DATA CAPTURING USING MOBILE RFID-BASED TECHNOLOGY IN TOURIST INDUSTRY

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ABSTRACT

In the developed parts of the world, tourist's demands have been met by regularizing tourist-related services and defining tourist industry. Extending the tourist supply system can help to obtain real-time information and enhance dynamic control to reduce costs and delays. Integrating promising information technologies such as radio frequency identification (RFID) technology, mobile devices (such as PDAs) and web portals can help to improve the effectiveness and convenience of information flow in tourist supply chain system. This study demonstrates the effectiveness of a RFID-based supply chain management application called the mobile RFID-based tourist supply chain management system (M-RDTSCM). Also presents its architecture and implementation.

KEYWORDS: Tourist industry, RFID, Supply chain management, PDA.

1   INTRODUCTION

Due to the large intake of money for business and the opportunity for employment associated with tourism, tourism industry is one of the most exciting, progressive and vital industry for all countries around the world.

Throughout the history, tourism has been a phenomenon characterized by immense innovativeness. Books and articles have drawn attention to particularly distinctive individuals and enterprises, and their achievements have been analyzed and assessed from all angles [1].

Furthermore, planning to meet the tourist needs from when they begin their tour until returning home can be a noticeable situation for making money for countries. Due to the flows of information and services between this industry components, we can discuss tourist's supply chain as a new concept.

Also time-sensitive competitions have become apparent over the past decade. Companies have become more and more concerned with improving the customer service and increasing company profits through the efficient management of the supply chain [2].

A supply chain consists of parties involved, directly or indirectly from inside as well as outside an organization, that affect the desired outcomes of the supply chain, these outcomes include, but are not limited to, new product development, marketing finances and customer services [3].

Supply chain management (SCM) involves coordinating and integrating activities and process among different business functions for the benefit of entire supply chain and one of the most important factors in supply chain management under dynamic environment are the understanding of the state change of supply chain resulted from the inner/outer influences of the supply chain and predicting the short-term and long-term effects on the supply chain [4]. Tourism supply chains involve many portions not just accommodation,

transport and excursion, but also bars and restaurant, handicrafts, food productions, waste disposal and the infrastructure support tourism in destinations.

Furthermore, improvements in Information Technology (IT), internet security and bandwidth have spurred the growth of wireless technology or mobile applications for SCM and specifically for tourist SCM. The most obvious advantages of using wireless or mobile technology in SCM is that it enables firms to provide services to consumers at the time they are needed. Also, it is possible with Global Positioning System (GPS) and Geographical Information System (GIS) to locate and target consumers in specific locations [3,5].

In addition, Mobile SCM applications can be used to ensure efficient flow and exchange of supply chain activities of different functions. Also integrating promising information technologies such as personal Digital Assistant (PDA), Radio Frequency Identification (RFID) can help in improving the effectiveness and convenience of information flow in mobile supply chain system. Our study present a novel system called mobile RFID-based tourist supply chain management (M-RDTSCM) system for providing an information sharing platform among all participants of tourist supply chain using web technology, RFID-enabled PDAs and scanners.

2   TOURIST SUPPLY CHAIN (TSC)

During the last decades, the tourism industry has evolved and modernized considerably. The highly competitive environment of the industry has forced tourism firms to looking for ways to enhance their competitive advantages. For example, Figure 1 shows a more general TSC network with destination [6]. The downstream end includes tourists from target market. Travel agents are retail branches of tourism branches of tourism products and deal with tourists and tour operators.

Travel agents and tour operators can be the same or separate business entities. Tour operators buy individual travel services (such as transport and accommodation) from their suppliers (such as carries and hotels) and assemble them into holiday packages which are sold to public directly or through travel agents.
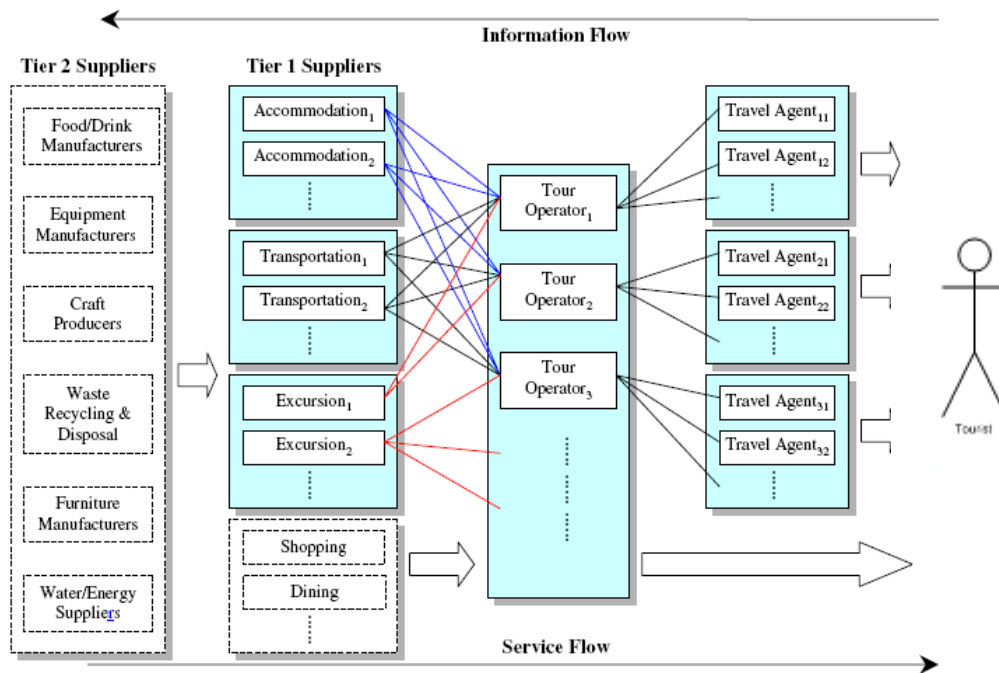

Figure 1: A Typical Supply Chain

The first tier of upstream end of TSC includes direct suppliers which directly supply tourism services intermediaries. Typical direct suppliers include shopping centers, hotels, bars, restaurants and transportations. A more complex TSC may also include second-tier suppliers, which supply services or products to first tier suppliers, but today by using web technology and mobile devices the Mobile RFID-based TSCM system has tremendous potential to increase the efficiency and effectiveness of information flow. Thus, this system with elimination of some further retails makes a real-time access to suppliers. Figure 2 illustrates the problem statements and solutions use to improve current tourist supply chain circumstances, to achieve these 3 purposes:

1) Applying such a system that integrates RFID technology with PDA technology to increase the efficiency of data capturing for identifying tourists among others and help him/her to find best and nearest places.

2) Designing a web-based portal for supply chain management, providing real time information by using GPS and GIS to indexing tourist location and wireless communication between nodes.

3) Supporting and controlling suppliers by tourist's opinion about them. In next sessions we try to consider ways of achieving these goals.

A pre-requisite for an accurate management of moveable assets is the adoption of appropriate identification systems to patronage the traceability and data collection of those fragments of information, which could turn out to be relevant along the life cycle of an asset (In this article, the tourist is considered as a moveable asset). [7]

2.1   Appling RFID

RFID integration to any process is usually achieved according to three sights: Context, Capture and Control. In the context facet, one must explore the evolution environment of the process subjected to RFID integration, by investigating the environmental conditions under which RFID tags will be operating. Inventorying information to gather from the process, and identifying communication constraints/obstacles inflicted by the process environment (interference, reflection, and other communication obstacles) must be investigated. The capture sight deals with the selection of RFID equipment (tags and readers) to ensure accurate data collection from the explored process and environment. At this stage, operation frequencies, RFID tags reading range, RFID antenna locations, power control, information privacy and security issues are among few factors to be adjusted, for efficient data capture, and reliable RFID interrogation regions design. The control facet deals mainly with RFID system real-time control (middleware link to other enterprise applications, EPC database, graphical user interfaces), and business intelligence rules implementation (information processing, system response to RFID tag triggered events, control rules, algorithms). Usually an RFID middleware is developed based on the constraints dictated by the context, and capture facets. [8]

Radio Frequency Identification (RFID) systems have important role in the mobile and wireless communication technologies and have influenced various industries from different aspects. An increasing variety of enterprises are employing RFID to strengthen their management ability to enhance organizational change and to manage growth in an increasingly competitive environment [9].

The use of RFID to improve the delivery process control is not a novel concept but according to our research it has not been previously used in tourist industry. Moreover, there is no universal roadmap for the successful deployment of RFID within interlinked supply chains [10].

An RFID system consists of an RFID tag and antenna; data is stored in the tag usually in the form of a unique serial number [11]. RFID tags can be either "passive" (no battery) or "active" (battery present). Active tags are more expensive than passive tags and have a read range between 10mm and 5m. The vast majority of RFID tags are passive in nature [12, 13].

The suggestion of this study is applying RFID tags in special tourist cards issued by "tourist guidance organization" to identify tourist among others to presenting particular services. Especially in tourist industry saving tourist information in these cards make tourists free from carrying passport everywhere even they can use it instead of electronic passports (An Electronic Passport is the same as a traditional passport with

Problem Statements

General Problems

- ✓ No real time site/information update
- ✓ No Suitable Portal to cover all information tourist wants

- ✓ No Automated data capture
- ✓ Easy to make mistakes in input process
- ✓ Necessity to carry passport all the time by tourist
- ✓ No suitable way to identify tourist among others in a restaurant or other places

- ✓ No access to a comprehensive Portal to find nearest restaurants, hotels or fair places any time
- ✓ Ineffective data collection on site

Supply Chain Participants

- ✓ No Dynamic Real-time Control on tourists (specially about tourists who travel alone)
- ✓ No information Sharing Environment

Improve Data in Site Using PDA

Determine Needed Data to enter PDA

↓

Determine PDA software and hardware

↓

Develop mobile PDA system

↓

Test and modified system

Integrating RFID with PDA and computers in ancient places, hotels and restaurant

Determine RFID hardware and software

↓

Design Data attribute for RFID

↓

Use RFID Tag to Monitored tourist and his guidance organization needed information

↓

Connection between PDA and computers (equipped card scanner) with RFID

Developing Portal to Centralize and Improving Information Sharing

Determine how to transfer data between control center and site

↓

Determine needed Data for Portal

↓

Develop Portal system

↓

Link PDA to portal

Determine information sharing among participants

↓

Determine information/data to monitor or information sharing

↓

Design and Develop delivery status for development in the system with focus on tourist opinion

↓

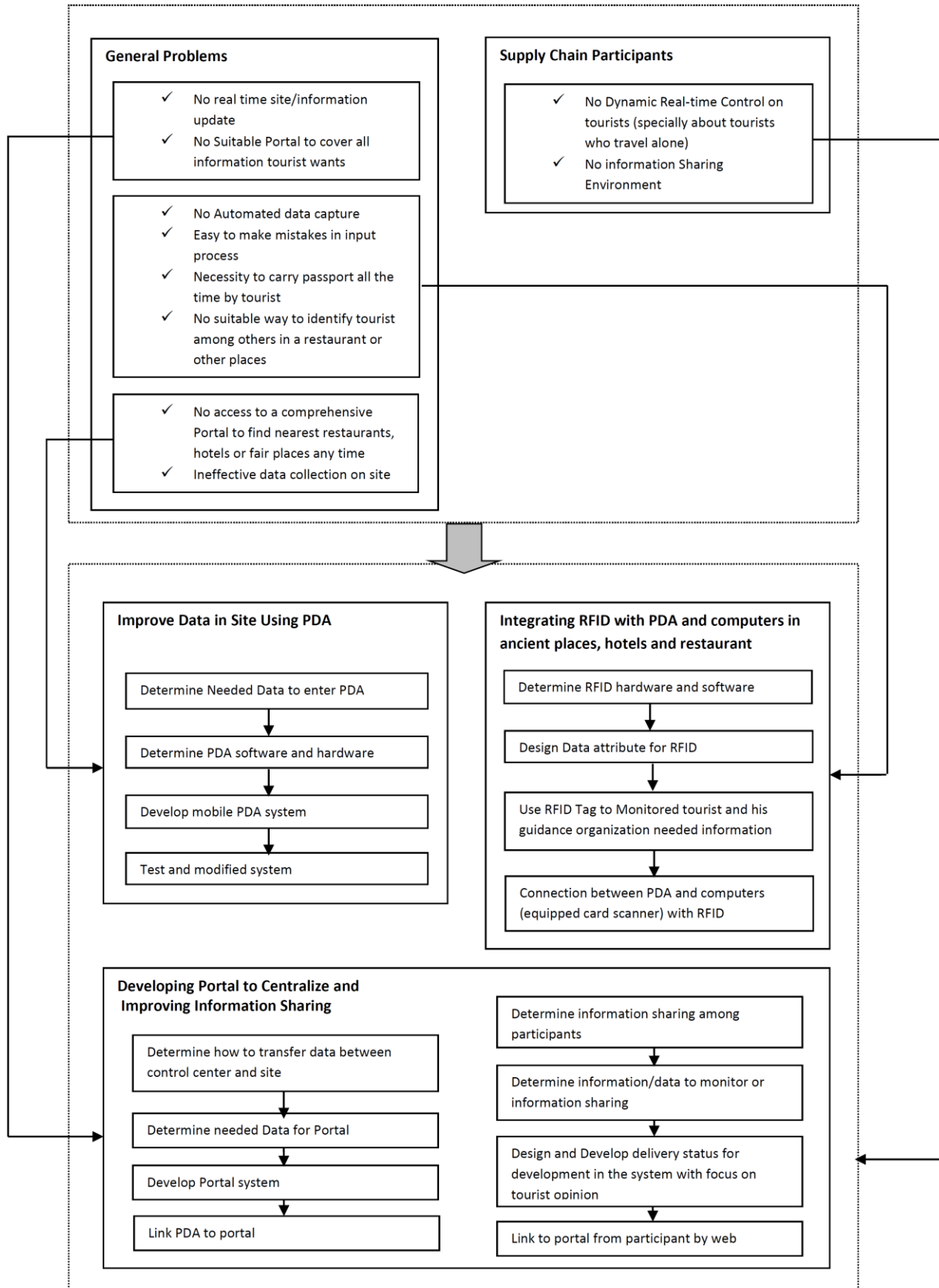Link to portal from participant by web

Figure 2: Problem Statement in information sharing

the addition of a small chip embedded in the back cover). The chip stores the same data visually displayed on the data page of the passport and maybe a digital signature to protect the stored data from alteration [14]. Also due to tags with short read range suffices, using passive tags are cost-effective too.

With RFID-enabled scanners plugged into restaurants, hotels, shopping centers, transportation terminals, fair and ancient places not only receiving tourists' opinion but also suggesting best and nearest places by identifying his/ her location (applying GPS and GIS). Also information has been stored on tags shows where he/she has seen and what was his/her opinion about. Figure 3 depicts the application of RFID-enabled scanner has been used in project.

2.2   Using RFID-enabled PDA

RFID-enabled PDA can be a powerful portable data collection tool. The polarity of PDAs is growing rapidly as more devices are developed and a wider range of applications become available. The key features of PDA include: 1) Calendar, address book, notes and to do lists; 2) Browsing internet 3) Internet access either via modem, cell phone or wireless access 4) synchronizing data between PDA's and desktop Pc's and 5) Platforms for add-on software [5,12].

Furthermore, the application of mobile devices in tourist industry can be noticeable specially when tourist doesn't have any access to RFID-enabled scanners just with a PDA can directly find best and nearest restaurants, hotels, shopping centers or other places. Figure 4 illustrates the application of RFID-enabled PDA used by tourist.
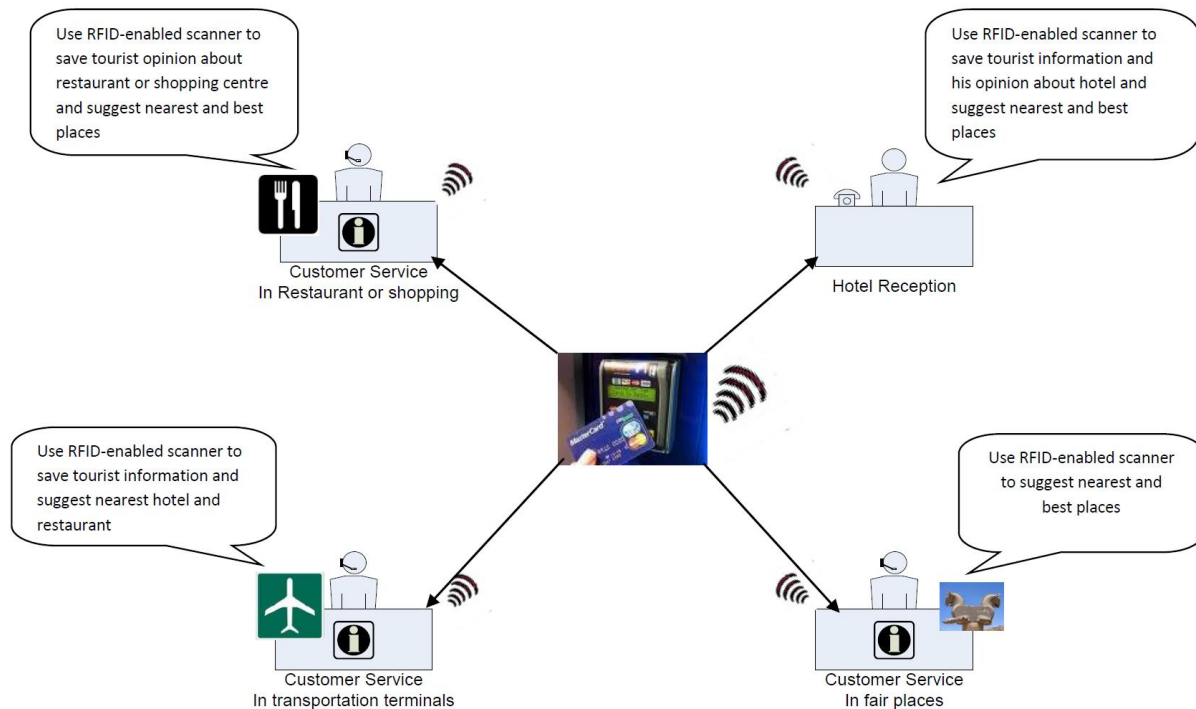

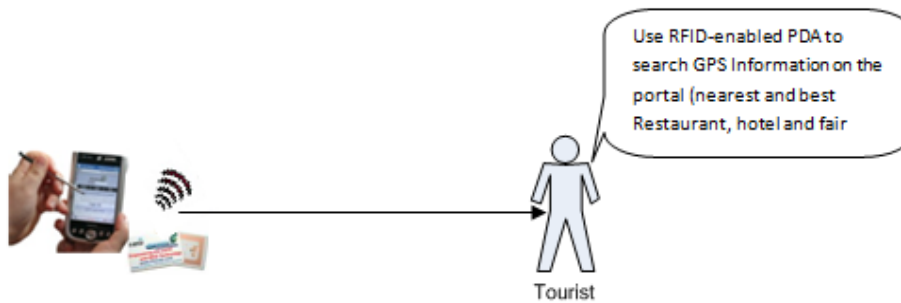Figure 3: Application of RFID-enabled Scanners

Figure 4: Application of RFID-enabled PDA

2.3 Using a Portal in the Tourist Supply Chain

The word portal is derived from the Latin porta, or gate, through which something will pass in an effort to get to another place. In the traditional sense of the word, the portal is not the desired end-state. Rather, a portal is a necessary or convenient place one must go to get to the desired location. For example, the airport is not the desired location for most people but rather a necessary portal through which they must pass to obtain transportation to another location. Similarly, web-based portals assist by directing the transport of the web user to the ultimate location of their choice. Thus, the portal is intended to be the beginning point of a consumer's Internet experience.

Portals are web sites and ideal platforms for collecting information related to specific items or topics and information in supply chain systems. one of the most popular and useful web sites that tourists use recently is TRIPADVISOR [15].

Portal technology allows all the partners in a supply chain to log onto a single portal site and immediately get the relevant information they need to make certain decisions. The portal has uses for both suppliers and customers. Suppliers can be given insight into the inventory levels of other portal users and tune their products based on this information. Customers can be given diverse information and services on a unified front-end on the Internet [16].

When a portal is used in tourist supply chain, all project related information that is centralized in a project database can be obtained only via web interface. For example, tourist can find best and nearest places through the decision making system by using his/her information in RFID memory. Besides, tourist guidance organization can consider related location's operations by tourist's opinion about them and suppliers can identify tourist among other to presenting customized services. Also we can put user's profile upon the portal to gathering tourist's information and favourites in a special data base for future uses. Portal can handle all of those mentioned with a user friendly design.

3 MOBILE RFID-BASED TOURIST SCM SYSTEM

Similar to other SCM system it has supply-side that provides services for demand-side through four components: RFID-cards, PDAs, scanners and portal.

PDA's, scanners and RFID-cards are components on the client-side while the portal is on the server-side (See Figure 5). Within the M-RDTSM system all project related information is centralized in a supply chain system data base (Portal model database) and people in the project can access all or some of this information via the portal, depending on their access privileges. So it is a growth in the global economy, since mobility has risen rapidly during recent decades [17,18].

For example, in airport or other transportation terminals, officers can check tourist's passport by RFID-cards or in a restaurant tourist can save his/her opinion about this place and just "tourist guidance organization "can consider it on portal. Also because these related locations can detect tourists, try to provide customized services and making more money by attracting more tourists (this will be a competitive advantage). The system implementation flow diagram has been shown in Figure 6.
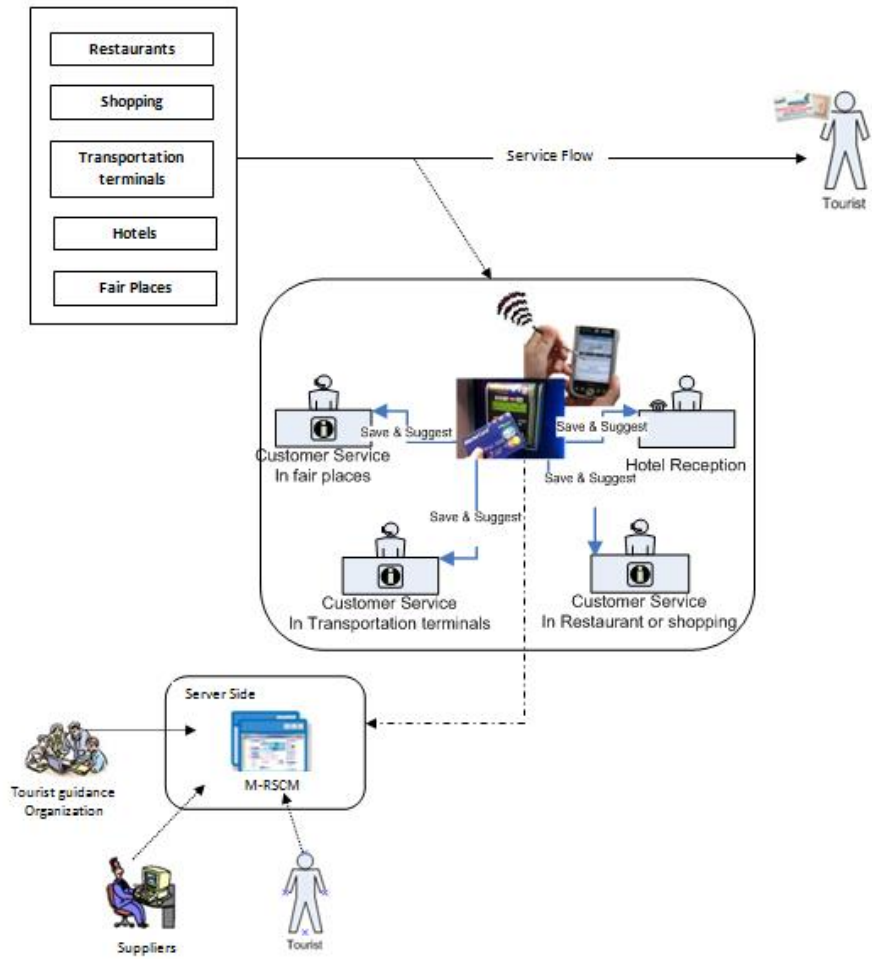
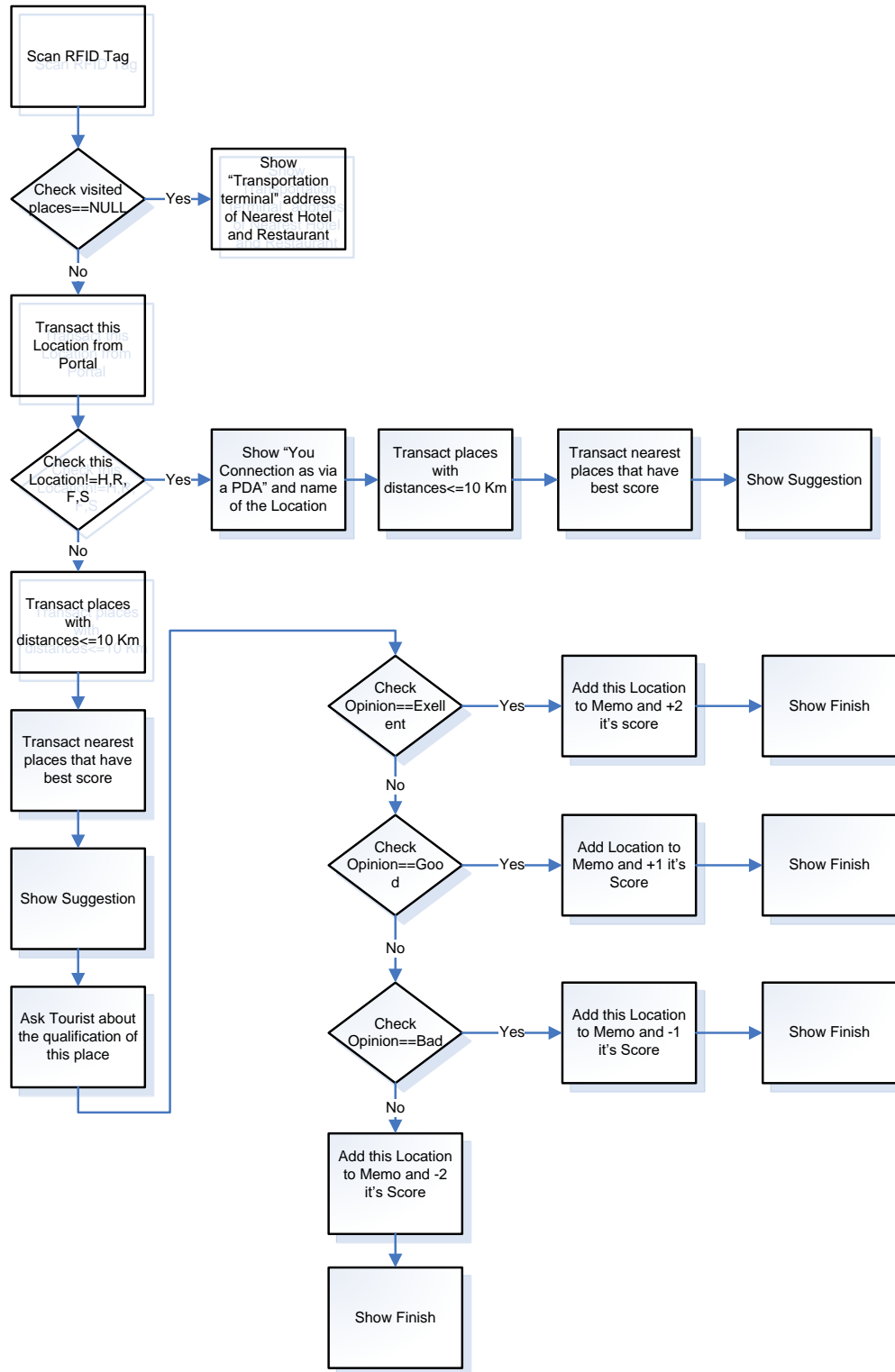Figure 5: Mobile RFID-based SCM system framework overview

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                    ┌─────────────┐
                    │ Scan RFID Tag│
                    └──────┬──────┘
                           │
                      ◇ Check visited ◇ ──Yes──► ┌──────────────────┐
                      ◇ places==NULL  ◇          │ Show             │
                           │                     │ "Transportation  │
                           No                    │ terminal" address│
                           │                     │ of Nearest Hotel │
                    ┌─────────────┐              │ and Restaurant   │
                    │ Transact this│             └──────────────────┘
                    │ Location from│
                    │    Portal    │
                    └──────┬──────┘
                           │
                      ◇ Check this ◇ ──Yes──► ┌──────────┐   ┌──────────┐   ┌──────────┐   ┌──────────┐
                      ◇ Location!=H,R,◇        │Show "You │   │Transact  │   │Transact  │   │Show      │
                      ◇    F,S      ◇          │Connection│──►│places    │──►│nearest   │──►│Suggestion│
                           │                   │as via a  │   │with      │   │places    │   │          │
                           No                  │PDA" and  │   │distances │   │that have │   └──────────┘
                           │                   │name of   │   │<=10 Km   │   │best score│
                    ┌─────────────┐            │Location  │   └──────────┘   └──────────┘
                    │Transact places│          └──────────┘
                    │    with      │
                    │distances<=10 Km│─────────────────┐
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                           │                           │
                    ┌─────────────┐              ◇ Check ◇ ──Yes──► ┌──────────┐   ┌──────────┐
                    │Transact      │              ◇ Opinion== ◇      │Add this  │   │Show Finish│
                    │nearest places│              ◇ Exellent ◇      │Location  │──►│          │
                    │that have     │                   │            │to Memo   │   └──────────┘
                    │best score    │                   No           │and +2    │
                    └──────┬──────┘                    │            │it's score│
                           │                           │            └──────────┘
                    ┌─────────────┐              ◇ Check ◇ ──Yes──► ┌──────────┐   ┌──────────┐
                    │Show          │              ◇ Opinion== ◇      │Add       │   │Show Finish│
                    │Suggestion    │              ◇ Good     ◇      │Location  │──►│          │
                    └──────┬──────┘                   │            │to Memo   │   └──────────┘
                           │                           No           │and +1    │
                    ┌─────────────┐                    │            │it's Score│
                    │Ask Tourist   │                   │            └──────────┘
                    │about the     │              ◇ Check ◇ ──Yes──► ┌──────────┐   ┌──────────┐
                    │qualification │              ◇ Opinion== ◇      │Add this  │   │Show Finish│
                    │of this place │              ◇ Bad      ◇      │Location  │──►│          │
                    └─────────────┘                   │            │to Memo   │   └──────────┘
                                                       No           │and -1    │
                                                       │            │it's Score│
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Figure 6: M-RDTSCM system implementation flow diagram

4 CONCLUSION

The highly complex and fragmented structure of the tourism sector remains a key challenge for achieving consensus and developing coherent sustainable tourism strategies [19,18]. So, this study tried to present a web-based portal system that incorporate RFID technology and mobile devices to improve the efficiency and effectiveness of information sharing among participants to assist "tourist guidance organization" in controlling tourists and related-locations behaviours in tourist supply chain.

The M-RDTSCM system not only improves sharing information by using RFID-enable scanners and PDAs, but also provides a monitor to control the progress. To examine this system, the most adequate way is simulation and we've used Arena 15.0 to simulating tourist behaviour and evaluating the usage of resources and waste time, of course in a partial M-RDTSM system.

Due to the delay type in queue resources is constant we can extend it to any city with different numbers of hotels, restaurants or other places.

Figure 7 shows the waiting time in average, minimum and maximum value that a tourist consumes for scanning RFID-card. As displayed in the figure it is not noticeable in compare with the time that tourist waste in traditional situation. Also Figure 8 depicts the usage of related-resources and shows shopping and restaurant scanners are busier than others, so by applying more scanners can be decreased. Also Figure 9 shows another chart that shows the usage of related-resources obviously.

Furthermore, compared with current methods, data on the site can be enhanced using RFID technology, PDAs, scanners. Also the information sharing among participants can be accelerated via the portal technology. This study looks at the perceived ability of components of IT infrastructure integration and supply chain process integration to predict specific RFID system deployment outcomes-exploration, exploitation, operational efficiency, and market knowledge creation.

Replications: 1   Time Units: Hours

Queue

Time

Waiting Time	Average	Half Width	Minimum Value	Maximum Value
Recieve info AirPlane Scanner.Queue	0.1650	(Insufficient)	0.00	0.3612
Recieve Info Fair Scanner2.Queue	0.3280	(Correlated)	0.00	0.6075
Recieve Info Hotel Scanner1.Queue	0.00281354	(Insufficient)	0.00	0.03333333
Recieve Info Hotel Scanner2.Queue	0.00785566	(Insufficient)	0.00	0.03289114
Recieve Info Restaurant Scanner1.Queue	0.2690	(Insufficient)	0.00	0.5171
Recieve Info Restaurant Scanner2.Queue	0.2391	(Correlated)	0.00	0.6425
Recieve Info Shop Scanner2.Queue	0.3320	(Correlated)	0.00	0.5500

Figure 7: The time that a tourist consumes for scanning RFID-card

Replications: 1   Time Units: Hours

Resource

Usage

Instantaneous Utilization

	Average	Half Width	Minimum Value	Maximum Value
Fair Scanner	0.9837	(Correlated)	0.00	1.0000
Hotel Scanner	0.05416667	(Insufficient)	0.00	1.0000
Restaurant scanner	0.9900	0.013484297	0.00	1.0000
Shopping Scanner	0.9955	(Correlated)	0.00	1.0000
terminal scaner	0.06944444	(Insufficient)	0.00	1.0000

Number Busy

	Average	Half Width	Minimum Value	Maximum Value
Fair Scanner	0.9837	(Correlated)	0.00	1.0000
Hotel Scanner	0.05416667	(Insufficient)	0.00	1.0000
Restaurant scanner	0.9900	0.013484297	0.00	1.0000
Shopping Scanner	0.9955	(Correlated)	0.00	1.0000
terminal scaner	0.06944444	(Insufficient)	0.00	1.0000

Number Scheduled

	Average	Half Width	Minimum Value	Maximum Value
Fair Scanner	1.0000	(Insufficient)	1.0000	1.0000
Hotel Scanner	1.0000	(Insufficient)	1.0000	1.0000
Restaurant scanner	1.0000	(Insufficient)	1.0000	1.0000
Shopping Scanner	1.0000	(Insufficient)	1.0000	1.0000
terminal scaner	1.0000	(Insufficient)	1.0000	1.0000

Scheduled Utilization

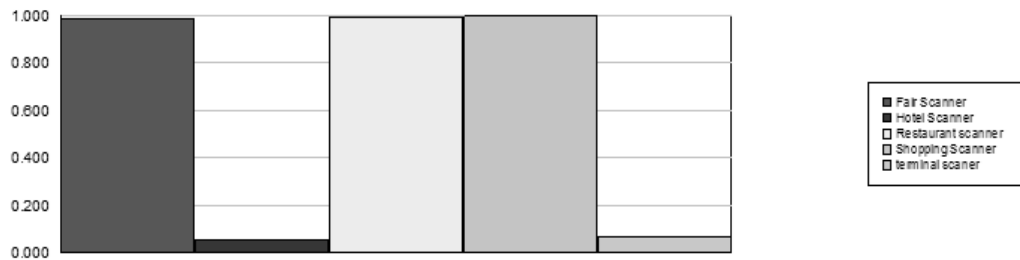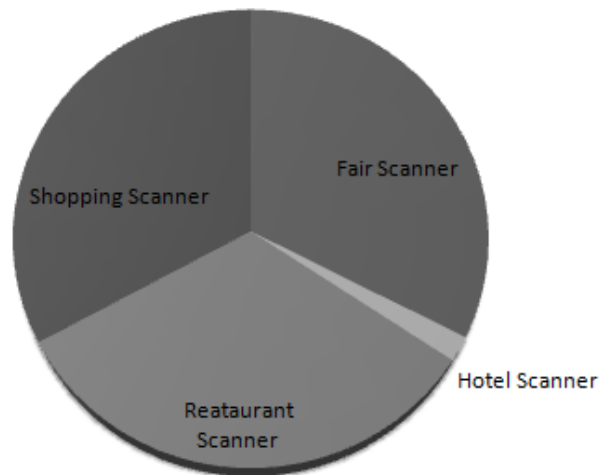|	Value
Fair Scanner	0.9837
Hotel Scanner	0.05416667
Restaurant scanner	0.9900
Shopping Scanner	0.9955
terminal scaner	0.06944444

Figure 8: Usage of related-resources

Figure 9: Usage of related-resource

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