general explanation of the “before” and “after” of the sequence. That is the model does not depict any contextual factors leading to the recognition of an information need (e.g., school or work or everyday life demands and curiosities), nor does it follow the actions out to their specifics (e.g., types of sources considered and pursued).

Leckie Model

The model by Leckie, Pettigrew, and Sylvain (1996) features six factors connected by arrows, all but one of them unidirectional (i.e., “outcomes’’ and “characteristics of information needs’’ influence each other in mutual fashion). The Leckie model is depicted as flowing from top to bottom (Figure 2.5). The causal process begins on the top with “work roles,’’ which in turn influence “tasks.’’ The meaning of some of the terms is not explained in very much depth in the accompanying text, although some of their significance can be inferred from the authors’ review of other studies (seemingly the main objective of their article) and their discussion of commonalities among those studies. Given that the Leckie model is restricted to “professionals’’ (such as doctors, lawyers, and engineers), it is not surprising that “work roles’’ and “tasks’’ are thought to be the prime motivators for seeking. Although individual demographics (age, profession, specialization, career stage, and geographic location) are not depicted in the model itself, they are said to be “variables that influence or

shape the information needs,'' along with certain aspects of the need itself. The later include the context, frequency, predictability, importance, and complexity of the need situation.

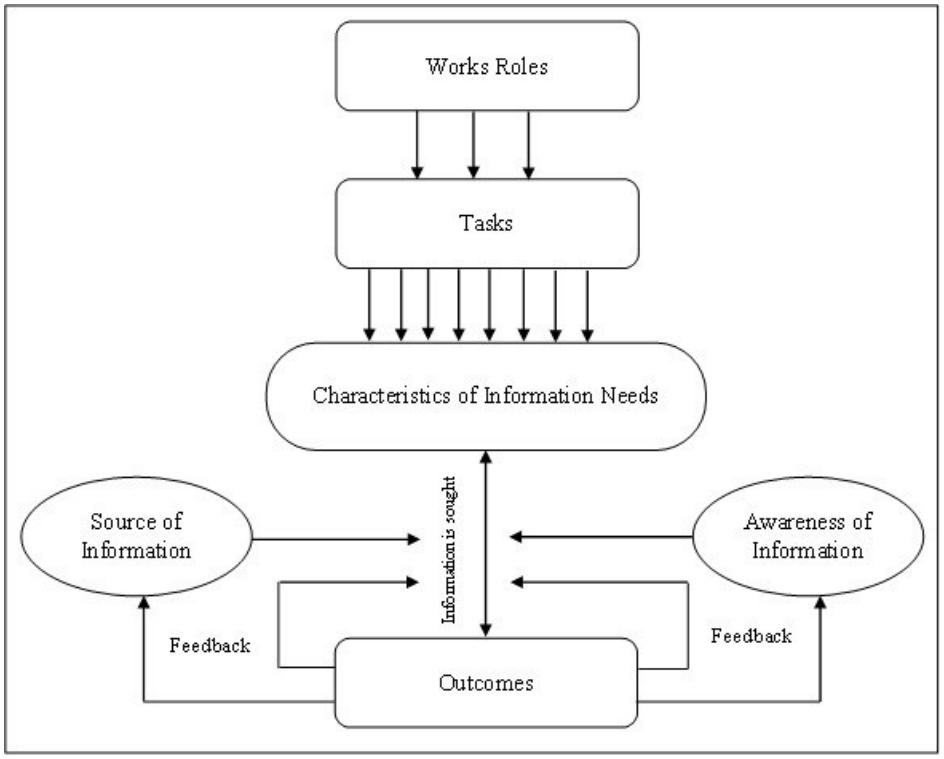


Figure 2.5: Leckie model (Leckie, Pettigrew, & Sylvain, 1996)

Because the emphasis is on the facts of working life, beliefs or attitudes are seemingly less relevant, so their role is not discussed. In the Leckie model, needs create an awareness of information sources and/or content, and thus motivate a person to examine those. Here, the most important variables are thought to be the familiarity and prior success with the source (or the search strategy employed), along with the trustworthiness, packaging, timeliness, cost, quality, and accessibility of the source(s). The Leckie model depicts information seeking behavior itself as a two-way arrow labeled "information is sought.'' The end results of information seeking, labeled "outcomes,'' affect most other aspects of the model through feedback loops to "sources,'' "awareness,'' and "information is sought.'' The diagram by Leckie, Pettigrew, and Sylvain is clearly intended to feature work-related processes. Thus, it has somewhat limited applicability to everyday life information seeking.

Byström and Järvelin Model

This model drew attention to the importance of "task complexity" in information seeking; that is, how an information seeker proceeds depends on the degree to which they see the task as complicated. Complex tasks are those for which a person lacks an adequate "mental model" that would enable them to judge exactly what needs to be done, or to evaluate information efficiently; such tasks are quite distinct from those of a routine variety. Byström and Järvelin (1995)'s painstaking study of 14 civil servants demonstrated that as the complexity of a task increases, needs grow for more complex information, for more information about the problem domain and problem solving; the successfulness of information seeking tends to decrease with complexity.

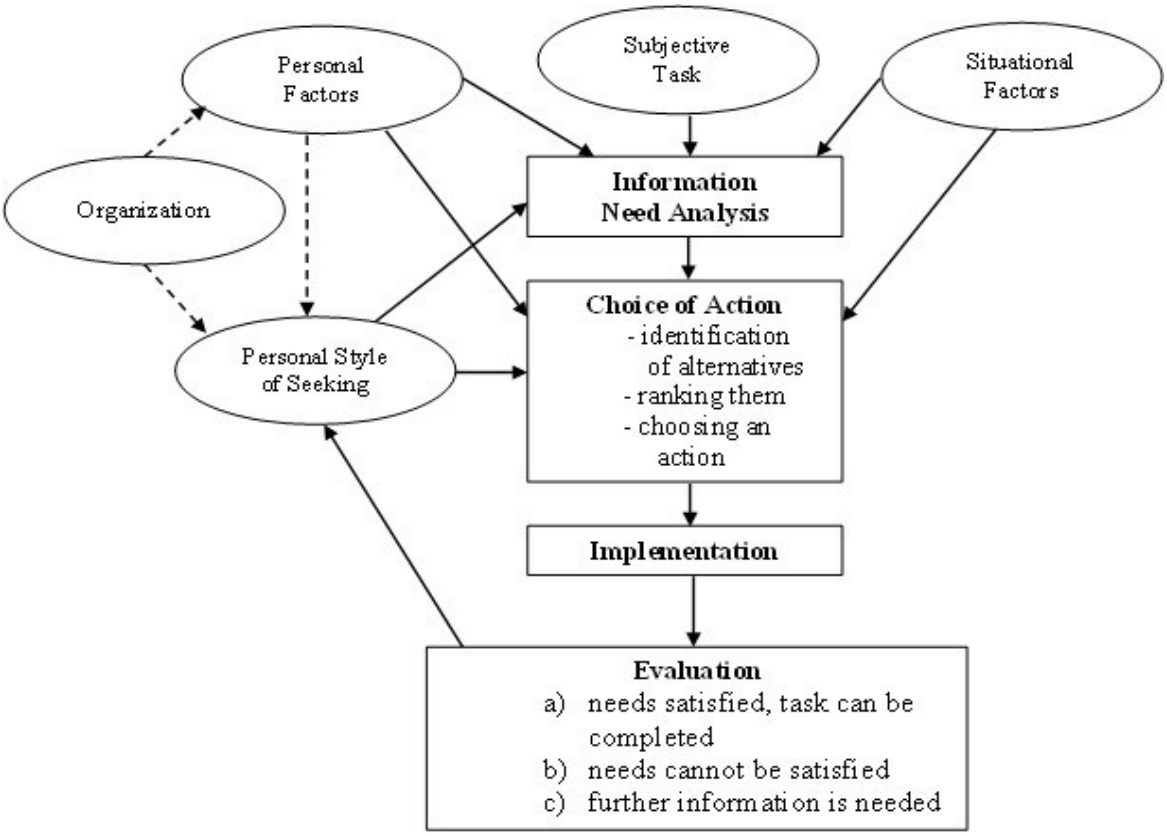


Figure 2.6: Byström and Järvelin model (Byström, & Järvelin, 1995)

The model (Figure 2.6) is structured as a feedback loop. It begins with the task as perceived by the user, and the personal factors (e.g., education, experience, attitude, motivation, and mood) and situational factors (e.g., time available for performing the task) affecting the user. These factors affect how the user determines what information is needed, and then what

actions (such as selection of a source) he or she takes to satisfy the need. Once a course of action has been chosen and implemented, the results are evaluated for sufficiency and pertinency; the evaluation tends to fall into one of three categories, roughly "the search is done," "the search is impossible," or "I need to continue searching." This evaluation feeds back into the determination of needs, yet is mediated by the user's personal style of seeking, which also affects the user's choice of actions to implement before results are obtained and evaluated. As with the personal factors, seeking style is also affected by the organization in which the user works.

These traditional information seeking behavior models are helpful for describing how people conduct their information searches, but it does not indicate clearly how their information search behaviors would be supported during their interaction with information search systems. Although the models described above are for individual information searchers, they will augment our understanding of users' information search behaviors that can be incorporated into the CIS environment.

2.2 Collaborative information search behavior

CIS refers to active and explicit searching of information for solving a specific task, involving human beings interacting with other human(s) directly and/or through texts as information sources (Hansen & Järvelin, 2005). CIS represents the important collaborations that take place between team members as they seek, retrieve, and use information (Bruce et al., 2003; Fidel et al., 2000; Fidel et al., 2004). For example, based on the examination of CIS activities of design teams in Boeing and Microsoft, Fidel and her colleagues found that team members collaborated when developing information seeking and retrieval strategies to address an information problem within the team (Fidel et al., 2000; Fidel et al., 2004). A team's information retrieval was qualified as CIS only when members participated in the same work process and together they acquired information they did not already have in order to resolve an information problem. There are some studies in collaborative information searching in different domains, such as in the academy, industry, medicine, and the military.

Previous studies have investigated systems and practices for collaborative information seeking in academic arena, including the types of information needed to support collaborative research, academics' information sharing behavior, and collaborative information seeking as a group learning method. In a combined ethnographic and experimental study of physicists, researchers discovered that successful scientific collaboration requires the collection and use

of a range of awareness information that updates team members on the current state of their teams' activities (Sonnenwald et al., 2004). The study investigated the types of information and knowledge that need to be shared to support situation awareness and the ways in which technology can be used to facilitate such information sharing. They discovered work patterns and practices. The study's main finding was the identification of three types of information that each team member needed to support his or her situation awareness: contextual, task-and-process, and socio-emotional.

Additionally, Sonnewald et al. (2004) identified a role for technology in supporting access to the awareness information. Studies of collaborative information seeking in the academy have also focused on academics' information sharing behavior (Talja, 2002). Talja (2002) identified four types of information-sharing practices: Strategic sharing occurs when information sharing serves a broader purpose or goal, for example, as part of a conscious strategy of maximizing efficiency in a research group. Research groups engage in paradigmatic sharing to establish a novel and distinguishable research approach or area within a discipline or across disciplines. Directive sharing involves two-way exchange of information, (in contrast with one-way information giving), such as when senior and junior scholars both benefit from the results of each other's searches. And social sharing contributes to relationship- and community-building activity. She also identified a role for digital libraries in supporting collaborative information seeking (e.g., collaborative keyword formulation, document retrieval, filtering, and problem solving).

Two further studies of collaborative information seeking in the academy illustrate its use as a group learning method. One study focused on understanding the characteristics of collaborative information behavior in a group-based educational setting and took the form of a case study of two groups of information science students (Hyldeghrd, 2009). The primary findings of Hyldeghrd (2009)'s study were that, over time, the subjects read and wrote more and searched less; that the perceived usefulness of information sources varied within the same group; and that group members' formulations of the focus of the project were generally weak at the beginning but strengthened over time - a process facilitated by increasing intra-group understanding; variation among group members as to their perceived degrees of understanding highlighted the need for good communication and discussion. Hyldeghrd (2009) concluded that both social sources of support and intragroup problems affected individuals' cognitive experiences on the project. A further study focused on understanding

the impact of extrinsic motivation on students' information behaviors in relation to their use of a collaborative information searching system (Shapira, Kantor, & Melamed, 2001).

AntWorld (Kantor et al., 2000) is a collaborative information finding system where items predicted to be of interest to a student are recommended to them by calculating the similarity between a student's current "quest" (i.e., an information need represented in the form of a description similar to a query) and the past quests of other students that have been stored in the system. In order for the AntWorld system to perform most effectively, students are expected to evaluate the items that they find, in this case through a rating system.

Examples of collaborative approaches to information-seeking tasks in industrial settings include two studies of the role of collaborative information seeking in research and development and a study examining the role of collaborative information seeking during patent application approval processing. A study of two teams engaged in the design of computer-related products focused on how team members collectively sought and shared external information acquired within the team (Poltrock, Grudin, Dumais, Fidel, Bruce, & Pejtersen, 2003). The teams serving as subjects were a software design team at Microsoft and a hardware design team at Boeing. In their analysis, Poltrock et al. (2003) isolated five collaborative information retrieval strategies: (1) identifying needs collaboratively, (2) formulating queries collaboratively, (3) retrieving information collaboratively, (4) communicating about information needs and sharing retrieved information, and (5) coordinating information retrieval activities. They also identified a role for a common information space specifically designed to support these collaborative information retrieval strategies.

Based on their analysis of a single case, Fidel et al. (2004) make a number of methodological points relevant to the adoption of a multidimensional approach. First, they introduce the notion of a collaborative information retrieval event (Fidel et al., 2004); second, they suggest that collaborative information retrieval serves not only informational purposes but also social and organizational ones; and third, they recommend that systems designed to support collaborative retrieval should incorporate features that support interactions between actors and enhance their access to one another's knowledge, ideas, and opinions or help them keep on track (Fidel et al., 2004).

Another study reports on collaborative information seeking during the patent application approval process (Hansen & Jarvelin, 2005). The study concluded by noting the importance

of collaborative information seeking and retrieval for the completion of a range of tasks specific to patent application approval processing (e.g., planning tasks, problem definition, search topic selection, and query formulation, search paths and query construction, and relevance assessments). The study also called for frameworks and models that move beyond single user interaction to collaborative interaction during information seeking and retrieval. Hertzum (2002) investigated how a group of software engineers assessed and chose their information sources. It turned out that whenever an engineer made a decision based on a given source the whole project became dependent on it. Consequently, discussion of sources became a recurrent issue at the project meetings. Indeed, one of the important roles of these meetings was to provide a forum for collaboratively reviewing the trustworthiness of sources that were being used or considered for use. Furthermore, it appeared to be a well-established conversational practice to accompany the mentioning of sources that might be new to some project participants with information that put these sources in context.

Investigators have examined collaborative approaches to information seeking in medicine and have identified a number of factors that affect the efficacy of information seeking in intensive care units (ICUs) (Gorman, Lavelle, Delcambre, & Maier, 2002; Reddy & Dourish, 2002). Such factors include coordination across a range of personnel (e.g., physicians, nurses, and pharmacists); the satisfaction of a range of information needs relating to the familiarization, stabilization, and monitoring of a patient's condition; and the dynamic nature of information seeking and use, as personnel update themselves on a changing clinical situation. The researchers noted that the physicians seemed to be attending only to information that had a direct bearing on the problem presented in the scenario (Gorman et al., 2002).

They also observed that the physicians invested a considerable amount of effort in the process of information selection, deciding what information to examine and what to ignore; that they frequently resorted to informal annotation and note-taking during the process of information selection; and that they were interested in knowing how a previous physician had navigated the documents in relation to the same patient. Field observations confirmed the assumption that the same information selections were being used and re-used by different personnel. Collaborative use and reuse of information led researchers to propose a new user model, based not on the individual user but on the collaborative user.

A further study enhances understanding of collaborative information seeking in medical settings (Reddy & Dourish, 2002). Conducted within the surgical intensive care unit (SICU) of a large metropolitan teaching hospital, it investigated how the work of the SICU, revolving around patient stabilization and bed management, motivated collaboration in information seeking not only among physicians but also between physicians, nurses, and pharmacists. Reddy and Dourish noted that this collaboration in information seeking, along with the constraints created by staffs work rhythms, created the need for the continual assembly and collective interpretation of a heterogeneous collection of information" (Reddy & Dourish, 2002). They observed the work of the SICU over a period of seven months, collecting data by means of formal and informal interviews, observations, and internal communications. Their main finding was that staffs work rhythms acted both as a resource for and a constraint on collaborative information seeking.

This led Reddy and Dourish (2000) to propose a new concept of information retrieval, one that moves away from the database query model to one that embeds information retrieval within work activities. Roles for technology in supporting such an approach include the utilization of awareness technologies that integrate information spaces with representations of activity, the development of information displays that incorporate temporal and cyclical information, visualizations, and social navigation approaches that create information spaces enhanced by the inclusion of temporal information on the scheduled work of the unit. In so doing, information retrieval systems act not as locations where information is stored and retrieved but as places where work gets done (Reddy & Dourish, 2002).

Collaborative approaches to information seeking have also been studied in military settings, more specifically in the conduct and organization of simulated command and control exercises (Prekop, 2002; Sonnenwald & Pierce, 2000). Successful performance of a command and control exercise requires a shared understanding of the mission, the battle plan, and of course the battle itself. This, in turn, requires the communication and sharing of information from multiple domains across groups of people. Sonnenwald and Pierce (2000) posited that each person involved in the exercise can be deemed an information handler. They gathered data on collaborative information behavior through analysis of command and control exercise documentation, observation of a simulated command and control exercise, and semi-structured and critical incident interviews. At the organizational level, Sonnenwald and Pierce (2000) found that the commander played an important role in identifying critical information needs, as did a plans and operations group responsible for creating situation awareness of the

battlefield among the battalion staff and the companies that report to the battalion (Sonnenwald & Pierce, 2000).

At the informational level, they identified three characteristics of information sharing and their ultimate impact on team performance. Two characteristics supported achievement of team goals: interwoven situation awareness involved shared understandings of the situation and dense social networks supported frequent, bi-directional information flow among team members; contested collaboration, however, where team members challenged the contributions of others hindered achievement of goals (Sonnenwald & Pierce, 2000). In another study, Prekop (2002) examined the collaborative information seeking behaviors of a working group created to perform a command and control exercise (Prekop, 2002). He identified three components of the working group's collaborative information behavior: information-seeking roles, information seeking patterns, and the contexts within which these roles and patterns were performed. He concluded by noting that collaborative information seeking has emerged as an important field of study. However, to be able to support collaborative information seeking with technology, a richer understanding of collaborative information seeking, based on studies of real world collaborative information seeking activities, needs to be developed (Prekop, 2002).

Based on their examination of the CIS practices of information workers in patent offices, Hansen and Järvelin (2005) claimed that awareness of each other's work activities played an important role in successful collaborative information searching. Awareness of team colleagues' work responsibilities and information activities is also recognized as supporting and facilitating marketing information sharing and collaboration in the workplace (Du, 2014). Shah (2013) further explored the effects of awareness support on coordination during CIS and found that teams with no awareness, or with personal awareness support, needed to spend more time and efforts in doing coordination than those with proper group awareness support. In general, research has suggested that the information search models focusing solely on individual users in an isolated situation should be revisited and extended to support collaboration in a group-based situation (Hansen & Järvelin, 2005; Hyldegard, 2006). Provision of appropriate group awareness support is considered to be essential for effective collaborations in a CIS system (Shah, 2013).

The aforementioned studies and models have informed our understanding of collaborative information search. However, little research to date has investigated in detail CIS behavior

during travel information search. Few CIS systems have been designed specifically for supporting tourists' collaborative search. Collaboration in obtaining travel information and planning a trip is quite common in everyday life. It is thus important to study and analyze tourists' search behaviors including trip planning and making decisions in collaborative environments. Such reflection will provide a guideline for designing CIS tools in the tourism domain.

2.3 Information search behavior in tourism

Web-based tourist information search behavior has been investigated by Ho and Liu (2005). They established the measures for search behavior as: total number of sites (with different initial URL) visited, total number of Web pages (or screens) viewed, total search time, the number of Web pages read within each site (including return visits), the number of information categories clicked within each site (including the return clicks), the number of different search engines used, the number of key words used by search engines, the number of sites visited by a search engine link, the number of sites visited by direct URL entry, the number of sites visited by site-to-site links, the number of within-site search engines used, the number of times the user returned to previously visited sites. A model for tourist information search behavior has been developed where search strategies are related to search contingencies, individual characteristics and behavioral search outcomes (Fodness & Murray, 1999). Another analysis has been conducted in the tourism domain to examine the impact of national culture on using information sources (Gursoy & Terry Umbreit, 2004). They also investigated the influence of national culture on the external information search behavior of travelers from the European Union (EU) member states. This study identified five distinct market segments based on respondents' information search patterns. Findings suggest national culture is likely to influence a traveler's information search behavior.

The travel behavior perspective focuses on what tourists do and why they do it, and places the emphasis primarily on travel planning and decision-making (Pearce, 2005). Advocated by many others, it is postulated that the experience of a trip begins with anticipation and planning, and sequentially involves the movement to the destination, the on-site experience and activities, the movement back to the origin, and the recollection and sharing of the experience (Crompton 1992; Crompton, & Ankomah, 1993; Dellaert, Borgers & Timmermans, 1997; McKercher, 1998). Many types of research have been developed to describe and explain the planning activities included in a trip. The decision model (Jeng, &

Fesenmaier, 2002) considers the decision to travel is a complex process which entails the solution of many sub-decisions or facets including destination, travel party, attractions, activities, timing, and route. Corresponding to the decision-making structure, information search manifests a sequential, hierarchical, and contingent structure whereby each facet of information is directly or indirectly related to all other facets. It is argued that the information required to plan each of the facets of the trip provide the basis for travel planning and that certain information is given priority in terms of the importance of each facet.

In the case of most travel decisions, particularly to new destinations, the search is often predominantly external, involving considerable effort and a variety of information sources (Fodness & Murray, 1997; Raitz, & Dakhil, 1989). Evidence suggests that travelers are likely to utilize the following four broad external information sources when planning their trips: family and friends; destination-specific literature; media; and travel consultants (Snepenger, & Snepenger, 1993). Literature also suggests that several factors influence travelers' external information search (Fodness, & Murray, 1998; Gursoy, & Chen, 2000; Vogt, & Fesenmaier, 1998). Factors mentioned are demographic variables; the environment (Fodness, & Murray, 1998); situational variables, e.g., previous satisfaction, time constraints, perceived risk, composition of traveling party; consumer characteristics, for example education, prior product knowledge, and socio-economic status (Schmidt, & Spreng, 1996; Vogt, & Fesenmaier, 1998); product characteristics, for instance purpose of the trip, mode of travel (Gursoy, & Chen, 2000); and culture (Gursoy, & Chen, 2000).

Gursoy and McCleary (2004) proposed a model which organizes determinants of search behavior into eight categories: previous visits, involvement, intentional learning, incidental learning, familiarity, expertise, cost of internal search, and cost of external search. All these categories are essential to better understand tourists' information search behavior.

The information search and decision process for tourists is complex (Fodness & Murray, 1997). Researchers have tried to capture this process and its influencing factors. For example, Fodness and Murray (1997, 1998, 1999) developed a general model that is the backbone for many subsequent studies (Vogt & Fesenmaier, 1998; Jeng & Fesenmaier, 2002; Gursoy & McCleary, 2004) investigating the whole process. A study within the DIETORECS project analyzed search strategies of users by observing them during their travel information search using an online travel agency (Grabler, & Zins, 2002). As a result six different decision styles were discovered. These decision styles orientate their search either on the price, destination,

accommodation, activities, and are highly pre-defined. In a study by Mitsche (2005), the keywords used within an open text query were manually recoded into groups and subgroups for a better understanding of the structure and kind of keywords users have in mind when they start their search. These groups were based on the common topics within tourism information (accommodation, hospitality, attractions, etc.). The detailed taxonomy derived is presented in the following table (Mitsche, 2005).

Table 2.1 Taxonomy for keyword aggregation.

Accommodation • Hotels • Other accommodation types • Accommodation named Attractions • Sights general • Sights more special (e.g. museum) • Sights named • City cards • City tours Destination (Places) • City name • Country name • Other places/surrounding areas • Special places named (address, centre) • Map Transport	Information • Information, Brochures • Guides • Special Information (e.g. weather) • Pictures • Languages Hospitality Activities (Leisure and Sports) Events • Events general • Evens named • Culture and music Target groups • Business, Jobs, Congress • Shopping • City breaks • Diff. target groups

The results of the study (Mitsche, 2005) show a general strong orientation on the city. Users look for a particular city, browse or are getting inspirations for choosing a city. Keyword search is adequately used but its major proportion is in the combination of the keyword with a particular city. Accommodation and destinations (places) are the categories users are most searching for, however, within a particular city users more frequently also quote attractions and transport. Keyword search within particular cities is also more specialized than a general keyword search. Overall the keyword search is dominated by a few keywords (hotel, map, information, guide and events) and a few categories (accommodation, destination and information). Since the search engine is the gateway to information it is important to provide links with appropriate tourism information to the user in a fast, easy and appealing way.

There have been a growing number of recent studies on how people plan their trips and search information collaboratively, including the effectiveness of assigning explicit roles to group

members in travel planning (Imazu, Nakayama, & Joho, 2011), the requirements for company employees in their social travel arrangements (Aizenbud-Reshef, Barger, Guy, Dubinsky, & Kremer-Davidson, 2012), as well as the prototyping study of a social website to support more unstructured, ad-hoc trip planning and information searching activities by remote users (Hargreaves & Robertson, 2012). Planning an itinerary of activities that satisfies a traveler's desires is a complex task. While there exist numerous online resources, searching information and creating a plan is difficult and time consuming (Rafidi, 2013).

If a traveler unexpectedly has an extra day to spend or a previously planned activity is closed, there is no immediate assistance available to them. One possible solution is to seek help from others to plan the trip. Zhang, Law, Miller, Gajos, Parkes, & Horvitz (2012) described a trip planning process through a crowd-powered trip planning application, where users input a natural language request and a list of constraints on the types of activities they want to have planned for them. This process takes several days to plan a trip, making it helpful prior to traveling but not during the travel.

Rafidi (2013) introduced another collaborative itinerary planning and information searching process where travelers can get quick and convenient assistance through a system Crowdcierge that supports real-time trip planning. The user sends a natural language request and then information is searched for planning the trip. After having all information, users can request changes in the plan at any time, as they encounter problems or wish to do something different during their trips. Based on the request, information is re-searched and trip plan is rearranged using the input, the current itinerary, and all previous ideas from the planning task. Though the author claims that this process is real time but the tourists still need to wait for the information and trip plan done by other people. The collaboration in this process does not occur between tourists; it occurs between tourists and other people who searches information and make tour plan for the tourists.

Understanding the trip planning process, information search patterns and the search starting point is the basis for innovative developments and improvements to support travelers' information search and decision processes.

2.4 Collaborative information search behavior in tourism

There are very limited studies on tourists' CIS behavior. In a study on collaborative activity, Prestipino (2004) proposed a community system supporting communication and collaboration

in tourism which is thread- and forum-based. In this forum-based system a user can discover his/her information needs more explicitly: the community provides accurate and up-to-date information for individual information needs, the shared information is accessible without interfering with the community, and this forum-based information is reliable because it is reviewed by many people. Sometimes real-time interaction is necessary for dynamic information searching like tourism but this forum-based collaboration does not provide such real-time interaction among users. As forum-based systems take more time to obtain any information, this model is not suitable for situations where tourists need information instantly. Real-time interaction among tourists is required in such situations.

Imazu, Nakayama and Joho (2011) investigated how explicit roles assigned to group members affected collaborative information seeking behavior during a travel planning task. Some paired participants were given a specific instruction to divide the roles into a searcher, while other pairs were given no such instruction. The evaluation looked at travel plans generated, search interaction logs, task perceptions, and dialogues between members. The results suggest that explicit division of roles can have significant effects on a group's knowledge building during the collaborative search task.

However, these particular studies have some limitations that are: the collaboration was assumed asynchronously; these studies did not consider any factors that might influence collaboration; and the studies were conducted with non-collaborative tool.

2.5 Query reformulation and collaborative query reformulation

Web searching is a process of querying and reformulating queries to satisfy certain information needs. Web searchers frequently modify their queries to obtain better results and this process is referred as query reformulation (Jansen, Booth, & Spink, 2009). Typical searchers have little tolerance for viewing low-ranked search results and they prefer to reformulate the query rather than see the complete result lists (Jansen et al., 2009). Previous studies have shown that 52% of users reformulate their queries (Jansen, Spink, & Pedersen, 2005). When information needs become complex and exploratory, it might be in searchers' best interests to collaboratively explore the information space and participate in shared learning (White, & Roth, 2009). For instance, healthcare providers tend to collaboratively search for information to diagnose a patient's illness (Hansen & Järvelin, 2005). Therefore, although information seeking has been traditionally studied as an individual search activity,

collaborative information seeking and QR have attracted much attention in recent years (Hust, Klink, Junker & Dengel, 2002; Hansen & Järvelin, 2005; Yue, Jiang, Han & He, 2012).

Complex and exploratory Web searches often involve iterative interactions with retrieval systems. Query formulation and reformulation are important topics not only in individual exploratory searches but also in collaborative searches which may cover issues such as patterns of QR (Jansen et al., 2009) and the reliable sources for query expansion. Typically users involve in multi-query sessions to fulfil their information needs. In her study Xie (2002) investigated the relationships between users' information seeking goals and their information seeking behaviors. She also illustrated how changes in interactive intentions are associated with changes of information seeking strategies. The results presented how eight types of interactive intentions, four types of entities, eight types of methods, and six types of resources constitute the patterns of interactive intentions and information seeking strategies.

Aloteibi and Sanderson (2014) investigated the ways in which users reformulate the queries to fulfil their needs. They showed that users mostly reformulated their queries by changing the content of the query rather than the structure. Understanding QR behavior and being able to accurately identify reformulation queries have several benefits. One of these benefits is learning from user behavior to better suggest automatic query refinements or query alterations. Another benefit is that, if we are able to accurately identify QRs, we will be in a better position to evaluate the satisfaction of users with query results. Identifying query terms for QR can be very useful in cases where the retrieved results are irrelevant to users' information needs. Successful assistance to QR must be designed based on the understanding of users' query behavior (Jansen et al., 2009). However, as a much more complex form of exploratory search, collaborative Web searching has seldom been the focus of QR research.

Researchers have developed different taxonomies concerning QR types. For instance, Fidel (1985) categorized two groups of QR, that is, operational and conceptual. Operational reformulation referred to query modifications with the same meaning, while conceptual reformulation changed the meaning of query components. Rieh and Xie (2006) further elaborated Fidel's (1985) classification to three QR dimensions, namely, content, format, and resource. In content change, they classified QR into four sub-groups: specification, generalization, replacement with synonyms, and parallel movement. Lau and Horvitz (1999) developed a method to automatically classify queries into four mutually exclusive types which included generalization, new, reformulation and specialization, depending on the

change of query content and query length. Based on prior work, Liu, Gwizdka, Liu, Xu and Belkin (2010) identified five QR types considering the common terms and differences in length of two successive queries, including generalization, specialization, word substitution, repeat, and new.

Previously learned queries and relevant documents have been reused in new and similar search sessions to improve the overall retrieval quality in CIS (Hust et al., 2002). Reddy et al. (2008) investigated the role of communication in collaborative information searching, from the perspective that the communication is necessary to establish common grounds among members of the team. They found that users communicated their plans, thoughts, and search queries through the chat functionality of the retrieval system while seeking information. Furthermore the communication (i.e. chat) function played a critical role in QR and in enhancing search results by enabling the team members to share common views. A collaborative querying system has been sketched (Fu, Goh, Foo & Supangat, 2004) to show how communication and prior queries help collaborators with query formulation and reformulation. In their work, Yue et al. (2012) identified that actions, such as querying, saving, viewing, and chatting, seem more likely to be the sources for new query terms in collaborative searches. They observed that despite the dominance of traditional resources such as previous search histories and relevant documents in QR, chat log is an important resource for new query terms in the leisure (travel) task. Yet little is known about the impact of individual queries and chat logs generated by team members on QR in the collaborative search process. This study is also interested in addressing these collaborative query (CQ) reformulation issues.

2.6 Gender differences in information search behavior

According to the Social Role Theory (Eagly, 1987), each gender tries to acquire specific skills and resources for successful gender role performance to meet the requirements set by gender roles. Earlier research (e.g., Broverman, Broverman, Clarkson, Rosenkrantz, & Vogel, 1970; McKee & Sherriffs 1957) identified a series of features differentially attributed to gender difference, with McClelland's work (1975) especially relevant to information search behavior.

According to McClelland (1975), males tend to be assertive, independent, self-centered, and they spend less effort in information search, thus probably searching fewer information sources and topics; conversely, females are more inclined to search for information from friends and relatives and they maintain interpersonal harmony. Following McClelland's

(1975) work, there have been more studies on gender-specific differences in information search behavior. For instance, Large et al. (2002) found that groups of boys significantly used fewer words per search and more one-word searches than groups of girls. In an eye-tracking study, Lorigo et al. (2006) observed men had greater average fixation durations on selected Web documents than females and that women submitted significantly longer queries to the Google search engine than what men did. In travel information search, Xie, Bao and Morais (2006) examined the influence of gender on tourists' information search behavior when visiting Yellow Mountain and Guilin in China. The authors identified gender as a factor influencing information search in terms of the number of information topics searched, the selection of information topics for search, and information sources. In terms of online travel sources, females attached more value to general websites and official destination websites than their male counterparts (Kim, Lehto, & Morrison, 2007).

In summary, previous studies of gender factor affecting information search behavior have shed more light on how males and females conduct their search, how they use the source of information and how they seek help from others during their searches in different ways. QR process is one of the information search behaviors reflecting searchers' information needs. In the travel context, tourists are found to reformulate queries for refining their results both in individual search and collaborative search. There have been a few studies on collaborative Web search showing the differences between males' and females' CQ reformulation. Since gender is one of the key factors affecting the travel information search behavior, it is worth examining the gender differences in tourists' collaborative Web searching including CQ reformulation strategies which is currently unexplored. The findings of such studies may be important for designing a CIS system that supports gender-specific collaborative search tactics.

2.7 Cultural differences in information search behavior

Culture has been conceptualized in many ways by researchers over the years. For example, Herskovits (1955) defined culture as everything that is human made, while Helman (1990) referred to culture as a set of guidelines which individuals inherit as members of a particular society, and which tells them how to view the world, and how to behave with other people. The culture of a society can be defined at different levels such as national, regional, corporate, and professional culture (Trompenaars, 1998). Hofstede (1980) identified five national cultural dimensions, these being: power distance, uncertainty avoidance, individual or

collectivism, masculinity or femininity, and Confucian dynamism. Together they described the common values of the central core of the culture that came about through the "collective mental programming" of a number of people (a tribe, a nation or a national minority) who were conditioned by the same life experiences and the same education (Hofstede, 1980).

Although the "collective mental programming" will not make everybody the same, a country's nationals share a common cultural character, the national norm, which is more clearly visible to foreigners than to themselves (Hofstede, 1991, 1995). Consequently in the present study, culture refers to nationality, for instance, if a person is Australian, he or she would be believed to have an Australian cultural background. Following Hofstede's work (1980, 1991, 1995), a number of studies have sought to explore the relationships between national culture and consumer behavior. Even though the impact of culture on consumers' decision-making processes has been extensively studied, the impact of national culture on travelers' information search behavior has not been given much attention except for a few studies (Chen & Gursoy, 2000; Gursoy & Chen, 2000; Uysal, McDonald, & Reid, 1990), which are reported below.

Uysal et al. (1990) studied the information search behavior of British, French, German, and Japanese travelers to the United States by examining how they used external information sources for travel information searching. The findings suggested that travelers from different countries utilized different information sources with varying priorities. For example, British travelers employed travel agents as the main source of information while family and friends were the most important information sources to Germans and French people. The authors also observed that Japanese travelers perused books and other library materials as their primary sources of travel information. Ten years later, Gursoy and Chen (2000) further investigated the information search behavior of British, French, and German travelers' when looking for external information sources at home to make their travel decisions to the United States. According to their study, German tourists relied slightly more on computers, i.e. online tourism portals and government travel agencies as information sources whereas British and French business travelers preferred airlines and travel agencies. On the other hand, British and French leisure vacationers were more likely to use tour companies, newspapers and magazines than others. These finding suggested that national cultures of travelers were likely to influence their information search behavior. Chen and Gursoy (2000)'s study on travelers from Britain, France, and Germany to the USA confirmed that national culture along with their past experience influence travelers' information search behavior.

Gursoy and Umbreit's (2004) study on information search behavior of tourists from 15 European Union countries suggested that travelers from France, Greece, the Netherlands and Spain preferred to use travel guides and free tourist information leaflets more than other national culture segments identified in the study. Travelers from Denmark and Finland tended to access the Internet and other written information sources more than other nationals. Furthermore, travelers from Austria, Germany, Ireland, Luxembourg, and Sweden were more likely to use TV/radio and travel agents as external information sources. The results confirmed that national culture is likely to influence travel information search behavior. The findings are consistent with the results of previous studies in that culture was considered to be one of the important factors that impact on the way travelers make their vacation decisions (Chen & Gursoy, 2000; Gursoy & Chen, 2000; Vogt & Fesenmaier, 1998).

In addition to the effects on tourists' information search behavior, the factor of nationality has also been studied in the context of general Web search behavior and QR strategies. For example, Spink, Ozmutlu, Ozmutlu, and Jansen (2002) analyzed the searching behavior of European users of the FAST search engine compared with U.S. users who looked at the Excite search engine. Results highlighted clear differences in the topics searched and search behaviors, such as the vocabulary of queries used and query lengths, across the two countries. Boldi, Bonchi, Castillo, and Vigna (2008) compared QR patterns identified in query logs from Yahoo! UK and Yahoo! U.S. U.S. users were found to employ more QR than UK users in generalization and parallel move. In contrast, UK users performed more QR than U.S. users in specialization and changing words. In a recent study, Jesper, Clough, and Hall (2013) investigated the effect of geographical region (country) on the queries issued and typical patterns of QR for searches at The National Archives (TNA), the UK government's physical and digital repository for all government documents. As suggested by prior work, culture has been identified as a significant factor in information search behavior including the tourism domain. However, the impact of culture on collaborative search behavior and CQ reformulation during tourism information search remains under-explored. To fill this gap, this thesis aims to study the effect of culture on collaborative tourism information search behavior.

2.8 Collaborative information search tools

Many critical situations call for collaboration. When it comes to accessing or processing some information, it seems that in many situations, people working together are able to do a better job than any one of them individually. In many problem-solving cases, it seems that when

people work together in collaboration they can complete more jobs, benefit from one another's experience and expertise on the given task. They influence one another and develop more understanding than when they are isolated or alone. Collaboration is intentional and more beneficial. To develop a model of CIS interface, this research reviewed some existing collaborative interfaces. Then a collaborative interface for tourism information retrieval is proposed as a part of this study.

Some tools have been developed to support collaborative search, such as Cerchiamo, Querium, Ariadne, SearchTogether, and Coagmento. Cerchiamo (Golovchinsky, Adcock, Pickens, Qvarfordt, & Back, 2008) provides an independent interface that supports synchronous communication and algorithm mediation for collaboration, while Querium (Golovchinsky & Diriye, 2011) facilitates session-based collaboration that keeps track of query and other activities during a specific session. Ariadne (Twidale, Nichols, & Paice, 1995) includes collaboration through annotated discussions, asynchronous comments, and search process visualization. In addition to the query formulation and division of labor, SearchTogether (Morris & Horvitz, 2007) supports searchers' collaboration through instant messaging while searching. By emphasizing query, result, contextual and workplace awareness, Coagmento (Shah & Marchionini, 2010) was designed to include a search interface, chat, and document space, and there was no need to switch to different windows or tabs such as those in SearchTogether. As a tourism-specialized CIS system, Prestipino (2004) proposed a system architecture which was considered to be more suitable for community-based creation, storage, and diffusion of tourism information. The author believed that the system should support communication, for example, through a forum, and should provide facilities to build and maintain the community knowledge (i.e. shared materials) collaboratively. Specifically, the online communities should not only provide places for socializing and give social support to their members but also create and distribute valuable tourism information. The details of design and functionalities of some CIS tools are discussed below.

2.8.1 C-TORI (Cooperative Task-Oriented Database Retrieval Interface)

Information search in databases should be a highly interactive process in which the steps of target recognition (i.e. result browsing) and QR are iterated to approximate an optimal or ideal result. Intelligent support and human-human cooperation between end users are complementary means to support this process. To support human-human cooperation, the

researchers have to consider synchronous and asynchronous communication channels. In this model, Hoppe & Zhao (1994) concentrate on synchronous communication and cooperation in the task environment. Communication in the cooperation model of C-TORI is supported by general operations (copy, merge, etc.) in each step of the iterative cycle of database retrieval.

C-TORI employs a centralized cooperation control. A coordinator distributes retrieval tasks to a group of information searchers who may work remotely. Each searcher uses his or her knowledge and tools to perform the assigned tasks individually. Once a task has been finished, the coordinator is requested to collect and integrate the results, by opening multiple query (and result) forms to which the participant's query specification or query result is copied, or with which the participant's query (result) window is coupled. During his or her individual work, each participant is free to communicate with the coordinator for suggestions and discussions, or to ask the coordinator for establishing direct couple links with other participants.

Even in the formulation of single queries, users may cooperate, e.g. exploiting their different knowledge of the domain vocabulary or of the semantics of the database. C-TORI supports a group of users in jointly specifying a query at the same time. However, this technique needs a coordinator to initiate and control the collaborative process. So the users do not independently collaborate with each other.

2.8.2 TeamSearch

TeamSearch (Morris et al., 2006) is a collaborative tool for searching collections of digital content, such as photos, that have previously been associated with relevant metadata. TeamSearch users sit around a DiamondTouch table, which is run by a 3.2 GHz PC, and a display is top-projected onto the table's surface with a projector. The DiamondTouch is a touch-sensitive surface that can receive simultaneous touch input from each of up to four users, and of identifying the location of each touch on its surface as well as identifying which of the four users are associated with each touch event.

A rectangular area in front of each of the four users is initially blank – this is the area where query results, shown as thumbnails corresponding to query-satisfying images, are be displayed. To each user's left is a circular token marked with a "?" – this is a query token. A user can move a query token by touching and dragging it about the surface of the table with his fingertip. When a token is moved from its original location, a new one appears underneath

it – essentially, there is an infinite pile of query tokens for each user. Near the center of the table are several circular widgets, which are subdivided into wedges. Each circle represents a category of metadata (e.g., "location"), and each wedge within that circle is labelled with a specific possible value for that category (e.g., "Italy," "Israel," "Sri Lanka").

Under the collective query tokens implementation, when tokens are placed onto the circular widgets the system interprets all tokens collectively as a single query no matter which group member placed them. For example, if User X placed a token on "Larry" and User Y placed a token on "Lisa" and a token on "Sri Lanka," then the result would be a single query "location=Sri Lanka AND people=Larry AND people=Lisa," and the thumbnails that matched that query would be displayed in front of each user. For collaborative information search, people need to be co-located. Two demerits of this system are: it is not suitable for Web search and it does not support more than four users.

2.8.3 SearchTogether

SearchTogether (Morris & Horvitz, 2007), on the other hand, is based on information seeking on the Web. This CIS tool facilitates collaboration by supporting awareness, division of labor and persistence. It focuses on supporting collaboration during the process of searching the Web, including formulating query, exploring search results and evaluating the information that has been found. SearchTogether instantiates awareness in several ways, one of which is per-user query histories, which is done by showing each group member's screen name, his or her photo, and queries in the "QueryAwareness" region. Access to the query histories is immediate and interactive, as clicking on a query retrieves the results of that query from when it was executed. The authors identified query awareness as a very important feature in collaborative searching, which allows group members to not only share their query terms but also learn better query formulation techniques from one another. Another component of SearchTogether that facilitates awareness is the display of page-specific metadata. This region includes several pieces of information about the displayed page, including group members who viewed the given page, and their comments and ratings. Thus, SearchTogether provides awareness support via person, query, or Web page.

The persistence of the query history associated with a search topic in SearchTogether aims to reduce the wasted effort of query repetition by providing users with a shortcut to revisit prior results. The authors claim that such visitation information can help one to choose to either avoid a page already visited by someone in the group, to reduce the duplication of efforts or,

perhaps, visit such pages, as they provide a sign of promising leads as indicated by the presence of comments and ratings.

The upside of the system is: i) it supports collaboration during Web search; ii) since it stores the queries and search results, it reduces the duplication of search which has been found already by any user in the group; and iii) it reduces the cognitive overhead of application switching between browsing and instant messaging by integrating instant messaging and browser in a single window. On the other hand, the downside of this tool is that it does not support the execution of query as a single one if multiple users provide the queries for the same target.

2.8.4 MUSE and MUST

Krishnappa (2005) developed a CIS model (MUSE – Multi User Search Engine). This prototype allowed them to examine how teams' members who may not be physically co-present interact while collaboratively searching for information. MUSE (Krishnappa, 2005) allows two users to search independently for information while sharing that information and at the same time communicate with each other through a built-in chat feature. MUSE is a fully functional prototype developed using JAVA and JAVA Swing. An Apache server was used to enable networking between different computers. MUSE has features to support communication and sharing of the search results between two users. The front-end interface consists of three distinct features: search, share, and chat.

- Chat: MUSE supports text-based messaging between two users.
- Share: Users can share the search results with each other in the share window. The users selects the results they want to share from the results in the search window and then clicks the 'share the search results' button. The results will appear in the share window of the other user.
- Search: Users type in a keyword to search for information. The search engine retrieves the available results from the database and displays the first twenty results.

Though it was an effective collaborative search tool, it had some limitations. For instance it did not support complete sharing of search result (displayed only few results) and it failed to display the queries to collaborators.

Reddy et al. (2008) developed another collaborative information searching prototype known as MUST (Multi-User Search and Talk) where communication was the focus of CIS. In

MUSE Chat played an important role in supporting the CIS by allowing team members to interact with each other during the process. MUST provided automatic search feature and also both the search results and search histories were visible to users but MUSE did not provide a search history that was visible to all users.

2.8.5 Coagmento

Shah and Machionini (2010) described collaborative information seeking where different kinds of awareness (understanding of activities of others which provides a context for your own activity) are the main issues. They developed a collaborative information seeking tool called Coagmento which provides support for communication and awareness of personal and group histories while working together. Their work is not to study the optimal design or compare different designs for collaborative information seeking tool but to examine the impact of different awareness components for their effectiveness, efficiency, usefulness and usability in supporting collaborative activities and inducing higher levels of satisfaction and engagement in collaboration. Coagmento includes a toolbar and a sidebar. The toolbar has several buttons that help one to collect information and be aware of the progress in a given collaboration. The sidebar features a chat window, under which there are three tabs with the history of search engine queries, saved pages, and snippets. With each of these objects, the user who created or collected that object is shown. Anyone in the group can access an object by clicking on it. For instance, one can click on a query issued by anyone in the group to rerun that query and retrieve the results in the main browser window. This is an interface that supports online collaboration like SearchTogether and it emphasizes query, result, contextual and workplace awareness.

The comparisons of these above mentioned CIS tools are presented in Table 2.2 based on the following characteristics:

- Number of users supported by the tool
- Whether they tool supports synchronous collaboration or asynchronous collaboration or both
- Whether they support remotely located collaboration, or co-located collaboration or both
- Query sharing capability
- Results sharing capability

- Chat functionality
- Whether they are suitable for database searching or Web searching
- Search domain for CIS tools

Table 2.2. Comparison of different CIS tools.

CIS Tools	Characteristics							
	Number of users supported by the tool	Synchronous or Asynchronous	Remote collaboration/ Co-located collaboration	Query sharing	Results sharing	Chat functionality	Suitable for Database or Web searching	Domain
C-TORI	any number of users	Synchronous	Remote	Yes	Yes	No	Database	General
TeamSearch	4	Synchronous	Co-located	Yes	Yes	No	Database	Digital photo
SearchTogether	any number of users	Both	Remote	Yes	Yes	Yes	Web	General
MUSE	2	Synchronous	Remote	No	Yes	Yes	Web	General
MUST	2	Synchronous	Remote	Yes	Yes	Yes	Web	General
Coagmento	any number of users	Both	Both	Yes	Yes	Yes	Web	General

2.9 Chapter summary

A review of the literature from Information Search Behavior, Information Search Behavior in Tourism, Collaborative Information Search Behavior, Collaborative Tourism Information Search Behavior and CIS tools was presented in this chapter. The main findings of the review are summarized below.

It is concluded that collaboration involves a group of people intentionally working together in an interactive mode to achieve a common goal. The focus in this thesis is on exploring the collaborative search behavior in the tourism domain and facilitating the CIS coordinated by a CIS tool. A number of models for information searching were discussed and the models that are based on tourism information access and organization were criticized.

Since one of the aims of this research is to develop an interactive CIS system for the tourism domain, it was essential to look at various tools and system interactions. As such, this research reviewed a number of CIS tools that address various issues of CIS and implement environments for searching or browsing information in collaboration. To summarize, the following key points were derived from the review of the literature.

- Collaboration involves people working together for the solution of a common goal, not for just working together or interacting to each. Collaboration is intentional and interactive.
- The value of collaboration in information seeking depends on the type of task. People may not find collaboration useful in simple known-item or fact-finding tasks. It may help an individual to achieve what he or she could not do while working in alone.
- Understanding derived from literature about how people communicate and work with each other is very useful in realizing CIS environments.
- While collaborating over an information seeking process, collaboration among the users can occur at various levels: (i) while making search strategy (ii) while sharing query terms, (iii) while sharing results, and (iv) while making decision on obtained results. A CIS system should support all of these levels for effective collaboration.

Having reviewed relevant literature, it is clear that there are still several issues that are missing in the field of CIS. Some of them come as follows:

1 Obtained a fairly good understanding of why people collaborate. However, these motivations are not identified in the context of situations (i.e. tourism) in which

collaboration occurs. There are few or incomplete model of user behavior which cannot reflect the attributes of comprehensive collaborative tourism information search activities.

2 The literature points to a list of tools and methods that people use for collaborating. However, the relative merits of these tools and methods are not very clear for a specific domain. Often tools were not specifically designed for collaboration for a specific domain. One could argue that we need specialized tools to support CIS, but we do not know what such tools may look like and how we could promote them to people without causing additional burden to them. There are very few studies on design and support for developing interfaces for searching for tourism information but they are not designed for supporting synchronous CIS in the tourism domain.

These issues are at the core of the CIS domain, and studying them could help us get closer to having a better understanding of users' behavior in CIS environments, as well as designing better CIS systems. From these, the present thesis focuses on the issue of collaboration in the tourism domain. To be precise, the thesis investigates how and why tourists collaborate, how they plan tourism information search, what are the primary activities during collaborative tourism information search, what they do at different stages of their collaborative search, and what types of problems they encounter during this collaborative search. It will also help us to understand various behavioral patterns of the user in a collaborative environment. Finally, this thesis is important and timely even though the value of collaboration is a complex task. The models and concepts obtained from collaborative tourism information search studies and designing and developing a CIS tool for the tourism domain are the main contributions of this PhD thesis.

3 Research Design

Three sequential studies, namely User Study 1 (Survey through questionnaire), User Study 2 (Simulated tourism CIS with existing tools) and User Study 3 (Tourism CIS with ColTIS) were designed to answer the research questions. Along with the research design, the development of a CIS system is also described in this chapter (Section 3.3). The results of the evaluation of the system are presented in Section 4.4 of Chapter 4. A flow chart showing how the user studies (involving RQs) and CIS tool development took place, is shown in the following figure (Figure 3.1).

As parts of this PhD thesis, three user studies namely User Study 1, User Study 2 and User Study 3 were conducted. The purpose of the User study 1 was to identify habits and practices of tourists' collaborative information searching. In User Study 2, collaborative tourism information search environment was simulated and this study investigated collaborative tourism information search behavior, stages of collaborative tourism information search and information flow breakdown in collaborative search for tourism information. In both studies, the main goals were to explore the collaborative tourism information search behavior in general perspective irrespective of gender and culture. Then this PhD study further looked into gender and culture-based tourism information search behavior through User Study 3 as gender and culture are considered as important factors for tourism information search in individual and collaborative mode. Consequently, there were equal number of participants for male and female in User Study 3 but not in User Study 1 and User study 2.

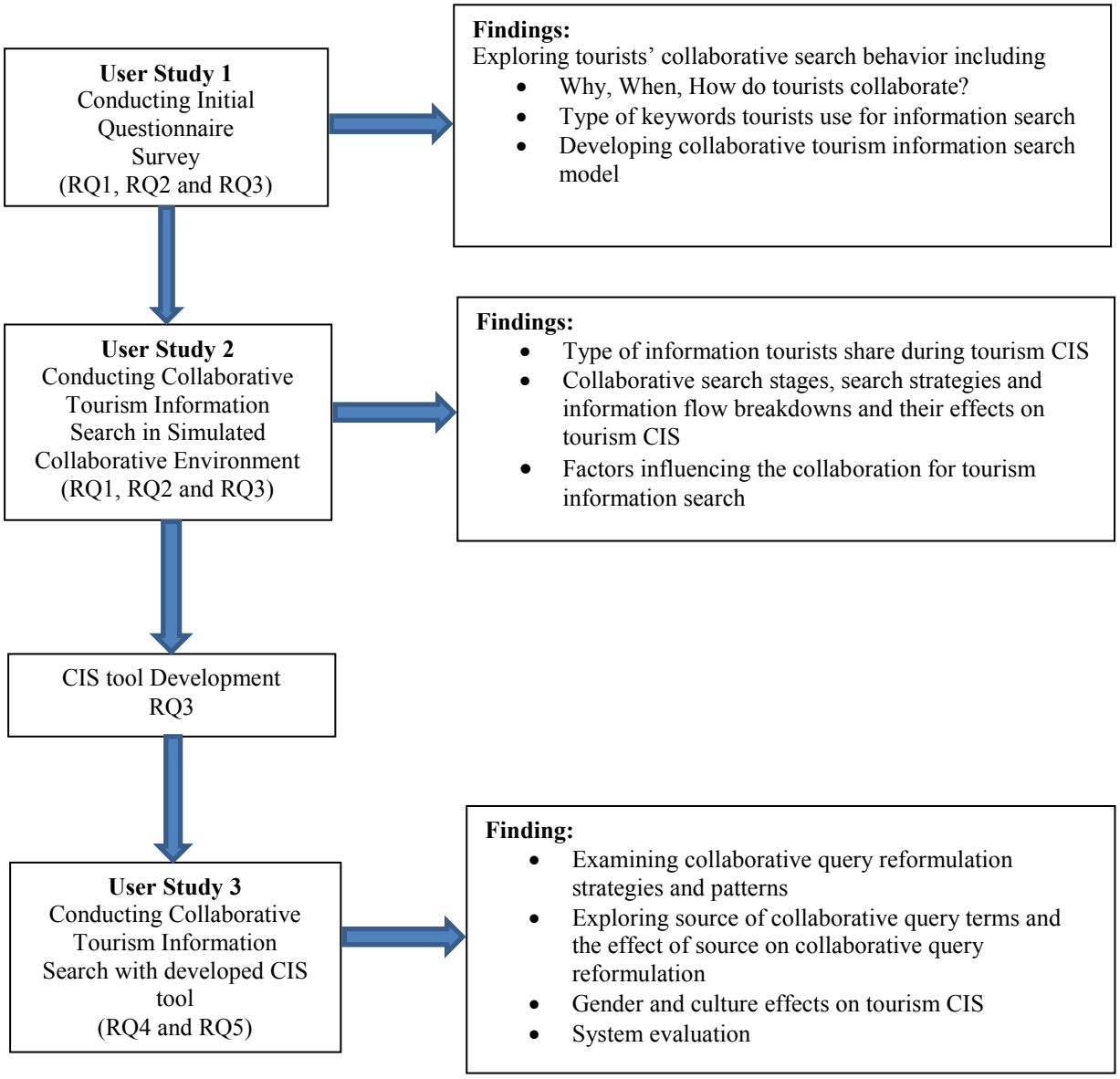


Figure 3.1 Flow chart of user studies undertaken in this research.

The following sections describe the methods of data collection and analysis employed in each user study.

3.1 User Study 1: Survey through Questionnaire

The objectives of Study 1 were to:

- investigate the characteristics of collaborative user search behavior when searching for tourism information
- explore the frequent search keywords used for tourism information searching by the collaborators
- find out how users can collaborate and retrieve information effectively in the tourism domain
- determine the characteristics of a CIS interface in the context of tourism
- identify the design issues for a tourism information retrieval interface

To that end, an initial survey was conducted in a university community. This study explores the user collaborative behavior and activities relating to tourism information search. The study entails a survey questionnaire and data analysis. The participants of the study included PhD students and academic staff (researchers, teachers and academic support officers) in a university in Adelaide, Australia.

3.1.1 Questionnaire design

A survey questionnaire (see Appendix A) was designed to obtain preliminary data about users' information search behavior and the collaborative activities during tourism information.

This study is the preliminary phase of the PhD research, which is limited to the survey through a questionnaire and addressed some of the very fundamental issues of collaboration in tourism information search such as how and why people collaborate together, and what methods and tools are used while collaborating. To investigate these issues and come up with design guidelines to build support for CIS tool, potential participants were contacted for the survey questionnaire regarding their tourism information search experiences with collaboration. The method of collecting data by questionnaires is most extensively employed in various economic and business surveys. User Study 1 aimed to understand how people typically collaborate in tourism information searching. In particular, the focus was on studying their collaborative behavior, the tools they use, and the methods they employ for

such collaboration. For the study, graduate students, staffs and faculty members, working in different fields at a large university in South Australia, Australia were contacted using a convenience sampling method. These participants have been involved in some collaborative work. The participants were not given any compensation. Instead of asking about respondents' collaboration for information seeking tasks only, the questions were formulated looking at a larger context, focusing on the situations that got them into collaborative search for tourism information, how they worked together, and what they thought about the process.

Morris (2008) explored similar type of questions using a survey. She surveyed knowledge workers at a large technology company to investigate collaborative web search practices that people employ. Her survey included questions to determine whether people need and/or want to collaborate while searching the web, and if they do, what strategies they employ to collaborate given that such an activity is not explicitly supported by current search interfaces. The study reported here was much more preliminary and different in two major ways from Morris's study. First, the participants were chosen with highly selective criteria; Only those people who had been involved in several collaborative endeavors. Choosing this method limited the number of participants for the survey, but provided a rich set of data for analysis. Second, in contrast to Morris's study, this study targeted collaboration in the information searching in tourism domain.

The aim of the study presented here is to help better understand the participants' general collaborative activities and the patterns of their tourism information search process. The questionnaire seeks to discover the causes of collaboration, ways of collaboration, the medium of different collaborating tools and their expected features when retrieving tourism information. The findings from this study describe users' perceptions of a CIS tool for the tourism domain.

3.1.2 Study participants

A total of 35 postgraduate students and staff from the Division of Information Technology, Engineering and The Environment (ITEE), University of South Australia (UniSA), in Adelaide, South Australia participated voluntarily in this study. E-mails were sent to all postgraduate students and staff of within the division, inviting them to participate in the study. The subject and aim of the study, what was expected from the study participants, confidentiality of the data, as well as the permission from the division head and Human Research Ethics Committee for undertaking the study were documented in the e-mails.

If a contacted person was willing to participate in the study, he or she emailed back to the given e-mail address. Those participants were chosen because they were experienced in using search engines or any information searching system involving different programs, and they came from various backgrounds. Prior to taking part, each person completed a consent form regarding their participation, confidentiality, and rights and protections under the guidelines established by the UniSA Human Research Ethics Committee.

The participants had various roles within the institution: 42.9% were PhD students, 31.4% were teaching staff, 11.4% were researchers, and the remaining 14.3% included project managers, IT managers and academic support officers. About 60% of them were between 26-35 years of age. Only 2.9% respondents were from the 55+ year's age group. The rest were evenly distributed by corresponding decade. Gender distribution was unbalanced in that 65.7% were male and 34.3 % were female. Statistics about gender, age group, education and profession are presented in Table 3.1, Table 3.2, Table 3.3 and Table 3.4, respectively.

Table 3.1 Gender category of respondents.

Gender	No. of Respondents	%
Male	23	65.7
Female	12	34.3

Table 3.2 Age group of respondents.

Age Groups	No. of Respondents	%
26-35 years	21	60.0
36-45 years	5	14.3
16-25 years	4	11.4
46-55 years	4	11.4
55+ years	1	2.9

Table 3.3 Educational background of respondents.

Highest Education	No. of Respondents	%
Masters	24	68.6
PhD	5	14.3
Bachelor	4	11.4
Certificate Course	2	5.7

Table 3.4 Distribution of respondents' profession.

Profession	No. of Respondents	%
PhD Student	15	42.9
Teaching staff	11	31.4
Researcher	4	11.4
Academic Support Officer	3	8.6
Project Manager	1	2.9
IT Manager	1	2.9

When asking for how many years they have been searching on the Internet, 37.1% of respondents answered "9-12 years", 31.4% responded "more than 13 years" and the rest indicated that they have done so for 5-8 years. For traveling and tourism information, 36.5% of the observed population use the Internet and 22% usually get information from friends. Brochures and agents are used by 15% and 14% of the respondents, respectively. The rest 10.4% prefer relatives and books as sources of tourism information.

The research targeted this survey to this demographic of skilled searchers because they often travel for many reasons like attending seminars and conferences, giving lectures, and recreation. They collaborate with other people for gathering traveling and tourism information.

3.1.3 Data collection

This study designed thirty survey questions including both multiple choice and free-form responses in terms of Web search habits and collaborative activities relating to tourism information. This survey was undertaken in June 2011 and thirty-five respondents completed the survey.

Questionnaires were administered to the participants for collecting data on user search behavior and collaboration for searching for tourism information. Some questions were chosen to parallel those asked in prior studies regarding collaborative Web information seeking behavior of knowledge workers (Morris, 2008). The questionnaire comprised five different categories:

- A group of questions was used to collect demographic data, including educational background, age, gender, occupation, search experience.

- Another group of questions was designed to elicit search frequency, duration for a particular query (time), keyword length, and search engines used for tourism information.
- Some questions were designed to collect collaborative activities of the users such as why they collaborate, how they collaborate, what are the mediums of collaboration.
- Questions were also asked to understand the participants' search term preferences for tourism information, and their sharing activities related to the tourism information searching.
- The participants were asked a question to express what they expected of a CIS tool/interface.

3.1.4 Data analysis

The data were analyzed to uncover the characteristics of users' collaborative search behavior for tourism information and their expected features of a tourism CIS interface. In particular, the participants' responses to the questions such as whether they need and/or want to collaborate when searching on the Web for tourism information, and, if they do, what strategies they employ to collaborate were examined. The statistical software SPSS was employed to generate various descriptive statistics on users' demographic information and their collaborative tourism information searching behavior. Content analysis (Schamber, 2000) was adopted to analyze the participants' narrative descriptions in the open-ended questions. The results of this study are presented in Chapter 4.

3.2 User Study 2: Simulated tourism CIS with existing tools

After identifying the collaborative behavior involved in looking for tourism information through survey questionnaire (Study 1), a user study (User Study 2) was conducted recruiting 20 participants who worked in 10 pairs to perform CIS with the existing search tools. Study 2 aimed to obtain insights into the planning processes, search stages, and the search strategies during collaborative tourism information search on the Web.

Specifically, the objectives of Study 2 were to:

- identify the search systems and search keywords tourists use for searching on the Web
- discover the sorts of information that tourists exchange during collaborative Web searching
- determine factors affecting collaborative searching for tourism information

- explore the stages of collaborative search for tourism information
- explore the strategies tourists apply during collaborative search for tourism information
- identify types of IFBs and their effect on collaborative tourism information searching

While it would be ideal to observe real tourists in their collaborative travel information search it is time-consuming and hard to examine in-depth how and why they behave in certain ways. On the other hand, conducting a user study could be an ideal strategy. By designing a set of instruments and software to record the interaction process during the collaborative search, the data can be collected. The purpose of Study 2 was to investigate the collaborative tourism information search behavior, factors affecting collaborative search, search stages, search strategies and information flow breakdown during collaborative search, and interaction with the system. Therefore, it is necessary to observe users' behavior and explore why they behave in certain ways. It could work to observe real tourists in their real-life information search settings. However, it is time-consuming and hard to examine in depth how and why they behave in certain ways. On the other hand, conducting an experiment could be an ideal way. Designing a set of instruments and using software to record the entire interaction process during the experiment to collect the data. The data include search systems and search keywords tourists use for searching on the Web, sorts of information that tourists exchange during collaborative Web searching, factors affecting collaborative searching for tourism information, stages of collaborative search for tourism information, strategies tourists apply during collaborative search for tourism information, and types of IFBs and their effect on collaborative tourism information searching. Accordingly, mixed method (multiple methods) could be an effective and efficient way to collect data for this research.

The multiple data collection methods capture a comprehensive picture of a complex process. Though each data collection instrument provides partial manifest on the process, the combination of multiple methods could cover more aspects. In addition, multiple methods allow for cross-checking the results of each, which thus increasing the reliability and validity of the data: giving rise to the term triangulation (Ingwersen & Jarvelin, 2005). Tourists' collaborative Web search is a complex phenomenon involved with a lot of activities and behavior efforts. The method of interview or questionnaire could provide only a partial picture of the interaction because users may not be aware of or able to recollect what they did during the searching process. Triangulation through multiple

methods revealed a more complete picture of users' Web searching behavior. Saracevic, Mokros and Su (1990) used videotaping, search logging and observation to collect data on the nature of online searching interaction between users and intermediaries. Bystrom (1999) used multiple data collection methods including interviews, observation and diaries in the study on civil servants' information seeking behavior. In addition to a pre-search questionnaire, Wang, Hawk & Tenopir (2000) employed a process-tracing technique for recording individual user's processes and behaviors, specifically the transactions with timestamps and verbal reports as they interacted with the Web when searching for information. These studies provided good examples of using a variety of methods to collect data in order to explore users' information behavior. In this study, a combination of multiple data collection techniques, including pre- and post-search questionnaires, Web search logs, online chat logs, and post-search interviews, were used to gather data. Multiple methods provided in-depth and comprehensive insights into the users' collaborative tourism information behavior. Detailed data collection and data analysis methods concerning User Study 2 are described as follows.

3.2.1 Study participants

Recruited via e-mail groups at a large university in Adelaide, Australia, a total of twenty staff members and postgraduate students (17 males and 3 females) participated in this study. To facilitate collaborative search, the study participants were grouped into ten pairs (i.e. Participants 1 and 2 as Pair 1, Participants 3 and 4 as Pair 2,…, Participants 19 and 20 as Pair 10) to search for tourism information. Selection of the participants and the grouping of the pairs were based on the following criteria: both participants in a given pair knew each other; and the paired participants either had worked or traveled together before the study, thus ensuring that they would feel comfortable when working together in a collaborative environment (Mohammad Arif et al., 2013).

The participants' mean age was 32.5 (standard deviation = 6.96). The majority of them (N = 13) were between 26 and 35 years old and the rest were in their 40s (N = 4), early 20s (N = 2), or 50s (N = 1). They came from different educational backgrounds, including Computer Science, Environmental Science, Mechanical Engineering, Soil Science, Water Resource Management, Public Health, and Electrical Engineering. The participants reported their information searching experiences on a 7-point Likert scale (1 stands for low experience, 7 stands for high experience). They had experienced Web searching (mean = 6.80, standard

deviation = 0.41) and these varied from 3 to 20 years, with the average being 10.65 years. The mean length of traveling experiences was 9.80 years and the reasons for travel included attending conferences, visiting family, working, studying, training, business, and recreation/holidays. Five out of ten pairs had traveled together and they were Pairs 2, 3, 6, 8 and 10.

3.2.2 Data collection

3.2.2.1 Search tasks

Searching for travel information is believed to be a common collaborative search task (Morris, 2008). All pairs of participants were given three generic and exploratory search tasks (see Appendix B) associated with their planned trips in future (i.e. planning a trip), which described three different travel scenarios. Research shows that information search for preparing a trip to a destination may yield different degrees of complexity, depending on how much knowledge and experience tourists have about the destination (Chang, 2009). Prior knowledge about a destination enables tourists to evaluate its attractiveness by retrieving information related to attributes and attractions (Ratchford, 2001) and such knowledge can be gained from one's own experience or that of others (Vogt & Fesenmaier, 1998). Search Task 1 and Search Task 2 were designed to examine tourists' collaborative search behavior with no prior knowledge/experiences (i.e. nobody on the team had any relevant knowledge) and with prior knowledge/experiences (i.e. at least one of the team had relevant prior knowledge) about a destination respectively. The third search task (Task 3) simulated a complex situation where the participants were asked to go to a place which was known to at least one of the teammates, and several travel conditions, such as accommodation, weather, and budget, needed to be satisfied concurrently. These search topics were designed to motivate and inspire for conducting tourism information search. The search topics used in the user study try to ensure that the search tasks are close to real world situations. Borlund and Ingwersen (1997) pointed out that the laboratory study settings are unrealistic. They further proposed a simulated work task situation in which search scenarios reflecting real-life situations were described. Borlund (2000) found that the scenarios created the same behavior as real information needs. In this study, the simulated search task situation was used to make participants' behavior as real as possible, and thereby hopes to get rich data and robust results.

3.2.2.2 Data collection instruments and procedures

The study was conducted in a laboratory in the university. The participants in a pair engaged in the same search processes, ensuring that their information retrieval is collaborative in nature (Fidel et al., 2004). After signing a consent form under the guidelines of the University Human Research Ethics Committee, each participant followed the identical data collection procedures, as described below:

1 Each participant filled out a pre-search questionnaire (see Appendix C), which was used to record the demographic information and their experiences associated with information searching and travel. Two questions were designed to ask about previous experiences on traveling and collaborative work: (a) Have you ever traveled with your teammate as a pair? (b) Have you worked (e.g. doing research, writing papers, or laboratory work) with your teammate as a pair before?

2 Each pair of participants conducted Web searches on the three search tasks. Each task lasted around 20 minutes. In order to simulate remotely-located collaboration, communication tools, including Google Talk and Skype (text message functions), were installed on the computers to facilitate chatting and discussions between members of each pair during the search. The team members sat in a room and used two computers separately for searching for tourism information on the Web and they typed text messages when communicating. Only one form of communication the collaborators employed was texting (sending and receiving text message through chatting). There was no treatment or control on how the participants interacted with the Web to find their information, including no restrictions on choosing Web search systems.

3 At the time of searching on the Web, the participants' search logs and their communication logs were recorded simultaneously using the software Camtasia Studio, which were then saved into the computer for further analysis. The search logs captured the websites visited, the URLs, certain information sought, search keywords employed, and search queries (re)formulated, which were analyzed later for examining the search stages and search strategies. The chat logs were captured to discover what sort of information the pairs discussed, exchanged or shared during the collaborative search for tourism information, such as discussions and comments on search strategies, experiences, search queries, URLs, and search results.

4 At the end of the search, the participants filled out post-search questionnaires (see Appendix D), which contained the following questions: (a) How did your teammate help you during the search?; (b) Which information (e.g. search queries and results) did you discuss with your teammate?; and (c) How did you cooperate (collaborate) with your teammate during the search? The participants' responses were deemed to be their own personal explanations of their collaborative search activities.

5 At the end of the study an interview was conducted with each pair of participants. Interviews solicited the participants' collaborative search experiences which were not easy to express in the short questionnaire, such as barriers, problems, or breakdowns encountered during the collaborative search effort and their impact on the search, and the expectations of a CIS tool for supporting collaborative tourism information search. Interviews were recorded using a voice recorder for further transcription and analysis.

6 At the end, the researcher collected all the documents and thanked the participants.

3.2.3 Data analysis

The data set for analysis included pre- and post-search questionnaires, search and chat/communication logs consisting of 252 search queries and 971 text messages between the paired participants for various purposes, and post-search interviews. The search and online chat logs, post-search questionnaires, and interview transcriptions were analyzed to obtain insights into the planning processes, search stages, and the search strategies during collaborative tourism information search. The post-search questionnaires and interview transcriptions were examined further to find out if IFBs occurred during CIS. The Grounded Theory approach (Strauss & Corbin, 1998) and content analysis (Schamber, 2000) were employed, which have been widely used in analysis of exploratory user-Web interactions (e.g. Du & Spink, 2011; Reddy et al., 2010).

The Grounded Theory approach provides an overall methodology for systematically gathering and analyzing data, while content analysis describes a specific context within which distinct types of data are gathered and analyzed (Schamber, 2000). The data were examined to identify the categories and their descriptions and interactions in relation to collaborative tourism information search on the Web. The analysis was conducted in several phases. Firstly, a line-by-line, open-coding procedure was performed, which was followed by comparisons and negotiated outcomes. Initial descriptive coding using the participants' search actions, words or phrases involved looking for repetitions therein and across the recorded search logs,

chat logs and interview transcriptions. Meanwhile, the logs and transcriptions were coded to identify the search stages and strategies in collaborative search. After the open-coding was completed, similar code terms and phrases were grouped together and then regrouped to include all of the identified concepts into categories of similar topics. In the last stage, the researcher went back and forth constantly between the data and the classification system to identify dominant categories by recognizing code words or phrases that were repeated consistently within and across the data.

A coding scheme (see Appendix E), consisting of 14 categories, was derived for the analysis of collaborative search stages, search strategies, and IFBs during CIS for tourism information. The researcher coded all the empirical data. To ensure inter-coder reliability, a second coder, who was experienced in tourism information search and open coding, did a separate open-coding procedure on the data of three pairs. The inter-coder agreement was 82.05%, which represents a consensus regarding the analyses and indicates an acceptable level for drawing conclusions in qualitative research (Krippendorff, 2004).

The checklist analysis of the DIB method was applied to assess the occurrence of IFBs in tourism CIS. The IFB scenarios and the collaborative search were compared using the DIB checklist of questions (Galliers et al., 2007), which includes: Has information not been discussed effectively? Is any necessary information missing in the CQ formulation? Is there inconsistent/unusual information in the system? And is there any desired information which has not been found? In addition to the qualitative analysis, statistics of frequency and relative frequency of the categories were also undertaken where appropriate to examine major trends and to enhance the descriptions (Du, Liu, Zhu, & Chen, 2013). The results obtained from this user study are described in Chapter 4.

3.3 Design and implementation of a CIS tool - ColTIS

To my knowledge, no tool has yet been developed for searching for tourism information on the Web in a collaborative environment. Though the recognition of the importance of supporting collaborative information search in tourism, limited work has been dedicated to designing tourism-specialized collaborative search system. Prestipino (2004) proposed a forum-based community system supporting communication and collaboration in tourism. Sometimes real-time interaction is necessary for dynamic tourism information searching. This forum-based collaboration model did not provide such real-time interaction among tourists. Current collaborative tools do not effectively support the collaborative activities in travel

information search. From User Study 1 and User Study 2, the users' recommended features of a CIS tool for the tourism domain have been concluded which are as follows:

- A collaborative search tool should facilitate synchronous and asynchronous sharing and discussion.
- It should be able to provide search history to the collaborators so that duplication of results that have already been retrieved by others is avoided.
- A collaborative search tool should have communication functions for planning search strategies, as these will make the collaboration convenient.
- It should provide the options for sending or sharing the links of search results to collaborators.
- It should facilitate preparing a trip plan that can be edited by collaborators.
- It should include maps to visualize destinations, accommodations, and historical places pertaining to the trip plan.
- Screen sharing may be a means for sharing search keywords or search results.

Applying content analysis, the limitations of current tourism Web portals in terms of collaborative search also have been identified which include:

- Lack of communication during collaborative search

There is a lack of embedded communication processes in tourism Web portals to support the exchange of ideas, views, and experiences of searchers while they performed group search.

- Lack of distribution of cognitive and physical loads

Current tourism Web portals lack the division of search task feature for distributing both cognitive and physical loads that can help to avoid duplication of search.

- Lack of collaborative query formulation

Collaborative query refers to the query that is formulated by multiple users. Collaborative query formulation is needed when a user fails to convert his/her need into search keywords or multiple users have to execute a query satisfying everybody's preferences. Not one current tourism Web portal provides this collaborative query formulation function.

- Lack of collaborative travel planner

Tourism Web portals provide itinerary planning for a single user activity. However, collaborative travel searching requires itinerary planning that can be edited by any participating collaborator to reflect his or her preference and to inform others.

- Lack of automatic query sharing

To facilitate the collaborative search, ColTIS (**Col**laborative **T**ourism **I**nformation **S**earch), an interface was devised for facilitating and supporting explicit collaboration between a group of tourists who share a same goal for Web search and travel planning. In developing ColTIS, the above mentioned recommended design features of a CIS tool for the tourism domain based on User Study 1 and User Study 2 were considered. The limitations of current tourism Web portals were also taken into consideration for developing ColTIS.

ColTIS supports single users as well as collaborating users, through the support mechanisms of chatting for communication, searching and information sharing simultaneously. The design of ColTIS was greatly inspired by two user studies as described in the above sections and two other studies that include SearchTogether (Morris & Horvitz, 2007) and Coagmento (Shah & Marchionini, 2010). Unlike SearchTogether and Coagmento, ColTIS provides tools and support for dividing search tasks and CQ reformulation. Furthermore, this tool supports not only collaborative searching but also a short travel plan editor and map for showing or locating the destination, attractive places and location of accommodation. In addition to CQ reformulation, ColTIS incorporates automatic query sharing and results sharing. This tool also allows users to plan their trip and share their experiences through a chat facility in CIS environment. ColTIS allows users to be co-located or remotely located, searching synchronously and asynchronously.

Each member of a group conducts a collaborative search using ColTIS. While tourists in different places may not be able to meet together, using ColTIS each group member can communicate to each other for devising the travel plan and search information both individually and collaboratively. Chatting, formulation and execution of individual and collaborative queries, division of search tasks and editing travel plan are the tasks performed explicitly by the collaborators. The functionalities of query sharing, result sharing and displaying location of travel places, accommodation and attraction are executed by the system itself. The e-mail option allows team members to send an e-mail to their teammate if needed. ColTIS interface was developed using PHP and MySQL. An Apache server was used so that different computers could be networked. The MySQL database stores users' login information, individual search (query) logs, collaborative search (query) logs and chat logs. Both the individual search window and the collaborative search window connect users' queries to the Google search engine and display search results.

Screenshot of ColTIS

The screenshot of the interface is presented in Figure 3.2. The main interface of ColTIS contains ten windows that are described below:

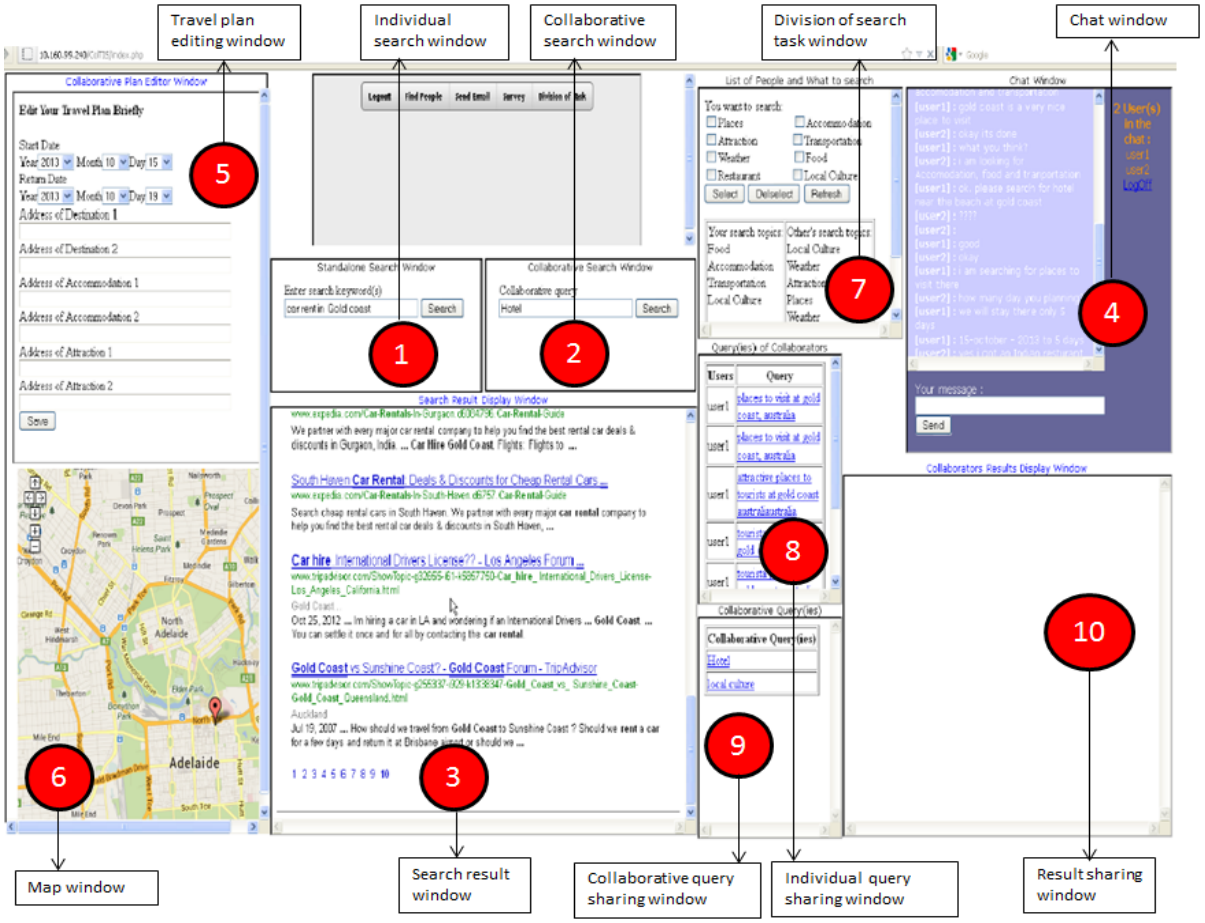


Figure 3.2 ColTIS interface.

- *Individual search window* (indicated by number 1) keeps the search queries issued by a single user. Despite the increasing interest in collaborative query formulation, conducting individual queries is still being treated as the primary action during collaborative search.
- *Collaborative search window* (indicated by number 2): Multiple users can compose search keywords simultaneously to search for information using this window.
- *Search result window* (indicated by number 3) is incorporated within ColTIS to display the results based on individual queries or collaborative queries.

- *Chat window* (indicated by number 4): Users can chat with each other using the chat window. ColTIS supports text-based messaging among multiple users.
- *Travel plan editor window* (indicated by number 5): A user can write, edit or delete dates for traveling, destination address, and accommodation address or attractions information. This travel plan is made available immediately to all other users.
- *Map window* (indicated by number 6) provides a facility for showing the destination, accommodation, or attraction on the map.
- *Division of search task window* (indicated by number 7) enables the users to divide the search task so that they can see who is doing what sub-task.
- *Query sharing window* (indicated by number 8) displays the lists of queries issued by individuals.
- *Collaborative query sharing window* (indicated by number 9) displays the collaborative queries formulated by multiple users.
- *Result sharing window* (indicated by number 10): Users share the search results with each other in the result sharing window. A user can select any of the queries issued by others and retrieved results of that query are displayed in the result sharing window.

The features incorporated into ColTIS meet previously mentioned expectations and also overcome the limitations of current tourism Web portals for collaborative search discussed earlier. The provision of automatic query sharing and options for division of search task shift both physical and mental loads to the system. The query sharing and result sharing windows in ColTIS address the expected features of sharing search history and search results. Chat and e-mail facilitate users' expectations on synchronous and asynchronous communication. They also fill the communication gap found in the current tourism portal. Moreover, the collaborative query formulation process that is rarely found in existing tourism portals enables several tourists to formulate their query jointly. Furthermore, a trip planner combined with a map showing destination, accommodation and attraction meet tourists' expectations of a travel planner.

Workflow of ColTIS

Before starting the search, the collaborators may negotiate for a travel plan through the chatting and divide the search task using the division of search task window. When one user executes a query in the individual search window, the results appear in the search result window. Any group member can see the queries issued by other collaborators in the query

sharing window and can click on any of the queries to see the results in the result sharing window. He or she can also click on links within the page to see more specific information. While a user fails to find the desired information or is unable to formulate an appropriate query, he or she then utilizes the collaborative search window to initiate a collaborative query formulation. This collaborative query is visible to all members of the group and they can contribute to formulating the collaborative query by adding terms to, editing or deleting terms from it. When the collaborators are satisfied with the collaborative query, they can execute the query to retrieve the results and these also appear in the search results window.

After choosing destination, accommodation and attraction any collaborators can put them in the travel plan window with starting and end date of the proposed travel plan and this plan is also visible to all. If the plan needs to be edited, any collaborator can do this and changes are sent to all members of the group so that they are informed. The location of the destination, accommodation and attraction are shown on the map included in the system. Throughout the search session any member can perform chat using the chat option for various reasons.

Updates of collaborative queries, stand-alone queries and search results are automatically visible to collaborators who are logged onto the system. Collaborators who are not logged onto the system can see the updated searches and travel plan when they log onto the system. Collaborators are also able to see the full histories of queries and chats (according to the order of the entry in the database). Users are facilitated to track and view the latest updates of a travel plan that is always visible in the travel plan-editing window. Though each component of ColTIS has its own functionality, different components work together to perform collaborative search for users. For example, a click on a link in the chat window brings the corresponding information in the search result window or execution of standalone query (in individual search window) and collaborative query (in collaborative search window). The locations of destination, accommodation and attraction in the travel plan editing window are viewed automatically in a map in the map window. Clicking on an individual query (in individual query sharing window) or a collaborative query (in collaborative query sharing window) displays the results in results sharing window.

The combination of ColTIS's features, such as the query sharing, result sharing, chatting, the ability to browse others' search result and division of search task, makes it unique among existing travel portals. There are several existing commercial systems that either allow groups to plan trips for themselves or to ask friends and other members for suggestions. Examples

include FriendTripper, Gogobot, Tripit, and Triporama. ColTIS differs from these systems in that it supports not only to make a trip plan but to perform the communication, individual search and collaborative search for tourism information. These functionalities make it a real-time collaborative search tool.

Usage Scenarios

To better understand the functionalities of ColTIS, example scenarios for tourism information search using ColTIS are given below:

Division of Search Task. To distribute the search load and avoid duplicate search, one participant selected accommodation, food, restaurant and local culture as search topics while his/her teammate picked places to be visited, attraction, transportation and weather as search topics using ColTIS built-in division of search menu.

Individual and Collaborative Search. In addition to the individual search, users can perform collaborative search by initiating or contributing to a collaborative query. This collaborative search is unique for the collaborative search tool because it facilitates searching information based on queries composed by multiple users. Using ColTIS individual search option, one participant searched for a place in New Zealand with the query "Queenstown New Zealand". His/her teammate searched for a restaurant in Queenstown with the query "Burger restaurants in Queenstown" using individual search option as this participant could see through the automatic query sharing window of ColTIS that the other participant searched for Queenstown.

Finding no other way, one participant initiated a collaborative query to search for flight with keywords "Queenstown New Zealand flight" using the collaborative query window. Having noticed this, his/her partner contributed to this query by adding more terms that resulted in the keywords "Queenstown New Zealand flight from Adelaide". This is an example of collaborative query formulation feature provided by ColTIS.

Chatting. A chat function is incorporated into ColTIS for assisting tourists to communicate with others. For example, one participant sent a message "where are we going" and his/her teammate responded with the message "Let's go to Queenstown".

Information Sharing. Sharing of queries, search results and links (URLs) is common in collaborative search. ColTIS provides query and results sharing without any load (interaction) among the tourists (an example of query sharing is given in Individual and Collaborative

Search scenario). Participants also shared results using the chat option. For example, a participant shared "There are fancy restaurants [in Queenstown] and they have good burgers".

Editing Travel Plan. ColTIS takes a travel plan with preference of start date, return date, destinations, accommodations, and attractions as input. Any collaborator can view the current itinerary information and can modify and save at any time after each change.

Both the individual search window and collaborative search window connect a user's query to the Google search engine, displaying the Google search results from the tourism Web portal. Users can examine search results retrieved by people clicking on their teammate's query. The evaluation results concerning the effectiveness of ColTIS are reported in Chapter 4.

3.4 User Study 3: Tourism CIS with ColTIS

When setting up ColTIS was complete, User Study 3 was then designed. Combined with a generic travel search task, pre- and post-search questionnaires, Web search logs and online chat logs, the third user study was designed to examine tourists' CIS behavior while using ColTIS and to examine its effectiveness. The objectives of User Study 3 were to:

- investigate the effectiveness of ColTIS compared to other tourism Web portals
- explore the strategies for CQ reformulation when searching for tourism information on the Web
- discover the interplay between individual querying, chatting, and CQ reformulation in collaborative Web searching
- determine types and patterns of QRs employed during collaborative tourism information searching
- explore the effects of tourists' gender on collaborative search behavior (QR and tourism information choice) during tourism information searching
- explore the effects of tourists' nationality on collaborative search behavior (QR and tourism information choice) during tourism information searching

The detailed research methodology is described below.

3.4.1 Study setting

The purpose of this study is to explore tourists' collaborative behavior while searching for tourism information on ColTIS as well as to investigate the effectiveness of ColTIS compared to other tourism Web portals. Online information sources vary in character and it is evident that community websites are becoming increasingly important. These universal platforms enable travelers to share their experiences and post reviews with like-minded others (Gretzel & Yoo, 2008; Gretzel, Lee, Tussyadiah, & Fesenmaier, 2009; Gupta & Kim, 2004). Tens of millions of travelers share their travel experiences through online communities such as Tripadvisor, Yahoo! Travel, Igougo, and Lonelyplanet. Founded in 2000, Tripadvisor is the most popular travel portal with over 47 million monthly visits (Yoo & Gretzel, 2009), 20 million members, and over 35 million travel reviews as at August, 2010 (Tripadvisor, 2010).

Using its own search engine, Tripadvisor enables travelers to plan and book their trips. It offers advice from millions of travelers and a wide variety of travel choices and planning features with links to booking tools that check hundreds of websites. For example, Tripadvisor allows users to conveniently make accommodation booking through its booking partners without leaving this site. Forums of Tripadvisor enables members to ask for and share their opinions, advice, and experiences in asynchronous interactive discussions (some sort of collaboration) with the community. Its Maps feature makes finding the accommodation, attraction and other events in the right location (Fact Sheet, 2014). But Tripadvisor.com does not provide real-time collaboration between group travelers during travel information search. To simulate the collaborative search with Tripadvisor.com, a communication tool (Google Talk with text message functions) was incorporated and it facilitated communications between team members. ColTIS has been designed to support planning and searching travel information collaboratively. For instance, it provides both synchronous and asynchronous communications between users during the search. It supports the sharing of results and links among users. Experiences and opinions of travelers can also be shared via ColTIS. In addition, ColTIS has a Map feature which facilitates tourists to visualize accommodation, attractions, and other places on the map. Taking these factors into account, Google Talk-embedded Tripadvisor.com was chosen to compare with Google search engine supported ColTIS.

In this study the collaborators employed one form of communication between them which was texting (sending and receiving text message through chatting). A screenshot of Google Talk-embedded Tripadvisor.com is shown in Figure 3.3.

This study focuses the CQ reformulation types and patterns and the differences in search behavior of tourists based on their attributes, i.e. gender and culture. The study was undertaken in a laboratory at a university in Adelaide, South Australia between October 2013 and March 2014. The participants were brought to the university laboratory, allowing them to practise the ColTIS system and conduct collaborative search. Each team comprised two participants and they worked on the same tourism information search task collaboratively. As the study was trying to simulate remotely-located collaboration, the participants in each team were separated by a partition in the laboratory so that they could not talk to each other directly or see what the other person was doing (see Figure 3.4). The team members could only communicate with each other by sending instant text messages or reading each other's search histories. The retrieved results were shared in the results sharing window. Both participants used PC workstations, running Windows XP, with Ethernet connectivity and 21-inch monitors.

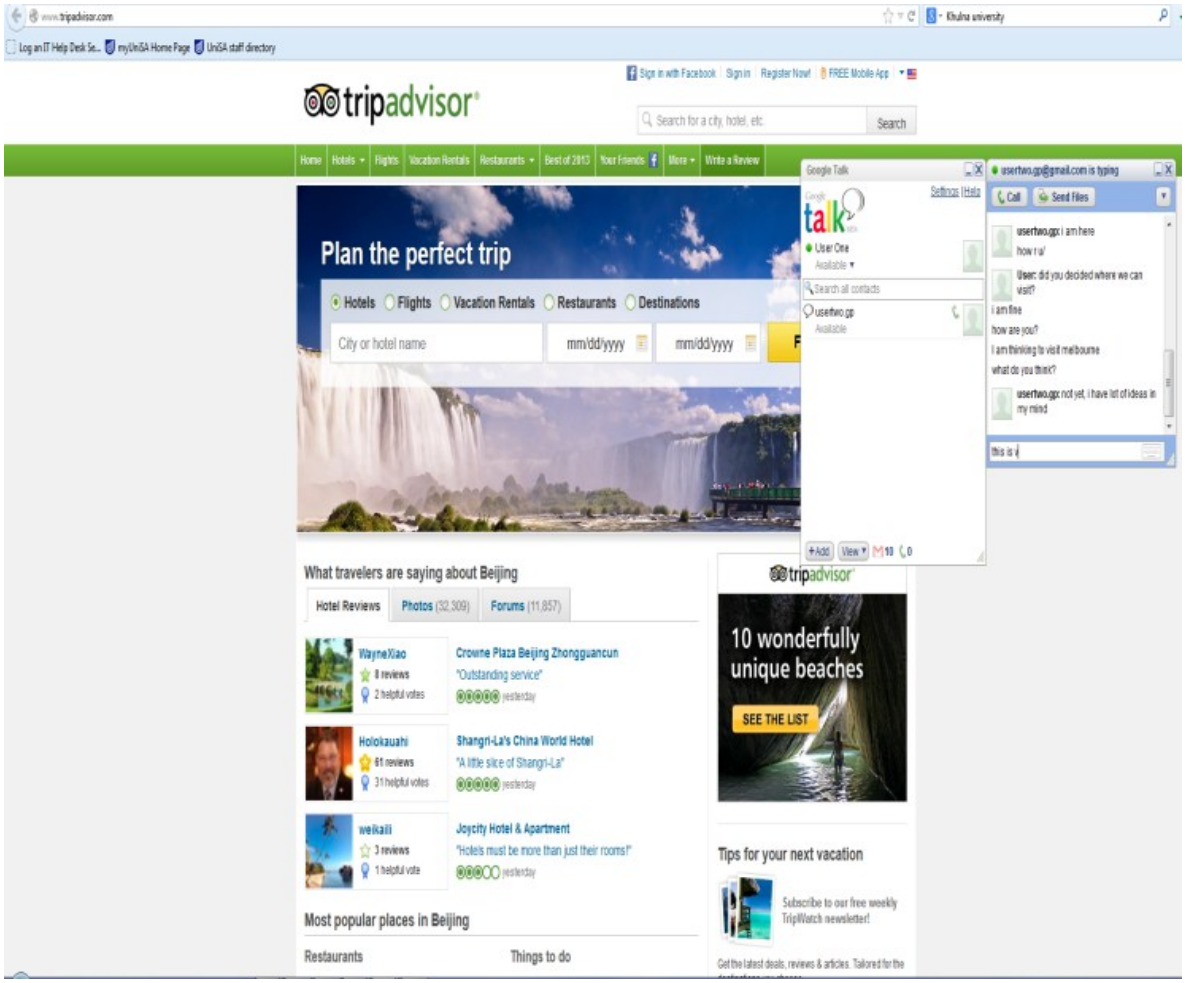


Figure 3.3 A screenshot of Google Talk-embedded Tripadvisor.com.



Figure 3.4 A pair of participants in a study session.

3.4.2 Search tasks

An exploratory Web search task (see Appendix F) was used in this study. This type of exploratory search had been used in other collaborative Web search studies (Shah & Marchionini, 2010; Paul & Morris, 2009), so its validity for collaborative search has been proven. Since the research aimed to study tourists' collaborative search behavior and the measures of effectiveness of ColTIS compared to Tripadvisor.com with pseudo-collaboration, the same travel related task was given to each pair of participants for searching information with ColTIS and Google Talk-embedded Tripadvisor.com.

The task is in the leisure category, asking participants to collect information for planning a trip. Morris (2008) noted that academic literature and travel planning searches are two common collaborative search tasks. Hence, this task is appropriate to study collaborative Web searching. The task description states the kind of information that the participants need to collect.

3.4.3 Study participants

Thirty-six participants, including 18 females and 18 males, were recruited from a large university in Adelaide, South Australia and its local community area. University participants were recruited via university e-mail groups. Local residents were recruited via an invitation letter that was put into their mail box. Of 36 participants, 22 (61.11%) were university

students, eight (22.22%) were university staff and the remaining six (16.67%) were local residents. As the research aimed to study the collaborative search behavior and CQ reformulation based on gender and culture, an effort was made to maintain the pairing of participants. Nine pairs were formed by Australian participants and the remaining nine pairs consisted of Asians from Bangladesh (N=6), India (N=4), Malaysia (N=3), Iran (N=2), Sri Lanka (N=2) and Indonesia (1). Australian participants referred to people who were born and raised in Australia. On the other hand, Asian participants referred to people who were born and brought up in Asian countries and moved to Australia within the last five years. Although it is well recognized that Asian cultures differ among themselves (Hofsete & Bond, 1988), Asian countries had been treated as a group in previous research (Fletcher, Olekalns, & De Cieri, 1998). A cross-cultural study (Fletcher, Olekalns, & De Cieri, 1998) observed that there are cultural differences between Australian and Asian in collaborating, accommodating and compromising. In another study between Australian-born and Asian-born respondents, differences were observed between these two groups on consumer behavior (Nayeem, 2012). Therefore in this thesis, people from different Asian countries are deemed as a separate group which is termed as "Asian". Among these 18 pairs, there were nine male pairs (five Australian pairs and four Asian pairs) and nine female pairs (four Australian pairs and five Asian pairs).

The participants had the freedom to choose the attending day and time that was convenient to them. It was required that the participants in a given pair should have done some collaborative work or traveled with each other before, thus, ensuring they not only knew each other, but were comfortable working with each other on a collaborative search task. Of the 18 pairs of participants, four pairs were colleagues, three were friends, two were relatives and the rest (nine pairs) were fellow students. Their ages ranged from 15 to 60 years with an average of 30.93 years. Participants were from different educational backgrounds: 12 participants held bachelor degree, 12 held Master's degree and others held doctoral titles. All these participants were experienced in online tourism information search with a mean of 7.75 years. The participants' demographic characteristics are shown in Table 3.5.

Table 3.5 Demographic characteristics of the participants.

Characteristics	Value	No.
Age		
	15-19	2
	20-24	6
	25-29	11
	30-34	10
	35-39	2
	40-44	2
	55-60	3
Educational Background		
	Computer Science	12
	Marketing	6
	Information and Library Science	3
	Mathematics	3
	Accounting	2
	Education	2
	Environmental Science	2
	Telecommunication	2
	Theology	2
	Visual Science	2
Degree earned		
	Bachelor	12
	Masters	12
	PhD	12

3.4.4 Data collection

Each team worked on the search task collaboratively. The participants were firstly introduced to the study and the system ColTIS. Then, the participants worked on a training task for 5-8 minutes to become familiar with ColTIS. As the users were experienced in using Tripadvisor system (along with other travel portals for searching tourism information) with an average of more than 7.5 years, the users were trained only on ColTIS. Prior to participation, each participant completed a consent form under the guidelines of the university's Human Research Ethics Committee. For each system, each pair had 20 minutes to complete the search task. Study sessions were monitored by the researcher. On average, each study session lasted 80 minutes. Each participant was provided with a gift card of $10 for their participation.

Multiple data collection methods were employed in User Study 3. Different kinds of data were collected , including pre-search questionnaires on participants' demographics and other background information, search logs and chat logs, post-search questionnaires on participants'

opinion about the search, their rating on search systems and suggestions for improving the CIS system. A single data collection method could not be able to facilitate the capture of the whole picture of such complex situation. To collect such diversified data, multiple data collection methods were employed. The participants in each pair engaged in the same search processes ensuring that their information search is collaborative (Fidel et al., 2004). Each participant followed the same data collection procedures, as described below:

1 Each participant filled out a pre-search questionnaire which was used to record the demographic information and their experiences associated with information searching and travel, for instance: How many years do you have experiences in information searching? How many years do you have experiences in tourism information searching? Do you have any experience in working in a group when searching for information? Please describe your previous collaborative work with this teammate.

2 Each pair of the participants conducted Web searches on the given search task using both ColTIS and Google Talk-embedded Tripadvisor.com. Each pair of participants performed the search task using ColTIS first and then after 10 minutes break they conducted the search task using Google Talk-embedded Tripadvisor.com. There was no control on how the participants interacted with the Web to find their information.

3 Queries are the key to obtain better search results. Collaborative searches may retrieve better results than individual searches (Shah & Marchionini, 2010). As each member in a team had different experience, knowledge and ability in formulating a query, both team members contributed to reformulating CQs to meet their common goals on particular tourism items. When a participant was unable to obtain expected results from his or her own queries, then he or she initiated the CQ reformulation informing the teammate to contribute directly to the CQ rather than sending a message. This CQ was visible to all team members and each teammate contributed to the CQ. Each participant of a pair contributed to the CQ reformulation using collaborative search window (see Window #2 in Figure 3.2). Participants in a team continued to modify the CQ until they were satisfied with their search results.

4 At the time of searching on the Web, the participants' search logs and their communication logs were saved to a database by ColTIS and search logs and chat logs were recorded using the software Camtasia Studio for Tripadvisor.com for further analysis. The search logs captured the websites visited, the URLs, certain information sought, search keywords employed, and search queries reformulated, which were analyzed

later for examining the search behaviors and QR pattern. The chat logs were captured to discover what sort of information the participants discussed, exchanged and shared during the collaborative search for tourism information.

5 At the end of the search, the participants filled out post-search questionnaires which contained the questions regarding the searches, experiences and satisfaction based on the given search task. For example: How did you plan your search strategies using ColTIS (for example, division of search task, managing the search load)? How did you exchange the queries and URL links using ColTIS? How did you communicate or collaborate with your team mate using ColTIS during the search?

6 At the end the researcher collected all the documents and thanked the participants.

Lewis and Rieman (1993) mentioned that there are two alternatives to compare two systems. One approach uses two groups of test users, one of which uses version A of the system and the other uses version B. One would like to know whether the measured value for version A is likely to differ from the measured value for version B, and by how much. With other approach one can use only one group of test users and he/she gets each of them to use both the system. Doing same task the second time would be different from doing it the first time, and one has to worry about who uses which system first, as there might be some advantage or disadvantage in being the system someone tries first (due to learning effect). The latter approach works best for simple and well-known tasks about which there aren't much to learn. In this user study, second approach was selected since the task is very common and well-known. On choosing the order of tasks (in case of more than one task) the question may arise: Should everyone do them in the same order, or should they scramble them, or what? Lewis and Rieman (1993)'s advice is to choose one sensible order starting with some simpler things and working up to some more complex ones, and stay with that. This means that the tasks that come later will have the benefit of practice on the earlier one, or some penalty from test users getting tired, so one cannot compare the difficulty of tasks using the results of a test like this. This user study did not compare the difficulty of tasks and hence was strict to one order. The similar order was considered in previous evaluation study (Yuan and Belkin, 2007).

3.4.5 Data analysis

The objective of CIS is to search relevant information to the solution of a common goal. In such a process, forming queries is a very important activity to meet every party's interest. This study focuses on the analysis of CQ reformulation and collaborative choice behavior

involved in the collaborative search process. The data for analysis included the pre-search questionnaire, the search logs including individual queries and CQs, users' chat logs and post-search questionnaire. Individual queries refer to those queries composed by individual users using the standalone query window, while CQs refer to the queries composed by both participants in a pair using collaborative query window. A total of 217 (12.05 queries per pair) tourism-related individual queries and 149 (8.28 queries per pair) CQs were collected. Of the 534 chat log entries between pair of participants for various reasons, 512 were deemed to be valid and the rest were either blank or meaningless.

The search logs were examined to explore the CQ reformulation pattern during collaborative tourism information search. The post-search questionnaires and chat logs were examined further to find out the CQ reformulation and tourism information choice behaviors of users based on gender and culture during CIS. The content analysis (Schamber, 2000) was employed; it has been widely used in analysis of exploratory user-Web interactions (e.g. Du & Spink, 2011; Reddy et al., 2010).

3.5 Chapter summary

This chapter described in detail the research design and explained the methodologies involving the data collection and analysis. It also discussed how multiple data collection methods were integrated in capturing and recording different types of data during the collaborative tourism information search. The qualitative data analysis approaches, such as grounded theory and content analysis together with statistical analysis were applied to develop insights into users' collaborative search activities for tourism information on the Web. The following table (Table 3.6) shows the summary of data collection and data analysis methods to answer the proposed research questions.

Table 3.6 Summary of data collection and data analysis method for responding to the research questions.

Research Question	Data Collection Method	Data analysis
RQ1	Paper-based survey	Statistical analysis Content analysis Grounded theory
	Pre-search questionnaire	
	Post-search questionnaire	
	Transaction logs	
	Face-to-face interview	
RQ2	Post search questionnaire	Content analysis Grounded theory
	Transaction logs	
	Face-to-face interview	
RQ3	Paper-based survey	Content Analysis
	Pre-search questionnaire	
	Post-search questionnaire	
	Interview	
	Transaction logs	
RQ4	Pre-search questionnaire	Statistical analysis Content analysis
	Post-search questionnaire	
	Transaction logs	
RQ5	Post-search questionnaire	Statistical analysis Content analysis
	Transaction logs	

The following chapter reports the results based on all data sources, measures, and data analysis methods discussed here in investigating users' collaborative search behavior on tourism information.

4 Results

Three studies, namely User Study 1, User Study 2 and User Study 3, were conducted to address the research questions posed in this thesis. The following sections present the results and findings of these studies.

4.1 Results of User Study 1

This section reports the results and findings of User Study 1. This study was designed to explore the collaborative behavior of users and their interaction with the search systems for tourism information. The research goal was to outline a collaborative information search model for tourists by analyzing the data and drawing conclusions which are applicable to the development of a collaborative tourism information search tool.

This part is based on the results of the preliminary phase of the study, which is limited to the small-scale survey through a questionnaire. The findings were used for designing User Study 2. Moreover, the findings from this study provide the initial basis for developing a CIS tool for the tourism domain.

4.1.1 Questionnaire findings

4.1.1.1 Collaborative search pattern

In response to the question "Do you communicate with other people for traveling and tourism information?", 94.3% of respondents answered "Yes" and only 5.7% answered "No". A question such as "Do you share your search results with others?" resulted in 80% of respondents answering "Yes". Another question was asked, this being "Do you share your travel experience with others?"; 97.1% respondents shared traveling experiences and only 2.9% did not. Out of thirty-five respondents, only one mentioned the name WIKI as the chosen collaborative searching tool but the other 34 respondents were not familiar with this type of searching tool. The various sharing activities regarding tourism information searching are summarized in Table 4.1.

Table 4.1 Tourism information search sharing activities.

Types of sharing activities	Yes (%)	No (%)
Communicate with others for travel and tourism information	94.3	5.7
Sharing of search results	80.0	20.0
Sharing of travel experience	97.1	2.9

In response to the question "How do you communicate with others for tourism information?", 71.4% respondents mentioned Phone as the medium of collaboration and Email had been mentioned by 60% respondents. Furthermore 31% use others (Face-to-face and Web inquiry) as media. Table 4.2 shows the tools used as collaborating media. It is worth noting that the search tools they employed do not explicitly support collaborative activities.

Table 4.2 Collaborating tools utilized by user.

Collaborating Media	Respondents
Phone	71.4%
E-mail	60.0%
Instant messaging	34.3%
Others (Face-to-face and Web inquiry)	31.4%
Social network	25.7%

4.1.1.2 Frequency and reasons for tourism information searching

The search frequency with which users engaged in Web search for tourism information is summarized in Table 4.3. Over a quarter of respondents engage on a half-yearly basis and a quarterly basis.

Table 4.3 Frequency of search by the user.

Frequency of tourism information searching	Respondents
Half-yearly	28.6%
Quarterly	25.7%
Yearly	17.1%
Weekly	14.3%
Monthly	11.4%
Daily	2.9%

The study shows that people collaborate when searching for tourism information with relatives (66.7%), friends (93.9%), colleagues (57.6%), agent (39.4%) and others (12.1%). The study also reports that users collaborate during the search for various reasons which are tabulated in Table 4.4 below.

Table 4.4 Reasons for collaboration when searching for tourism information.

Reasons for collaboration when searching for tourism information	Respondents (%)
For gathering Information	20.00
For Sharing Information	14.28
For Reliable and Accurate Information	14.28
For Information Verification	11.42
For Tour Planning and Sharing Knowledge and Experience	37.14
For More Information	22.85
For Specific Information	2.85
For Different Thoughts and Opinions	5.71
For Advices/Suggestions	11.42
For Updated Information	14.28

Most users collaborate for tour planning and sharing knowledge and experiences (37.11%) followed by obtaining more information (22.85%) and planning and gathering information (20.00%). The least two reasons for collaboration are to obtain specific information (2.85%) and any alternative thoughts or ideas.

4.1.1.3 Keywords used in tourism information searching

The respondents were asked about the number of keywords they use for searching for tourism information. Here, 71.4% respondents use 3-4 keywords for searching: 5-6 keywords and 1-2 keywords are used by 22.9% and 5.7% of the respondents, respectively. Table 4.5 shows the search keywords pattern. Table 4.6 shows the priority data that the respondents mentioned (priority 1 stands for the highest priority, priority 2 stands for next highest priority and so on) for different search words according to their importance.

Table 4.5 No. of keywords used for searching.

No. of search keywords	Respondents
3-4 words	71.4%
5-6 words	22.9%
1-2 words	5.7%

Table 4.6 Highest prioritized (priority 1) search terms for tourism information.

Important search terms for tourism (for priority 1)	Respondents
Place of Interest	76.5%
Visa	12.1%
Travel Route	2.9%
Hotel/Motel	2.9%
Weather	2.9%
Food	2.9%
Local Culture	0%
Local Transport	0%

4.1.1.4 Alternative option if desired information not found

If the proper information is not found on websites, 97.1% respondents commented that they would try to get the information from other sources. Only 2.9% would reroute their travel plans (Table 4.7).

Table 4.7 Alternatives if information were not found during the Web search.

Alternative if information not found on a search engine	Respondents
Try to get information from some other sources	97.1%
Reroute travel plans	2.9%

4.1.1.5 Group search and proximity of users

The respondents were asked about their group work collaborations and where collaborating people were located. As shown in Table 4.8 on group work, 31.4% responded as "Searching first by each individual and then combining and refining the results", 28.6% responded as "Sharing search keywords" and 25.7% as "Dividing the search task, distribution of sub-tasks among the individuals and then combining the results together".

Table 4.8 Group search strategy.

Group work search strategy	Respondents
Searching first by each individual and then combining and refining the result	31.4%
Sharing search keywords	28.6%
Dividing the search task, distribution of sub-tasks among the individuals and then combining the results together	25.7%

Regarding the location of collaborating people (Table 4.9), 68.6% of respondents indicated that they collaborate with both co-located and remotely located people. Another 17.1% indicated that they collaborate with only remotely located people and the rest (11.4%) prefer to collaborate with co-located people.

Table 4.9 Statistics for the location of collaborating people.

Location of the collaborating People	Respondents
Co-located	11.4%
Remotely located	17.1%
Both	68.6%

4.1.2 Tourist information search model

The findings show that tourists collaborate and plan among themselves while searching for tourism information. A tourist may obtain information from internal sources (i.e. own experience, previous travel), external sources (i.e. friend, family) or from accompanying tourists for making a better trip plan. This planning process is embedded in searching travel information. This study shows that destination is the most frequently used search term category for tourism information. Tourists firstly search for information on a specific place (i.e. destination). And then under the specific destination they search for information like weather, transport etc. This preliminary study agrees with that of Mitsche (2005) on tourists' search behavior which identifies the most frequently used keywords as: destination (e.g. country, city), hotel, weather, food, travel route, and visa information. Based on these findings, the tourists' search behavior model (Figure 4.1) was developed. Different components of this model are discussed below.

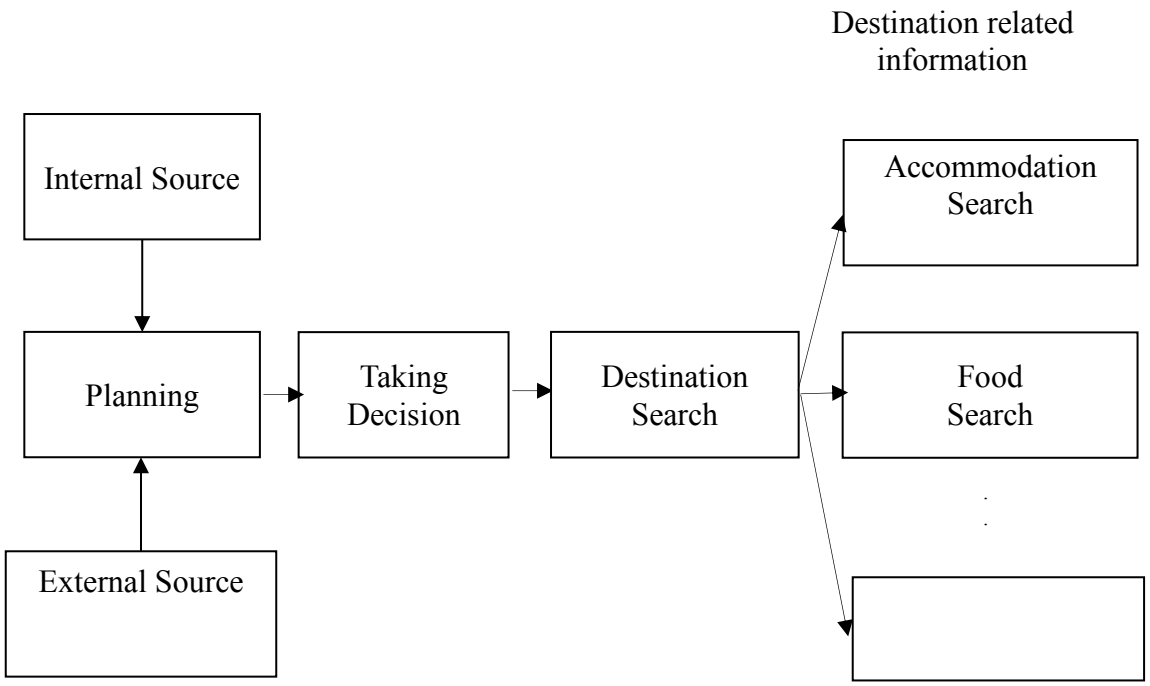


Figure 4.1 Tourists' search behavior model based on User Study 1.

Planning

As shown in Figure 4.1, planning is an activity embedded in the course of initial information searching. It involves two aspects: internal searching and external searching. Internal searching refers to the retrieval of information from the memory (knowledge, experience) while external searching consists of collecting information from other sources (family, friends, the Web, etc.). Tourists' collaboration for information searching refers to external searching. In the planning phase, tourists make a tour plan and collaborative search strategies.

Taking Decision

Taking decision on finalizing tour plan and search strategies are activities prior to begin the search for tourism information. After completing the planning process, tourists make the decision to search for specific tourism information which belongs to the selection and exploration of information seeking stages (Kuhlthau, 1993). If there is any conflict on any particular issue, the tourists resolve this conflict by discussing their views and ideas.

Destination and other Information Search

Tourists firstly search for information on a specific place; namely, a destination search and then they search for information on topics such as accommodation, transportation, attraction, food and etc. in that particular destination according to their choice of preferences.

This study attempts to better understand the collaboration among tourists which reveal that users often collaborate over both search process and search results. The finding provided detailed on why and how they collaborate for tourism information, collaborative search pattern, sharing of search tasks and results. Tourists' keywords preferences for tourism information searching, their search frequency and types of keywords used for tourism information searching have also been identified. Based on tourists' search behavior model (Figure 4.1) another model "Tourist's collaborative information search model" (Figure 4.2) was developed.

Figure 4.2 illustrates tourists' collaboration while searching for tourism information. During this collaboration process a tourist seeks information from other tourists in addition to internal sources and other external sources (e.g. friend or family). Tourists collaborate for various reasons such as gathering information, sharing information, information verification, sharing knowledge and experience, and updating information. Collaborative searching includes sharing the following: travel experiences, planning search strategies, keywords and search results. Tourism keywords database refers to the list of possible keywords being used for searching tourism information. Tourists submit their queries to the search tool and the search results are returned to collaborators depending on their search keywords. This CIS model incorporates the tourists' search behavior model (Figure 4.1) for facilitating the search pattern hierarchy (Gargi, 2003; Hearst, 2006).

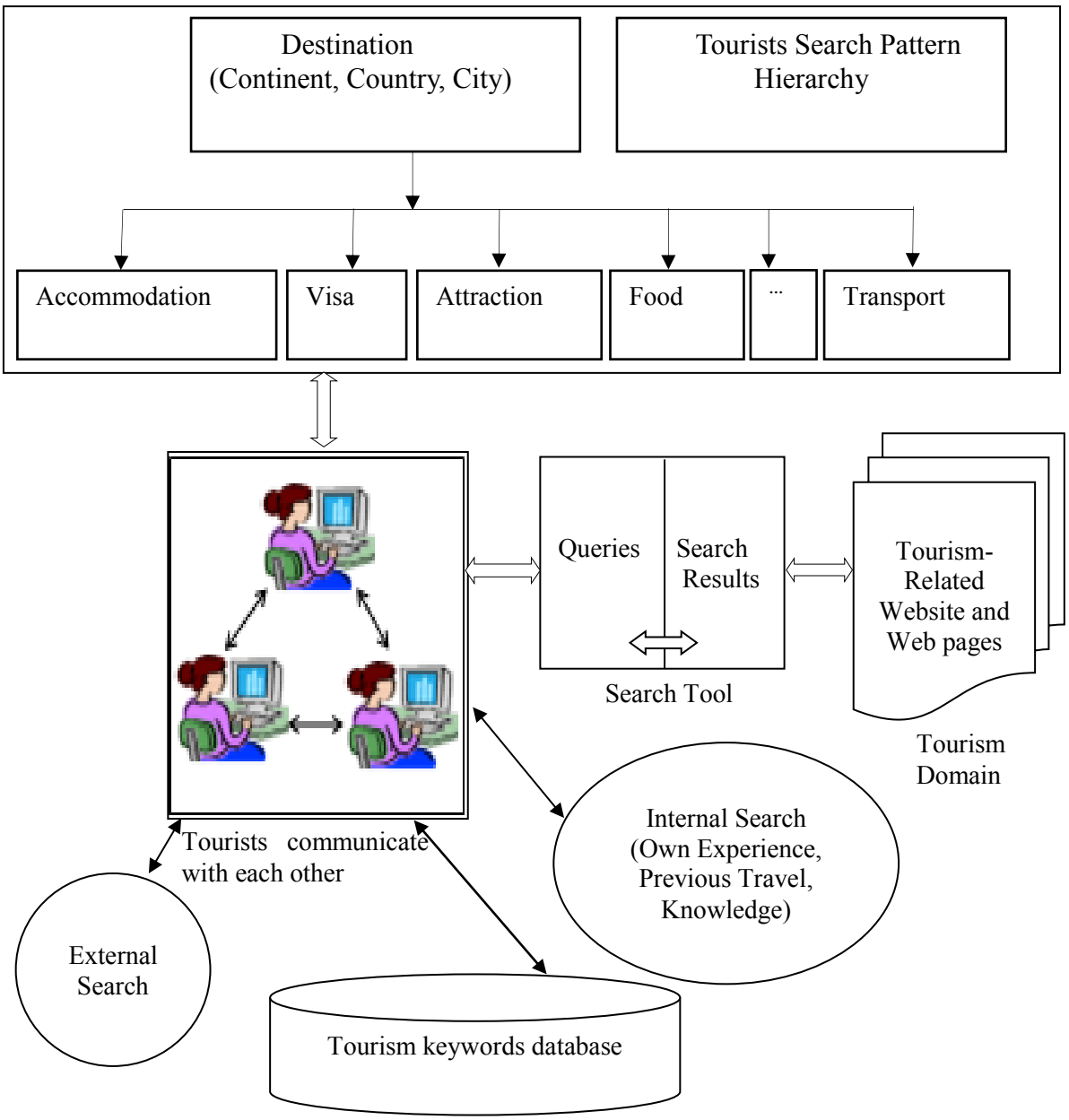


Figure 4.2 Tourist's collaborative information search model.

A tourism keywords database (tourism vocabulary) for query formulation suggestions makes users aware of the keyword patterns when they are searching for tourism information. It also helps users to avoid undesired keywords as shown in Figure 4.2. This will assist searchers in creating an effective query.

4.1.3 Summary of results of User Study 1

The findings showed that for tourism information search, searchers preferred to collaborate with friends, family members, colleagues, agents and others for various reasons that included sharing information, gathering reliable and accurate information, and sharing knowledge and experience. For information searching and results sharing, tourists employed different strategies. In addition, tourists' information search behavior model and Tourists' collaborative information search behavior model have been sketched.

4.2 Results of User Study 2

This section reports the results of User Study 2. The results of the study on collaborative search behavior of users and their interaction with the search systems for tourism information are presented here. This section also report findings on various stages of the collaborative search for tourism information, the search strategies employed, and the occurrence of IFBs during the collaborative search. The results are presented below.

4.2.1 Overview of Web search

This section presents results about which search engines the participants used, which websites the participants visited for tourism information and why and which keywords they employed for searching for tourism information.

4.2.1.1 Search systems used by the participants

All the participants used the Internet Explorer as their browser. Search engines used include Google, Yahoo and Bing. The users visited different websites for tourism information. Sometime they visited general websites but most of the time they visited tourism-specific websites for information. The major websites visited by the participants and the reasons for visits are listed in Table 4.10. Some of these websites, for instance Tripadvisor.com and Agoda.com provide not only information on accommodation, flights, restaurants, etc. but also provide other users' reviews and comments.

Table 4.10 Major websites visited by the participants and the reasons for visit.

Major websites visited by the tourists	Reasons for visit
www.tripadvosir.com	For accommodation, flights and restaurants
www.flightcenter.com www.airfaresflights.com	For flight information
www.wotif.com www.expedia.com	For accommodation, flights and restaurants
www.agoda.com	For accommodation
www.orbitz.com	For accommodation, flights, transport, local culture
www.lonelyplanet.com	To know about local attractions
www.wikipedia.org wikitravel.org	To know about food, local culture and attractions
www.cheapflights.com	For flight Information
www.bbc.co.uk	For weather information
www.youtube.com	To gather information about culture
www.farecompare.com	For fare comparison
www.booking .com	To know about booking information
www.hostels.com	For accommodation, flight, and restaurants
www.stayz.com	For accommodation
travel.yahoo.com	For attraction, food, tour package
finance.yahoo.com/currency	For currency conversion

4.2.1.2 Searching keywords used by the participants

Types of keywords used by participants for search query and the type of exchanged information (which is termed as message) through a chatting tool have been classified for a better understanding of the structure and contexts of keywords users had in mind during their collaborative search. The classifications were based on common tourism topics (destination, accommodation, attractions, local transport, food, etc.). The detailed taxonomy derived is presented in Table 4.11. Similar findings were reported in Mitsche's (2005) study but this presentation improves on Mitsche's (2005) presentation in that the current research represents the keywords in two levels: first level keywords and second level keywords. The second level keywords were used within the corresponding first level keywords. This hierarchy of keywords helps to understand the structure and order of keywords employed by the users during the search for tourism information. For instance, a user searches for an accommodation in a particular city and found some hotels, hostels/motels and service apartments. For making the decision the user then searches for hotel, hostel/motel and apartment separately to compare the cost and service of each of these accommodation types.

Table 4.11 Taxonomy of search keywords and information during tourism collaborative search.

First Level Keywords	Second Level keywords	First Level Keywords	Second Level Keywords
Destination	Country City Island	Food and Restaurants	Halal Local Food
Accommodation	Hotel Hostel Apartment	Visa	Visa office Visa Type Visa Form
Attraction	Beach Shopping Mall Park Zoo Museum Building Sporting event	Culture	Local Song Local Movie Local language
Local Transport		Budget	Total Tour Cost Flight Cost Accommodation Cost Food Cost
Flight	-	Package Tour	-
Security	-		

4.2.2 Useful evidence of searchers' collaboration and types of information exchanged during collaborative search

Sharing of experiences, exchanging messages, exchanging Web links, communicating to each other for planning and requesting information provide useful evidence of searchers' collaboration. In addition to the contextual classification of tourism keywords presented in Table 4.12, the exchanged information is divided into two subgroups: Web link (URL) and Message. Messages for the collaboration were also classified into three categories for all three search tasks which are: 1) Messages for planning - messages exchanged for planning the travel and searching information 2) Messages for division of search tasks – messages exchanged for distribution of the search, tasks or sub tasks and 3) Messages for sharing the

search results – messages regarding the sharing of search results. In addition to this classification an extra message category for search task 2 and search task 3 has been identified which are termed 'Message for sharing experiences'. For search tasks 2 and 3, some team members are familiar with the travel destination, so they shared their knowledge and experiences. Table 4.12 shows the total number of Messages and URL information exchanged during the collaboration for three search tasks.

Table 4.12 Number of messages and Web links exchanged during collaboration information search tasks.

Task	Messages exchanged (No.)				Web link exchanged (No.)
	Messages for Planning	Messages for division of search task	Messages for sharing results	Messages for sharing experience	
Task 1	141	45	58	-	33
Task 2	130	28	26	59	29
Task 3	119	28	35	47	23

The interesting finding is that for all three search tasks the participants exchanged different kinds of messages and Web links but for search task 1 there is no message exchanged for sharing experience. The reason is that for search task 1 no participant previously shared an experience.

Figure 4.3, Figure 4.4 and Figure 4.5 highlight the number of messages and Web links exchanged by each pair of participants for search task 1, search task 2 and search task 3, respectively. In all cases, the participants exchanged more messages than Web links while collaborating.

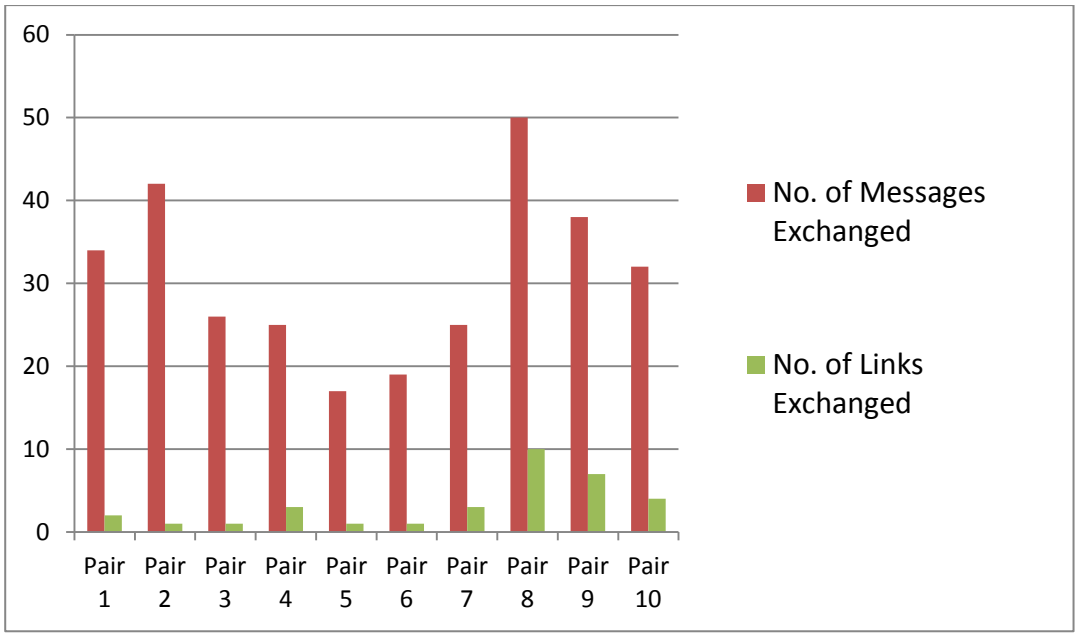


Figure 4.3 Number of messages and Web links used in collaboration for search task 1 employed by each pair.

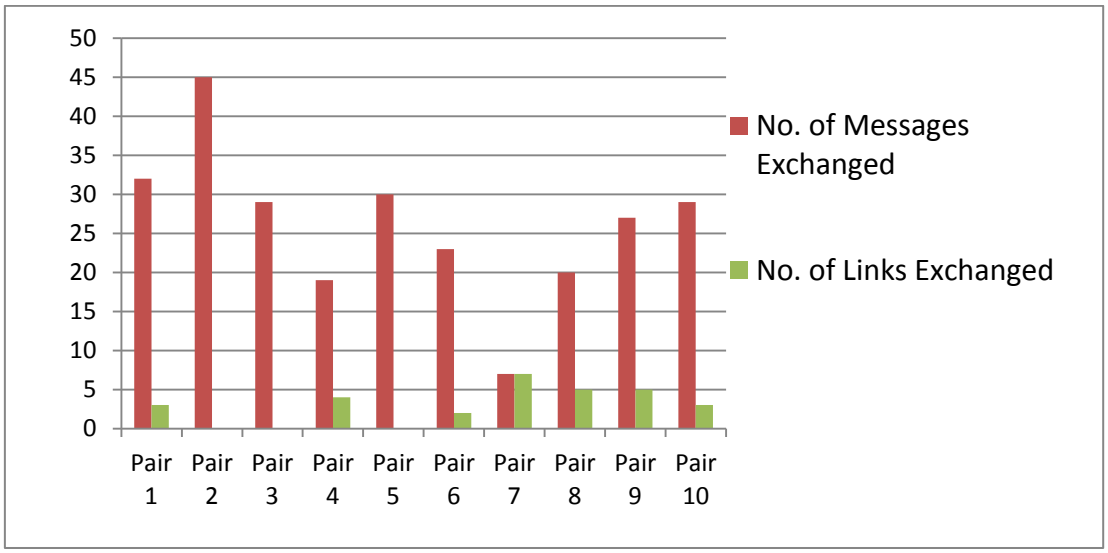


Figure 4.4 Number of messages and Web links used in collaboration for search task 2 employed by each pair.

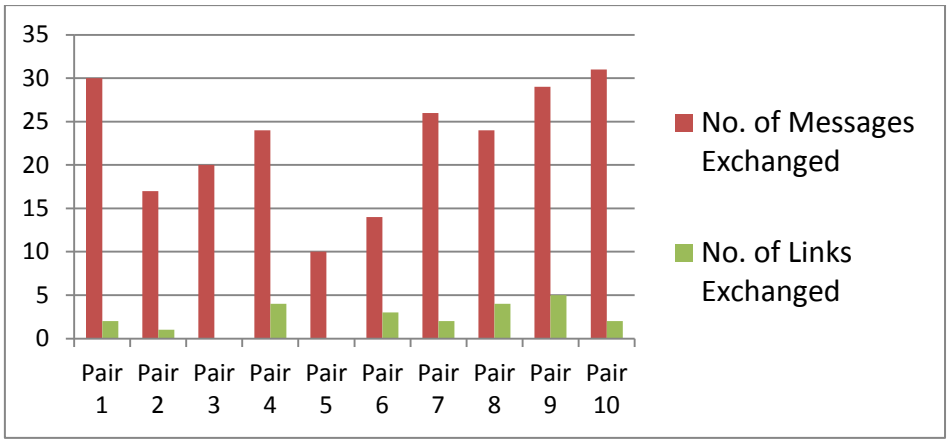


Figure 4.5 Number of messages and Web links used in collaboration for search task 3 employed by each pair.

The data concerning collaboration through planning, division of search task and sharing of search results employed by each pair are illustrated in Figure 4.6, Figure 4.7 and Figure 4.8 for task 1, task 2 and task 3, respectively. For these three search tasks, the participants collaborated more on planning (141 messages for task 1, 130 message for task 2 and 119 messages for task 3) compared to the number of messages on division of search task (45 messages for task 1, 28 messages for task 2 and 28 messages for task 3) and sharing the search results (58 messages for task 1, 26 messages for task 2 and 35 message for task 3). For task 1 the participants exchanged more planning related messages than tasks 2 and 3 as the latter two were designed for known places. More messages regarding sharing of search results were exchanged by the participants for task 1 compared to tasks 2 and 3. As the place for searching for tourism information described in task 1 was unknown to the participants, they exchanged more messages on planning and sharing of results. For search task 2 and search task 3 the users exchanged messages for sharing their experiences but for search task 1 no messages were exchanged. These findings indicate that previous knowledge on destination has an impact on the collaborative search for tourism information.

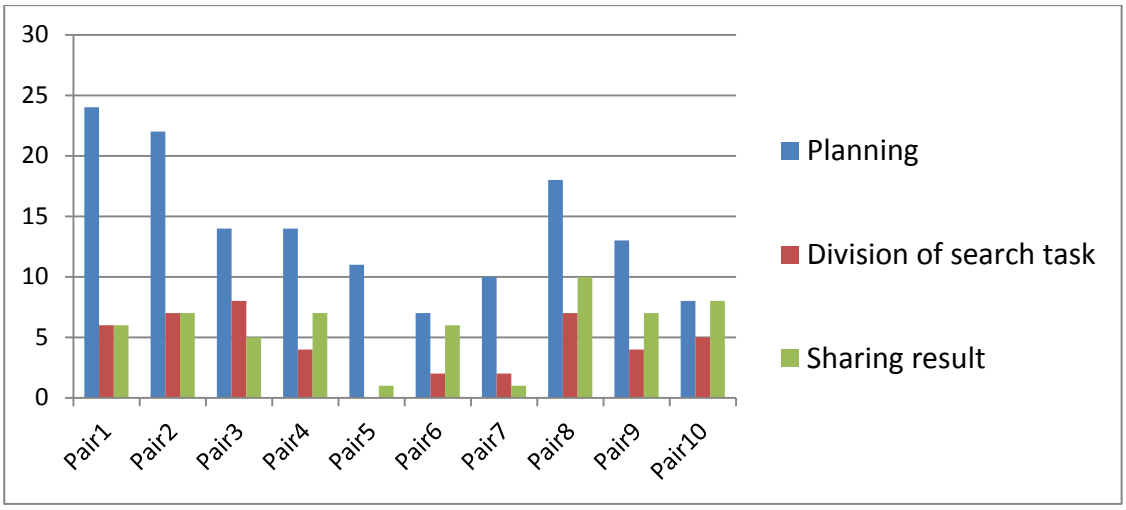


Figure 4.6 Collaboration on planning, task division and result sharing for task 1.

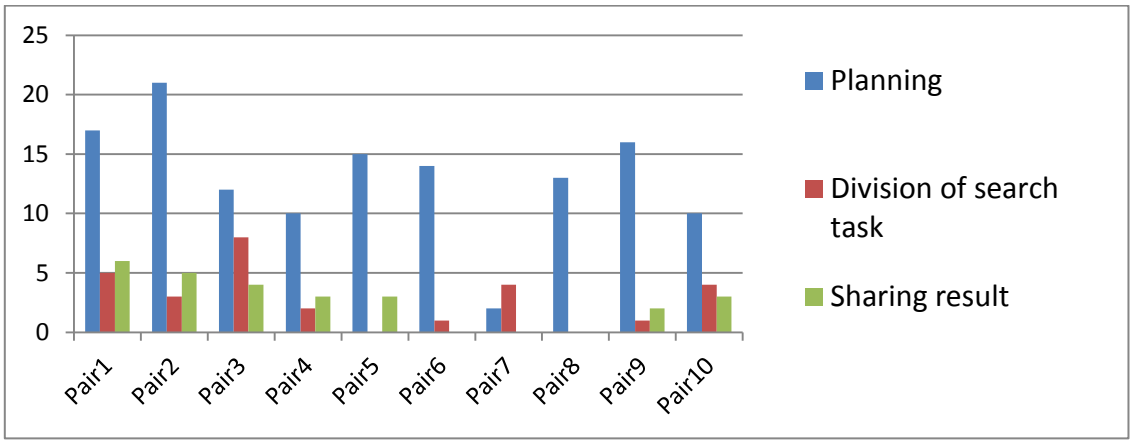


Figure 4.7 Collaboration on planning, task division and result sharing for task 2.

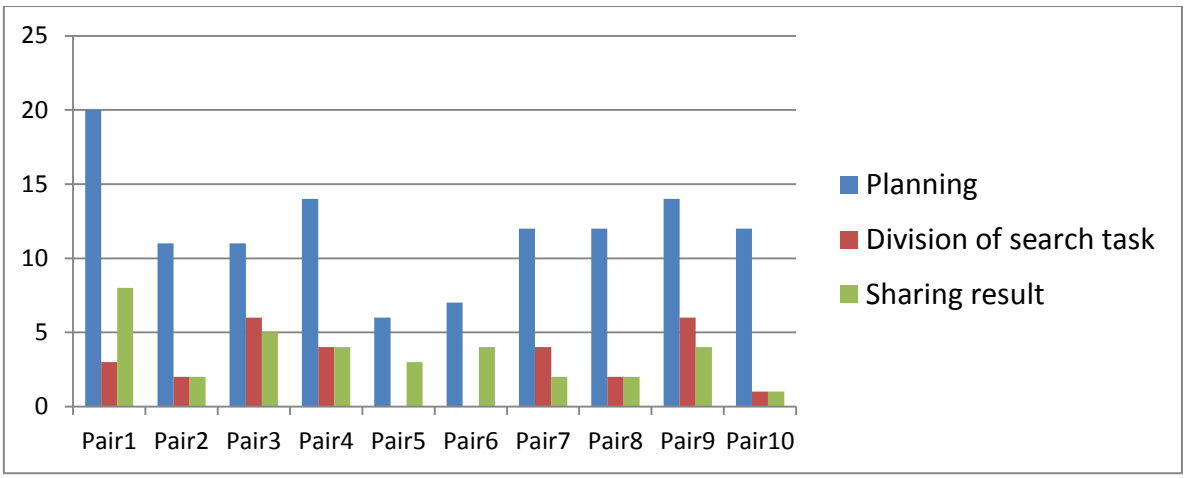


Figure 4.8 Collaboration on planning, task division and result sharing for task 3.

4.2.3 Stages of collaborative search for tourism information

Analysis of the qualitative data consisting of search and chat logs and post-search questionnaires identified four stages of collaborative search for tourism information, including *collaborative planning*, *collaborative information searching*, *sharing of information*, and *collaborative decision-making*. The details of the four collaborative search stages and their characteristics are presented below.

4.2.3.1 Stage 1: Collaborative planning

The collaborative planning stage refers to the collaborative planning activities for various aspects of a trip prior to the search, such as planning for destination, budget, accommodation options, time and length of the trip, information search strategies, and division of search tasks. Planning is the natural process of any travel (Ratchford, Talukdar, & Lee, 2001; Hoffman & Novak, 1996). It is argued that the experience of a vacation often begins with anticipation and planning (McKercher, 1998). All pairs of participants had planning discussions before they conducted Web search sessions. The following example shows the conversations between Participants 3 and 4 in Pair 2 for planning their trip to Cairns, Australia (The example quotations were taken from the excerpts of the participants' online chat logs):

> Participant 4: Just want to talk regarding our plan to visit a place.
>
> Participant 3: Can we make a plan to visit any tourist place in the coming Easter holiday?
>
> Participant 4: Have you thought something? Which place?
>
> Participant 3: I prefer to visit Cairns.
>
> Participant 4: I also have not been to Cairns. Let's plan it then.
>
> Participant 3: How long can we stay there?
>
> Participant 4: 5-6 days.
>
> Participant 3: Hope we could cover most of the attractive places within that time.
>
> Participant 4: Can we ensure the dates of Easter holiday?
>
> Participant 3: Can we start on 24th of April?

Below is another example showing the discussions about planning for information search strategies and division of search tasks between Participants 19 and 20 in Pair 10:

> Participant 20: Let's try to find some information on Egypt.

> Participant 19: I am finding some information regarding the transport and also about food.
>
> Participant 20: Can you please see halal food?
>
> Participant 19: At first we need to find flight.
>
> Participant 20: OK. Then I will look at accommodation and weather. Any tour package?

The results found that planning a trip served as the starting point to initiate the follow-up collaborative search actions. Furthermore, a sound planning strategy might lead to a more effective collaborative search.

4.2.3.2 Stage 2: Collaborative information searching

The stage of collaborative information searching describes the collaborative searching behavior for tourism information on the Web, including the employment of various search strategies. The search strategies included the selection of search engines and websites, selection of search keywords, selection of divided search tasks, and assignment of sub search-tasks between the collaborators. Group searching or collaborative searching takes place when two or more searchers share a common aim and choose to coordinate their searching efforts (Shah, 2013). Xie, and Joo (2012) revealed the factors that are associated with users' search tactical selections. Eight factors that represent task (work task and search task), user perceived knowledge level (familiarity with topic, familiarity with sources, and search skills), search process (search session length and search phases), and system (system types) were examined in relation to the selection of search tactics. During the search, the participants in each pair coordinated with each other, for example, by discussing search strategies as they selected search engines, search keywords, and ordering keywords for sub-search tasks in order to obtain comprehensive trip-related information. As Participant 8 noted,

> My teammate and I were looking for places [to] go and some special spots for visit. We usually do searches in different search engines like Google, Yahoo or others. But for this specific search, we decided to use Google,…, we discussed what should we do because we are doing in collaboration. So at first we divided what to do right now then [after] finishing one task, we discussed what to do next, in that way we just decided what to do for this specific period of time.

Most pairs (nine of ten) began their online searches using Google search engine. Only one pair chose Yahoo and Microsoft Bing. It is noted that around 19% of the pairs utilized two or more search engines at the same time for various reasons. For instance, in Pair 2, Participant 4

preferred Google to find hotels in Cairns and Yahoo to look for attractions, and Participant 3 chose Google Map to search for accommodation and restaurants. Apart from general search engines, the participants also employed a range of travel portals with searching features, such as tripadvisor.com, wotif.com, expedia.com, and orbitz.com. The pairs visited travel websites for searching one-stop travel information and looked at other tourists' reviews and comments. The websites famous for providing specialized information on flights (e.g. flightcenter.com), accommodation (e.g. stayz.com), and local attractions (e.g. lonelyplanet.com) were also very popular.

It is interesting to note that the websites providing travel-related information were also favored, such as wikitravel.org, travel.yahoo.com, and finance.yahoo.com/currency. For example, Participants 13 and 14 in Pair 7 preferred Wikipedia to browse local food and weather information. These results are consistent with a previous study where Tann and Sanderson (2009) observed that the majority of users would start their search on Google regardless of how they initiated their search, and many users had one of a limited number of websites in mind as their eventual sources. This occurs because users have a clear intention to obtain their information from these particular sites.

Search keywords reflect the generic terms or broad categories and form the queries to search for tourism information (Xiang, Wöber, & Fesenmaier, 2008). The types of keywords employed by the participants and their frequency are shown in Table 4.13.

Table 4.13 Types of tourism-related keywords (self-generated and provided by the teammate in the pair) used in collaborative information searching.

Keyword type	Self- generated keywords	Keywords provided by teammate
	Frequency (%)	Frequency (%)
Accommodation	34 (13.49)	25 (9.92)
Package tour	25 (9.92)	9 (3.57)
Attraction	24 (9.52)	21 (8.33)
Flight, bus, and train	16 (6.35)	7 (2.78)
Food	15 (5.95)	12 (4.76)
Local transport	12 (4.76)	8 (3.17)
Weather	11 (4.36)	10 (3.97)
Cost	2 (0.79)	1 (0.40)
Culture	2 (0.79)	9 (3.57)
Visa	2 (0.79)	3 (1.20)
Festival	1 (0.40)	1 (0.40)
Currency	-	2 (0.79)
Total	144 (57.14)	108 (42.86)

The participants used search keywords which were either self-generated (57.14%) or provided by the teammate in the pair (42.86%). As shown in Table 4.13, accommodation was the most frequently used type of keyword in both situations (13.49% self-generated and 9.92% contributed by mates). The participants relied fairly more on self-generated search keywords than the keywords received from teammates for package tour and transportation information. For local transport, a few more self-generated keywords (4.76%) were utilized than those by recommendation (3.17%). There is little gap between the number of self-induced and teammate-provided search keywords associated with attraction (9.52% versus 8.33%), food (5.95% versus 4.76%), and weather (4.36% versus 3.97%). In contrast, more recommended search keywords were used to search for cultural information. Visa, currency and festival were the least employed search keywords in both situations during the collaborative search process. Although the participants employed comparatively more self-generated keywords, they adopted a considerable number of search keywords provided by the collaborators, which demonstrates the evidence of collaboration on query formulation.

In summary, it is observed that, in most cases, the paired participants performed the search relying on the search keywords provided by teammates as well as self-generated keywords. For example, Participant 12 searched for accommodation by typing the search query “Hotel in Mount Gambier”. Meanwhile, his teammate (Participant 11) recommended searching for accommodation using the query “House with 2 bedrooms in Mount Gambier” because Participant 11 preferred a holiday house to a hotel. It is noted that even if the pair divided the search task already, they sometimes repeated the similar type of search by trying different keywords in order to consider the teammate’s preferences, which may lead to a longer collaborative search time. It is also worth noting that although done less frequently in this study, people did search for visa information especially when they traveled overseas. However, many current travel portals do not provide visa information (links) appropriately as expected.

As discussed earlier, a search task for tourism information may be divided into sub-search tasks concerning various related aspects, including information on accommodation, attraction, flight, food, weather, and visa. The events of defining, allocating, and distributing the sub-search tasks occurred within each pair, and then all the retrieved information was collated in order to create an understanding of the whole picture on one trip. The participants exchanged 104 (10.71%) out of 971 text messages for the division of search tasks and distribution of sub-tasks. It is interesting to note that before conducting the search, the participants firstly planned

and confirmed a destination through their discussions. They then applied different search strategies on sub-search tasks for that particular destination.

4.2.3.3 Stage 3: Sharing of information

The stage of information sharing refers to the sharing of known information, the need for information, search strategies, and retrieved objects by the collaborating participants. The sharing of already known information and information need will also guide and influence the search strategies and actions. To achieve a more efficient collaborative searching process, frequent sharing and exchanges of information must take place between collaborators (Sonnenwald & Pierce, 2000; Twidale et al., 1997). Information sharing and collaborative information searching do coincide sometimes (Hansen & Järvelin, 2005). Team members in each pair were found to communicate with each other to share information on trip planning, personal experience, search queries, Web links, and search results. The participants not only shared the search findings but also the search processes. This sort of intra-group communication is of importance in the collaborative search to learn each other's preferences, to facilitate an efficient completion of search tasks, and to make decisions for the travel. Table 4.14 summarizes the information sharing (exchanged messages captured by chat logs) during the current collaborative searches.

Table 4.14 Overview of sharing of information during collaborative search.

Messages exchanged	Planning of information need	Query sharing	Search result sharing	URL link sharing	Experience sharing	Total
Frequency	390	145	119	107	106	867
%	44.98	16.72	13.73	12.34	12.23	100

As shown in Table 4.14, a total of 867 (out of 971) text messages were exchanged by the participants for sharing of information. Remarkably, the participants exchanged 44.98% of the messages for planning what information they needed, making planning-related discussions a separate stage as described in Stage 1 collaborative planning. The participants also shared search queries/keywords (16.72%) on different aspects of traveling information. In addition to the queries, they also shared the retrieved search results (13.73%) and URL links (12.34%). When interesting or useful results were found, the results or the URL links, for instance, about accommodation type and cost, would be sent to the teammate via online chatting tools.

Sharing of search results was a process documented in other collaborative search studies as well (for example, Hoppe & Zhao, 1994; Morris & Horvitz, 2007; Reddy et al., 2008).

Moreover, the teammates shared URL links as the recommendation for the source of tourism information. Sharing of experience (12.23%) was another evidence of collaboration. Even though the sharing of experience was relatively less than other types of sharing information, it is noted that the participants spontaneously shared their previous experiences or knowledge, if any, with each other during the collaborative search. Sharing of experience did take place during the search for Tasks 2 and 3 on a known place to at least one of the collaborators. Previous relevant experiences had an impact on standalone search (Vogt & Fesenmaier, 1998) and collaborative search (Mohammad Arif et al., 2013). Sharing of queries, URL links, and results are further analyzed and reported in the results of collaborative search strategies.

4.2.3.4 Stage 4: Collaborative decision-making

The stage of collaborative decision-making describes the process whereby collaborating participants collate and integrate the obtained information in order to make decisions on an upcoming trip by considering individual preferences. As stated, tourism information involved multiple aspects, including accommodation, food, culture, and cost. Different participants demonstrated distinct preferences for a variety of these aspects. Preferences about particular information affected teams' collaborative decision-making process. As one participant (Participant 19) stated,

> The main problem is that all of us are not having the same requirement regarding searching that for example if when I go in some other places I may find some accommodation like near beaches and my teammate may find some accommodation which is nearer to the city and there are such type of differences when just searching in a collaborative environment.

Another participant (Participant 20) mentioned,

> I think the most important problem is in the synchronization of different aspects of travel like the budget, different person has different level of expenditure. People also have their taste in food. Some may like different season or different weather.

Eight of ten participatory pairs in this study reported that they encountered conflicts when making a group decision. When conflicts of opinions arose, they sought solutions either by accommodating everybody's preferences or searching for an alternative solution. For

instance, when working on Search Task 3, Participant 5 wanted to go to Melbourne from Adelaide by air, whilst Participant 6 disagreed as the airfare was too expensive. Finally, they decided to go to Melbourne by bus as Participant 6 found that to be affordable.

In the case of alternative solution, the participants often re-started a new search for particular information, as shown in the following example (Pair 1, Task 1):

> Participant 1: I found a 3-star hotel, $155 per night
>
> Participant 2: We need to accommodate our budget
>
> Participant 1: Ok, I can find a bit cheaper
>
> Participant 1: Still trying to find hotel …
>
> Participant 1: I found this http://www.ibishotel.com/gb/hote/ ….. that's not too far off the city, less than $150 per night , twin room …

The results also demonstrate that reformulating search queries and conducting multiple rounds of search in the collaborative searching context might occur more notably and frequently than that during the course of individual searching. This may be due to the nature of collaborative decision-making.

4.2.4 Collaborative search strategies for tourism information search on the Web

Communication is one of the critical components in any form of collaboration (Reddy et al., 2008). During the collaborative search for tourism information, all pairs of participants communicated synchronously about search strategies through Google Talk instant messaging. Collaborative search strategies were discussed, coordinated, and employed at the search stages of planning, collaborative information searching, and sharing of information. Collaborative search strategies were represented as the participants in each pair collaborated with each other in regard to planning travel information search strategy, division of search task into sub-tasks, using search queries/keywords recommended by teammate, using URL links recommended by teammate, and observing and discussing search results. Table 4.15 shows the collaborative search strategies that were used for each search task based on the communications/text messages exchanged.

Table 4.15 Collaborative search strategies for each search task.

Collaborative search strategies	Task 1		Task 2		Task 3	
	%	No.	%	No.	%	No.
Search strategy planning	36.15	141	33.33	130	30.51	119
Division of search task	44.23	46	27.88	29	27.88	29
Using search queries recommended by teammate	28.70	31	32.41	34	38.89	42
Using URL links recommended by teammate	47.62	30	25.40	16	26.98	17
Observing and discussing search results	48.74	58	21.85	26	29.41	35

The adoption of search strategies varied for different search tasks. Details of these collaborative search strategies are reported below.

4.2.4.1 Collaborative search strategy planning

Planning a collaborative search strategy is an important part of travel planning during CIS. The participants made plans for the travel-related search strategies by typing and exchanging text messages through Google Talk. For example, they exchanged messages for planning where to start the search and which websites providing certain tourism information could be chosen. As shown in Table 4.15 (see Row 3), the participants communicated more planning-related messages in search for Task 1 (36.15%). This may mean that for an unknown destination, more planning is required.

4.2.4.2 Collaboration for the division of search task

Dividing a search task into sub-tasks is a common practice in collaborative searching (Morris & Horvitz, 2007) in order for collaborators to share the search load. The participants exchanged messages with their teammates regarding the division of search task into various sub-tasks. As one participant (Participant 9) stated,

> Well … primarily we both discussed about some very crucial topics of search and then we just subdivided the topics. I have searched some information regarding hotel and some attractions, and my teammate found information on food and transportation.

By looking at the statistics for the division of search task in Table 4.15 (see Row 4), it is found that the teams performed more divisions of search task for Task 1 (44.23%) than for Task 2 (27.88%) and Task 3 (27.88%). This measure may suggest that the division of search

task would be done more often when participants had no prior knowledge about the destination.

4.2.4.3 Using search queries recommended by teammate

Each pair of participants formulated search queries collaboratively using the search keywords recommended by each other. Results show that the search keywords suggested by teammates covered a range of aspects for a trip, including destination, accommodation, transportation, attraction, food, and travel cost. Two examples are presented below to demonstrate this sort of collaborative search strategy:

> I provided the search query "Places to visit in and around London" to my teammate for searching attractive places in London. (Participant 1, Task 1)

> I helped my teammate by suggesting the search query "Delhi to Jaipur bus service" for searching transportation from Delhi to Jaipur. (Participant 3, Task 3)

The results confirmed that when multiple users engage in searching for information they tend to share search keywords for formulating better queries in order to produce better search results in a collaborative environment (Hoppe & Zhao, 1994; Morris & Horvitz, 2007). The data in Table 4.15 (see Row 5) show that the participants shared more queries for Search Task 3 (38.89%) in which multiple travel/search conditions needed to be satisfied simultaneously.

4.2.4.4 Using URL links recommended by teammate

In addition to using the search queries recommended by teammates, the participants also collaborated by using the team-recommended URLs which were believed useful to direct to desired information. They clicked and opened the links sent by the group mate to look for further information. In total, around 107 URLs were shared by the pairs of participants and 63 of them were actually used. Of these, Tripadvisor.com was the most suggested tourism Web portal, followed by Booking.com and Wotif.com. Table 4.15 (see Row 6) indicates that the participants adopted more recommended URLs for Task 1 (47.62%) than for Task 2 (25.40%) and Task 3 (26.98%). It may be concluded that the search strategy of sharing and using URL links suggested by teammates is more likely to apply when traveling to an unknown destination.

This research also shows that the participants recommended the most URLs related to accommodation (32 URL links). The second most suggested URLs were about local attractions (16 links). The URLs on flight information and local transportation were also

shared frequently within the pairs, having 14 links each. Less frequently, the tourists used the recommended URLs on food and custom reviews (with two links, respectively). The remaining aspects concerning travel information were shared with only one URL link each.

4.2.4.5 Observing and discussing search results

During the collaborative search, the collaborators were observed to frequently comment on search results together via Google Talk text messaging. As one participant (Participant 4) described, "Yes, as I said we divided the search task so individually we conducted the searching and shared and discussed what results we obtained." Another participant (Participant 8) stated, "We both searched in parallel by our own knowledge. After finding some information then we shared the results of our search, it was easy for us to share our results with each other, e.g. sharing the prices of air ticket and doing the comparisons."

Overall, the teams shared more results for Search Task 1 (48.74%) than for Search Tasks 2 (21.85%) and 3 (29.41%). A possible reason could be that, without prior knowledge about a place, participants tend to explore and search for more information and consequently they shared and discussed more results.

4.2.5 IFBs and their effects on collaborative tourism information searching

Adverse events may occur while the collaborators search for tourism information for making a better holiday plan. The DIB checklist method was used to identify and locate the IFBs in relation to adverse events that hindered the normal flow of information gathering or shared understanding as the collaborators searched for travel information. The IFBs encountered by the participants were identified at three of the collaborative search stages, these being collaborative planning, collaborative information searching, and collaborative decision-making. Analysis of the interview transcriptions revealed that most of the IFBs occurred during information searching (73.63%), followed by planning (25.27%), and decision-making (2.10%). The types of IFB and their effects are reported in detail in the following sections.

4.2.5.1 Types of IFB during tourism CIS

Four types of IFBs during collaborative tourism information search were identified, including missing information, unavailable information, incomplete information, and conflict of preference (Table 4.16).

Table 4.16 Types of IFBs during tourism CIS.

Types of IFB	Sub-types	No. of instances (%)
Missing information	Missing information in planning	22(24.18)
	Missing information in querying	19(20.88)
Incomplete information	Out-of-date information	10(10.99)
	Partial information	30(32.97)
Unavailable information	Unavailable URLs	3(3.30)
	Information unavailable on the Web pages	3(3.30)
Conflict of preference	Accommodation of individual preferences	2(2.20)
	Decision-making problems	2(2.20)

Missing information was found to be responsible for the largest number of IFBs (45.06%) during tourism CIS. Missing information refers to the type of IFB that occurred due to the absence of information during the search planning and search process. This type of IFB was further divided into two sub-categories: missing information in planning and missing information in querying. When discussing the information obtained and summarizing the information to finalize their decisions, the pairs of participants realized that some information was missing when they planned their trip and search strategies. A possible cause of this IFB type may be the lack of proper discussions on particular aspects of the search task. For example,

> In the decision making stage, we were talking about the facilities of the destination. My teammate raised his concern about the security of the locality and we perceived that we missed security issues in both planning and searching stages. (Participant 3, Task 2)

> We did not discuss currency conversion prior to the search...we noticed it later. (Participant 18, Task 3)

Missing information in planning has an impact on the search stages, search strategies, and decision-making. As Participant 11 stated, "food was searched but in the planning it was not discussed whether the food should be Indian or Halal. After the completion of search, it was identified that the food should be Halal". They had to search the food again with modified search keywords. Inappropriate or missing keywords in the search query led to irrelevant information being found. Two examples are given below:

> We found that the information about accommodation cost was missing and that was because we did not include the cost of accommodation in the search query. (Participant 4, Task 1)

> We intended to search for Asian food but forgot to put the keyword "Asian" in the query and consequently it took us to the results which we were not looking for. (Participant 3, Task 2)

Incomplete information refers to the adverse situation where the search results obtained (either self-collected or shared by teammate) were out-of-date or only partial. It was the second largest type of IFB (43.96%). Incomplete information affected collaborative search processes. For instance, without all the information, the participants were not able to choose a certain travel destination, attraction, or accommodation. It also affected the process of collaborative decision-making, for example, the participants were not able to finalize their trip plan due to having incomplete information. The participants were disappointed when the information found did not correspond to their needs, and then they had to switch to another website to continue with their searching (Fidel et al., 1999; Nazim, 2008).

Unavailable Information happens when the URLs shared by the participants, either according to their previous experiences or that they found during the search, were dead or did not contain the desired information. Some 6.6% IFB occurrences were due to the unavailability of information. In this adverse situation, the desired information could not be found at all. For example, "I could not open the link sent by my teammate" (Participant 6, Task 1), and "I could not find the review on accommodation" (Participant 9, Task 3). Unavailable information prevented the participants from making further decisions for their trip plan. For instance, Participant 7 mentioned that due to the unavailability of flight and accommodation costs, they could not make a travel decision.

Conflict of preference refers to the adverse situation that originated from the differences in collaborators' preferences (e.g. choice of flights) during the collaborative search. Personal preferences and judgments involved in tourism information searching. The occurrence of this sort of IFB was due to the conflict of personal interests and values. Conflict of preference took account of the lowest number (4.4%) of IFBs, which prompted accommodation of individual preferences and decision-making problems. The low rate may be due to the fact that the teammates in each pair already knew each other, yet personal preferences that take

place in CIS should be handled with care in order to preserve team harmony as well as the effectiveness of search outcomes.

4.2.5.2 Effects of IFB on tourism CIS

The occurrences of IFB impacted on tourism CIS activities including the planning process, search strategies, and search time.

Effects of IFB on Planning Process.

When encountering the problem of information missing in planning, the participants had to stop their current search to reconsider their travel plans. They either changed the attractive places they wanted to visit, or the location of accommodation, or even the tour time and length. An example of planning and re-planning is described as follows:

> We planned to travel to the Amazon in Brazil in December or February because of comfortable weather. As we did not discuss the budget during our planning and the confusion arose because the tour cost appeared very expensive. Immediately we changed our plan of traveling time to some other period when there would have discounts on ticket, accommodation cost etc. Eventually we found a suitable time which was in March that met our budget. (Pair 5, Task 1)

Effects of IFB on Search Strategies

Before starting the search, the collaborators discussed the search strategies such as types of keywords, query formulation, and use of certain Web portals. If they failed to find the wanted information (unavailable information), they usually changed their search strategies accordingly, for example, by choosing another travel portal or by modifying their queries. An example is provided below:

> Halal food was requested by my partner, so we typed the search query "Halal food in Mount Gambier" but it did not return any information on halal food. For an alternative solution, we changed the search query to "Muslim food in Mount Gambier" and again no desired information was returned. Finally we composed the search query "Indian restaurant" and found the desired food information. (Pair 6, Task 2)

Effects of IFB on Search Time

Search time is believed to be one of the important measures of search behavior (Ho & Liu, 2005). The occurrences of IFB associated with conflict of preference forced the collaborative

participants to discontinue the search temporarily and to initiate discussions about seeking solutions. They then either resumed the search or started a new search based on the discussions; such a process slowed down the search and sometimes made it inefficient. One participant mentioned the delay during the collaborative search:

> Probably because of things like when I found a hotel I had to send the link to the other people for him to look through so that he can decide whether he liked the hotel or not, so meanwhile I had to wait for his preference for hotels prior to moving further.

4.2.6 Factors that influence collaborative searches for tourism information

Three primary factors have been identified that influence collaborative search for tourism information. These factors are discussed in more detail below.

4.2.6.1 Budget for the travel

Different social classes demonstrate distinct preferences for a variety of products including leisure activities (Kotler & Armstrong, 1995; Morrison, 1996). The exact role and measurement of social class, however, continues to be controversial among consumer researchers (Boone & Kurtz, 1995). Whereas social class typically is determined by things such as occupation, sources of income, accumulated wealth, highest level of income achieved, place of residence, and family history, some scholars have argued that income alone suffices (Boone & Kurtz, 1995). In this study, it was found that budget which is associated with socioeconomic status affects collaborative tourism information searches. Travelers at lower income levels and higher income levels should match at a certain level of budget to plan for a better trip. As one participant noted:

> The problems depend on the budgeting because different people have different budget. So we have to take care of the budget of the other person if I am not searching for suppose flight information I have to accommodate the other person's budget for the flight, I will look for cheapest one or I will look for the comfortable one or other person have to search for accommodation which cheaper or accommodation which is closer to something like that. So it depends on collaborative as well as people or touring in a group. So we have to take care of everybody's budget.

4.2.6.2 Prior knowledge and previous visit

Tourists can learn from their experiences concerning a particular destination, and from the experiences of others (collaborators), and by means of visual, verbal, and sensory stimuli,

such as advertisements, newspaper/magazine articles, and television programmes (Vogt & Fesenmaier, 1998). Tourists also acquire information through ongoing searches (Bloch, Sherell, & Rodgway, 1986). They process information obtained through an ongoing search and store it in their long-term memory (Bettman, 1979). This, in turn, forms their (prior) knowledge (Bettman, 1979; Ratchford, 2001). When the need arises to evaluate a destination, tourists first attempt to retrieve information from their long-term memories (Vogt & Fesenmaier, 1998). Prior knowledge enables them to evaluate a destination's attractiveness by retrieving information related to its attributes and attractions (Ratchford, 2001). Thus, prior knowledge enhances internal memory and assists in the decision-making process (Brucks, 1985). Findings on the relationship between prior knowledge and information search have been contradictory (Gursoy, 2001).

Some researchers concluded that there is a negative relationship between the amount of prior knowledge and the amount of external search or collaborative search (Coupey, Irwin, & Payne, 1998; Fodness & Murray, 1998). One explanation for this negative relationship is that experienced consumers have prior knowledge about the attributes of various alternatives, and consequently do not need to acquire such information from external sources (Brucks, 1985). They make decisions based on their prior knowledge (Vogt & Fesenmaier, 1998). A second explanation is that experienced consumers perform more efficient information searches because they know what is important, useful, and where to get it (Coupey et al., 1998) and they can disseminate the information to others. However, several researchers argued that prior knowledge encourages searching by making it easier to process new information (Gursoy, 2001; Rao & Sieben, 1992). For example, knowledge of destination attributes and attractions may allow the individual to formulate more questions and, therefore lead to more external search.

Previous visits to a destination is one of the most commonly examined factors likely to influence tourists' information search behavior and decision-making process (Gursoy, 2003; Vogt & Fesenmaier, 1998). Fodness and Murray (1999) suggest that in the case of routine problem-solving, decisions are made quickly and with little apparent effort due to the fact that for routine trips, pre-purchase information search probably is not necessary if previous visits provide an adequate basis for decision-making. Knopf (1981), for example, studied the use of interpretative systems among tourist groups with differing levels of travel experience. He found that a more experienced tourist tends to use more detailed and specific travel information systems whereas the first-time tourist tends to use more general information. The

results suggest that the level of travel experience has differential effects on the usage of travel information and travel search behavior. For search task1, prior knowledge and previous visit have no direct impact as none of the team members knows anything about the destination. They have to explore all the information and interact more for taking any decision for the trip. However, for other two search tasks (search task 2 and search task 3), the person who has the prior knowledge can help the other to find more information that reinforces his own search. As one participant stated:

> Actually the first one (search task) is very interesting that both of us, the first one that we have to select a place where nobody been before. So that is in one sense it is very interesting and while searching these things we may face some little problems……. And for the second and third one, it needs time saving to collect the information because one may know very well about those place another one does not know, so one can share his experience another can be like, feel very much interest because when we say some story and some audience is there, they feel more interest about the story.

4.2.6.3 Technology

One characteristic of this research is that it involves not just the collection and analysis of tourists search data but also the development of a prototype for a CIS system for the tourism domain. Although no single systematic method has been developed, Computer Supported Cooperative Work (CSCW) and Human-Computer Interaction (HCI) researchers have developed effective methods for developing recommendations and designing systems (e.g. Ackerman & McDonald, 1996; Moran & Carroll, 1996; Twidale et al., 1997; McDonald & Ackerman, 1998). Research shows that tourism has to be understood as a special scenario where technology is used (Gretzel, 2011). The intention, in this research, is to use the data analysis as a means to systematically question the assumptions behind traditional technology designs of conventional IR systems, and through this questioning, to generate design recommendations for tourism CIS systems. Through the laboratory user study, how users collaborated during tourism information searching using traditional search technology was explored. However, issues such as communication amongst collaborators have largely been ignored in current information search tools in the tourism domain.

Due to the lack of a proper tourism CIS system, tourists cannot collaborate and can access only a tiny fraction of the information published on the Web. The technologies that influence the online collaborative search for the tourism domain are the search engines and communication facilities that tourists use. The participants were unable to see each other and

were instructed them to communicate with each other only through the chat feature. Data were captured through chat logs, search logs, observations, and interviews. The results found that the chat feature played a prominent role in supporting the collaboration between team members during their information seeking and retrieval activities. Tourists demand more facilities from a CIS tool. As one participant noted,

> I think about these how you can provide the immediate communication between the two users or more users on their preferences and specially where to how to share the information as well because sort of like to have the screen share between us. We can actually point places, so we can show a map on where to go, what to do and what are the hotels to look forward so because we look at two different computers. So we are not sure what the other person looking at sometimes like things like hotel's information. We need that information quickly to see whether we decide to go because sometime we have to book on line for hotels. So I need to find quick way of fully other person's choices whether they want whether they approve of those particular one or not. So I think of a screen sharing else something.

4.2.7 Factors affecting system design

These findings are based on the user study of collaborative search for tourism information. The users participating in the study were experienced in Web searching and tourism information searching. Though the participants are not representative of all groups of people, this research value their collaborative activities, their suggestions, the recommendations they made and their feedback on expectations from a CIS system for the tourism domain. The research has outlined how the findings reported in this study can be combined for designing a CIS tool for tourism information are as follows.

4.2.7.1 Technology: Screen sharing

The CIS tool can be incorporated with screen sharing technology. Screen sharing technology can help one team member to see the other's computer screen and avoid repeating the task the other person is doing. This will save search time and allow one member to see the information from the other without intervention.

4.2.7.2 Division of search task

The information search task can be divided into sub-tasks and each member of the collaborating team can perform some of the sub-tasks. With screen sharing technology

embedded in the CIS tool, each member can see useful information from the other person's screen. Each person does not need to search for all the information.

4.2.7.3 Sharing of search results

Search results are important for making travel decisions. A CIS tool should have the facilities to broadcast the results to all the members of the collaborating team. It is not the ideal case that everybody always looks for the others' computer screen. If someone retrieves interesting information then he or she can broadcast the results to all.

4.2.7.4 Budget (cost) minimization

Since different team members may have different budgets for a trip, a CIS tool may minimize this problem. A program (software) could be embedded within the CIS tool that can search for information (say accommodation cost) for an average budget of all collaborating members.

4.2.8 Summary of results of User Study 2

The results demonstrated that tourists performed collaborative planning, collaborative information searching, sharing of information, and collaborative decision-making at different stages of the search process. The results also showed that, using text instant messaging, tourists collaborated for planning their search strategies, dividing search tasks into sub-tasks, discussing search engines and tourism Web portals used, tourism search keywords, methods of sharing results and links, and reviewing search results together. Types and effects of IFBs during collaborative tourism information search were also identified. Tourists' desired features of a collaborative search tools have also been drawn.

4.3 Results of User Study 3

The third user study aimed to observe the collaborative search behavior of users using ColTIS, including CQ architecture, CQ reformulation strategies, impact of individual queries and chat logs on CQ reformulation and choice of tourism items based on users' attributes, as well as to evaluate the effectiveness of ColTIS with a widely used tourism portal, Tripadvisor.com. The results on evaluation and effectiveness of ColTIS and the comparison between ColTIS and Google Talk-embedded Tripadvisor.com are reported. The findings of this study also address the research questions proposed earlier, including the CQ reformulation type and pattern as well as the collaborative behaviors of users based on their culture and gender in the CIS process for tourism information. The detailed results are given below.

4.3.1 Evaluation of ColTIS system

4.3.1.1 Evaluation variables

A user study was conducted to evaluate the performance of ColTIS by assessing how well it achieved the initial design goal enabling collaboration during tourism information search. This study evaluated the usability of ColTIS and determined whether it succeeded in addressing the limitations of current tourism Web portals regarding collaboration. The study evaluated ColTIS in comparison to Tripadvisor with respect to the variables of performing the search task, including task completion time, collaboration, ease of use, usefulness, result satisfaction and result correctness. These variables have been measured in different studies to evaluate the system and task performance, for example, task completion time in Liu *et al*. (2013), collaboration in Mohammad Arif *et al*. (2015), ease of use in Xie and Cool (2000), usefulness, result satisfaction and result correctness in Yuan and Belkin (2007). The variables are briefly described as follows:

Task completion time. Task completion time is the time to complete an information search task using search systems.

Collaboration. During the search, the collaborators perform several actions pertaining to the collaborative search. Division of search task, chatting and result sharing were chosen as the measurable variables to compare the two systems as they were the common and prime activities observed:

- Division of task: Division of search task performed on both systems was compared with regard to how they (users) divide the search tasks.
- Chatting: Chatting messages through both systems were measured and compared.
- Result sharing: Number of instances and means of result sharing were measured and compared between two systems.

Ease of Use. In this context, "ease of use" refers to the ability of users to perform a search task without the need for an advanced explanation and/or help from others. The participants were asked to rate 'ease of use' for both ColTIS and Tripadvisor using a 7- point Likert scale.

Usefulness. Usefulness refers to the quality of any system's utility and applicability. Usefulness of both systems was measured and compared based on the users' rating.

Result satisfaction. Search result satisfaction is a personal belief that users are happy (satisfied) with the search results retrieved by a search system. Result satisfaction was also evaluated based on users' rating.

Result correctness. Search result correctness refers to the users' perception of the closeness of the retrieved results to users' expected results. Result correctness was computed from the post-search questionnaires where users judged the search results if they were correct, partially correct or not correct.

Search usability. Search usability of a system refers to the evaluation to test whether the system is easy to use. Search usability of two systems was tested based on: i) whether the systems were easy to start the search, ii) whether the systems could easily perform the search tasks, and iii) whether the systems were suitable for doing the search task within a specific/stipulated time.

4.3.1.2 Findings

Findings are organized according to the evaluation variables outlined in the above section and the details of findings are reported below.

4.3.1.2.1 Task completion time

Task completion time of each pair was calculated by the time that elapsed between the start of the search and the end of the search. Figure 4.9 shows task completion time for all 18 pairs of participants.

Table 4.17 shows the statistics for task completion time and significance values for both systems. Analysis of variance (ANOVA) indicated that the participants using ColTIS spent slightly more time (M =17.83, SD=3.97) than Tripadvisor (M =16.28, SD=5.58), but the difference was not statistically significant, $F(1, 34)=0.93$, $p=0.342$.

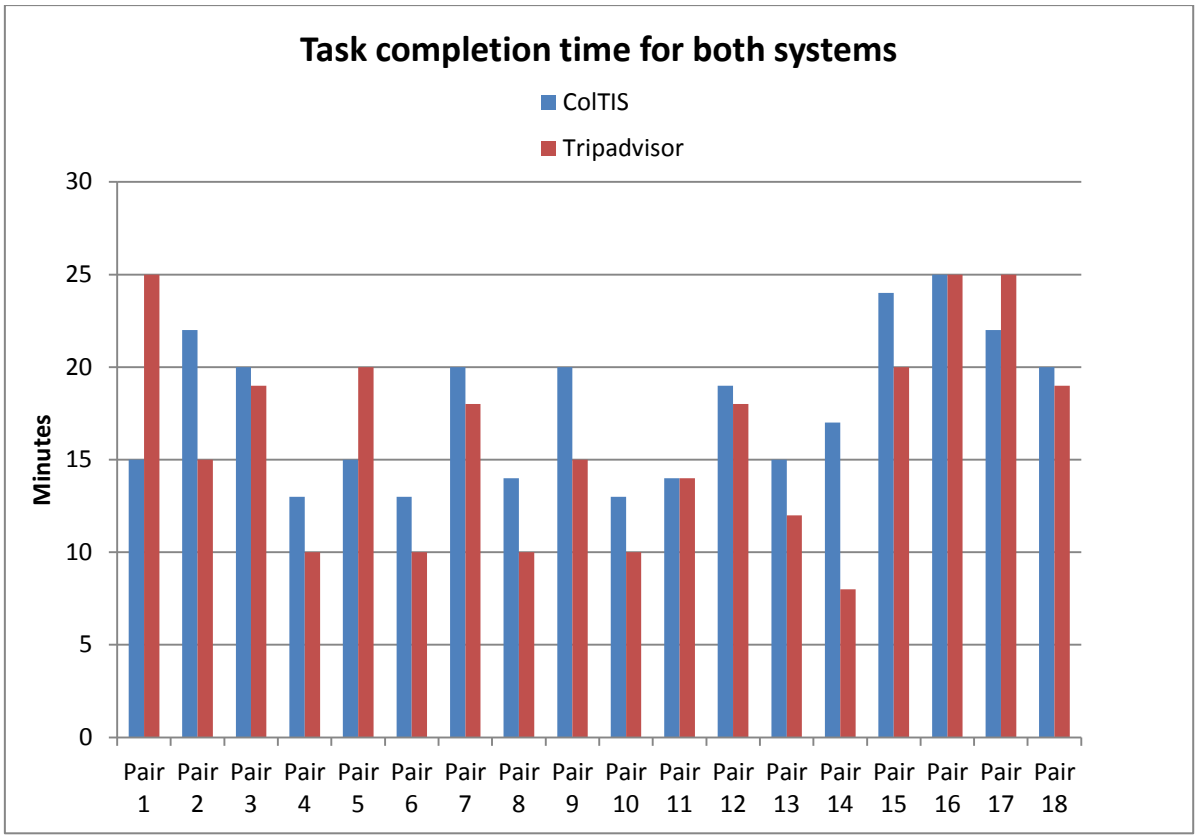


Figure 4.9 Task completion time using Tripadvisor and ColTIS.

Table 4.17 Statistics for task completion time using Tripadvisor and CloTIS.

System	Task completion time Mean(SD)	ANOVA
Tripadvisor	16.28(5.58)	0.342
ColTIS	17.83(3.97)	

One participant (Participant #27) noted the slowness of ColTIS as follows:

> …the overall performance of the system needs to be refined to handle larger volumes of text, more effective scrolling and faster processing…..

4.3.1.2.2 Collaboration

Collaborators were observed performing division of search task, chatting and result sharing while using both systems. The comparative results for these actions are reported below.

Division of search task. For dividing the search task, pairs of participants applied different strategies while using Tripadvisor and ColTIS. Collaborators employed the built-in "division of search task" option provided by ColTIS before beginning the search whereas the

collaborators exchanged the text messages for the division of search task when they used Tripadvisor. With ColTIS, 13 out of 18 pairs of collaborators had 8 sub-search tasks; one pair selected 7 sub-search tasks; one pair selected 6 sub-search tasks; one pair chose 5 sub-search tasks; and the remaining two pairs had 4 sub-search tasks. As one participant in Pair #5 stated,

> We divided the search task into 8 sub-search tasks (4 sub-tasks for each of us) using division of search task function of ColTIS.

On the other hand, with Tripadvisor, the collaborators (13 pairs) chose one through four sub-search tasks. Five pairs did not even divide the search task explicitly when they worked with Tripadvisor.

Chatting. Each pair of participants chatted during the collaborative search. The numbers of messages exchanged by each pair of participants for both systems are shown in Figure 4.10. The participants were observed to communicate less with each other when using ColTIS (Total 512, Mean 28.44) than Tripadvisor (Total 562, Mean 31.22) (Table 4.18). This might happen as ColTIS provided the functionality of automatic query, result and link sharing and consequently participants did not need to engage in more chat (communication) to accomplish these activities.

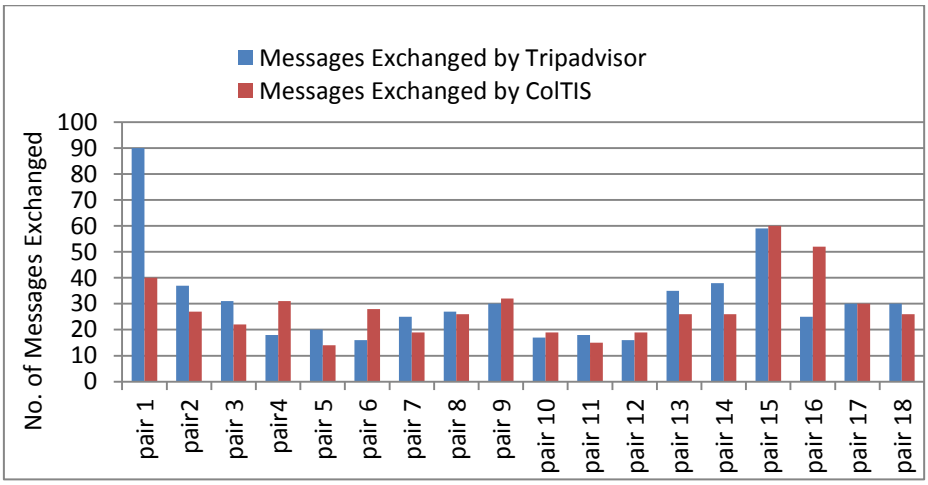


Figure 4.10 No. of messages exchanged by each pair of participants.

Table 4.18 Statistics of exchanging messages during collaborative search.

	Messages Exchanged by Tripadvisor during collaborative search	Messages Exchanged by ColTIS during collaborative search
Total no.	562	512
Average	31.222	28.444
Standard deviation	18.086	11.956

For example, Participant #9 stated regarding the chat functionality of ColTIS:

> Using the chatting tool, we exchanged and shared our views, experiences and ideas to help each other during the collaborative search.

Result Sharing. The pairs were found to share their results using instant messaging facilitated by Tripadvisor and ColTIS in either form: by sending a summary of the obtained results or by sending links (URLs) of the results. The collaborators shared more results (summary of the results) and information links in Tripadvisor (Table 4.19). Figure 4.11 shows the number of results shared and Figure 4.12 demonstrates the number of links shared by collaborators. Less results and links sharing through ColTIS are expected since it provides automatic results and links sharing option. This means that collaborators did not need to send any link or results to their teammate using instant messaging.

Table 4.19 Results sharing using Tripadvisor and ColTIS.

	No. of Results shared		No. of Links shared	
	Tripadvisor	ColTIS	Tripadvisor	ColTIS
Total no.	129	75	46	8
Average	7.166	4.166	2.555	0.444
Standard deviation	3.347	3.745	3.203	0.615

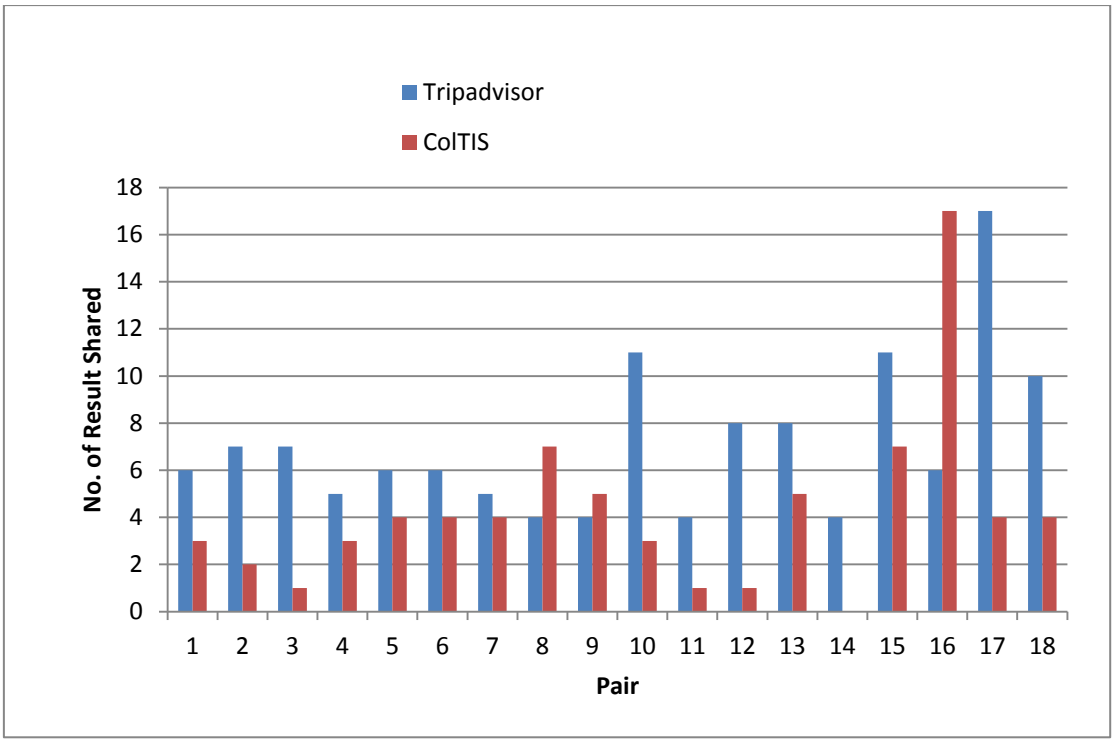


Figure 4.11 No. of results shared by collaborators through messaging for Tripadvisor and ColTIS.

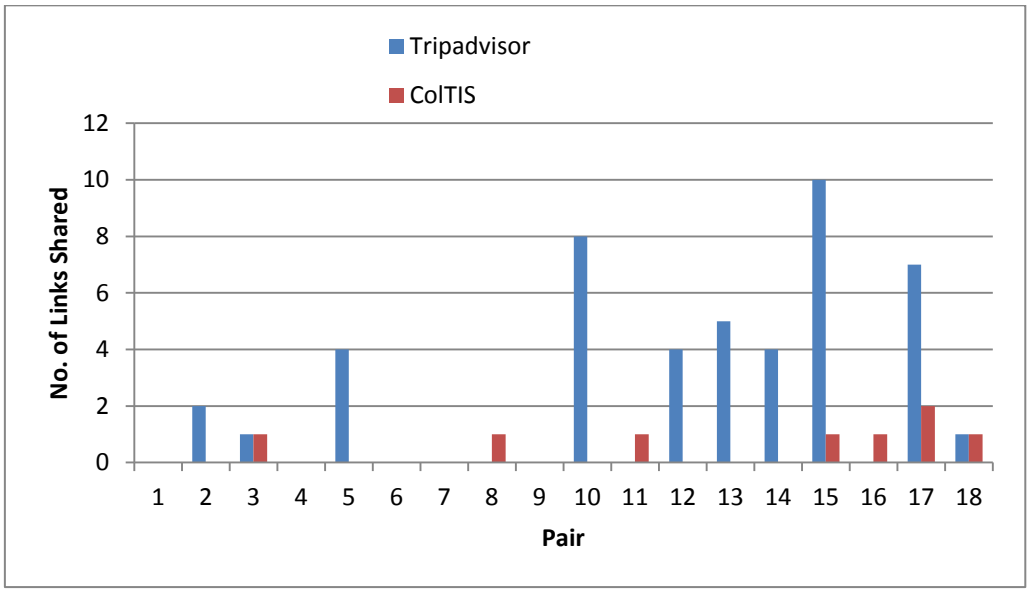


Figure 4.12 No. of links shared by collaborators through messaging for Tripadvisor and ColTIS.

For instance, Participant #19 commented on results sharing in ColTIS,

Some of the search results I shared using the chat function, and in most cases, results were shared automatically by ColTIS results sharing window.

4.3.1.2.3 Ease of use and usefulness of the system

Opinions on the systems' usability were assessed using the post-search questionnaire. Participants were asked if the system was easy to use and the usefulness of the system on a 7-point scale, where 1 = "lowest"; 7 = "highest." Figures 4.13 and 4.14 show the distribution of responses on use usability of systems for ease of use and usefulness of both systems respectively. Table 4.20 presents the mean and standard deviation results. The systems were compared for each question based on participants' responses using the non-parametric Wilcoxon signed rank test.

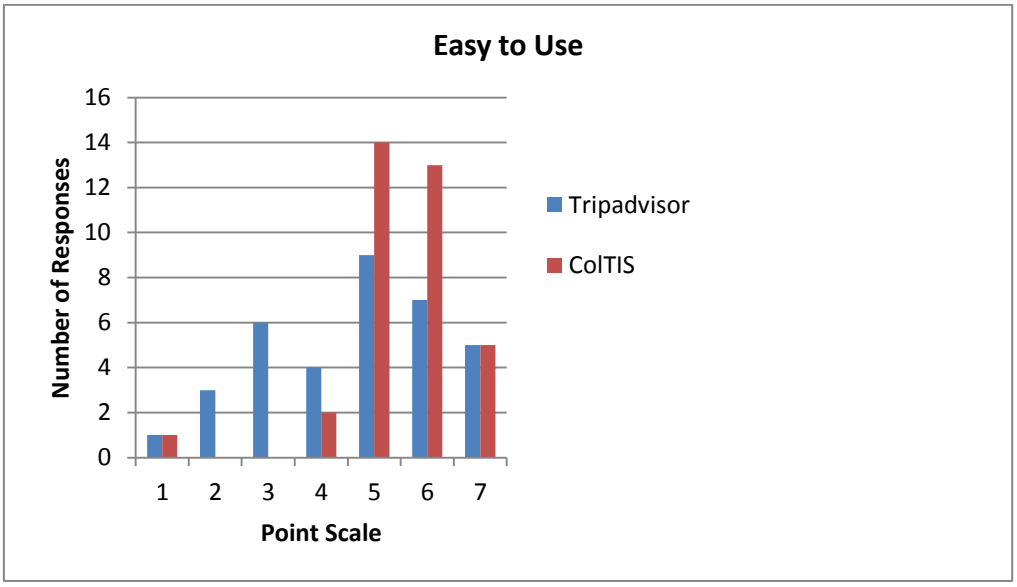


Figure 4.13 Users' rating on ease of use for both systems.

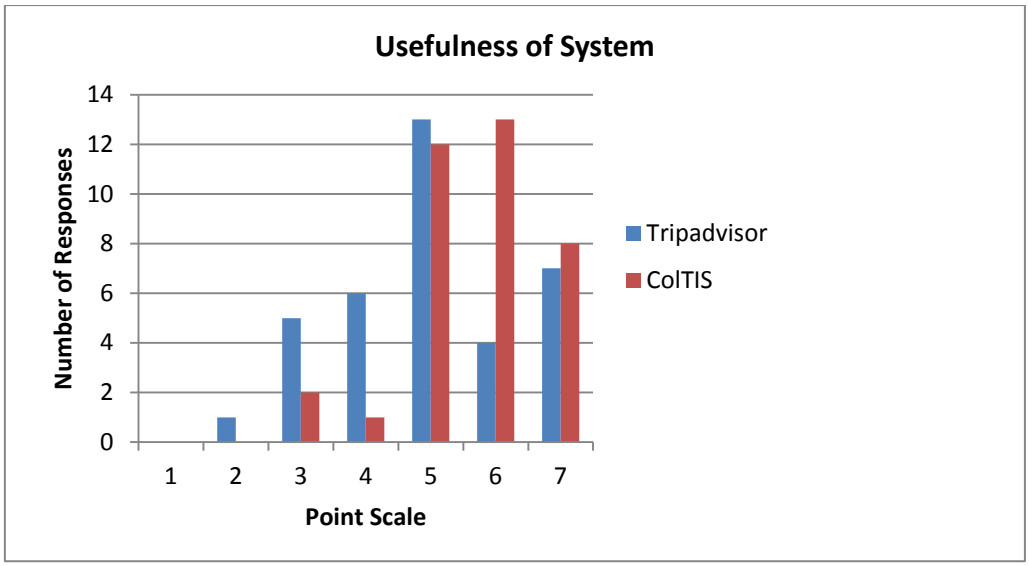


Figure 4.14 Users' rating on usefulness of both systems.

The participants felt that it was significantly easier to use ColTIS (M=5.53, SD=1.43) than Tripadvisor (M=4.53, SD=1.81), Z = -2.711, p = 0.007. They also believed that ColTIS (M=5.67, SD=1.04) was significantly more useful than Tripadvisor (M=4.97, SD=1.38), Z = -2.364, p = 0.018.

Table 4.20 Results on use usability.

	System	Ease of use	Usefulness of system
Mean	Tripadvisor	4.53	4.97
	ColTIS	5.33	5.67
Standard deviation	Tripadvisor	1.81	1.38
	ColTIS	1.43	1.04
p-value	Tripadvisor	0.007*	0.018*
	ColTIS		

*p<0.05

In terms of use and usefulness of ColTIS, one participant (Participant #10) remarked,

> I found the system useful. The collaborative search was efficient. I found what I needed.

4.3.1.2.4 Result satisfaction

User satisfaction was measured using the post-search questionnaire on a scale of 1 (lowest satisfaction) to 7 (highest satisfaction). Figure 4.15 displays the details of users' rating on result satisfaction with both systems.

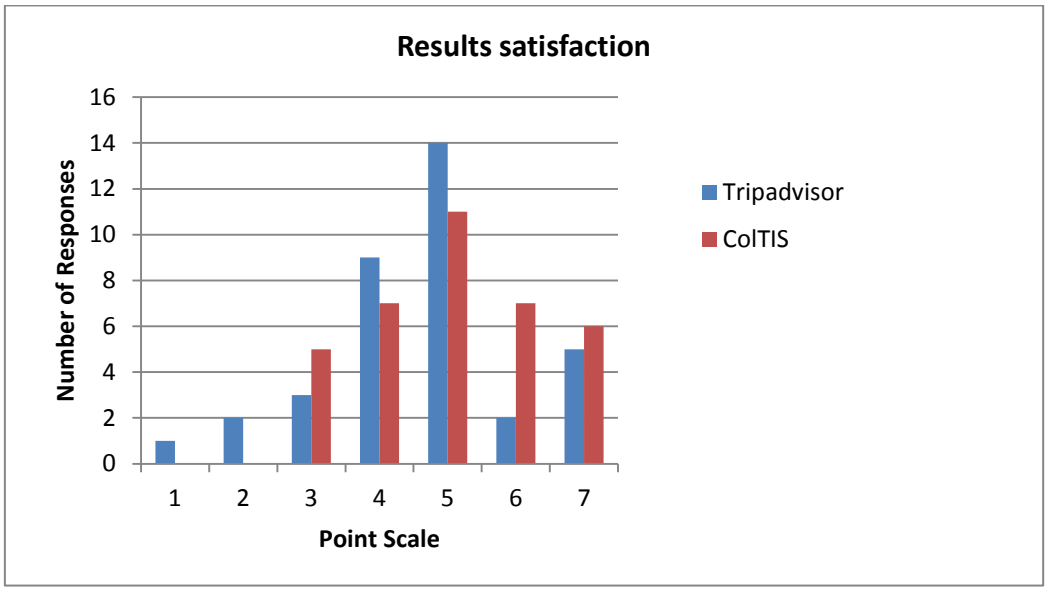


Figure 4.15 Users' rating on results satisfaction.

Table 4.21 displays the statistics for performance results and the statistics for significance value of system performance based on results satisfaction.

Table 4.21 Performance measure of both systems in terms of results satisfaction.

System	Result satisfaction (1-7) Mean (SD)	Wilcoxon signed rank test for Result satisfaction
Tripadvisor	4.64 (1.44)	0.149
ColTIS	5.05(1.29)	

Wilcoxon signed rank test results showed that the difference between two systems in terms of result satisfaction was not statistically significant (Z=-1.444, p=0.149). Interestingly, in the post-search questionnaire, eight pairs of participants (44.44%) reported that they were

satisfied with the results provided by ColTIS while four pairs of participants (22.22%) were in favor of Tripadvisor.com. Six pairs of participants (33.33%) were neutral in their opinion.

4.3.1.2.5 Result correctness

Result correctness was calculated from the post-search questionnaire where users rated their search results correctness on a 3-point Likert scale: Not correct (1), Partially correct (2), and Correct (3).

Table 4.22 shows the statistics for performance results and statistics for significance value of system performance based on result correctness.

Table 4.22 Performance measure of both systems in terms of result correctness.

System	Result correctness (1-3) Mean (SD)	Wilcoxon signed rank for Result correctness
Tripadvisor	2.53(.70)	0.796
ColTIS	2.55(.65)	

Wilcoxon signed rank test also showed there was no significant difference between ColTIS and Tripadvisor based on result correctness, although participants using ColTIS found somewhat more correct answers (M =2.55, SD=0.65) than using Tripadvisor (M =2.53, SD=0.70), Z = -0.258, p =0.796.

4.3.1.2.6 Search usability

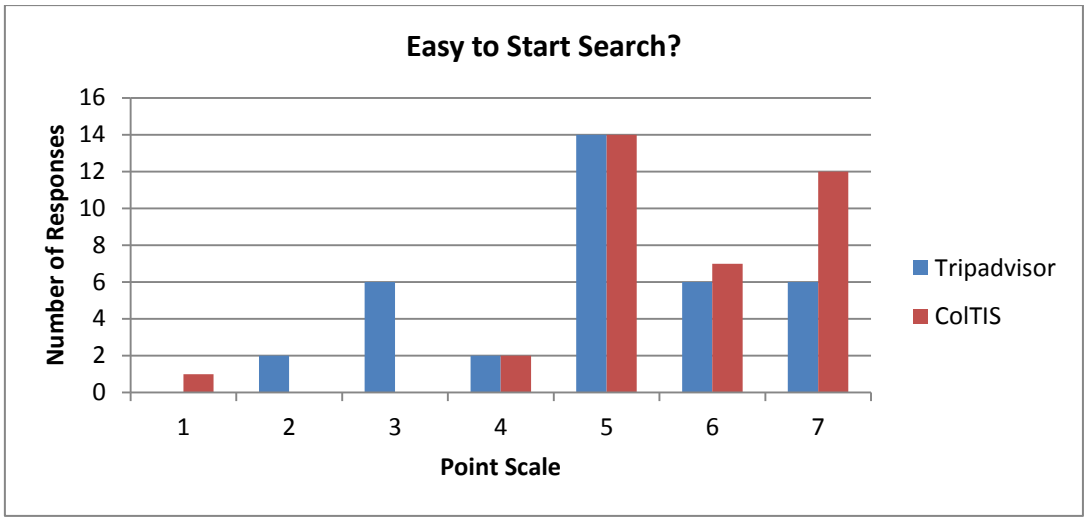
Subjects' opinions on each system's search usability were assessed by post-search questionnaire (Appendix G). Subjects were asked whether: it was easy to get started on the search with the system; it was easy to do the search with the system; and they had enough time to do the search with the system on a 7-point Likert scale where 1 = "lowest" and 7 = "highest." Table 4.23 lists the mean and standard deviation for each system for these questions. The systems were compared for each question based on the subject's responses using the non-parametric Wilcoxon signed rank test. SPSS 19.0 software was used to do the analysis.

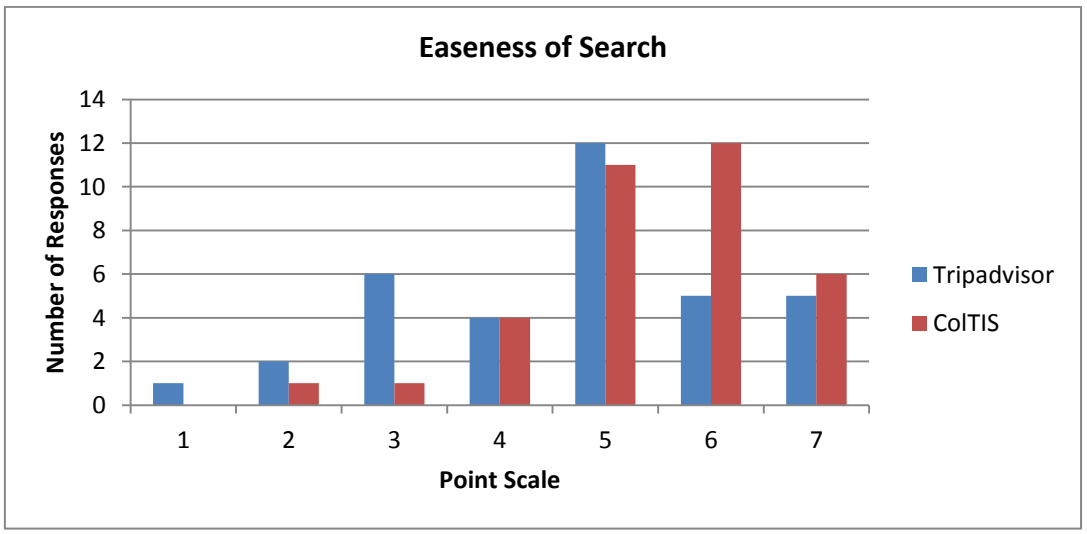
Table 4.23 Results on search usability.

	System	Easy to get started on the search?	Easy to search?	Enough time?
Mean	Google Talk-embedded Tripadvisor.com	4.94	4.55	4.95
	ColTIS	5.69	5.28	5.36
Standard Deviation	Google Talk-embedded Tripadvisor.com	1.45	1.73	1.71
	ColTIS	1.26	1.47	1.50
p-value	Google Talk-embedded Tripadvisor.com	0.017*	0.020*	0.052
	ColTIS			

*p<0.05

Results (see Table 4.23) showed that it was significantly easier to get started using the ColTIS system (M=5.69, SD=1.26) compared to Google Talk-embedded Tripadvisor.com (M=4.94, SD=1.45), Z = -2.393, p = 0.017. Participants felt it was easier to search using ColTIS (M=5.28, SD=1.47) than Tripadvisor.com (M=4.55, SD=1.73), and the difference was significant, Z = -2.323, p = 0.020. Participants felt that they did not have significantly more enough time to do the search when using ColTIS (M=5.36, SD=1.50) than Google Talk-embedded Tripadviosr.com (M=4.95, SD=1.71), Z = -1.942, p = 0.052. See Figure 4.16 for the distribution of responses to the post-search questionnaire on search usability of systems.





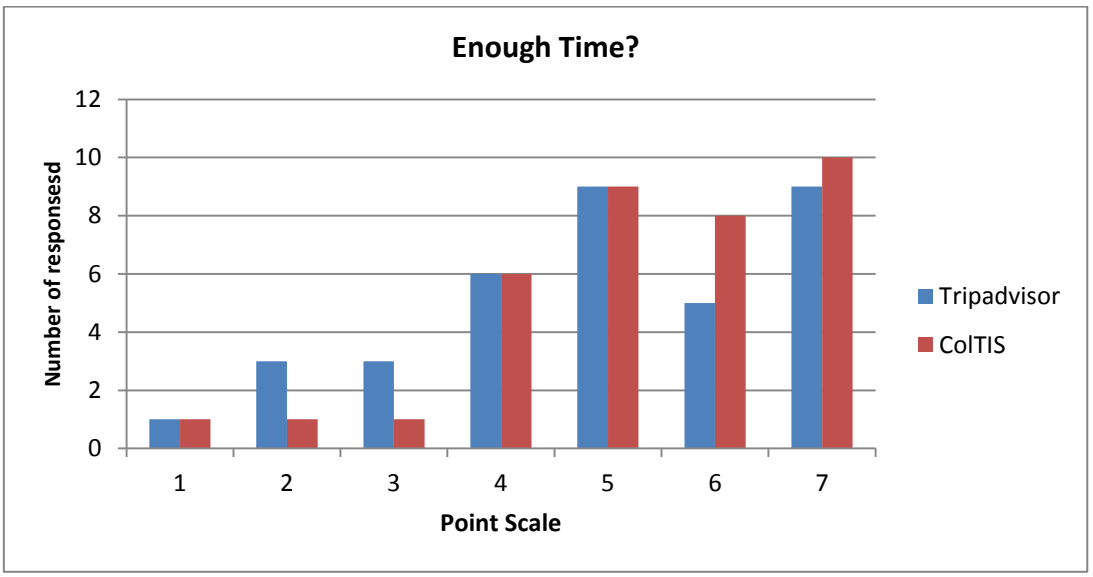


Figure 4.16 Statistics of the search usability.

4.3.1.2.7 Use usability of ColTIS

How participants rated ColTIS on various measures is shown in Table 4.24. Users' rating included judgments on the amount of information provided on the screen, the screen arrangement, sharing of queries and links, division of search tasks, and collaboration and screen terminology and layout.

Table 4.24 Usability of ColTIS.

Usability Criteria	Measuring Scale (1-7)	Mean user rating	User rating range
Ease of collaboration	Difficult to Easy	5.08	2-8
Ease of collaborative search	Difficult to Easy	4.92	1-7
Ease of division of search	Difficult to Easy	4.92	3-7
Ease of collaborative query reformulation	Difficult to Easy	4.58	3-7
Ease of query sharing	Difficult to Easy	5.17	2-7
Ease of link sharing	Difficult to Easy	4.25	1-7
Ease travel planning	Difficult to Easy	4.94	2-7
System speed	Too Slow to Too fast	3.69	1-7
Information arrangement	Illogical to Logical	4.44	1-7
Screen layout	Inadequate to Adequate	4.25	2-7
Screen terminology	Not helpful to Helpful	4.78	2-7
Time to learn	Lengthy to Fast	4.78	2-7
Ease of learning	Difficult to Easy	5.22	2-7
Overall satisfaction	Frustrating to Satisfying	4.72	1-7

4.3.1.2.8 Users' comparative comments between ColTIS and Google Talk-embedded Tripadvisor.com

From the post-search questionnaire, a list of users' positive and negative comments (what the participants said) were concluded on the differences between ColTIS and Tripadvisor.com. These are provided in the following table (Table 4.25).

Table 4.25 List of users' comparative comments between ColTIS and Tripadvisor.com.

User	Description
user1	"1. easy to use and collaborate with partner in ColTIS but not tripadvisor.2. no googlemap options in ColTIS but available in tripadvisor."
user2	"1. Trip adviser is location based where coltis does not provide it 2.Trip adviser has no collaborative section."
user3	"1. Tripadvisor is all included single website, while the CoITS provided the links to other websites.2. CoITS collaborative search is unique."
user4	"Tripadvisor incorporates most of the features"
user5	"ColTIS include the Chat, can find and make a group people who want to go the same place and then use it to make a plan and so on. Tripadvisor: search function is better."
user6	"ColTIS provides good collaboration facilities with collaborative search option and Tripadvisor provides good search and results"
user7	"CoITIS - basic search functionality. Trip Advisor- better overall search portal Collaborative search was better using Trip Advisor and Google Chat; It made no difference having the separate system as u can easily copy and share links; although having the collaborative search query is probably a novel function"
user8	"Tripadvisor: relevant results - sorting the results based on user preference - lots of tabs and options ColTIS: On the plus side it was easy to use."
user9	"CoITIS embeds more collaborative functions such as chatting and collaborative search."
user10	"ColTIS have real time chat services, while Tripadvosir does not have"
user11	"ColTIS is specifically for collaborative work, but tripadvisor is more organized, and easy to use interface"
user12	"ColTIS: One window more options necessary to travel User friendly, ease of use, saves time, complete information can retrieve, no need to open many windows Trip advisor: lot of details can be retrieved. Need to open lot of windows."
user13	"ColTIS- One interface for all (including chat). Tripadvisor.com- We have to other chat software."
user14	"ColTIS provides in built Chat, queries (both participants), search results from own and other. Tripadvisor provides all information but we do not know what the person is doing."
user15	"ColTIS has everything in one single screen unlike Tripadvisor.com"
user16	"ColTIS has all the things in one screen unlike tripadvisor."
user17	"I like both and both are suitable for traveling purpose"
user18	"The main difference is collaboration. ColTIS provides absolutely some brilliant features for collaboration."

User	Description
user19	"ColTIS: It is collaborative tools, provides sharing, chatting. Tripadvisor.com : It is non collaborative but provides booking option for hotel, flight. It provides robust search options."
user20	"ColTIS - you can have a search engine, but also incorporate chat and a webpage log into the program. TripAdvisor - you can search through just the 1 webpage for their search results."
user21	"it is more easy to work with Tripadvisor.com, it provides more information and it is more user friendly"
user22	"Group chatting is not possible in Tripadvisor."
user23	"Main difference is collaboration. Tripadvisor.com does not provide collaboration but ColTIS provides both collaboration and search"
user24	"Collaboration is supported by ColTIS but it is not provided by Tripadvisor."
user25	"Collaboration, chatting, sharing of information and results sharing are supported by ColTIS but Tripadvisor provides better search results"
user26	"the main difference is colTIS having everything contained in one screen, where as with tripadvisor you have to switch between chat and Web pages as mentioned previously, the chat function is a little slower on colTIS than Google talk though, so that does make it a little less appealing"
user27	"Tripadvisor offers a simple platform to search for information for travel. It provides it in a uniform manner which intuitive and consistent. However, extra details are generally limited to reviews. No collaborative functionality is provided. ColTIS on the other hand provides a more comprehensive search functionality mirroring using a search engine. It provides easier ability to refine and concentrate research. However searched information comes in a non uniform form and a variety of sources. The system however provides a collaborative functionality allowing user a chat ability as well as the ability to see what other users have already searched for."
user28	"Some good collaborative features in ColTIS not found on tripadvisor that could be useful for travel planning (collaborative plan editor, search query display). Tripadvisor easier to use to obtain a wide range of information in a timely fashion (tabbed browsing, only travel related information returned in search results). Tripadvisor well polished and no bugs (being a large commercial system certainly helps). Answers to previous questions highlight these differences and others."
user29	"ColTIS provides the collaboration but Tripadvisor does not."
user30	"In ColTIS, the system is self contained so collaboration and communication can occur with the system instead of having to use other, external services. Also, search queries and results are shared so that your group can all view the same information. Data-wise, tripadvisor uses its own information and forums to provided results to queries whereas ColTIS utilizes a number of other services."
user31	"One is text based but has a greater potential for obtaining results, the other is more focused and is contextual. TripAdvisor is also visually more pleasing."
user32	"ColITS gives a wider range that Tripadvisor."
User33	"ColTIS provides both search and communication but Tripadvisor provides only search"
user34	"ColTIS is designed for a collaborative holiday planning, where as Tripadvisor is for and individual planning a holiday."

User	Description
user35	"ColTIS seems like it tries to automate some more things. TripAdvisor.com is a very basic information search tool that does a good job of finding basic information."
user36	"ColTIS provides the collaboration and collaborative query formulation facilities but Tripadvisor.com provides smooth search"

Table 4.25 lists the comparative comments between ColTIS and Tripadvisor. These comments are regarding the characteristics and functionalities of both systems. Some differentiating conclusions have been made between ColTIS and Tripadvisor based on users' comments which are presented in Table 4.26. The comparisons of users' choices on both systems are presented in Table 4.27. Figure 4.17 represents the differences of users' choices on both systems. More statistical analysis on performance of both systems and their comparison are reported in subsections 4.3.1.2.1 through 4.3.1.2.7.

Table 4.26 Comparison between ColTIS and Tripadvisor based on users' quotes regarding the two systems.

	Tripadvisor	ColTIS
Difference between two systems	"…TripAdvisor is a very basic information search tool that does a good job of finding basic information." ; "…Tripadvisor.com provides smooth search …" ; "…more simpler, but not necessary more helpful…"; "...much more simplistic. Has far fewer search queries, and did not suggest search terms…"; "…with tripadvisor you have to switch between chat and Web pages …"	"ColTIS seems like it tries to automate some more things" ; "…ColTIS provides the collaboration and collaborative query formulation facilities.."; "…ColTIS provides both search and communication in a better way…" ; "…Some good collaborative features in ColTIS not found on tripadvisor that could be useful for travel planning (collaborative plan editor, search query display)…"; "…colTIS having everything contained in one screen…"
Collaboration	"… Tripadvisor uses its own information and forums to provided results to queries whereas ColTIS utilizes a number of other services….."; "Tripadvisor offers a simple platform to search for information for travel. It provides it in a uniform manner which intuitive and consistent. However, extra details are generally limited to reviews. No collaborative functionality is provided"	"… In ColTIS, the system is self contained so collaboration and communication can occur with the system instead of having to use other, external services. Also, search queries and results are shared so that your group can all view the same information ..."; ColTIS on the other hand provides a more comprehensive search functionality mirroring using a search engine. It provides easier ability to refine and concentrate research. However searched information comes in a non uniform form and a variety of sources. The system however provides a collaborative functionality allowing user a chat ability as well as the ability to see what other users have already searched for"
Easy to search	Tripadvisor.com : It is non collaborative but provides booking option for hotel, flight. It provides robust search options."; "…Tripadvisor provides good search and results …"	"…"ColTIS provides good collaboration facilities with collaborative search option …" ; " … Easy to user for collaborative search as ColTIS has all the things in one screen …"
Easier to use	"…Trip advisor: lot of details can be retrieved. Need to open lot of windows." …"	"…. Ease of use …. No need to open many windows ….."

Table 4.27 Features of both systems those users liked

Features	No. of usesr liked ColTIS	No. of users liked Tripadvisor	Neutral
Easy to use	20	6	10
Usefulness	17	5	14
Ease of searching	17	6	13
Easy to get started	17	7	12

Data represent that though significant number of participants were reluctant (neutral) in putting their opinion on either of the systems, still ColTIS was their more favorite tourism CIS tool than Tripadvisor.

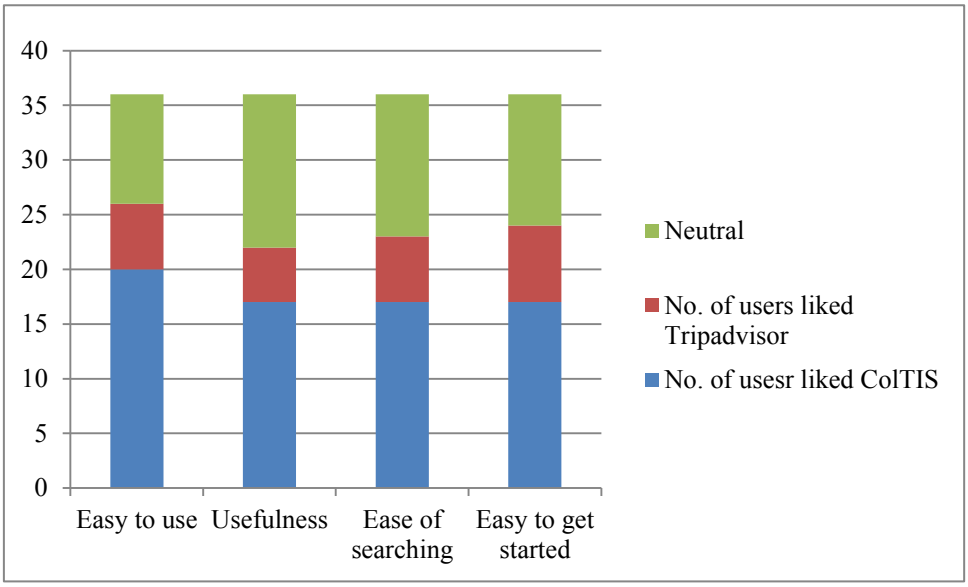


Figure 4.17 Statistics of users' choice on ColTIS and Tripadvisor.

4.3.1.2.9 Users' suggestions for improving the system

A list of users' suggestions to improve ColTIS functionality and its search feature is provided in Table 4.28.

Table 4.28 Suggestions to improve ColTIS.

User	Description
user1	outlook should be more attractive.
user2	Change the design layout
user3	Automatic itinerary completion considering the what is being chat. Comparison option for various itineraries considering the user satisfaction and cost.
user4	Should provide map search option and comprehensive itinerary planning
user5	-
user6	1. define the group or team members 2. function to outline a trip 3. planning for options 4. information sharing for each different tasks, like hotel, flights, etc 5. and vote by teammates or suggestion or discussion for specific item
user7	ability to customise and share user interests more easily. more interactive User Interface (UI)
user8	sorted result
user9	The screen could be resizable.
user10	the Layout needs to retouch
user11	Complete travel planner. Faster chatting option. Map searching
user12	For searching you can link to another screen
user13	Sound when I get a message from the other teammate.
user14	Buttons to go back and forth in search results.
user15	Speed should be enhanced.
user16	Speed should be more.
user17	Nothing.
user18	Chatting should be faster. Travel plan editor should be more comprehensive. Map search should be included.

User	Description
user19	I think it would be good if you could share links with the other person using the chat function.
user20	As per the answers in Q21.
user21	I already answered in a previous question
user22	Can add some chatting option.
user23	Map search can be implemented to improve the system
user24	Search function should be on the far-left as this is primarily what users will doing. Collaborative results etc. should follow this is the middle. Chat function is well-placed.
user25	Maybe making the search box a little bigger?
user26	making it easier to share link would be the best improvement from what i could see

user27	Perhaps modifying the chat functionality to separate from the rest of the system and provide additional functionality. The separation of chat to a floating window will also provide additional room to have a larger output for search queries.
user28	Colouring of dialog per chat participant, search results window need to be enlarged, support tabs or some other similar structure, display URL information. Better colouring of the interface and separation of features to better distinguish the features from one another.
user29	Chatting should be more faster and map search could be included
user30	Include more results into the search. Some useful sites like webjet seemed to be blocked. Limit the amount of panes visible at one time, or make them user-configurable.
user31	-
user32	make the search result window wider
User33	Chatting should be faster
user34	Make it clear as to how all the collaborative functions work.
user35	I suggest to include a good trip plannar and map search option
user36	Collaborative query terms can be automatically comes from individual query terms and Map search

4.3.1.3 Summary of Evaluation

ColTIS and Google Talk embedded Tripadvisor.com are not very similar tools. ColTIS is purely a collaborative search tool which employed Google search engine to find tourism information from the Web while Tripadvisor was combined with Google Talk to make it collaborative tool. Tripadvisor.com is the most popular travel portal that provides tourism information and it has its own search engine. Google talk was embedded within Tripadvisor.com to facilitate the communication between collaborators. The differences between ColTIS and Google Talk embedded Tripadvisor.com were made based on task completion time, collaboration (division of search task, chatting and result sharing), ease of use, usefulness, result satisfaction, result correctness and search usability. The rationale for the comparison between ColTIS and Gogle-Talk embedded Tripadvisor.com has been elaborated in Chapter 3.

The results showed that on average ColTIS took 17.83 minutes to complete the search task while Tripadvisor.com took 16.28 minutes for the same search task. One participant (Participant #27) noted the slowness of ColTIS as “the overall performance of the system needs to be refined to handle larger volumes of text, more effective scrolling and faster processing”. In terms of collaboration, the collaborators were more engaged in division of search tasks, chatting and result sharing as ColTIS provided these facilities through different components while simulated Tripadvisor.com provided only chatting for communication

sharing information. The differences between two systems based on ease of use, usefulness, results satisfaction, results correctness and search usability were measured on users' rating and users' comments. Participants were in favor of ColTIS than Tripadvisor.com in rating on ease of use (statistically significant), usefulness (statistically significant), results satisfaction, results correctness, easy to get started (statistically significant) and easy to search (statistically significant).

Overall, ColTIS performed better than Tripadvisor.com. There may be few reasons: i) Google search engine provides more relevant and correct results (Malik, (2014); ii) The all-in-one features (multiple functionalities in a single interface) of ColTIS; iii) ColTIS provide standalone searching as well as collaborative searching through the feature of collaborative query reformulation; iv) ColTIS facilitated the features of information (queries, results, experiences) sharing, and chatting in convenient way during the search; v) ColTIS retrieved results based on not only the queries provided by users but also based on (some) synonyms of those query term(s); and (vi) ColTIS included the desired features to meet the users' expectation.

4.3.2 Collaborative querying architecture

The CQ formulation architecture (Figure 4.18) illustrates how a CQ is initiated, reformulated and executed. The figure shows that a CQ is initiated by any of the collaborating team members using Window 2 (in Figure 3.2) which is visible to all other users. The initiator or any other team member can add any term(s) to the CQ, edit any term(s) of the CQ, or delete any term(s) from this CQ. After the end of the modification, the CQ is executed to retrieve the results which are similar in function to traditional IR systems. If the results are not satisfactory, then the users refine the CQ. This modification of the CQ is repeated until users are satisfied with it or the retrieved results. This satisfaction is defined as agreement on CQ or on results retrieved by the collaborators.

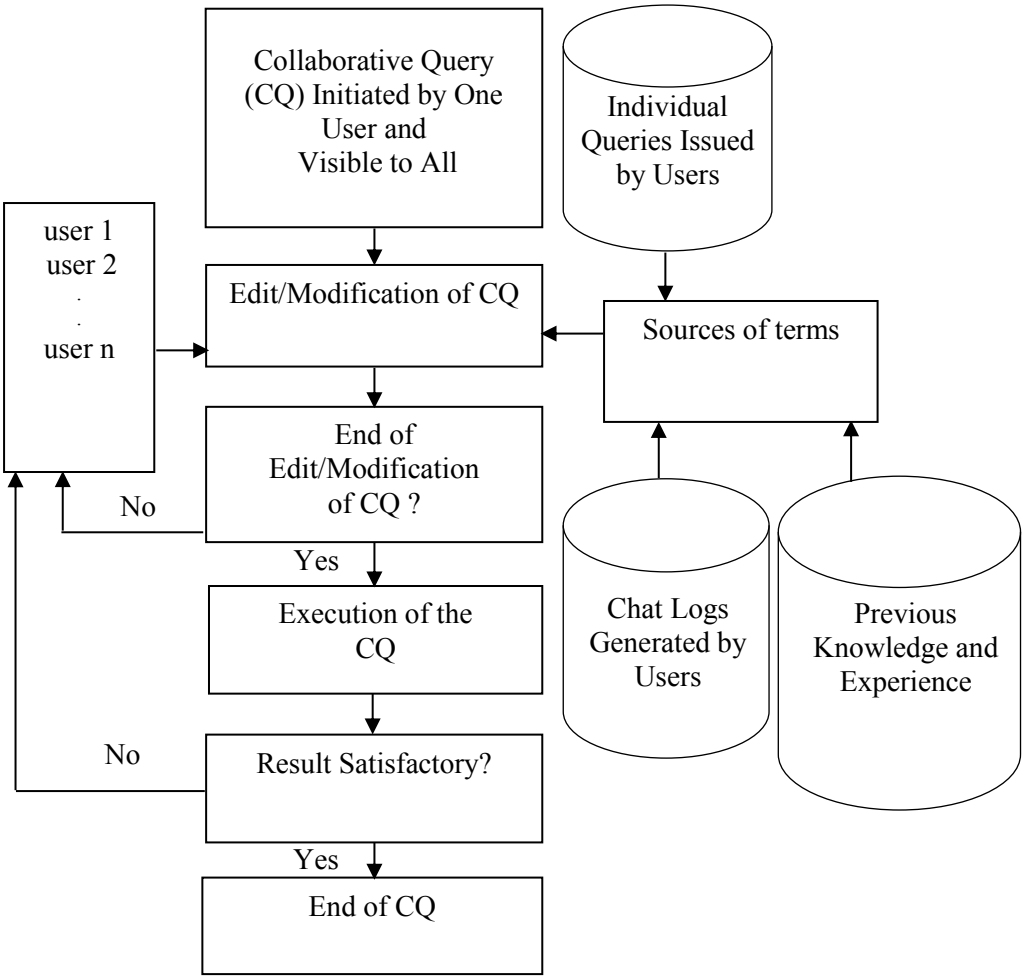


Figure 4.18 Flow of CQ reformulation.

4.3.3 Collaborative query reformulation strategy

In the process of formulating CQ, an obvious question may emerge: which terms should be selected in the query formulation and how does the CQ reformulation evolve? The analysis shows that three main sources were employed by the team for selecting terms earmarked for 140 CQ formulation, including individual queries (51%), chat logs (26%), and previous knowledge and experiences (23%) (see Table 4.29).

Table 4.29 Source of terms for CQ reformulation.

Source term(s) for collaborative query	Instances	%
Individual queries	72	51
Chat logs	36	26
Previous knowledge and experiences	32	23
Total	140	100

4.3.4 Sources of terms for collaborative queries

• **Individual queries:** It is evident that during CQ formulation, the collaborating team members employed the terms from either their own queries or their partner's queries. These terms were used to add to or replace any existing terms in CQ. Individual queries were identified as the mostly used source for CQ reformulation. Here is an example:

Individual query

Crown Hotel Melbourne (issued by User 4, Pair 2)

Collaborative query

hotel in Melbourne (initiated by User 3, Pair 2)

Crown Towers Hotel in Melbourne (modified by User 3, Pair 2)

Here, the query term "*Crown*" originated from the individual query.

• C**hat logs:** Chat logs also contributed over a quarter to CQ reformulation. The participants borrowed the terms from their own chat logs or their teammate's chat logs to form a CQ. An example is given below:

Chat log

I want to find the local culture in Pukhet (issued by User 13, Pair 7)

Collaborative query

Restaurant in Thailand (initiated by User 14, Pair 7)

Restaurant in Thailand, Pukhet (the term "*Pukhet*" is added by User 13, Pair 7)

Here, the query term "*Pukhet*" came from the chat logs.

• **Previous knowledge and experiences:** The sources of these terms originated in searchers' experiences, retrieved relevant results, preferences, or previous knowledge, which accounted for 23% of total CQ reformulations. An example is given below as follows:

Collaborative queries

Food in Seattle (initiated by User 34, Pair 17)

Australian food in Seattle (the term "*Australian*" is added by User 33, Pair 17)

The term "*Australian*" was from neither individual queries nor chat logs. It was derived from users' preferences.

4.3.5 Operations performed for collaborative query reformulation

It is interesting to note that the pairs of participants performed several operations to reformulate CQs. These operations are defined based on two consecutive CQs: CQ_i and CQ_{i+1}, where CQ_{i+1} is the query immediately following the query CQ_i in the same session. The detailed descriptions of these operations are given below:

• **Addition:** CQ_i and CQ_{i+1} contain at least one term in common and CQ_{i+1} contains more terms than CQ_i **.** Example: Food in Gold Coast Australia (CQ_i) → Indian food in Gold Coast Australia (CQ_{i+1})

• **Modification:** CQ_i and CQ_{i+1} contain at least one term in common and at least one term of CQ_i has been modified /replaced.

Example: Parkview Hotel in Melbourne (CQ_i) → Crown Tower Hotel in Melbourne (CQ_{i+1})

• **Reordering:** CQ_i and CQ_{i+1} contain exactly the same terms but

the order of these terms may be different. Example: Machu Pichu

hotel (CQ_i) → Hotel Machu Pichu (CQ_{i+1})

• **Addition and modification:**

CQ_i and CQ_{i+1} contain at least one term in common; CQ_{i+1} contains more terms than CQ_i and at least one term of CQ_i has been modified/replaced. Example: Restaurant in Sydney (CQ_i) → Restaurant near hotel CBD Sydney (CQ_{i+1})

• **Addition and reordering:** CQ_i and CQ_{i+1} contain at least one term in common; CQ_{i+1} contains more terms than CQ_i and the order of the terms in CQ_{i+1} is different from CQ_i . Example: Gold Coast flight from Adelaide (CQ_i) → Flight from Adelaide to Gold Coast (CQ_{i+1})

Out of 140 CQs, 56 were initial CQs and the remaining 84 were outcomes of the CQ reformulation operation (Table 4.30).

Table 4.30 Operations performed during CQ reformulation.

Operation	Number	%
Addition	51	61
Modification	17	20
Addition and reorder	12	14
Reorder	3	4
Addition and modification	1	1
Total	84	100

It was observed that in most cases, the participants added query terms to the previous CQ (61%) and modified the previous CQ (20%) for reformulating the query.

4.3.6 Impact of individual queries and chat logs on collaborative query reformulation

In this section the results regarding the usage of individual queries and chat logs during collaborative searching and their influences on the formulation of CQs are reported. Significance tests were performed to show the difference between individual queries and chatting logs on CQ reformulation. Results show that during the collaborative search process, users collaborated more through chat logs (486 instances, mean= 28.59, SD = 12.31) than through queries (210 instances, mean= 12.35, SD = 5.49). The usage of chatting is statistically more significant than the usage of queries (p=.00005) collaboration (Table 4.31, Row 3).

Table 4.31 Comparison between query and chat for collaboration and CQ reformulation in collaborative information searching.

	Mean (SD)		Statistical Test
	Individual Query	Chat	
Collaboration	12.35(5.49)	28.59(12.31)	p=0.00005
Query reformulation	8.00(5.29)	5.14(3.00)	p=0.206

However, when comparing the usage of individual queries and chat logs as the source of query terms, the statistical test (Table 4.31 Row 4) indicates that individual query is not significantly different from chat logs in terms of formulating CQ (p=0.206).

The individual queries which contributed to the CQ reformulation were further divided into two types: self-generated queries and partner's queries, and the chat logs used for CQ reformulation were also classified into two categories: self-generated chat logs and partners' chat logs. Further analyzing self-generated and partners query transactions and chat logs (Table 4.32), it was find that self-generated query terms differ significantly from self-

generated chat logs (p = 0.0054). This suggests that as a resource of CQ, the participants reused more query terms they had used before than their own chat logs. However, there is no statistical difference between partners' queries and partners' chat logs (p = 0.0909) with respect to CQ formulation. This may suggest that the query terms in partners' query histories and partners' chat histories are equally important for the CQ (re)formulation.

Table 4.32 Comparison of self-query versus self-chat and partners-query versus partners-chat as the source for CQ.

	Mean (SD)		Statistical Test
	Query	Chat	
Self	2.50(1.41)	1.30(0.48)	p=0.0054
Partner	2.28(1.13)	1.64(0.74)	p=0.0909

In summary, collaborators pose individual queries and chat with teammate as they conduct collaborative searching on the Web. These individual queries and chat logs influence users' CQ reformulation, adoption of search strategies, and results evaluation. The evaluation of search results might further lead to reformulating CQ during the collaborative searching process.

4.3.7 Collaborative query reformulation for tourism information search patterns

Pairs of participants were found to reformulate the CQs employing a single keyword or a set of keywords into the previous query, which matched their tourism information needs. These keywords reflected the types of information that tourists needed and the components of CQ reformulated during the search (Xiang, Wöber, & Fesenmaier, 2008). The categories of tourism keywords for CQ reformulation and their frequencies employed by the participants are presented in Table 4.33.

Table 4.33. Categories of tourism-related keywords used in CQ reformulation.

Keyword categories of CQ reformulation	Frequency (Number)	Percentage (%)
Accommodation	20	22.22
Attraction	16	17.78
Flight	14	15.56
Food	13	14.44
Restaurant	13	14.44
Weather	8	8.89
Transportation	4	4.44
Local culture	2	2.22
Total	90	100

The two most used keyword categories for CQ reformulation were accommodation (22.22%) and attraction (17.78%), followed by flight (15.56%), food (14.44%) and restaurant (14.44%). Transportation (4.44%) and local culture (2.22%) were two least employed keywords to reformulate CQs for seeking tourism information. It is worthy to note that, even though with a lower frequency, people did perform CQ reformulation to search for transport and local culture especially when they traveled new places. The findings show that weather is another keyword for which participants reformulated CQs to examine the weather conditions at the destination during the proposed travel time.

Gender- and culture-based CQ reformulation on tourism information is presented in Figure 4.19. Compared to female pairs, male pairs demonstrated more CQ reformulation on accommodation, attraction, flight and restaurant while female pairs performed more CQ reformulation on food, weather and transportation (Figure 4.19a). These findings indicate that male and female pairs performed more CQs on information which they wanted to explore to satisfy their needs. It also implies the differences regarding the importance of types of tourism information between male pairs and female pairs. A similar trend has been found among Australian pairs and Asian pairs where the former group reformulated more CQs on accommodation, attraction, flight and restaurant whilst Asian pairs relied more on CQ reformulation for food, weather and transportation information (Figure 4.19b).

It is noted that the participants reformulated more CQs on accommodation, flight, restaurant, food, and attraction and they formulated less CQs on weather, transport and local culture irrespective of their gender and cultural background. These results imply that accommodation,

flight, attraction, food and restaurants are more important tourism information items/categories in collaborative tourism information search (Mohammad Arif, Du, & Lee, 2013; 2015). These findings may be used to inform tourism Web portal or collaborative tourism information search tool designers to implement how these sorts of tourism information can be retrieved and presented efficiently to satisfy tourists' information needs.

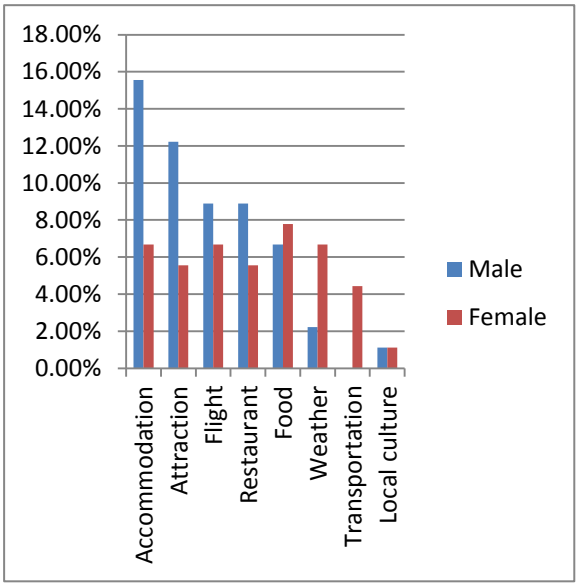


Figure 4.19a. Percentage of CQ reformulation on tourism information categories employed by male and female pairs.

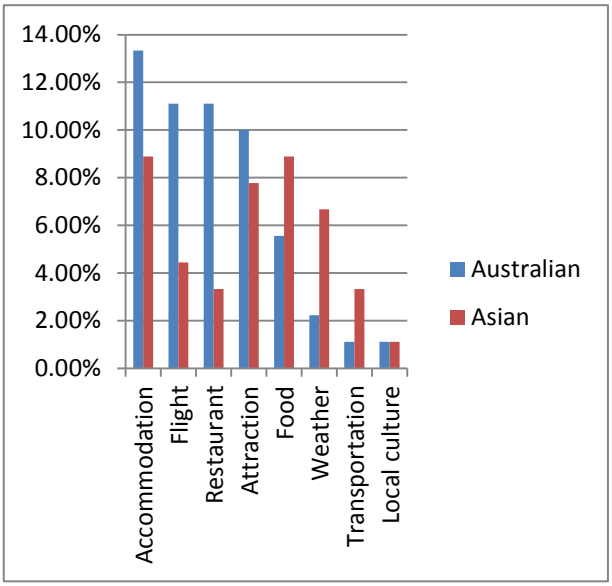


Figure 4.19b. Percentage of CQ reformulation on tourism information categories employed by Australian and Asian pairs.

Figure 4.19 Percentage of CQ reformulation on tourism information categories employed by participants based on their gender and culture.

Table 4.34 Statistics for CQ reformulation on tourism information between male pairs and female pairs

CQ reformulation on tourism item category	No. of male pairs	No. of female pairs	Statistical test
Accommodation	14	6	χ^2 =1.69, p = 0.2
Attraction	11	5	χ^2 =1.128, p = 0.3
Flight	8	6	χ^2 =0.014, p = 0.9
Restaurant	8	5	χ^2 =0.188, p = 0.7
Food	6	7	χ^2 =0.465, p = 0.5
Weather	2	6	χ^2 =3.025, p = 0.1
Transportation	0	4	χ^2 =5, p = 0.01
Local culture	1	1	χ^2 =0.025, p = 0.9

Statistical analysis (Table 4.34) shows the significant difference between male pairs and female pairs in formulating CQ on transportation. In formulating all other categories of tourism information, no significant differences were found between male pairs and female pairs.

Table 4.35 Statistics for CQ reformulation on tourism information between Australian pairs and Asian pairs

CQ reformulation on tourism item category	No. of Australian pairs	No. of Asian pairs	Statistical test
Accommodation	12	8	χ^2 =0.16, p = 0.7
Flight	10	4	χ^2 =1.428, p = 0.2
Restaurant	10	3	χ^2 =2.403, p = 0.1
Attraction	9	7	χ^2 =0.003, p = 0.95
Food	5	8	χ^2 =1.538, p = 0.2
Weather	2	6	χ^2 =3.025, p = 0.1
Transportation	1	3	χ^2 =1.512, p = 0.2
Local culture	1	1	χ^2 =0.025, p = 0.9

Statistical test (Table 4.35) was also conducted to show the differences between Australian pairs and Asian pairs in formulation CQ for different categories of tourism information. No significant differences were found though there were variations in formulating CQ on different tourism information.

4.3.8 Query reformulation types and patterns

Based on previous research on QR type detection and the CQs employed by the participants in this study, eight reformulation types were identified according to the common terms and query length difference in two successive queries (Q) denoted by Q_i and Q_{i+1}. The details of these CQ reformulation types are shown in Table 4.36, which modify the Liu et al. (2010) QR

classification. In addition to three types of Generalization (GN), Word Substitution (SB), and New (NW) identified by Liu et al.'s (2010) study, five more types were found for CIS in this study for travel context, including Generalization and Reordering (GN_RO), Specialization Beginning (SP_Beg), Specialization Middle (SP_Mid), Specialization End (SP_End), and Specialization and Reordering (SP_RO).

Table 4.36 Query reformulation types.

CQ reformulation type	Definition	Example
Generalization (GN)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains fewer terms than Q_i	"tourist spot evening in Paris" → "tourist attraction in Paris"
Generalization and Reordering (GN_RO)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains fewer terms than Q_i and the order of these terms may be different	"New York fast food restaurant" → "New York restaurant recommendation"
New (NW)	Q_i and Q_{i+1} do not contain any common terms	"tourist attraction Toronto" → "popular travel destination Canada"
Specialization Beginning (SP_Beg)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains more terms than Q_i and terms are added at the beginning of Q_{i+1}	"food in seattle" → "Australian food in Seattle"
Specialization Middle (SP_Mid)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains more terms than Q_i and terms are added in the middle of Q_{i+1}	"restaurant in london" → "restaurant in waterloo london"
Specialization End (SP_End)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains more terms than Q_i and terms are added at the end of Q_{i+1}	"Sydney transport " → "Sydney transport with bus and train"
Specialization and Reordering (SP_RO)	Q_i and Q_{i+1} contain at least one term in common; Q_{i+1} contains more terms than Q_i and the order of these terms may be different	"flight Canada Adelaide" → "flight from Adelaide to Canada"
Word Substitution (SB)	Q_i and Q_{i+1} contain at least one term in common; Both Q_i and Q_{i+1} have the same length (number of query terms);	"castle in Canada" → "fortress in Canada"

For identifying the types of QR, it is important to know the differences (based on length and content) between two successive queries reformulated by the users and how the changes were made between two successive queries by adding, deleting or modifying the query terms (Mohammad Arif et al., 2014; Jansen, Spink, & Saracevic, 2000). Based on this evidence, the

researcher of this study classified the strategy of Specialization (Liu et al.2010) into four categories depending on the position of the added terms in previous queries, which include SP_Beg, SP_Mid, SP_End, and SP_RO. An initial CQ was the first query issued by any user of a pair and it was not classified as a CQ reformulation type. Excluding these initial CQs, 90 CQs (an average of 5 queries per pair) were recognized. The following figure (Figure 4.20) shows the CQ reformulation types employed by the participants.

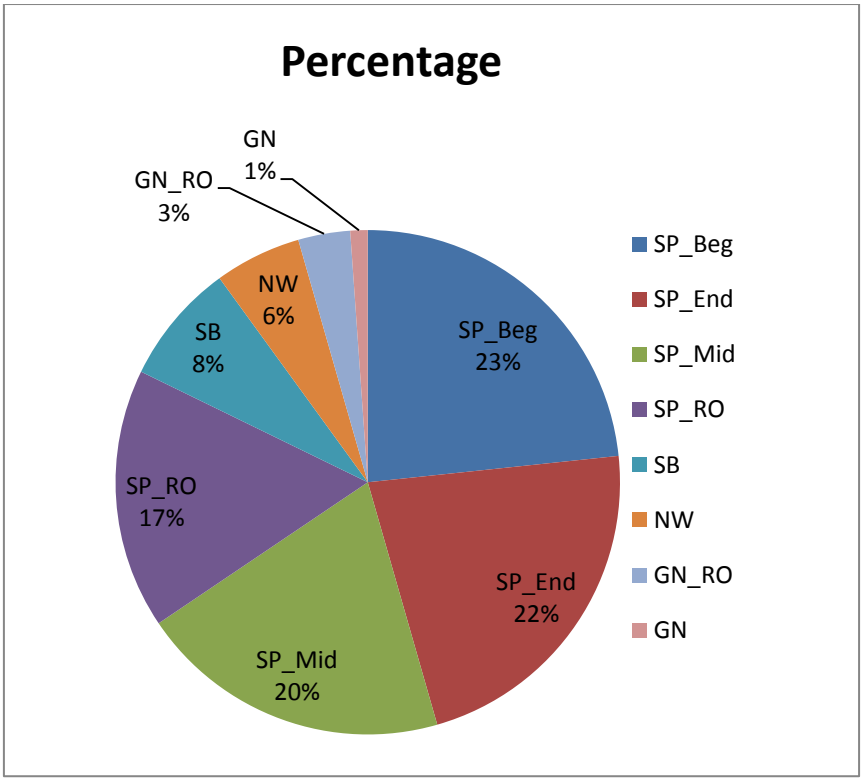


Figure 4.20 Occurrence of CQ reformulations.

In the CQ reformulation process, the participants mostly (23%) added terms at the beginning of the previous query (SP_Beg) followed by SP_End (22%) where terms were added at the end and SP_Mid (20%) with terms added in the middle of the previous query. Participants were also observed performing Specialization and Reordering (17%) where terms were rearranged with or without new terms. They seldom used strategies of Word Substitution (8%) and New (6%) for CQ reformulation. Generalization and Reordering (3%) and Generalization (1%) were the least three CQ reformulation types adopted by the pairs of participants.

Patterns of CQ reformulation were investigated following the identification of types of CQ reformulation. Considering the sequence from an initial query to a final query, participants

were found to follow one to three- step QR patterns (termed as high-level QR pattern), namely one-step QR, two-step QR, and three-step QR. The results are consistent with previous findings (Aloteibi & Sanderson, 2014) in which users were observed not to follow a unified sequence of modification of queries. X-step QR is defined as the QR which required x step(s) to achieve the final query from its initial query. The final query is defined as the last CQ on a particular tourism item which was reformulated by both participants in a pair. Here is an example for three-step QR performed by Pair 16 on accommodation:

Initial query(issued by Participant 32):	machu pichu accommodation
CQ step 1(modified by Participant 31):	machu pichu hotel
CQ step 2(modified by Participant 32):	hotels in machu pichu
CQ step 3(modified by Participant 31):	3-star hotels in machu pichu

Within the high-level CQ reformulation pattern (i.e. one-step QR, two-step QR, and three-step QR), a total of twenty-seven specific QR patterns were determined by the combination of CQ reformulation types (defined in Table 4.36), which demonstrate how pairs of participants formed the final query from the initial query. The summary of CQ reformulation patterns (both high-level and specific) is shown in Table 4.37 and the details of CQ patterns applied on tourism information are displayed in Table 4.38.

Table 4.37 Patterns of CQ reformulation.

High-level CQ reformulation pattern (Frequency, %)	Specific CQ reformulation patterns	Frequency
One-step CQ reformulation (62, 68.89)	Initial → SP_Mid	17
	Initial → SP_End	15
	Initial → SP_Beg	13
	Initial → SP_RO	12
	Initial → SB	4
	Initial → NW	1
Two-step CQ reformulation (23, 25.56)	Initial → SP_Beg → SB	3
	Initial → SP_End → SP_End	3
	Initial → SP_Mid → SP_Mid	2
	Initial → SP_Mid → GN_RO	2
	Initial → SP_RO → SP_Beg	2
	Initial → SP_RO → SP_End	1
	Initial → SP_Mid → GN	1
	Initial → SP_Mid → SP_Beg	1
	Initial → SP_End → SP_Beg	1
	Initial → SP_Mid → SP_RO	1
	Initial → SP_End → GN_RO	1
	Initial → NW → NW	1
	Initial → SB → SP_RO	1
	Initial → SP_End → SP_RO	1
	Initial → SP_Beg → SP_Beg	1
	Initial → SB → NW	1
Three-step CQ reformulation (5, 5.55)	Initial → SP_End → SP_End → SP_End	1
	Initial → SP_Mid → GN → SP_Beg	1
	Initial → NW → NW → NW	1
	Initial → SB → SP_RO → SP_Beg	1
	Initial → SB → NW → NW	1

Table 4.38 Details of CQ patterns applied to tourism information.

High level CQ pattern	Specific CQ reformulation pattern	Tourism information category	No.
One Step CQs	Initial → SP_Mid	Accommodation	2
		Attraction	1
		Food	2
		Flight	3
		Local Culture	1
		Restaurant	4
		Transport	2
		Weather	2
	Initial → SP_End	Accommodation	2
		Attraction	3
		Flight	2
		Local Culture	1
		Restaurant	4
		Weather	3
	Initial → SP_Beg	Accommodation	4
		Attraction	2
		Food	5
		Restaurant	1
		Transport	1
	Initial → SP_RO	Accommodation	3
		Attraction	2
		Food	3
		Flight	4
	Initial → SB	Accommodation	3
		Attraction	1
	Initial → NW	Attraction	1
Two Step CQs	Initial → SP_Beg → SB	Accommodation	1
		Food	1
		Restaurant	1
	Initial → SP_End → SP_End	Accommodation	1
		Restaurant	1
		Weather	1
	Initial → SP_Mid → SP_Mid	Accommodation	1
		Transport	1
	Initial → SP_Mid → GN_RO	Flight	1
		Restaurant	1
	Initial → SP_RO → SP_Beg	Flight	1
		Weather	1
	Initial → SP_RO → SP_End	Food	1
	Initial → SP_Mid → GN	Weather	1
	Initial → SP_Mid → SP_Beg	Flight	1
	Initial → SP_End → SP_Beg	Restaurant	1
	Initial → SP_Mid → SP_RO	Attraction	1
	Initial → SP_End → GN_RO	Flight	1
	Initial → NW → NW	Attraction	1

	Initial → SB → SP_RO	Accommodation	1
	Initial → SP_End → SP_RO	Flight	1
	Initial → SP_Beg → SP_Beg	Accommodation	1
	Initial → SB → NW	Attraction	1
Three Step CQs	Initial → SP_End → SP_End → SP_End	Food	1
	Initial → SP_Mid → GN → SP_Beg	Attraction	1
	Initial → NW → NW → NW	Attraction	1
	Initial → SB → SP_RO → SP_Beg	Accommodation	1
	Initial → SB → NW → NW	Attraction	1

One can see that one-step CQ reformulation was the mostly used pattern (68.89%). Specifically, Initial → SP_Mid is the top one employed (17) one-step CQ reformulation pattern followed by Initial → SP_End (15), Initial → SP_Beg (13), and Initial → SP_RO (12). Conversely, Initial → SB and Initial → NW were least observed one-step QR patterns used by the participants. Accommodation, attraction, and food were the three top-most tourism information categories reformulated with one-step QR pattern. Initial → SP_Mid, Initial → SP_End and Initial → SP_Beg of one-step CQs have been found to apply on most categories of tourism information (Table 4.38). As a single entity, Initial → SP_Beg was observed as highly used (5 instances) QR pattern on a single type of tourism information which is food.

Two-step CQ reformulation accounted for 25.56%, with a variety of specific CQ reformulation patterns. The three top most tourism information categories reformulated with two-step CQ reformulation patterns were accommodation, flight, and restaurant. Only 5.55% belonged to the three-step CQ reformulation. It is noted that pairs of participants preferred mostly to use one-step QR pattern for CQ reformulation and they retained a limited specific choice of the pattern, which is similar to Aloteibi and Sanderson (2014)'s findings in which users mostly performed single (one-step) QR. This might due to pairs of participants either obtaining relevant information from their first modification (i.e. one-step QR) or they were less interested in keeping reformulating queries.

4.3.9 Query reformulation types of male pairs and female pairs

One of the research objectives was to explore the effect of gender on CQ reformulation types in collaborative tourism information search. The CQ reformulation types employed by male

pairs from those of female pairs were differentiated. Figure 4.21 shows the comparison of CQ reformulation types between male pairs and female pairs.

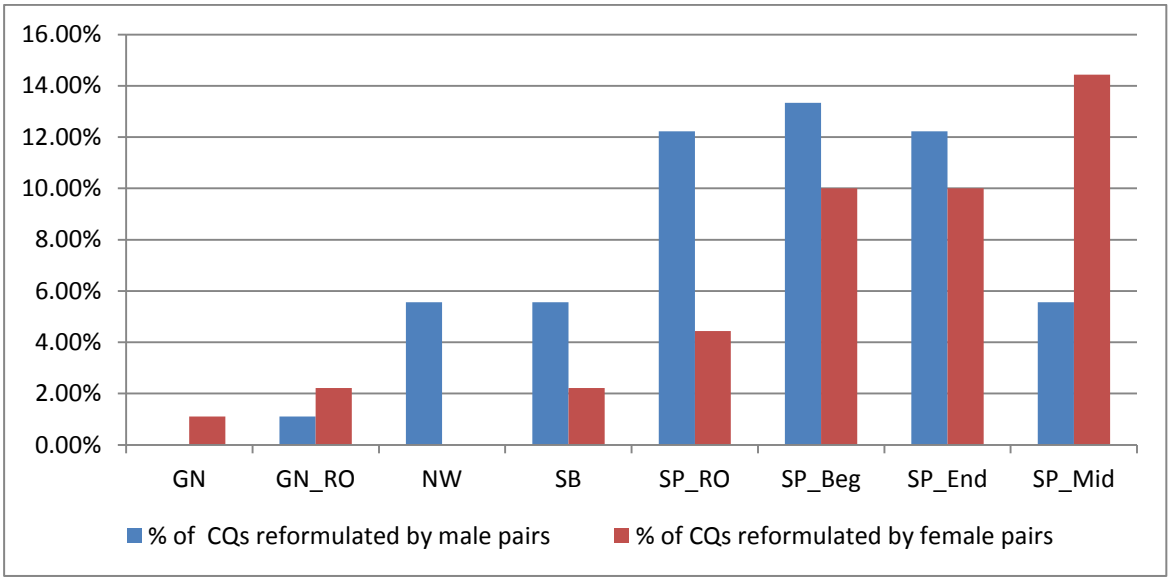


Figure 4.21 Occurrence of CQ reformulation among male pairs and female pairs.

The pairs of males reformulated more CQs (55.56%) than that of female pairs (44.44%). Not a single male pair was identified as performing GN type CQ reformulation whereas no female pairs did NW CQ reformulation. For each of the SB, SP_RO, SP_Beg, and SP_End types, male pairs performed more CQs than female pairs. On the contrary, for each of GN_RO and SP_Mid types, female pairs were observed to reformulate more CQs than what male pairs did. It is notable that male pairs performed SP_RO just below three times of SP_RO by female pairs while female pairs reformulated SP_Mid more than two times of CQs reformulated by male pairs. In terms of Specialization QR type, the female pairs followed the Specialization QR strategy more by adding terms in the middle of the previous query (SP_Mid), whilst male pairs tended to follow Specialization more with added terms in the beginning (SP_Beg) and at the end of the previous query (SP_End). Male pairs were also found to exploit more New and Word Substitution QR patterns than female pairs.

Table 4.39 Statistics for CQ reformulation types between male pairs and female pairs

CQ reformulation type	Performed by male pairs	Performed by female pairs	Statistical test
GN	0	1	χ^2 =1.25, p = 0.3
GN_RO	1	2	χ^2 =0.6, p = 0.5
NW	5	0	χ^2 =4, p = 0.05
SB	5	2	χ^2 =0.714, p = 0.5
SP_RO	11	4	χ^2 =1.92, p = 0.2
SP_Beg	12	9	χ^2 =0.021, p = 0.9
SP_End	11	9	χ^2 =0.002 = 0.95
SP_Mid	5	13	χ^2 =5.625, p = 0.01

Statistical analysis (Table 4.39) shows for both NW (χ2 =4, p = 0.05) and SP_Mid (χ2 =5.625, p = 0.01) CQ reformulation type, male pairs and female pairs were statistically different. For all other types, no significant differences were observed.

4.3.10 Collaborative query reformulation types by Australian pairs and Asian pairs

Australian pairs were found to reformulate more queries (55.56%) than Asian pairs (44.44%). The comparison of the employed CQ reformulation types between Australian pairs and Asian pairs is shown in Figure 4.22. It was observed that Australian pairs did not perform the reformulation type of GN and Asian pairs did not follow GN_RO and NW CQ reformulation types. With regard to the types of SB, SP_End, and SP_Mid CQ reformulation, Australian pairs and Asian pairs showed very different behaviors: Australian pairs applied more SB (6.67%) and SP_End (14.44%) compared to Asian pairs who employed 1.11% SB and 7.78% SP_End CQ reformulation. In contrast, Asian pairs utilized more SP-Mid CQ reformulation type (13.33%) which was double that of SP_Mid CQ reformulation (6.67%) as utilized by Australian pairs. Moreover, the Asian pairs were observed to follow Specialization QR type with added terms at the beginning (SP_Beg) and middle of the previous query (SP_Mid) while Australian pairs tended to follow Specialization with added terms at the end of the query (Sp_End). Furthermore, New and Word Substitution QR patterns were deployed more by Australian pairs than Asian pairs.

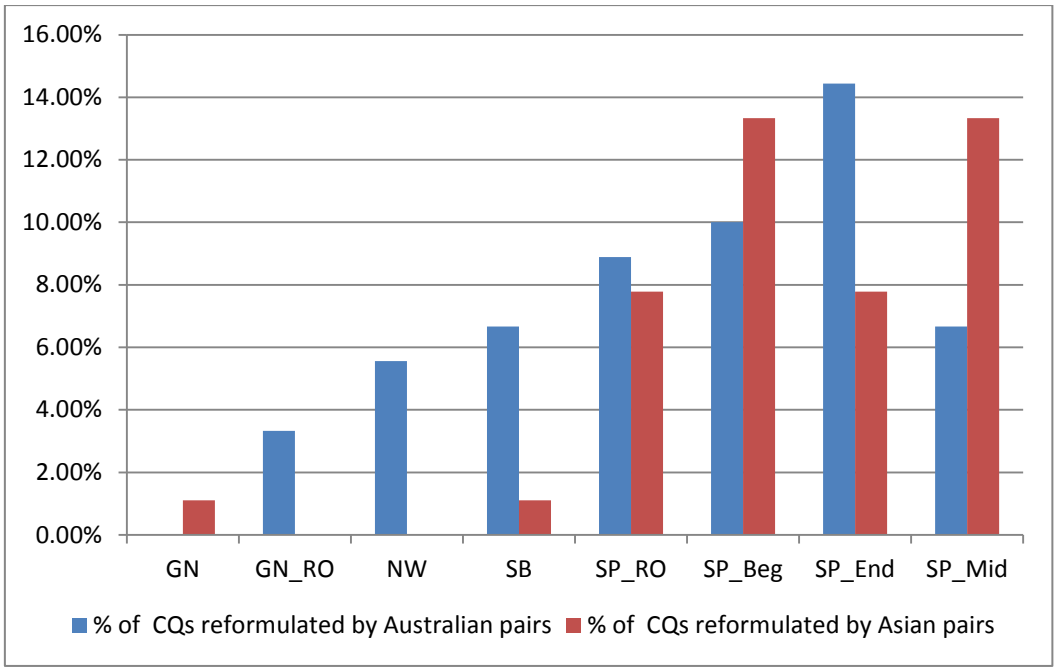


Figure 4.22 Query reformulation patterns of Australian pairs and Asian pairs.

Table 4.40 Statistics for CQ reformulation types between Australian pairs and Asian pairs

CQ reformulation type	Performed by Australian pairs	Performed by Asian pairs	Statistical test
GN	0	1	χ^2 =1.25, p = 0.3
GN_RO	3	0	χ^2 =2.4, p = 0.3
NW	5	0	χ^2 =4, p = 0.05
SB	6	1	χ^2 =2.578, p = 0.3
SP_RO	8	7	χ^2 =0.03, p = 0.9
SP_Beg	9	12	χ^2 =1.371, p = 0.2
SP_End	13	7	χ^2 =0.722, p = 0.5
SP_Mid	6	12	χ^2 =3.6, p = 0.05

Statistical Analysis (Table 4.40) shows that Australian pairs and Asian pairs exhibited the significant difference for NW (χ^2 =4, p = 0.05) and SP_Mid (χ^2 =3.6, p = 0.05). In all other cases, no significant differences were found.

4.3.11 Differences in collaboration query reformulation patterns based on gender and culture

In this section, the differences in CQ reformulation patterns based on gender and cultural factors are reported. The details on gender and cultural differences in CQ reformulation patterns are described below.

4.3.11.1 Male pair versus female pairs

Three high-level CQ reformulation patterns identified (as mentioned above) are: one-step, two-step and three-step CQ reformulation. The summary of the usages of these high-level patterns by male pairs and female pairs is shown in Tables 4.41. As for one-step CQ reformulation, 64.52% pattern was performed by male pairs whereas 35.48% one-step CQ was reformulated by female pairs. Only approximately 26% of two-step CQ patterns were followed by male pairs while female pair reformulated 73.92% two-step CQ reformulation. There was little difference in the number of three-step pattern employed by male pairs and female pairs. To show the difference in CQ reformulation patterns performed by male pairs and female pairs, statistical analysis was conducted. The results (Table 4.42) revealed that, male pairs and female pairs showed significant differences in two-step CQ reformulation (χ^2 =8.089, p = 0.001). No significant difference was found for one-step CQ patterns (χ^2 =2.016, p = 0.2) though there was variation in one-step CQ patterns for male pairs and female pairs. In other case (three-step CQ pattern), significant difference was not observed (χ^2 =0.49, p = 0.5). The usages of these patterns on tourism information category by male pairs and female pairs are given in Table 4.43. Comparative data on specific CQs reformulated by male pairs and females are presented in Table 4.44.

Table 4.41 Summary of high-level CQ reformulation patterns based on gender.

Types of CQ reformulation pattern	Male pairs (frequency, %)	Female pairs (frequency, %)
One-step CQ reformulation pattern	40(64.52)	22(35.48)
Two-step CQ reformulation pattern	6(26.08)	17(73.92)
Three-step CQ reformulation pattern	2(40.00)	3(60.00)

Table 4.42 Significant test on CQ patterns based on gender.

CQ reformulation pattern	Employed by male pairs	Employed by female pairs	Statistical test
One-step CQ reformulation	40	22	χ^2 =2.016, p = 0.2
Two-step CQ reformulation	6	17	χ^2 =8.089, p = 0.001
Three-step CQ reformulation	2	3	χ^2 =0.49, p = 0.5

Table 4.43 Gender-based high-level CQ reformulation patterns on tourism information.

Tourism information category	Gender	One Step CQ reformulation	Two-step CQ reformulation	Three-step CQ reformulation
Accommodation	Male	10	4	0
	Female	4	1	1
Attraction	Male	7	3	1
	Female	3	0	2
Food	Male	7	2	1
	Female	3	0	0
Restaurant	Male	4	2	-
	Female	5	2	-
Flight	Male	7	2	-
	Female	2	3	-
Local Culture	Male	2	-	-
	Female	0	-	-
Transportation	Male	0	0	-
	Female	3	1	-
Weather	Male	3	1	-
	Female	2	2	-

Table 4.44 Specific CQ reformulation pattern by male pairs and female pairs.

High-level CQ reformulation pattern	Specific CQ reformulation patterns	Frequency (male pairs)	Frequency (female pairs)
One-step CQ reformulation patterns	Initial → SP_Mid	12	5
	Initial → SP_End	9	6
	Initial → SP_Beg	8	5
	Initial → SP_RO	8	4
	Initial → SB	2	2
	Initial → NW	1	-
Two-step CQ reformulation patterns	Initial → SP_Beg → SB	1	2
	Initial → SP_End → SP_End	1	2
	Initial → SP_Mid → SP_Mid	-	2
	Initial → SP_Mid → GN_RO	-	2
	Initial → SP_RO → SP_Beg	1	1
	Initial → SP_RO → SP_End	-	1
	Initial → SP_Mid → GN	-	1
	Initial → SP_Mid → SP_Beg	-	1
	Initial → SP_End → SP_Beg	1	-
	Initial → SP_Mid → SP_RO	-	1
	Initial → SP_End → GN_RO	1	-
	Initial → NW → NW	-	1
	Initial → SB → SP_RO	-	1
	Initial → SP_End → SP_RO	1	-
	Initial → SP_Beg → SP_Beg	-	1
	Initial → SB → NW	-	1
Three-step CQ reformulation patterns	Initial → SP_End → SP_End → SP_End	1	-
	Initial → SP_Mid → GN → SP_Beg	-	1
	Initial → NW → NW → NW	-	1
	Initial → SB → SP_RO → SP_Beg	-	1
	Initial → SB → NW → NW	1	-

The results indicate that male pairs put much more stress on one-step CQ reformulation with the changes from initial CQ to Specialization CQ. Female pairs also showed similar patterns. Both male pairs and female pairs were observed to follow Initial → SP_Mid, Initial → SP_End, Initial → SP_Beg, Initial → SP_RO, and Initial → SB CQ patterns. However, male pairs and female pairs were not that interested in formulating CQ with new word(s). Only one male pair employed one instance of Initial → NW CQ reformulation.

For one-step, male pairs performed more CQ reformulation on tourism information which includes accommodation, attraction, food, flight, local culture and weather whilst female pairs applied more CQs on restaurant and transport (Table 4.43). In reformulating two-step CQs, female pairs utilized more patterns on flight, transport and weather whereas male pair employed more patterns on accommodation, attraction and food. For restaurant, both male pairs and females pairs used similar number of two-step CQ patterns.

Male pairs and female pairs demonstrated very opposite behaviors when reformulating two-step CQs. With regard to two-step CQ reformulation pattern, the results seem to confirm gender differences in following CQ patterns (as shown in Table 4.44). The two-step patterns used by female pairs employ were: Initial → SP_Beg → SB, Initial → SP_End → SP_End, Initial → SP_Mid → SP_Mid and Initial → SP_Mid → GN_RO. Male pairs employed Initial → SP_Beg → SB, Initial → SP_End → SP_End, Initial → SP_End → SP_Beg, Initial → SP_End → GN_RO. In reformulating two-step CQ, women pairs started with Initial → SP_Beg and Initial → SP_Mid patterns as the first modification and men started with Initial → SP_End in reformulating two-step CQs as the first modification. These results are useful to predict the QR pattern and the number of steps the participants may follow during the CQ reformulation. Moreover the results show that women performed more two-step CQ patterns, which indicates more collaboration among woman pairs. This finding confirms the nature of women's collaborative information searching (Steinerová & Šušol, 2007).

4.3.11.2 Australian pairs versus Asian pairs

This part concerning the results concentrated on CQ reformulation patterns employed by Australian pairs and Asian pairs. The summary of the usage of high level CQ reformulation patterns by Australian pairs and Asian pairs is presented in Table 4.45. The data in Table 4.45 demonstrate that the Australian pairs were inclined more to one-step CQ reformulation pattern (58.06%) than their Asian counterparts (41.93%). In most cases, the changes in CQ reformulation for both Australian and Asian pairs were from initial to Specialization CQ type while performing one-step CQs. In terms of two-step CQ reformulation pattern, Asian pairs did more (65.22%) than the Australian pairs (34.78%). Significant test was performed to show the difference between Australian pairs and Asian pairs in formulating CQ patterns. The results (Table 4.46) indicate the significant difference (χ^2 =4.019, p = 0.05) for two-step CQ reformulation pattern while no significant differences were found for one-step (χ^2 =0.158, p = 0.7) and three-step (χ^2 =0.49, p = 0.5) CQ patterns.

Table 4.45 Summary of CQ patterns based on culture.

Types of CQ reformulation pattern	Australian pairs (frequency, %)	Asian pairs (frequency, %)
One-step CQ reformulation	36(58.06%)	26(41.97%)
Two-step CQ reformulation	8(34.78%)	15(65.22%)
Three-step CQ reformulation	2(40.00%)	3(60.00%)

Table 4.46. Significant test on CQ patterns based on culture.

CQ reformulation pattern	Employed by Australian pairs	Employed by Asian pairs	Statistical test
One-step CQ reformulation	36	26	χ^2 =0.158, p = 0.7
Two-step CQ reformulation	8	15	χ^2 =4.019, p = 0.05
Three-step CQ reformulation	2	3	χ^2 =0.49, p = 0.5

The usages of high-level CQs applied to tourism information categories are shown in Table 4.47. Table 4.48 represents specific CQ reformulation patterns employed by Australia pairs and Asian pairs.

Table 4.47 Culture-based high-level CQ reformulation patterns on tourism information.

Tourism information category	Culture	One-step CQ reformulation	Two-step CQ reformulation	Three-step CQ reformulation
Accommodation	Australian	8	2	0
	Asian	6	3	1
Attraction	Australian	4	2	2
	Asian	6	1	1
Food	Australian	4	2	0
	Asian	6	0	1
Restaurant	Australian	9	3	-
	Asian	0	1	-
Flight	Australian	6	4	-
	Asian	3	1	-
Local Culture	Australian	1	-	-
	Asian	1	-	-
Transportation	Australian	2	0	-
	Asian	1	1	-
Weather	Australian	2	1	-
	Asian	3	2	-

Table 4.48 Specific CQ reformulation pattern followed by Australian pairs and Asian pairs.

High-level CQ reformulation Pattern	Specific CQ reformulation patterns	Frequency (Australian pairs)	Frequency (Asian pairs)
One-step CQ reformulation patterns	Initial → SP_Mid	10	7
	Initial → SP_End	10	5
	Initial → SP_Beg	7	6
	Initial → SP_RO	6	6
	Initial → SB	3	1
	Initial → NW	-	1
Two-step CQ reformulation patterns	Initial → SP_Beg → SB	-	3
	Initial → SP_End → SP_End	1	2
	Initial → SP_Mid → SP_Mid	1	1
	Initial → SP_Mid → GN_RO	-	2
	Initial → SP_RO → SP_Beg	-	2
	Initial → SP_RO → SP_End	1	-
	Initial → SP_Mid → GN	1	-
	Initial → SP_Mid → SP_Beg	1	-
	Initial → SP_End → SP_Beg	-	1
	Initial → SP_Mid → SP_RO	-	1
	Initial → SP_End → GN_RO	1	-
	Initial → NW → NW	-	1
	Initial → SB → SP_RO	1	-
	Initial → SP_End → SP_RO	1	-
	Initial → SP_Beg → SP_Beg	-	1
	Initial → SB → NW	-	1
Three-step CQ reformulation patterns	Initial → SP_End → SP_End → SP_End	-	1
	Initial → SP_Mid → GN → SP_Beg	1	-
	Initial → NW → NW → NW	-	1
	Initial → SB → SP_RO → SP_Beg	-	1
	Initial → SB → NW → NW	1	-

Australian pairs performed more CQ reformulations on accommodation, restaurant, and flight than female pairs while using one-step CQ reformulation patterns. For the same CQ reformulation patterns female pairs performed more on attraction, food and weather (Table 4.47). When the issue concerns two-step CQ patterns, female pairs utilized more patterns on accommodation, transport and weather while male pairs employed more CQ on attraction, food, and restaurant.

Table 4.48 shows that Asian pairs mostly followed the two-step CQ patterns, including Initial → SP_Beg → SB, Initial → SP_End → SP_End, Initial → SP_Mid → GN_RO and Initial → SP_Mid → GN_RO. The two-step CQ pattern followed by Australian pairs included Initial → SP_RO → SP_End, Initial → SP_Mid → GN, Initial → SP_Mid → SP_Beg, and Initial → SB → SP_RO. It can be stated that Asian pairs are less confident in finding information with one-step CQ reformulation than Australian pairs while the latter are more efficient in query formulation with fewer changes in query terms. Both Australian and Asian pairs showed little differences in applying three-step CQ reformulation.

4.3.12 Variables of tourism items choice behavior: Destination, accommodation and budget

For exploring the tourism items choice based on gender and culture the research focused on: 1) attribute of destination, 2) accommodation, and 3) budget (cost). The destination of the journey has an obvious effect on the choices available and the decision made (Hough & Hassanien, 2010). Van Middelkoop, Borgers, and Timmermans (2003) stated that destination elements such as safety and road conditions can influence the decision regarding a travel plan. Different factors may influence destination choice, which include income, cost etc. Tourism literature emphasizes the importance of factors in shaping tourists' motivations and in choosing vacation destinations (Crompton, 1979).

Factors are mainly related to the attractiveness of a given destination and tangible characteristics such as beaches, accommodation and recreational facilities and cultural and historical resources (Uysal & Hagan, 1993). The destination choice process might therefore be related to tourists' assessments of destination attributes and their perceived utility values. Numerous attempts have been made to classify major aspects of destinations (Kale & Weir, 1986; Sirakaya, McLelllan, & Uysal, 1996). Among these are climate, ecology, culture, architecture, hotels, catering, transport, entertainment, and cost, etc. Destination-based attributes could be many and differ from one destination to another.

Accommodation is an another important search topics of tourists and it is importantly found that more than 50% of the tourists made accommodation choices first, indicating that this action is a central and rigid decision in their trip plans (Pan & Fesenmaier, 2006). Hyde (2008) found that the extent of vacation bookings made for accommodation in specific locations varies with the amount of information search undertaken. Furthermore the extent of

vacation bookings made for accommodation in specific locations varies with characteristics of both the vacation and the vacationer, in particular.

Fodness and Murray (1999) made the connection between socioeconomic status defined by income and tourist search behavior and they observed that income and cost influence information search. Travelers with smaller incomes might be expected to engage in more searches to offset their relatively greater perceived risk (Van Raaij, 1986). Higher income levels, on the other hand, have been found to be positively associated with greater levels of information search including the use of destination-specific sources (Gitelson & Crompton, 1983).

In the previous study (Mohammad Arif et al., 2012), place of interest and accommodation were found in the top five categories of search terms in collaborative tourism information search. Destination and accommodation have also emerged as the two top-most search terms (Mitche, 2005) employed by the tourists. Mohammad Arif et al. (2013) identified that budget is one of the factors influencing the collaborative tourism information search. These led to explore the destination, accommodation and budget choice behaviors of pairs of participants based on their gender and culture.

4.3.13 Choice of tourism items based on gender and culture

Choice of tourism items differs from person to person, group to group, and context (vacation) to context (vacation) (Pan & Fesenmaier, 2006). The study observed the differences of choosing tourism items based on each pairs' gender and culture. In a few cases, both teammates in each pair showed differences in choosing tourism items, for instance, Participant 35 was in favor of a destination which is "Close to City" and his teammate (Participant 36) favored one that is "Close to Mountain". In the study, only the collective choices of each team for selecting tourism item were considered. For example, Participant 35 and Participant 36 (Team 18) decided collectively to choose the destination which is "Close to Mountain" despite the differences in their individual choices. The choice differences based on gender and culture are described below.

4.3.13.1 Male pair versus female pairs

Male pairs were looking for a hotel, motel or resort (8 pairs) for their accommodation whereas female pairs were interested in a rented house or apartment (5 pairs), and friends' or relatives' house (4 pairs). In choosing their destination, female pairs and male pairs also showed

different characteristics. Female pairs would like to visit the places Close to City (4 pairs) and Restaurant (5 pairs). Conversely, male pairs were interested in the places Close to City (3 pairs), Mountain (4 pairs) and Sea-beach (2 pairs). Female pairs were observed to plan for a higher cost tour than the male pairs. Out of 9, 7 female pairs agreed to set their budget at $400 or more per day whereas 7 male pairs set their budget at $400 or less per day for the travel.

Significance tests were performed to show the difference between male pairs and female pairs on choosing tourism items which include destination accommodation and cost. The results (Table 4.49) indicate that during the collaborative search process, male pairs and female pairs showed significant differences in choosing "hotel/motel/resort" ($\chi^2 = 8$, $p = 0.01$) and "rented house/apartment/unit" ($\chi^2 = 5$, $p = 0.01$) for accommodation and "destination close to restaurant" ($\chi^2 = 5$, $p = 0.01$) and "destination close to mountain" ($\chi^2 = 4.8$, $p = 0.05$) for destination. No significant difference was found for travel cost despite the variation in travel cost for male pairs and female pairs. Eight of nine female pairs exhibited their tendency in spending more money for the travel. On the other hand, six of nine male pairs were interested in spending more money for the travel. In other cases, significant differences were not observed based on the culture of pairs.

Table 4.49 Tourism information choice of male pairs and female pairs.

Tourism item	Choice	No. of male pairs	No. of female pairs	Statistical test
Accommodation	Home of friend/relative	1	4	$\chi^2 = 1.8$, $p = 0.2$
	Hotel/motel/resort	8	0	$\chi^2 = 8$, $p = 0.01$
	Rented house/apartment/unit	0	5	$\chi^2 = 5$, $p = 0.01$
Destination	Close to City	3	4	$\chi^2 = 0.142$, $p = 0.7$
	Close to Restaurant	0	5	$\chi^2 = 5$, $p = 0.01$
	Close to Mountain	4	0	$\chi^2 = 4.8$, $p = 0.05$
	Close to Sea-beach	2	0	$\chi^2 = 2$, $p = 0.2$
Travel budget/per day (in $)	1-200	3	1	$\chi^2 = 1$, $p = 0.3$
	201-400	0	1	$\chi^2 = 1$, $p = 0.3$
	401-600	4	3	$\chi^2 = 0.142$, $p = 0.5$
	601-800	1	2	$\chi^2 = 0.333$, $p = 0.5$
	>800	1	2	$\chi^2 = 0.333$, $p = 0.5$

4.3.13.2 Australian pairs versus Asian pairs

Australian pairs were looking for a hotel, motel or resort (5 pairs), and a rented house or apartment (4 pairs) for their accommodation whereas Asian pairs looked for a rented house or apartment (1 pair), hotel, motel or resort (3 pairs) and friends' or relatives' house (5 pairs) as their accommodation during the travel. Regarding destination, Australian pairs were in favor of places which were Close to City (4 pairs), Close to Mountain (4 pairs) and close to Sea-beach (1 pair) but Asian pairs showed different characteristics with places Close to City (3 pairs), Close to Restaurant (5 pairs) and Close to Sea-beach (1 pair). Australian pairs showed their interest in spending more money ($400 or more per day) for the tour than their Asian pairs who agreed to spend $400 or less per day for their trip.

A statistical test was applied to examine the significant differences between Australian pairs and Asian pairs in selecting accommodation, destination, and travel cost. The test results (Table 4.50) show that there are significant differences in a few options for accommodation, destination and cost. The choice of Asian pairs on "home of friend" as accommodation is statistically different from Australian pairs ($\chi^2 = 5$, $p = 0.01$). The test result also found significant differences on "close to restaurant" ($\chi^2 = 5$, $p = 0.01$) and "close to mountain" ($\chi^2 = 4$, $p = 0.05$) between Australian pairs and Asian pairs for destination choice. In terms of choosing the travel cost per day as "$1 to $200", Asian pairs are significantly different to the Australian pairs.

Table 4.50 Tourism information choice of Australian pairs and Asian pairs.

Tourism item	Choice	No. of Australian pairs	No. of Asian pairs	Statistical test
Accommodation	Home of friend/relative	0	5	$\chi^2 = 5$, $p = 0.01$
	Hotel/motel/resort	5	3	$\chi^2 = 0.5$, $p = 0.5$
	Rented house/apartment/unit	4	1	$\chi^2 = 1.8$, $p = 0.2$
Destination	Close to City	4	3	$\chi^2 = 0.142$, $p = 0.7$
	Close to Restaurant	0	5	$\chi^2 = 5$, $p = 0.01$
	Close to Mountain	4	0	$\chi^2 = 4$, $p = 0.05$
	Close to Sea-beach	1	1	$\chi^2 = 0$, $p = 0.95$
Travel budget/per day (in $)	1-200	0	4	$\chi^2 = 4$, $p = 0.05$
	201-400	0	1	$\chi^2 = 1$, $p = 0.3$
	401-600	3	4	$\chi^2 = 0.142$, $p = 0.7$
	601-800	3	0	$\chi^2 = 3$, $p = 0.1$
	>800	3	0	$\chi^2 = 3$, $p = 0.1$

4.3.14 Summary of results of User Study 3

Collaborative tool for searching tourism information - ColTIS (developed based on users' expectations and gaps of current tourism Web portals) was evaluated and compared to a simulated collaborative search tool (Google Talk-embedded Tripadvisor.com). ColTIS performs better than Google Talk-embedded Tripadvisor.com in terms of usability, result satisfaction and result correctness. Types and patterns of collaborative query reformulation for tourism information search have been explored. Gender and cultural effects in formulating collaborative query and choice behavior on tourism information have also been discovered.

4.4 Chapter summary

This chapter presented the results of three user studies. These results included the habits and practices of collaboration in tourism information searching, collaborative search behavior including search strategies, search stages, IFBs during the collaborative search. The findings also showed that ColTIS performed better compared to Google Talk-embedded Tripadvisor.com. The results on CQ reformulation process and the effect of gender and culture on CQ reformulation types and patterns were also identified. This chapter therefore addressed four research questions: (1) What are the characteristics of user search behavior in collaboration for tourism information?; (2) What are the factors affecting users' collaborative search behavior in tourism?; (3) What are the design issues for developing a CIS system?; (4) What are the effects of gender and culture on collaborative tourism information search?; and (5) How can users collaborate and retrieve information effectively in the tourism domain using a CIS tool?

The following Table (Table 4.51) represents the summary of how different research questions have been addressed using different user studies.

Table 4.51 Summary of results integrating research questions and user studies

Research questions	User study	Summary of findings
RQ1. What are the characteristics of collaborative search behavior when searching for tourism information?	User Study 1	The findings showed that for tourism information search, searchers preferred to collaborate with friends, family members, colleagues, agents and others for various reasons which included sharing information, gathering reliable and accurate information, and sharing knowledge and experience

	User Study 2	The findings revealed that tourists performed collaborative planning, collaborative information searching, sharing of information, and collaborative decision-making at different stages of the search process. The results also showed that, using text instant messaging, tourists collaborated for planning their search strategies, dividing search tasks into sub-tasks, discussing search engines and tourism Web portals used, tourism search keywords, methods of sharing results and links, and reviewing search results together. Types of IFB - information flow break down Stages and strategies for tourism CIS
	User Study 3	Collaborative query reformulation types and pattern for tourism information search
RQ2. What are the factors affecting collaborative search behavior in tourism?	User Study 2	Contextual factors which influence the collaboration for tourism information are: the budget for the travel, the previous knowledge and the previous visit and the technology Influence of IFBs on tourism CIS
RQ3. What are the design issues for developing a collaborative information search tool?	User Study 1 User Study 2	Desired features for tourism CIS
RQ4. What are the effects of gender and culture on collaborative tourism information search?	User Study 3	Gender and cultural effects in tourism CIS
RQ5. How can users collaborate and retrieve information effectively in the tourism domain using a CIS tool?	User Study 3	ColTIS performs better than Google Talk-embedded Tripadvisor.com in terms of usability, result satisfaction and result correctness.

The next chapter discusses in detail the results reported here. A collaborative search behavior framework is also presented in the next chapter.

5 Discussions

Collaboration is a useful and often essential part of complex tasks we deal with in everyday life. These task range from planning a family vacation to co-authoring an article, and from filing taxes to cooking holiday meals (Shah, 2010). People collaborate with others when the task is difficult or impossible for a single person to do. For example, since tourism information search is a complex task and there are many variables to consider, accompanying tourists will collaborate with others. This PhD thesis addressed some of the fundamental issues of collaborative tourism information searching in a computer-aided environment on the Web. This chapter discusses the results and findings of this thesis research.

5.1 Collaborative search stages model

Traveling with family members or friends is a common practice in everyday life. Due to the diverse nature of information needs, collaboration between tourists is ubiquitous in the course of group trip planning and travel information searching. The IFBs, namely, adverse situations of information acquisition, may exist in travel planning, information searching, and decision-making. The risk of experiencing adverse consequences increases the central importance of CIS and creates an obligation to learn from problems caused by IFBs in CIS. This research investigated in detail collaborative search behavior when tourism information is being sought. This study extends the findings of previous research on CIS in the tourism domain in terms of identifying collaborative search stages, search strategies, and types of IFBs, and lays a foundation for the development of search systems supporting tourists' CIS.

This research identified the behavioral characteristics of collaborative search as well as the cognitive process of decision-making in collaborative environments. In the non-collaborative travel information search context, Ho, Lin, and Chen (2012) characterized tourists' Web information searching as a four-stage activity which was composed of start of online searching, online searching, end of online searching, and offline searching. The start of online searching dealt with prior knowledge, the online searching comprised information processing,

barriers to searching and search strategies, the end of online searching involved termination of the search, and the final stage, offline searching comprised summarizing, exchanging and further searching of information.

In this thesis, tourists were found to place their emphasis primarily on planning and decision-making (Pearce, 2005). Tourists were also found to exchange messages mostly on search strategies and trip planning. Tourism information involved multiple aspects, including accommodation, food, culture, and cost. Different participants demonstrated distinct preferences for a variety of these aspects. They had to explore all the information and interact more for taking any decision for the trip. The results of this PhD research support the findings of Correia (2002) and Vogt and Fesenmaier (1998) by reporting the process of decision-making with an information acquisition phase. Individuals collected and utilized information from a wide range of sources in their pre-decision stage in the collaborative decision-making process (Bieger & Lasser, 2004).

Moreover, unlike standalone travel information searching, the findings highlight the sharing of information between collaborators. Team members in each pair were found to communicate with each other to share information on trip planning, personal experience, search queries, Web links, and search results. The participants not only shared the search findings but also the search processes. Sharing of information was an essential part of collaboration (Reddy et al., 2010). As stated earlier, the stages of collaborative information searching and sharing of information occurred in parallel and alternately. The results confirm that team members in a collaborative search followed an iterative pattern of information seeking-sharing-seeking (Reddy et al., 2010). The tourist participants not only shared previous personal knowledge and experience, if any, to guide the trip planning and tourism information search, but also shared search queries, URL links, and search results. The sharing of information allowed team members to collect pieces of information that they put together to resolve their search task and move forward towards trip decision-making. Awareness is one of three components (the other two are control and communication) that are conspicuous in the CIS (Rodden, 1991). Awareness involves knowing who is around, what activities are occurring and who is talking with whom (Dourish & Bly, 1992). Providing awareness is one of the issues of collaboration (Shah & Machionini, 2010). The results also demonstrate that awareness existed among the collaborators in travel information searching and such awareness was supported through the sharing of queries, Web links, search results, and prior

experiences, and what group members visualized. These results are supported by the previous study on collaborative information search (Morris & Horvitz, 2007).

It is worth noting that prior knowledge and experiences did influence the stages of collaborative planning and information searching. Tourists' knowledge and experience of a previous visit to a destination influenced their current information search behavior and decision-making process and they usually made decisions based on their prior knowledge (Vogt & Fesenmaier, 1998). The memories of the travel destinations or the traveling experiences also served as clues to initiate follow-up search actions (Ho et al., 2012). The findings of this research show that tourists with prior experience were able to locate accurate and useful information easily and they liked to disseminate that information to their teammates. The following two examples demonstrate the positive impact of previous experience and knowledge on the stages of collaborative planning and information searching:

> My teammate advised me to use wotif.com because he used it before. (Participant 2)

> I helped my teammate by providing air travel information from my experience; my teammate helped me by providing his accommodation booking and sight experience. (Participant 3)

From the results of set of studies that were reported in this PhD thesis as well as previous works, a model was developed to illustrate the search stages, search strategies and their elements involved in collaborative tourism searching, their characteristics, and the relationships between different search stages (Figure 5.1)

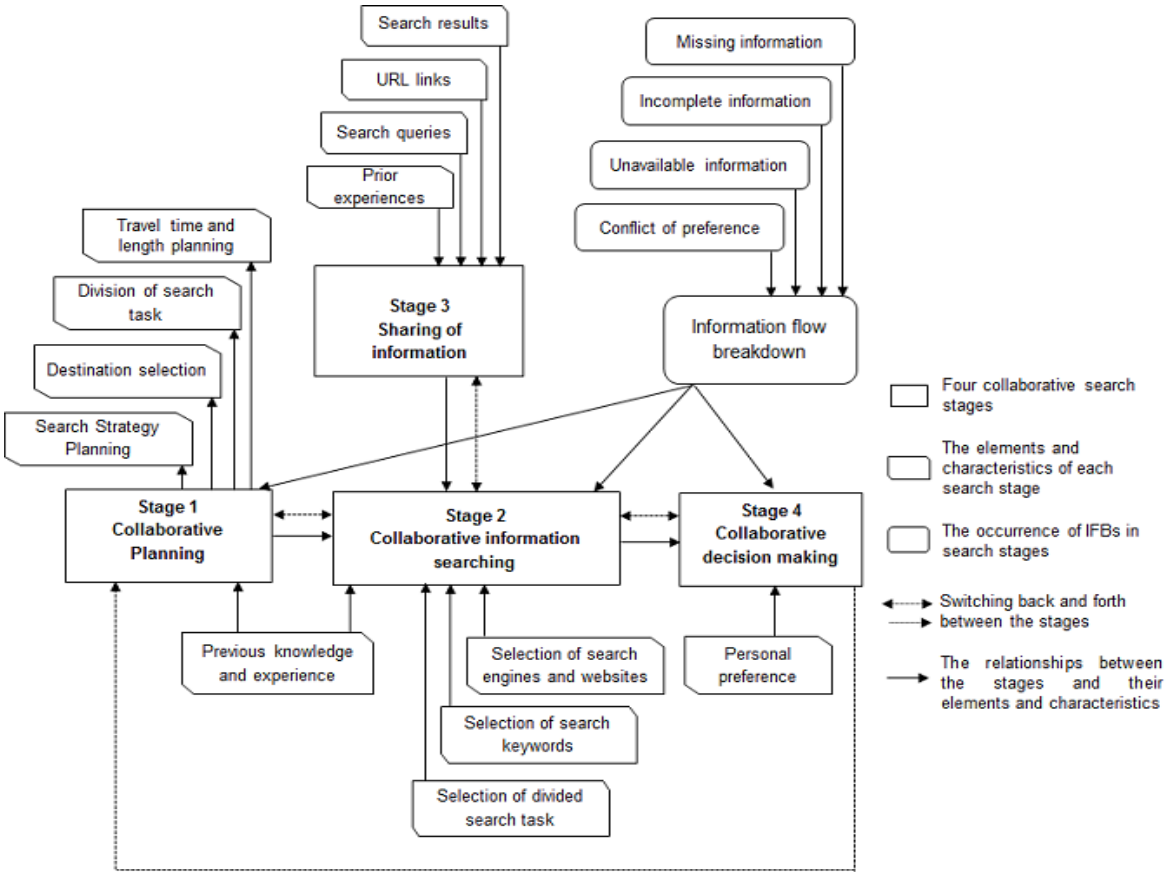


Figure 5.1 Collaborative search stages in tourism CIS.

There are some overlaps between this search stage model and Ho et al.'s (2012) findings. For example, the first two stages of our model conform to the start of online searching and online searching stages outlined in Ho et al.'s (2012) model, encompassing activities of planning, expectation formation, anticipation of the trip, and gathering pertinent information. However, their model does not consider the collaborations between tourists. For example, the division of labor in the search task could constitute an important element with particular planning characteristics during CIS prior to the commencement of the search. Also, due to the nature of collaboration during which many individual demands and preferences need to be satisfied, the progression of a collaborative search is in essence non-linear, with more switching back and forth in the search and the decision-making processes than that in an individual search scenario (Du, 2010; Du & Spink, 2011; Fidel et al., 1999). A recent study (Aloteibi, & Sanderson, 2014) also observed users' task switching behavior when either they start another search task or to return to previously submitted query.

Similar results for collaborative search stages were reported in Reddy et al.'s (2008) study where team members followed the stages of search strategies planning, sharing thoughts and

communication through the chat facility, performing search activities (searching), and sharing the results. In Morris et al.'s (2006) CIS model, the proposed system supported users' collaborative search in four phases, involving individual query formulation, combining queries from all users together, retrieving result depending on the query formulated, and displaying the results. However, these CIS models did not either reflect IFBs including the issue of preference conflicts during collaborative search, or consider the effect of previous knowledge on collaborative search as portrayed in search stages framework developed in this research.

Relationships between different collaborative search stages also appeared. The stages of collaborative information searching and sharing of information occurred in parallel. The process of CIS often involves information sharing between collaborators. Most trips begin with a plan. Based on the outcomes of the planning, the collaborators determine the best way to start their collaborative search. According to the plan, they employ certain search strategies on the Web. During the collaborative search, the collaborators may encounter diverse IFBs or barriers at different stages which may impact on collaborative planning, collaborative search, and decision-making. The sharing of various pieces of information relating to the trip affects collaborative search strategies, such as using queries and URL links recommended by teammates. Following online searching, teammates like to discuss the content of the obtained information and exchange mutual opinions with their co-searchers. They come to agreements or make suggestions to each other for decision-making. Depending on the decision, they would either start a new search (in case of disagreement) or take the decision (in case of agreement). They engage in searches for all related matters/aspects of their trip. It shows that tourists' CIS is an iterative process, that is, lots of 'back and forth' movement between the search stages may occur.

5.2 Collaborative search strategies for tourism information

Collaborative search strategies were applied during tourism CIS of which collaborative strategy planning, division of search task, using search queries and URLs recommended by teammates, and discussing search results were significant features. As the division of search task was negotiated with members within each pair by dividing labor issues, such as splitting the search into sub-search tasks for aspects of a trip, it allowed the collaboration among people with different levels of search skills, for example, by permitting a more expert searcher to compose a query while still involving other team members in exploring the results (Morris

& Horvitz, 2007). There may be several reasons why the collaborators divided a search task: firstly, all team members shared the search loads; secondly, team members may save searching time; and thirdly, team members could concentrate on his or her allocated sub-search task which they might be more familiar with or have knowledge about.

During the study, the participants typically started their searches from known sites and they visited these known sites by simply typing the URLs. These findings suggest that prior searching experiences and knowledge about a trip played an important role in the initiation of tourism information searching on the Web. Recommending URLs and search queries to the teammates were quite common in tourism CIS. It reflects the fact that the participants made good use of the knowledge/experiences possessed by their teammates for obtaining travel information. In the present study, the participants also performed interactive query formulation and reformulation. They adopted the search queries suggested by their teammates. Cooperative query formulation allowed a group of users to express their search goals jointly (Blackwell, Stringer, Toye & Rode, 2004; Hoppe & Zhao, 1994; Morris & Horvitz, 2007). Depending on the pairs' needs, these queries were sometimes further modified, reformulated, or merged to make a new query for obtaining alternative search results. Observing and discussing search results is an important feature of CIS practice. The participants commented on the Web pages they found and shared both the Web pages and comments and discussed them together. Sharing of search results could reduce retrieval costs and allow a user to browse the result sets with no need to search further.

The findings show that tourists in collaborative search situations do employ Web search strategies for tourism information which are similar to those identified in individual search contexts, such as using search engines and tourism Web portals, keywords, evaluating search results, and browsing Web pages (Ho et al., 2012). However, teamwork in collaboration introduces complex contextual factors into the processes of collaborative search and for this reason collaborative search strategies will have some distinct characteristics. For instance, these include more frequent usage and modification of search keywords, more frequently switching back and forth during search, division of search task, sharing search queries and links, and the occurrences of IFBs due to conflicts of personal preference.

5.3 IFBs during collaborative search for tourism information

The instances of IFBs were classified and their effects on travel planning and information search during tourism CIS were examined. The DIB method (Galliers et al., 2007) has

enabled us to determine risky and adverse situations at various stages of the collaborative search process, such as the participants failed to identify the updated information for preparing the trip plan. There was more than one breakdown in information flow that led to the occurrence of adverse events, which confirms the findings of previous studies on IFB (Hertz, 2010). Comprehensive and accurate travel information needs to be acquired by the collaborators throughout the collaborative information search process in order to make decisions on a trip. Yet the IFBs such as missing information, incomplete information, unavailable information, and conflict of personal preference happened at different stages of collaborative search. Most commonly, during the course of searching and finalizing a trip plan, the collaborators realized that they did not have sufficient information on a certain aspect of their trip (for example, accommodation, food, or attraction) and this sort of IFB (i.e. missing information) occurred due to the lack of discussions between the collaborators before starting the collaborative search. The IFBs also occurred, though these were few in number, when the collaborators found no relevant information from the website recommended by their teammates. It is worth noting that 11.11% of the shared URLs by the teammates were not active or information was unavailable on the opened websites. The occurrence of this sort of IFB may be considered as a side effect of collaborative search.

The breakdowns in collaborative information search for the tourism domain identified in this study have adverse effects in trip planning, information searching, and decision-making. The occurrence of IFBs in the planning stage led to further IFBs in the searching stage. The possible reasons may be: (a) the search strategies and the collaborators' preferences that were missing unconsciously in the planning process were not considered during the search; and (b) the search results did not match what they planned initially and consequently led to IFBs. It was also found that most IFBs were related to the topic of budget, which forced tourists to re-plan the tour, re-search the information, and change the final decision. Accommodating everybody's budget is a challenge in tourism CIS. This research includes the discovery of techniques and approaches to overcome IFBs in tourism CIS on the Web, which will support a smoother collaborative search process.

5.4 Supporting collaborative information search for travel planning

Tourists are now more inclined to collaborate in their search for tourism information when they travel in a group (Mohammad Arif et al., 2015; 2014). To support this group travel search process, this PhD thesis proposed ColTIS, a new multi-user search tool that allows

many tourists to plan their tour online and to search for information pertaining to their travel plan. The results showed that ColTIS addressed the issues which have not been considered by current tourism Web portals. The most widely used travel Web portal, Tripadvisor.com has not been designed for supporting collaborative search and consequently it cannot be compared directly to the collaborative search tool CloTIS. As such, to evaluate the performance of ColTIS, Google Talk was embedded within Tripadvisor.com, making it a collaborative tool and comparable. The results confirmed that ColTIS performed better than Google Talk-embeded Tripadvisor in collaborative searching on the Web.

The results showed that users collaborated through division of search task, chatting and results sharing. Each pair of participants was observed performing division of task on tourism-related information search through Google Talk chatting when using Tripadvisor. On the other hand, with ColTIS, the collaborators utilized built-in "division of search task" option. This "division of search task" selected by collaborators is visible to all collaborators to prevent a duplicate search being executed (Mohammad Arif & Du, 2012). The "division of search task" also shifted "cognitive load" from the collaborators to the system. For various reasons such as travel planning, search planning, division of search task, result sharing, and query sharing, collaborators exchanged instant messages using both systems. Collaborators exchanged fewer messages using ColTIS than Tripadvisor because ColTIS has automatic options for sharing results, links and queries. This enables ColTIS users to shift their cognitive and physical load to the system. There may have been several problems during the results sharing using instant messaging, especially for link sharing (Mohammad Arif & Du, 2012) such as spelling errors (during typing) or the link might not be working properly (when copying and pasting the link). Automatic result and link sharing options of ColTIS could resolve these problems.

In terms of usability, pairs of participants felt that ColTIS was easier to use. The results provided by ColTIS were considered to be more useful than those of Tripadvisor. Collaborators were also in favor of result satisfaction and results correctness of ColTIS. ColTIS may be more suitable for a specific group of tourists residing in different places desiring to search for tourism information and to make decisions based on the search results for preparing a holiday plan.

To conclude, pairs of participants reported ColTIS performed better in terms of easiness and usefulness. They were more satisfied with the results and correctness of the results provided

by ColTIS, and enjoyed efficient collaboration through division of search task, chatting and results and links sharing features. In addition to the current features of ColTIS, more features reflecting particular groups of tourists, e.g., collaborative search behavior of groups of female or male tourists may be valuable. Including such features can potentially improve the functionality of ColTIS.

5.5 Effect of gender on collaborative query reformulation

The statistical analysis shows that for NW CQ reformulation type male pairs formulated more CQs than female pairs. There may be two explanations: firstly, males might be more experienced in computer and Internet technology and these experiences affect the collaboration when male pairs are formed; secondly, male pairs might expect to find relevant information more successfully (Large et al., 2002) and quickly with the CQs they reformulated. This is consistent with previous computer-mediated communication (CMC) studies on gender. For example, Hiltz and Johnson (1990) found that females viewed CMC more favorably than males because females do not have as much experience in online searching as males. It seems that the need for user-friendly functionalities and a wider scope of information content are more important to women.

Male pairs were found to employ more new terms when reformulating CQs which might imply that males were more proactive in using new terms for the QR. This finding supports Large et al.'s (2002) conclusion that the group of boys formulated more queries entering one word (one word QR implies always QR with new word) than girls with averaging a total of boys' 4.67 one-word searches compared to the girls' 1.80 one-word searches. The query histories and search histories of team members were displayed during the search, which were the possible resources for new query terms. Male pairs probably learnt more new terms from displayed results and utilized them for QR. In contrast, female pairs were observed to use less new terms and they relied more on their teammates for QR.

Most previous studies have investigated users' QR process in searching for information from online databases and the Web in individual search environments. Only a few studies dealt with QR in collaborative information search highlighting the classification of QR, sources of QR terms and effects of task types on QR reformulation. The current study explores users' CQ reformulation in searching for tourism information on the Web and examines CQ reformulation types and patterns. This study identified eight (8) CQ reformulation types and 27 CQ reformulation patterns. The results revealed that, male pairs and female pairs showed

significant differences in two-step CQ reformulation. In addition, this study further identified the differences in CQ reformulation patterns taking the gender factor into account. The varied types and patterns of CQ reformulation performed by male pairs and female pairs in the study indicate their diversified information needs when they conduct CQ reformulation process on the Web (Suchman, 1987; Xie, 2000). Based on the finding that male tourists mostly performed one-step CQ reformulation patterns and female tourists performed more on two-step CQ reformulation patterns on different tourism information, it can be concluded that gender plays an important role in CQ reformulation process. Understanding the effect of gender on CQ reformulation would help CIS suggest better gender-specific query or query terms s for users.

5.6 Effect of culture on collaborative query reformulation

The research findings indicate that there were more instances of CQ reformulation in Australian pairs than Asian pairs. In particular, Asian pairs typically reformulated the query by adding more terms at the beginning of the previous query (13.33%), and with the equal frequency, they formulated the query by adding terms in the middle of the previous query. Australian pairs, rather, tended to reformulate the query with added terms more at the end and at the beginning of the previous query. Significant test shows the difference between Australian pairs and Asian pairs in formulating CQ patterns. The results indicate the significant difference for two-step CQ reformulation pattern while no significant differences were found for one-step and three-step CQ patterns. Australian pairs followed more in one-step CQ reformulation pattern while Asian pairs performed more two-step CQ reformulation pattern. The results of nationality-based differentiation on QR during tourism information search are supported by the previous work of Spink et al. (2002) who found the differences in queries of U.S and European users. For the QR, Generalization was used less frequently than other types of QR by both Australian and Asian pairs.

In an exploratory search, users may begin with general queries and then exploring the topic in more depth by narrowing down the scope of the queries (Jansen et al., 2009). This may explain why generalization was less frequently used. It was also found that both Australian and Asian pairs tended to use more New and Specialization compared to other CQ reformulation types. The explanation behind this is simple and obvious in that New and Specialization are higher cost , i.e. complex type of QR (Spink et al., 2002) than others and it is suggested that more collaborations are desired in complex situations (Shah, 2013).

Furthermore, numerous QR types of Specialization (SP) with different variations were observed in CQ reformulation for both Australian and Asian pairs. This result is supported by the findings of Spink et al. (2002) where cultural differences were found in Web searching patterns.

Understanding how users reformulate queries in collaborative search can help search systems to provide better query suggestions for group users. It was learned that team users in collaborative search tend to use New and Specialization more often and that they coordinate the search between team members. It is worth investigating whether providing query suggestions in collaborative search can help to make QR more successful. In addition, providing support for awareness in addition to query suggestion might help team users to select suggested queries. In this case, users are able to examine the current query and predict the direction of the following query.

5.7 Effect of gender on collaborative search on tourism items

This study made an initial exploration, for the first time, on gender differences in collaborative search for tourism information and found that male pairs and female pairs differed significantly in terms of searches and choices on accommodation and destination. Compared to male pairs, females searched for more information and were more inclined to choose a destination close to a city and restaurant. In terms of travel cost, eight female pairs were interested in expensive travel while six male pairs expressed the same interest. These results support females' response to the choices about lodging, food and travel cost as discussed in a previous study (Xie et al., 2006).

The impact on search and choice behavior from the perspective of gender differences resulted in important findings. The role that gender plays in search and choice behavior was particularly important and is similar to that found by Meyers-Levy (1988). In that study it was noted despite the availability of information, gender differences on accessing and using information varied. The research findings offer insights into how males and females search for and choose information in collaborative environments and it appears that male pairs are more likely to ask teammates for help (Barber, Dodd, & Kolyesnikova, 2009). Overall, the present research demonstrates that gender is likely to evoke different strategies in choosing consumable items while searching for tourism information. The results add weight to the notion that gender differences do have an impact on collaborative search and travel choices.

5.8 Effect of culture on collaborative search on tourism items

Compared to the Australian pairs, the Asians made their choices significantly more on "home of friend/relative" as accommodation. This result is contrary to the findings of Tourism Research Australia (2011b) where more Australians are in favor of friends'/relatives' properties when they travel abroad. This may be due to the small sample size or due to the collaborative decision-making where teammates have to match their preferences. A different pattern appeared for the amount of money spent (in a pair) per day during the stay. Compared to the Asian pairs, Australian pairs would like to spend more money in terms of travel cost per day. The travel expenditures depend on the socioeconomic context of the tourists (Fodness & Murray, 1999). This finding is similar to that in a study by Tourism Research Australia (2011) which found that the total expenditure by non-Australians was $18 billion for the year 1 October 2010 to 30 September 2011 (Tourism Research Australia, 2011a) and the total expenditure by Australians amounted to $43.3 billion for the same period (Tourism Research Australia, 2011b).

5.9 Implications of this research

This study investigated tourists' collaborative search behavior including how they followed the search stages and employed different strategies during collaborative search by interacting with a variety of general search engines, websites, and tourism-specific portals, from a more holistic perspective, i.e. from the initial stage of trip planning to the final stage of decision-making. This endeavor enhances the understanding of users' experiences of collaborative tourism information searching. The characteristics of collaborative search stages and search strategies constitute a generic search pattern, which could lay the foundation for developing a tourism CIS tool. The following sections discuss the implications of this study on the application and research area of collaborative Web search in tourism domain.

5.9.1 Collaborative travel planning

As planning is an essential part of almost every type of travel and tourists place their emphasis primarily on planning, a digital trip planner which facilitates the collaborators to mark and store such information as destination and travel time/length discussions and search strategy plan (e.g. websites to be visited, search engines to be employed, search queries to be used, etc.) could be embedded within a CIS system. In this way collaborators can search and check the activities that were planned in the initial stage of the collaborative search process. After making the final decision, tourists can also save important information such as

destination, accommodation, attractions, travel dates, and useful URLs into the trip planner for future use. A CIS system should also support the "what to do list" in the digital planner which can store the strategy for the division of search tasks so that each collaborator knows and performs his or her assigned tasks to share the search load, and can re-check the load later if needed.

5.9.2 Distribution of search load

Facilitating awareness of group members during the collaborative search may reduce overheads involved. The findings imply that displaying users' query history to other collaborator would eliminate the duplication of search efforts and strategies (Shah & Machionini, 2010). It was found that the tourists shared search queries and search results of all aspects of a trip, and inexperienced tourists may learn how to formulate or reformulate queries better by viewing both the queries and results shared by the collaborators. Each team member's search history (including queries and results) can be shown on the screen as requested.

5.9.3 Minimization of personal preferences' gap

Finding information on a certain topic is not a trivial task (Naderi & Rumpler, 2010). CIS in tourism is complicated due to many issues having to be satisfied by several tourists at the same time. One may disagree with his or her teammate on a certain aspect due to personal preference. The team members' interests (i.e. user preferences) should be handled with great care. Supporting real-life planning with many participating parties is a difficult problem for computers (Nau, Ghallab, & Traverso, 2004), and a major challenge is to make sense of people's goals, preferences and other 'soft' considerations (Chen & Pu, 2004). A sound CIS tool should aim to enhance tourists' collaborative search experience by complementing explicit user requests with implicit user preferences to better meet an individual user's needs. For example, a CIS tool should provide a common/shared space for inputting individual preferences so that other team members can easily check all team members' preferences, and discuss how to minimize any conflicting issues.

5.9.4 Preventing IFBs

Various types of IFBs during tourism CIS were also identified in this study. The occurrence of IFBs in collaborative grounding suggests that sometimes information sharing and acquiring among collaborators appears difficult in CIS. As a concrete example of an improvement,

tourists should be able to cross-check information by searching for the reviews or consulting with travel consultants for that particular information which may be causing the confusion. This would validate the tourism information and thereby prevent some breakdowns, such as incomplete information, in a collaborative context. As discussed earlier, a digital trip planner should be supported in CIS systems so that collaborators can consult with the planner when applying their search strategies and accommodating everyone's needs. This would relieve some IFBs due to missing information in planning and conflicts of preference. Also, the teammates shared search queries and URLs using text messages during CIS. At the time, they may make typos or mistakes when typing or copying queries or URLs, or they may exchange the links without checking whether these links provided certain information or not, which may produce IFBs of unavailable information. As such, a CIS tool might facilitate the way in which queries should be shared automatically without typing/copying and the links should only be shared if they contain valid information.

5.9.5 Coordination during CIS

The findings from the literature review and this PhD study relevant to collaborative planning, collaborative search stages, and search strategies for tourism information suggest that a favorable CIS system should have the following key attributes: (a) a flexible message passing facility for supporting proper communications and sharing similar interests between the collaborators and able to alert them when any collaborator is available online; (b) providing facilities for composing a CQ. The composition of CQ is supported by an existing tool (see Hoppe & Zhao, 1994) but this needs to be coordinated by an external administrator. The CIS system should provide a query composition facility so that collaborators can formulate the query jointly with no need for coordination or intervention by a third party and it would eliminate the load for executing several queries separately; (c) displaying both the queries executed and the search results obtained by individuals so that each collaborator can see and check other collaborators' queries and results. It would be able to prevent the IFBs caused by the duplication of search; (d) the CIS system should only store and display those queries and URLs based on the valid results that are found. This may prevent the IFBs arising due to the shared URLs not containing any information or those that have been removed.

5.9.6 Modeling CQ reformulation

This research investigated how tourists reformulated CQs, CQ reformulation types and patterns based on gender and culture during collaborative search interacting with the CIS tool

ColTIS. The findings enhance the understanding of users' CQ reformulation strategies (Liu et al., 2010), types and patterns in collaborative tourism information searching, which could lead to further development of tourism CIS tools. The following section suggests some implications based on the results.

Research on the detection of QRs patterns during Web searching is a critical area for designing more advanced search systems, especially in the more multifaceted search contexts of exploratory searching situations like collaborative tourism information search (Mohammad Arif et al., 2014). The findings presented in this thesis relating to gender and culture-based QR types and patterns are advantageous for real-time system implementation. The implications from these research results are promising for the design of CIS systems in the tourism domain. For instance, given that one can predict future states of query formulation based on previous and present states with a reasonable degree of accuracy (Jansen et al., 2009), one can design information systems that provide query-reformulation assistance (Anick, 2003), automated searching-assistance systems (Jansen, 2006), recommended systems (Smeaton, & Callan, 2005), and exploratory searching systems (White, Kules, Drucker, & Schraefel, 2005). Based on the findings of this study on CQ reformulation types and patterns, a CIS tool can be designed so that it can form CQ automatically by analyzing the similarity or dissimilarity of collaborators' individual queries.

5.9.7 Gender- and culture-based online tourism

According to the Pew Internet & American Life Project (2004), in 2000, about 60% of the Internet population consisted of men and 40% for women. By February 2004, the gender ratio among Internet users had shifted to 50% for both. A recent UN (United Nations) report states that of the worlds' 2.8 billion internet users, 1.3 billion (46.43%) users are women, while 1.5 billion are men (53.57%) (UN Report, 2013). In this sense, the findings of this research have practical implications for women's participation in Web-based marketing communications, and their use of the Internet in general. The findings of this research also seem to suggest that, as most tourism websites are gender- and culture-neutrally designed in terms of both functionality and content, the tourism Web portal can be redesigned supporting collaboration with the emphasis on CQ reformulation. These Web portals should emphasize both men's and women's preferences regarding tourism information. In today's competitive e-environment, the placement of appropriate messages on a website in an appropriate manner is paramount to success. The appropriateness of the content as well as the presentation of the message,

however, hinges upon having a good understanding of the characteristics of the audiences. Thus, commercial tourism Web portals may benefit by creating gender and culture-sensitive website content and presentation.

Based on the findings of this research, tourism marketers should develop online communication strategies targeting specific groups. For example, website contents targeting men should highlight the distinctive features of accommodation as they sought more information regarding accommodation, and the contents targeting women should focus more on the food matching with women preferences. A similar concept can be applied in designing collaborative search tools based on cultural differences. For example, since the Australian pairs of tourists (collaborators) tend to formulate Specialization (SP) CQs, the CIS tool should provide the query suggestion of Specialization (SP) types to Australian tourists. In sum, the different gender and cultural attitudes toward collaborative tourism Websites and search engine design and contents empirically supported in this study represent valuable inputs in designing better tourism Websites, communicating with potential visitors, and defining the most appropriate messages to deliver in the online environment (Kim et al., 2007).

The contribution of this research is to highlight the CQ reformulation types and patterns and the gender and culture based behavior on consumable items in the tourism domain. This study provides hospitality and tourism professionals with new insights to develop better strategies for the group of users based on their attributes (Barber, 2009). They need to be aware that customers' preferences and purchasing decisions may be driven by factors such as destination, accommodation and budget choices for different groups of users. These research findings will lead to a more critical look at tourism marketing strategies aimed at establishing relationships, particularly the gender and cultural differences in assessing types of consumable items and their attributes where male and female customers from different cultural backgrounds rely on items' attributes. For example, does "the places close to both Mountain and Beach" for selecting a resort make an impact when a group of consumers from the same cultural background select a destination? What if a group of men is making the selection? This understanding will lead hospitality providers to pursue in-depth marketing strategies to establish relationships and rethink their communication strategies towards hospitality consumers.

Another example would be a female group planning to visit a tourist destination. This group may have different choices for accommodation, destination, and budget. Thus, marketers may

benefit by creating gender-sensitive recreational sites with the content and presentation valuable to women.

Based on the findings of this research, tourism marketers may develop gender- and culturally sensitive tourism spots and corresponding online information strategies so that interested groups can retrieve them easily. For instance, website content targeting men should highlight the distinctive nature of selected attributes, and the content targeting women should focus on more affective themes underlying the various attributes of women.

5.9.8 Improvement of CIS System

How to enhance CIS systems to facilitate effective IR for travel information is given below:

- The identification of similarity between individual queries and collaborative queries and how collaborative queries can be formed automatically from the individual queries could make CIS tools more effective.
- Automatic extraction of terms from chat logs to reformulate individual queries and collaborative queries may be an efficient query reformulation process for a tourism CIS tool.
- Tourism CIS tools can be enhanced to explore how tourists can be classified automatically into groups based on their personal preferences (interests), chat logs and query logs. That will make collaborators convenient to do collaborative search with people with similar interests
- Handling multiple tasks during collaborative tourism information search can be the further development of CIS tools.

5.10 Chapter summary

This chapter discussed the key findings of three user studies. Firstly, tourists' CIS behavior including search stages, search strategies, their relationships and the factors which influence these stages and strategies were discussed. Then, the IFBs that tourists encountered during the collaborative search were described with the emphasis on how these IFBs affect tourism CIS. The evaluation and comparison between ColTIS and Google Talk-embedded Tripadvisor.com were illustrated and indicated how ColTIS could be an effective tool for preparing a travel plan during collaborative search. In addition, tourists' CQ reformulation behavior and the effects of gender and culture on CQ reformulation and tourism information choice behavior were deliberated. Finally the implications of the results of this PhD thesis were also discussed.

6 Conclusions and Future Research

This chapter summarizes the thesis followed by recognition of its limitations, and suggestions for further research.

6.1 Overall summary of this research

This PhD thesis provides important results and conclusions from three user studies on tourists' CIS behavior involving their collaborative search habits and practices, collaborative search stages and strategies, collaborative tour planning and decision-making. CQ reformulation strategies and the effects of gender and culture on collaborative search behavior have been explored. A collaborative tourists' information search model including different search stages and the relationships between the elements of these stages of the collaborative search were also examined. Moreover, the occurrence of IFBs that hindered the flow of collaborative tourism information search and their effects were identified. To that end, a collaborative tool – ColTIS – was proposed to support the collaborative search for tourism information on the Web.

User Study 1 attempted to understand the collaboration between tourists. The results of User Study 1 reveal that tourism information searchers often collaborate over both search process and search results. The findings provided some insights into why and how they collaborate for tourism information, collaborative search pattern, sharing of search tasks and results. Tourists' keywords preferences for tourism information searching, their search frequency and number of keywords used for tourism information searching have also been identified. The participants recommended some desirable features that a collaborative tourism information search system should have. Some of them are: synchronous and asynchronous communication, supporting strong vocabulary and audio and video call option, provision of past query and search history and provision of a ranked list of retrieved results. This study also shows that destination is the most frequently used search term category for tourism

information. Based on the findings of User Study 1, a preliminary collaborative tourism information search model was developed.

The results of User Study 2 presented the findings on understanding the collaboration among tourists where they can benefit from exchanging query terms, Web links and other information during information searching. This study explores important characteristics about tourists' CIS behavior, including their collaborative search stages, the strategies employed during collaborative search and the IFBs that occur during collaborative search. This study also investigated tourists' CIS as a complete process, from an initial stage of trip information search planning to the final decision stage. A model proposed from this study is an integrated framework of tourism collaborative search involving the issues of IFBs.

This PhD proposed a multi-user collaborative search interface called ColTIS which supports chatting, division of search task, query sharing and results sharing during tourism information search. A feature of CQ formulation was integrated into the search tool supporting the execution of queries formulated by multiple tourism information searchers and satisfying their preferences. Furthermore, following participants' suggestions, the functionality of trip planning which supports creating and editing a travel plan was incorporated. This tool also includes a map visualizing the selected accommodation, destination and attractions of places.

Furthermore, sources of terms for CQ reformulation, operations used to reformulate CQs, and the impact of individual queries and chat logs in reformulating CQs in the collaborative Web search were investigated. The results provide some evidence that both individual queries and chat logs contribute to CQ reformulation. Self-generated individual queries seem more likely to be the source for new query terms than those that are partner-generated. The sources for CQ formulation such as chat logs and previous experience and previous knowledge are also important for new query terms.

This research specifically explores important features of tourists' CQ reformulation behavior, such as QR types and patterns employed by the tourists and their choices on tourism items based on gender and culture while interacting with the CIS tool ColTIS. This research observed CIS activities in online tourism from the early stage of travel information search planning to the final stage of decision-making and found differences in both CQ reformulation process and choosing consumable tourism items involved in collaborative search.

It is the belief that an understanding of tourists' CIS behavior is fundamental to basic research directed toward theories and models and the development and improvement of the user–Web interactions involved in collaborative Web searching for tourism information.

In conclusion, this research focused on investigation of collaborative tourism information search and the development of a collaborative information search tool for tourism domain. For exploring characteristics of collaborative tourism information search behavior and the factors affecting these behaviors, three research questions (RQ) have been addressed: RQ1. What are the characteristics of collaborative search behavior when searching for tourism information? RQ2. What are the factors affecting collaborative search behavior in tourism? RQ4. What are the effects of gender and culture on collaborative tourism information search? For designing and evaluating CIS tool, two research questions have been included in the PhD thesis: RQ3.What are the design issues for developing a collaborative information search tool? RQ5. How can users collaborate and retrieve information effectively in the tourism domain using a CIS tool? To answer these research questions three user studies have been conducted. The summary of the results linked with research questions are reported below.

1. The preliminary findings uncovered why and how tourists collaborated during traveling information search. The findings showed that for tourism information search, searchers preferred to collaborate with friends, family members, colleagues, agents and others for various reasons which included sharing information, gathering reliable and accurate information, and sharing knowledge and experience (RQ1).

2. Data analysis revealed that tourists performed collaborative planning, collaborative information searching, sharing of information, and collaborative decision-making at different stages of the search process. The results also showed that, using text instant messaging, tourists collaborated for planning their search strategies, dividing search tasks into sub-tasks, discussing search engines and tourism Web portals used, tourism search keywords, methods of sharing results and links, and reviewing search results together (RQ1).

3. The research explored the types of IFB - information flow breakdown (RQ1) and the influence of these IFBs on tourism CIS (RQ2).

4. The results also provide the contextual factors that influence the collaboration for tourism information: the budget for the travel, the previous knowledge and the previous visit and the technology (RQ2).

5. The study results found the gender- and culture-based differences in CQ reformulation types and patterns. The findings demonstrated that male pairs performed more CQ reformulations than female pairs and Australian pairs utilized more CQ reformulations compared to Asian pairs as they performed collaborative search for tourism information. Asian pairs and Australian pairs exhibited different query reformulation patterns. Male pairs and female pairs followed different pattern while executing queries (RQ4).

6. This research highlighted key features for tourism CIS tools integrated into ColTIS that include: (RQ3):

- This collaborative search tool is able to facilitate synchronous and asynchronous sharing and discussion.
- It is capable of providing search history to the collaborators so that duplication of results which have already been retrieved by others is avoided.
- This collaborative search tool facilitates communication functionalities for planning search strategies, and hence it makes the collaboration convenient.
- This CIS tool provides the options for sending or sharing the links of search results to collaborators.
- It facilitates preparing a trip plan that can be edited by collaborators.
- This CIS tool includes maps to visualize destinations, accommodations, and historical places pertaining to the trip plan.

7. The results demonstrated that ColTIS performs better than Google Talk-embedded Tripadvisor.com in terms of usability, result satisfaction and result correctness (RQ5).

6.2 Limitations

The studies reported in this PhD thesis have several limitations that should be pointed out here. The first user study involving a questionnaire survey was limited in its scope since the participants were selected from a university. Had the participants included people from other fields, it is possible that they would have different kinds of collaborative experiences. The first study was also limited to a small number of participants, and the data were not gathered from a collaborative environment but from individual participants.

The rest of the design studies were limited in their scope as well, due to their dependence on the kind of task(s) as well as the number of participants. We cannot claim that the sample represents a wide range of information searchers for tourism information on the Web. User Study 1 and User Study 2 were time-bound, not allowing the participants to explore the given topic and engage with their teammates fully. The participatory design sessions were limited in scope due to the background of the participants (most of them were postgraduate students and staff from a particular division of a university). A good way to extend these studies is to involve participants from a variety of places (i.e. airports, tourist spots, etc.).

Moreover, there were, several limitations due to the design of the experiments, which are listed below.

- In User Study 2, only two participants were included in each team. The dynamics among the collaborators is likely to change with a number of participants in a team.
- Both the participants in a given pair were required to have worked together on at least one collaborative task before. This is not true for the collaborations in real life.
- The collaborative search tasks assigned to the participants were pre-defined. We may have observed a different level of collaborative engagement had the participants would choose or define their own tasks.
- The assigned tasks were easy to break into subtask. This enabled most of teams dividing the tasks between the teammates and this division of search was treated as of one of their collaborative strategies. Due to the time limit on tasks, the teammates limited their communication (chatting and sharing information). It is possible that if the tasks were non-dividable, the participants would have more interactions.

- Due to the laboratory experiment nature of user studies, they have limited applicability. The results obtained from these studies should be considered with the knowledge that the real life situations may be different from what was simulated in the laboratory. For instance, in reality, one may not have space and communication constraints that were presented in this study; in practice, one may be able to have face-to-face meetings with his/her collaborators and use other forms of communication media such as mobile phones.
- A small sample size (35 participants for User Study 1, 10 pairs for User Study 2 and 18 pairs for User Study 3) is another limitation of the study. Although they had much travel and Web search experiences, their searching behavior for tourism information over the Web may not be generalizable to that of real tourists.

Despite these limitations, this PhD thesis does form the basis for further research which is discussed below.

6.3 Future research directions

More efforts are needed to investigate other collaborative factors and to develop theories and models of CIS tool for search tourism information on the Web.

Areas of further research are listed below.

1 Division of search tasks, sharing of Web links, sharing of search results and experiences were found to influence the collaboration for planning and making the decisions for a trip. More in-depth analysis is needed to find out how these influence the design or improvement of CIS tool in online tourism.
2 In this study, CQ reformulation types and patterns were identified. Further research may include the identification of similarity or dissimilarity between individual queries and collaborative queries and how collaborative queries can be formed automatically from the individual queries.
3 This research indicates that the conversation (chat logs) influence the formulation of individual queries and collaborative queries. Future research can be carried out on automatic extraction of terms from chat logs to reformulate individual queries and collaborative queries.
4 The effect of social media (for example, Facebook and Twitter) on the collaborative Web search behaviors in the tourism domain constitutes another potential research area.

5 Tourists (who may be unknown to each other) would like to collaborate with other tourists who have similar interests but in most cases it is difficult to identify such people. Future work may include the enhancement/development of a CIS tool to explore how tourists can be classified automatically into groups based on their personal preferences (interests), chat logs and query logs.

6 Tourists are found to conduct multiple sub-search tasks and switch back and forth between these tasks during the collaborative search. The future efforts will also focus on managing and supporting multitasking and task switching in collaborative tourism information search.

7 Further research directions may include exploring other influential factors that may affect the CQ reformulation patterns and types and choices made concerning tourism items. This could include, for instance, the influence of tourists' age or previous experience on CQ reformulation and preferences.

8 Furthermore, the effect of travel type and the socio-economic nature of the traveling group on collaborative Web search behaviors in the tourism domain could be another potential research area.

9 It is not always true that participants from same sex or same region make travel plan. In real life, mixed group of participants (i.e., mixed group pairs of a male and a female, and of an Australian and an Asian.) travel together. The study of the effect, similarity or dissimilarity of mixed group of participants in collaborative tourism information search can be another future study.

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Appendix A Survey Questionnaire for User Study 1

Questionnaire

Respondent Number (To be filled by the researcher): ----------

Date:

Q.1 Indicate your gender (Please tick) :

☐ Male

☐ Female

Q.2 Your age (Please tick) :

☐ 16 -25 years

☐ 26-35 years

☐ 36-45 years

☐ 46-55 years

☐ 56-65 years

☐ 66+ years

Q.3 What is your educational background (highest degree achieved i.e. Bachelor, Masters, PhD etc)? Please write.

_____

Q.4 What is your profession? Please write.

_____

Q.5 How many years do you have experiences in web searching on the internet? Please tick.

☐ 1-4 years
☐ 5-8 years
☐ 9-12 years
☐ more than 13 years

Q.6 Which media do you generally use to have information about traveling and tourism? Please tick more option if applicable.

☐ Book
☐ Brochure
☐ Traveling/Tourism Information Provider (Agent)
☐ Friends
☐ Relative
☐ Internet

Q.7 If you choose internet in Q.6, please specify the reasons.

Reason 1.

2.

3.

Q.8 If you choose internet in Q.6, which search engine do you use for searching for tourism information? Please tick more option if applicable.

☐ Google
☐ Yahoo
☐ Alta Vista
☐ Teoma
☐ Excite
☐ Other(Specify):

Q.9 How frequently do you use searching tools for getting tourism information? Please tick.

☐ Daily
☐ Weekly
☐ Monthly
☐ Quarterly
☐ Half-yearly
☐ Yearly

Q.10 How much time do you spend for searching on tourism information in a session? Please tick.

☐ 1-20 minutes
☐ 21-40 minutes

- ☐ 41-60 minutes
- ☐ 1-2 hours
- ☐ more than 2 hours

Q.11 How much time do you take to complete (i.e. retrieve desired tourism information) a search on a particular topic? Please tick.

- ☐ 1-15 minutes
- ☐ 16-30 minutes
- ☐ 31-45 minutes
- ☐ 46-60 minutes
- ☐ more than 1 hour

Q.12 How many keywords do you use when searching for tourism information? Please tick.

- ☐ 1-2 terms
- ☐ 3-4 terms
- ☐ 5-6 terms
- ☐ 7-8 terms
- ☐ more than 8 terms

Q.13 Please prioritize the following terms according to the importance you look for (1 for highest priority, 2 for next highest priority and so on). Please put the number to the right of the choices.

- ☐ Place of interest
- ☐ Travel route
- ☐ Visa
- ☐ Hotel/Motel
- ☐ Weather
- ☐ Local culture of the places to be visited
- ☐ Food
- ☐ Local transport

Q.14 Please mention some common keywords that you use for tourism information searching:

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

Q.15 How do these terms help you to find your desired information? Please tick.

☐ Satisfactory

☐ Unsatisfactory

Q.16 Do you think that the present retrieval systems provide relevant information? Scale is 1 to 5 (1 for not relevant and 5 for more relevant). Please tick.

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

Q.17 Do you share your search results with others? Please tick.

☐ Yes

☐ No

Q.18 If yes in Q.17, how do you share? Please write. (Hints: By providing source of information i.e. web address, by describing the result, by sending the results through email, etc)

_____

Q.19 If you are unable to get proper information for a particular travel plan from the search engine/website what do you do? Please tick.

☐ Cancel the travel

☐ Reroute the travel

☐ Try to get information from some other sources

Q.20 Do you communicate with other people for traveling and tourism information? Please tick.

☐ Yes

☐ No

Q.21 If yes in Q.20, please mention the reasons of such communication.

Reasons

1.

2.

3.

4.

5.

Q.22 If yes in Q.20, with whom do you communicate? Please tick.

- ☐ Relatives
- ☐ Friends
- ☐ Colleagues
- ☐ Agent
- ☐ Others (Please specify)

Q.23 If yes in Q.20, how do you communicate with others for tourism information? Please tick.

- ☐ Phone
- ☐ Email
- ☐ Instant Messaging/Chatting (e.g Yahoo messenger, Google Talk, Skype etc)
- ☐ Social Network website (Facebook, Twitter, Myspace, hi5 etc)
- ☐ Others (Please specify)

Q.24 The people you communicate with are

- ☐ Co-located (people in the same place i.e. in a room, house, office etc)
- ☐ Remotely located (people located in different places)
- ☐ Both

Q.25 For group work how do you search? Please tick.

- ☐ Searching first by each individual and then combining and refining the result
- ☐ Dividing the search task, distribution of sub-tasks among the individuals and then combining the results together
- ☐ Sharing search keywords

Q.26 Are you familiar with any information searching system that supports collaboration with other people while searching? Please mention the name of the system.

1.

2.

3.

4.

5.

6.

Q.27 Please mention 4 prominent characteristics as you desire of a system that supports collaboration with others while searching information.

1.

2.

3.

4.

Q.28 Do you share your travel experience with others? Please tick.

☐ Yes
☐ No
☐ No previous travel experience

Q.29 Is there any influence of geographical location and information on making a travel plan? Please tick.

☐ No influence
☐ Moderate influence
☐ Extreme influence

Q.30 Which one is more helpful to you when you make a travel plan? Please tick.

☐ Experience from a person who visited the place
☐ Information from a person who lives near the place to be visited
☐ Other sources (Please specify) :

Appendix B Search Tasks for User Study 2

Search Tasks

Task	Task description
Search Task 1: Collaborative information searching without prior knowledge	You along with your friend plan to go out for travel for one month. For a better trip planning, you need to gather information about the destination, accommodation, transport, food, weather, attractions, etc. It is provided that nobody of your team has any prior knowledge about that destination or related information. Suppose you and your team member want to search information for this trip. You and your teammate are sitting in a room and using two computers separately for searching travel/tourism information on the Web and both of you have the communication tools (e.g. Google Talk and Skype) installed for discussions during the Web search. Now you along with your teammate are asked to find information as much as you can for your trip.
Search Task 2: Collaborative information searching with prior knowledge	You along with your friend plan to go out for travel for one month. For a better trip planning, you need to gather information about the destination, accommodation, transport, food, weather, attractions, etc. Somebody (including you) of your team has prior experience associated with visiting this destination. You and your team member want to search information for this trip. You and your teammate (who has prior experience) are sitting in a room and using two computers separately for searching travel/tourism information on the Web and both of you have the communication tools (e.g. Google Talk and Skype) installed for discussions during the Web search. Now you along with your teammate are asked to find information as much as you can for your trip.
Search Task 3: Collaborative information searching for a complex task	You along with your friend plan to go out for travel for one month. For a better trip planning, you need to gather information about the destination, accommodation, transport, food, weather, attractions, etc. Somebody (including you) of your team has prior experience of visiting this destination. You and your team member want to search information for this trip. You and your teammate (who has prior experience) are sitting in a room and using two computers separately for searching travel/tourism information on the Web and both of you have communicating tools (e.g. Google Talk and Skype) to facilitate discussions. Now you have to find an accommodation near the location of a sea

	beach. Moreover, the weather forecast should be good (say no rain and temperature is between 20^0C and 30^0C), and the accommodation should cost less than a certain amount of money (say AUD 100 per night).

Appendix C Pre-Search Questionnaire for User Study 2

Entry Questionnaire

Background Information

For Research use:
User Number: _____
Date: _____

1. What undergraduate or graduate degree(s) have you earned or do you expect to earn? Please list major(s).

Degree Major
1.

2.

3.

4.

5.

2. What is your gender?
   - ☐Male
   - ☐Female

3. What is your age group?
   - ☐16 -25 years
   - ☐26-35 years
   - ☐36-45 years
   - ☐ 46-55 years
   - ☐56-65 years
   - ☐66+ years

4. How many years do you have travel experiences?

Computer and Searching Experience

1. How often do you use computer in your daily life?

Never			Monthly			Daily
1	2	3	4	5	6	7

2. How do you rate your level of expertise with computers?

Novice						Expert
1	2	3	4	5	6	7

3. Please circle the number that most closely describes your general searching experience.

	None			Some			Great deal
a) Searching information from book or brochure or catalogs etc.	1	2	3	4	5	6	7
b) Searching from World Wide Web search engines (e.g., Google, AltaVista, Yahoo!, Teoma)	1	2	3	4	5	6	7
c) Searching from other systems (please specify):	1	2	3	4	5	6	7
	Never			Monthly			Daily
d) How often do you conduct a search on any kind of system?	1	2	3	4	5	6	7
	Rarely			Some-times			Often
e) When I search for information, I can usually find what I am looking for.	1	2	3	4	5	6	7

4. How do you rate you level of expertise with searching?

Novice						Expert
1	2	3	4	5	6	7

5. How many years have you been doing online searching? _____ years.

6. What are your favorite search engine(s)?: _____.

7. Why do you travel? Please mention some reasons.

8. Do you like to travel during any occasion, in a particular season or during holidays? Please write.

9. Do you do your searches yourself or do you seek the help from others for traveling/tourism information?

10. Have you traveled (any sort of traveling) with your teammate before? If yes, please give description with few words.

11. Have you worked (research, paper writing, laboratory work or any task) with your teammate before? Please give a short description.

Appendix D Post-Search Questionnaires for User Study 2

Post-search Questionnaire

For Research use:
User Number: _____
Date: _____

For each task, please answer the following questions after your search.

Search Task No.: _____

Please answer the following questions, as they relate to this specific task.

	Not at all			Somewhat			Extremely
1. Was it easy to get started on this search?	1	2	3	4	5	6	7
2. Was it easy to do the search on this task?	1	2	3	4	5	6	7
3. Are you satisfied with your results?	1	2	3	4	5	6	7
4. Did you have enough time?	1	2	3	4	5	6	7
	None			Some			A great deal
5. Did your previous knowledge of the topic help you?	1	2	3	4	5	6	7
6. Have you learned anything new during the search task.	1	2	3	4	5	6	7
7. How much information you use for this task from your memory (knowledge), experiences (previous travel).	1	2	3	4	5	6	7

8. Which Web search systems were employed in your search? Why did you use these systems?

9. How did you help your teammate during the search? Please write.

10. How did your teammate help you during the search? Please write.

11. Which information (query, result or anything) did you share with your teammate? Please write.

12. How did you cooperate (collaborate) your teammate in the following stages during the search? Please write in details.

Problem Identification (Understanding the search task):

Interacting with internal source (information from own knowledge and experience):

Interacting with external source (information from others source – i.e. teammate's knowledge):

Making decision for trip (Selection of destination, any particular attraction, particular season/time of the year, any occasion, etc. through the discussion):

Planning for search strategy (Selection of website, selection of search engine, information sharing strategy, division and distribution of search tasks, sharing of query, sharing of results):

Searching (Hierarchy of information for searching i.e. the order of query terms for searching)

Information gathering (collection/saving) strategy:

13. Did you find any problem in the following stages during the search? Please write in details.

Problem Identification (Understanding the search task):

Interacting with internal source (information from own knowledge and experience):

Interacting with external source (information from others source – i.e. teammate's knowledge):

Making decision for trip (Selection of destination, any particular attraction, particular season/time of the year, any occasion, etc. through the discussion):

Planning for search strategy (Selection of website, selection of search engine, information sharing strategy, division and distribution of search tasks, sharing of query, sharing of results):

Searching (Hierarchy of information for searching i.e. the order of query terms for searching)

Information gathering (collection/saving) strategy:

14. Have you found any one or more of the following problems during these collaborative searches with your teammate? Please write.

Missing information during discussion:

Missing information during query formulation:

Any incorrect information:

Any incomplete information:

15. If you think that you know any factors that can affect (negatively or positively) your collaborative search, please write them in the space below:

If you have answered this question, please circle the number that indicates how certain you are of these factors.

Extremely Uncertain			Neutral			Extremely Certain
1	2	3	4	5	6	7

Appendix E Coding Scheme (with examples from pair 1 in User Study 2)

Code	Description	Example (Pair 1)	Categories
CDS	Collaborative decision made by the team	Based on the information we found we arrived at the final decision.	Search stages
CIN	Disagreement between the teammates during the collaborative search.	We could not arrive at a decision on attractions during the search	Search stages
EXS	Exchange of previous traveling and search experiences between the collaborators.	I know it is cold in Japan in March.	Search strategies
IIN	Incomplete or irrelevant information found from the source provided by the teammate.	From the link provided by my teammate, I got the general weather information but it did not provide the detailed temperature information for the proposed travel time.	Information flow breakdown
LNS	Links sharing (URLs) between the two teammates.	I have never used it [www.tripadvisor.com] which you recommended.	Search strategies
MIN	Missing information during the collaborative planning, searching, and decision-making.	In the latter stage of the search, we realized that we forgot to discuss the budget during the planning in the initial stage.	Information flow breakdown
PDS	Collaborative planning for division of search task into sub-tasks.	I will look for hotel, attractions and you can look for flight and local transports.	Search stages
PLT	Collaborative planning for fixing date and time for the travel.	We will stay in London from March 26 to April 26.	Search stages
PR	Teammates expressing personal preferences (budget, food, attractions, etc.).	I found some Indian restaurants as I prefer Indian food; I would like to watch the greenery and scenery.	Search stages
PSS	Collaborative discussions on search strategies (the use of search engines, websites, search keywords, etc.).	I will be using wotif.com as it provides better travel related information; It's far away from the city, so you should search the accommodation with "Accommodation near to city	Search strategies

		London".	
QRS	Sharing of query terms performed by the team.	I found this (temperature) in Fahrenheit and you can try with "Conversion of Fahrenheit into Celsius"	Search strategies
RSS	Sharing of search results	I found [a] hotel and I sent the link to [the] other person.	Search strategies
SDT	Distribution of the divided sub-tasks between the teammates	According to our plan, I am starting to search for flight, transport and weather and you need [to] search for accommodation and attraction in Thailand.	Search strategies
UIN	Unavailable information (the web sources provided by the teammates did not provide any information)	I found nothing from the link www.berjayahotel.com that you sent to me.	Information flow breakdown

Appendix F Search Task for User Study 3

A college teacher is going to arrange a tour in the next summer vacation. The teacher has created several teams for doing several jobs and has asked your team to make a complete travel plan including destination, accommodation, cost, attraction, local transportation, weather, food and so on. You are required to collect all the relevant information from any available online sources that you can find.

To prepare this travel plan, search and visit any Web site that you want and look for specific aspects as given in the guideline below. As you find useful information, highlight and save as relevant information that can help to make your trip plan. You may also want to save the relevant Web sites, but you should bear in mind that, your main objective is to search as many relevant information as possible and collaborate with your teammate(s) during the search. You have to use ColTIS and Google Talk-embedded Tripadvisor.com for performing this search task as the following guide lines.

Using ColTIS

You can communicate to your teammate at any time during the search for any sort of help. You can plan or discuss your search task, you can talk to your teammate or you can exchange any sort of information if you wish but you need to do all these things using the ColTIS (Collaborative Tourism Information Search) interface provided. And also you have to employ this CIS tool for searching the tourism information to make a trip plan.

Using Google Talk-embedded Tripadvisor.com

You can communicate to your teammate at any time during the search for any sort of help using Google talk which is embedded with Tripadvisor.com. You can plan or discuss your search task, you can talk to your team mate or you can exchange any sort of information if you wish. To make a trip plan you have to use this Google Talk-embedded Tripadvisor.com Web portal for searching for tourism information.

Appendix G Post-Search Questionnaire for User Study 3

ColTIS (Collaborative Tourism Information Search) Interface Evaluation

Post Search Questionnaire

User Number: Date:

Q.1 How did you plan your search strategies using ColTIS (for example, division of search task, managing the search load)? Please write.

Q.2 How did you exchange the queries and URL links using ColTIS? Please write.

Q.3 How did you share the search results using ColTIS? Please write.

Q.4 How did you communicate or collaborate with your team mate using ColTIS during the search? Please write.

Q.5 Please mention the satisfaction level with the search results of (1 for lowest satisfaction and 7 for highest satisfaction):

ColTIS: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Tripadvisor.com: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Q.6 Please mention the correctness of search results of (1 for incorrect, 2 for partial correct and 3 for correct):

ColTIS: O 1 O 2 O 3

Tripadvisor.com: O 1 O 2 O 3

Q.7 Mention the ease of starting the search of (1 for lowest and 7 for highest).

ColTIS: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Tipadvisor.com: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Q.8 Mention the ease of search of (1 for lowest and 7 for highest).

ColTIS: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Tripadvisor.com: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Q.9 Was time sufficient for completing the task by (1 for not sufficient at all and 7 for very sufficient)?

ColTIS: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Tripadvisor.com: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Q.10 Mention the ease of use of (1 for lowest and 7 for highest).

ColTIS: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Tripadvisor.com: O 1 O 2 O 3 O 4 O 5 O 6 O 7

Q.11 How useful the system (1 for no useful and 7 for most useful)?

ColTIS:	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7
Tripadvisor.com:	○ 1	○ 2	○ 3	○ 4	○ 5	○ 6	○ 7

Q.12 Which system did you find suitable for collaboration?

☐ ColTIS
☐ Tripadvisor.com
☐ No difference

Please specify reasons:

Q.13 Which system did you find suitable for making travel plan?

☐ ColTIS
☐ Tripadvisor.com
☐ No difference

Please specify reasons:

Q.14 Which system did you like best overall?

☐ ColTIS
☐ Tripadvisor.com
☐ No difference

Please specify reasons:

Q.15 How do you compare the relevance of the search results provided by ColTIS and Tripadvisor.com?

Q.16 How do you compare the completeness of the search results provided by ColTIS and Tripadvisor.com?

Q.17 How do you compare the usefulness of the search results provided by ColTIS and Tripadvisor.com?

Q.18 Please summarise the differences between ColTIS and Tripadvisor.com.

Q.19 What system features of ColTIS did you like most? Please write.

Q.20 What system features of ColTIS did you dislike most? Please write.

Q.21 Do you have any comments or suggestions for improving the functionalities of ColTIS based on your experience of using it? Please write.

Q.22 Overall use experience of ColTIS:

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Frustrating Satisfying

Q.23 Evaluate the ColTIS interface based on the following aspects:

a. Ease of collaboration (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

b. Ease of collaborative searching (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

c. Ease of division of search task (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

d. Ease of collaborative query formulation (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

e. Ease of query sharing (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

f. Ease of link sharing (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

g. Ease of making tour plan (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Difficult Easy

h. System speed (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Too slow Fast enough

i. Arrangement of the information displayed on the screen (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Illogical Logical

j. Screen layout (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Inadequate Adequate

k. Screen terminology (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Not helpful Helpful

l. Time to learn ColTIS (1-7)

O 1 O 2 O 3 O 4 O 5 O 6 O 7

Lengthy Fast

m. Ease of learning ColTIS (1-7)

1	2	3	4	5	6	7
Difficult						Easy

Q.24 Which features of this interface have you already used in some existing systems? Please write.

Q.25 What do you suggest for changing some features (existing) of this interface to make it more functional (useful)? Please write.

Q.26 What did you do when

(i) you realised during the search process that you forgot to discuss any travel issue with your teammate in the planning process

(ii) the link (if any) which your teammate shared with you did not have the desired information

(iii) the keywords (if any) which your teammate shared did not provide the desired results

(iv) there were conflict of interests (different opinions) with your teammate

Q.27 Which type of accommodation did you search? Specify please.

☐ Rented house/apartment/unit
☐ Home of friend/relative
☐ Hotel/motel/resort

Please specify the reason:

Q.28 Which type of attraction did you search? Specify please.

i) Indoor

a. _____

b. _____

c. _____

ii) Outdoor

a. _____

b. _____

c. _____

Q.29 Which type of food did you search? Specify please.

Q.30 Which type of place (destination) did you search? Specify please.

☐ Close to city
☐ Close to Sea-beach
☐ Close to Mountain
☐ Close to Restaurant
☐ Close to Bar
☐ Close to Park

Please specify the reason:

Q.31 How much did you plan for travel cost?

☐ $1-$200 /day
☐ $201-$400 /day
☐ $401-$600 /day
☐ $601-$800 /day
☐ >$800 /day

Please specify the reason:

*** Thank You ***