

UNIVERSITY OF BAHRAIN

College of Engineering



Department of Mechanical Engineering

Development of Telematics Related Products and Services in Bahrain: Challenges for Start-Ups

(A Case Study of STS Company)

A Thesis Submitted in Partial Fulfillment of the Requirements for the
Master's Degree in Engineering Management

Submitted by

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B.Sc. in Computer Engineering, University of Bahrain, Kingdom of Bahrain, 2006

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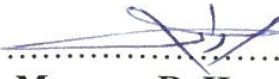
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KINGDOM OF BAHRAIN

June 2013

DECLARATION

I declare that this work is the result of my own investigation and that it has not already been accepted in substance for any degree, nor is it being currently submitted for any degree.

Signed:  Date: 27-6-2013
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“DEVELOPMENT OF TELEMATICS RELATED PRODUCTS AND SERVICES IN BAHRAIN: CHALLENGES FOR START-UPS (A CASE STUDY OF STS COMPANY)”

Submitted by **Marwan Rajeh Hussain** to the Department of Mechanical Engineering satisfactory and acceptable for the Master of Management Engineering.

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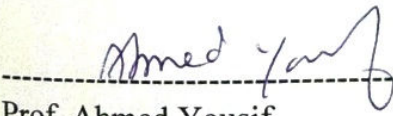
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ABSTRACT

Telematics is part of Information and Communication Technologies (ICT) which plays a major role in the economic development of countries. In modern transportation, telematics applications are becoming increasingly important, as they play a vital role in the safety and security for both vehicles and drivers. Moreover, it is being widely used by fleet owners around the world as a means of increasing fleet operational efficiency, and reducing fuel usage, which consequently results in reduced toxic car emissions.

Many countries around the world have benefitted from the increasing demands of telematics products and services, allowing their private sectors and service providers to develop and thrive, thus contributing to their economical development. Locally, Bahrain market has also witnessed an increasing demand for telematics products and services, particularly in the last six years. One positive indication is the increasing number of vehicle tracking service providers (being a major telematics application area) operating in Bahrain. Based on data obtained in this thesis the number of vehicle tracking service providers in Bahrain increased from a single company in 2005 to more than 12 in 2012, though most of them have very small customer base. During the same period the number of vehicle tracking installations increased from roughly 700 units to more than 4,700 in October 2012. With this in mind, and taking into consideration the total number of registered vehicles in Bahrain, we estimated that roughly only 6.5 % of the potential vehicles for Vehicle Telematics and Management Systems (VTMS) have installed the service, which gives a good indication that there is a large market growth potential for this service. On the other hand this very low market penetration also indicates that there are obstacles to market growth that needs to be addressed.

The aim of this thesis is to present and discuss issues related to the development of VTMS products and services in Bahrain, and to demonstrate the main challenges and obstacles to VTMS market growth in Bahrain. Spatial Technology Solutions Company (STS), a small but experienced VTMS service provider, which started operation in October 2010, was examined as a case study. In this study we examined the business operations of

STS in terms of its products and service offering, competitive advantages, and analyzed its strength and weakness, through SWOT analysis. And finally we present a set of recommendations to deal with the obstacles and challenges to the growth of vehicle VTMS market in Bahrain specific to start-ups entering the ICT market in Bahrain, and in general to government and policy makers.

عنوان الأطروحة : تطوير المنتجات والخدمات ذات الصلة بتقنية التليماتيكس في البحرين: التحديات للشركات الناشئة

اسم الطالب : مروان راجح حسين شحاده

إن أنظمة التليماتيكس هي من ضمن تكنولوجيا المعلومات والاتصالات التي أصبحت تلعب دورا رئيسيا في التنمية الاقتصادية للبلدان. ففي وسائل النقل الحديثة أصبحت أنظمة التليماتيكس ذات أهمية متزايدة، حيث أنها تلعب دورا حيويا في مجال السلامة والأمن لكل من السائقين والمركبات كما تعود بالنفع على ملاك اساطيل المركبات حيث أن استخدامها يؤدي إلى زيادة كفاءة تشغيل الأسطول، والتخفيف من الازدحام المروري، والحد من استهلاك الوقود، مما ينتج عنها تقليل نسبة الانبعاثات السامة من عوادم السيارات.

وقد استفادت العديد من البلدان حول العالم من الطلبات المتزايدة على المنتجات والخدمات القائمة على نظم المعلومات والاتصالات، مما سمح للقطاعات الصناعية ومقدمي الخدمات في تلك الدول بالتطور والنمو، مما ساهم بدوره في تنمية اقتصاديات هذه الدول. وأما على الصعيد المحلي فقد شهد سوق البحرين أيضا طلبا متزايدا على المنتجات والخدمات القائمة على أنظمة التليماتيكس، ولا سيما في السنوات الست الماضية ولعل من أهم المؤشرات الدالة على ذلك هو ازدياد عدد الشركات التي تقدم خدمة رصد/تتبع المركبات والتي تعتبر من أهم التطبيقات المعتمدة على أنظمة التليماتيكس. واستنادا على البيانات التي تم الحصول عليها في هذه الدراسة فقد ازداد عدد الشركات التي تقدم خدمات مراقبة المركبات في البحرين من شركتين عام 2006 إلى أكثر من اثنا عشرة شركة في عام 2012 علما بأن معظمهم لا يملك سوى عدد قليل من الزبائن. و إذا أخذنا بالاعتبار أيضا الزيادة الكبيرة في عدد المركبات المسجلة في البحرين خلال نفس الفترة، فإن هذه المؤشرات تدل على وجود فرصة كبيرة لنمو السوق في هذا المجال حيث مازال هناك عددا كبيرا من المركبات القابلة للاستفادة من هذا النظام.

إن الهدف من هذه الدراسة هو عرض ومناقشة القضايا المتعلقة بتطوير تقنية أنظمة التليماتيكس للمركبات و بحث العقبات التي تواجه نمو السوق في هذا المجال و التحديات التي تواجه الشركات الصغيرة للدخول في السوق المحلي. وقد قمنا من خلال هذه الدراسة بتسليط الضوء على تجربة شركة STS كدراسة حالة حيث أنها شركة بحرينية صغيرة استطاعت خلال فترة زمنية قصيرة من النمو حتى أصبح لديها أكبر قاعدة من الزبائن في البحرين.

و سنقوم من خلال هذه الأطروحة بتقديم لمحة عامة عن شركة STS و مناقشة مزاياها التنافسية، و نقاط القوة والضعف، والنهج الذي اتبعته للتغلب على العقبات والتحديات لدخول سوق أنظمة تعقب المركبات في البحرين وتليها جملة من التوصيات.

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ABBREVIATIONS

ABI	Allied Business Intelligence
BDB	Bahrain Development Bank
BTECH	Bahrain Technology Companies Society
EDB	Economic Development Board
ESRI	Environmental Systems Research Institute
EWA	Electricity and Water Authority
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
GIS	Geographical Information System
GM	General Motors Company
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
ICT	Information and Communication Technologies
IP	Internet Packet
ITS	Intelligent Transportation System
LAN	Local Area Network
LBS	Location Based Services
LMRA	Labor Market Regulatory Authority

MOW	Ministry of Works
PNDs	Personal Navigation Devices
R&D	Research and Development
SME	Small and medium size enterprises
STS	Spatial Technology Solutions Company
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TCP	Transmission Control Protocol
TQM	Total Quality Management
UDP	User Datagram Protocol
VTMS	Vehicle Telematics and Management Systems
VTU	Vehicle-mounted tracking unit

Chapter 1: Introduction

1.1 Background of the Thesis

In recent years, the world has witnessed a new technological revolution in the ICT field affecting many aspects of our life (Shirazi, Gholami, & Higón, 2009). One of the important developments in this field has been in the area of telematics, which evolved through the integration of ICT technologies such as GPS with telecommunication and Internet (Fierro, 2005). This opened the door for the development of many important and useful applications, thus giving rise to a new multi-facet industry (i.e. the telematics industry). Vehicle telematics is a major area in this field, allowing such important applications as in-car navigation devices and vehicle tracking systems (unknown to the general public few years ago) to become widely spread.

Many countries around the world have benefited from this ICT revolution, and where new industries evolved taking advantage of the new opportunities, offered by the recent advancements in telematics. These include new hardware manufactures (e.g. manufacturers of GPS devices), software manufacturers, and last but not least ICT services and solution providers (Ollo-López & Aramendía-Muneta, 2012). The rise of this new industry has contributed to the economical development of many countries around the world, and in particular countries like China, Taiwan, and South Korea, who have focused on hardware manufacturing, made possible through their skilful and cheap industrial labor force. In fact, most of the GPS hardware devices (as with other electronics) are made nowadays in China and Taiwan, although the origins of the technologies are set forth in North America and Europe.

ICT Industries in the rest of the world (particularly in the Arab world) is lagging behind, not only in the hardware manufacturing, but also in the software and services side as well. This thesis will focus on vehicle telematics as being a core component and hence a main indicator of the status of telematics industry in the country.

In Bahrain the demand for Vehicle Telematics and Management Systems (VTMS) has been increasing, but the market growth, has not been very encouraging. In this thesis we are going to discuss the current vehicle telematics status in Bahrain, by analyzing the VTMS market development in Bahrain, market trend, current market size and potential growth. The thesis will discuss the main obstacles and challenges facing new comers to the market (particularly small and medium size enterprises (SME), who form the backbone of any economical development). In doing so we will take a case study of a small, but successful local company Spatial Technology Solutions (STS), which was able to acquire the largest local market share in the VTMS (in terms of customer base) in less than two years, and to achieve 100% return on investment during this period. STS faced the market turbulence and went through the learning curve from the date it was founded in October 2010, and until it became fully operational and profitable. The thesis will analyze the strength and weaknesses of the company, and will try to draw some lessons from its experience, which can be useful, as a guide, for any new company thinking to start a telematics business in Bahrain.

1.2 Objectives of the Thesis

The objectives of this thesis are:

- To describe the basic concepts of telematics and its importance and contribution in economic development of the country.
- To emphasize the importance of Vehicle Telematics Management System (VTMS) as a fleet management tool and its role in modern transportation development and planning.
- To demonstrate the importance of vehicle telematics in Kingdom of Bahrain and how it can contribute to the economical development and in helping to reduce the problems associated with traffic congestion, accidents, fuel consumption, etc...).
- To identify and discuss the main obstacles and challenges to VTMS market growth in Bahrain.

- To analyze the strength and weaknesses of STS (as a case study) using SWOT analysis.
- To make recommendations that will benefit start-ups entering the ICT market in Bahrain, and help them to maintain a successful business growth.

1.3 Thesis Contribution

The author executed this work under the supervision of Dr. Abduljalil Zainal, Dr. Wael Elmedany, and Dr. Mohammed Waleed Fakhr, who also contributed in the discussions related to the development of telematics' products and services in Bahrain, and the discussions of obstacles and challenges, resulting in the following publications:

- M. R. Hussain, A. Zainal, W. M. Elmedany, M. W. Fakhr, (November 2012), *"Development of Telematics Products and Services in Bahrain"*, Canadian Journal on Electrical and Electronics Engineering, Vol. 3, No. 9
- M. R. Hussain, A. Zainal, W. M. Elmedany, M. W. Fakhr, (December 2012), *"Challenges and Obstacles Facing Telematics Companies in Bahrain"*, Accepted for publication in International Journal of Technology Diffusion (IJTD), IGI, ISSN: 1947-9301
- Hussain, M. R., Zainal, A., Elmedany, W. M., & Fakhr, M. W. (2013), *"Telematics Business and Management in Bahrain Market"*, Transport and Telecommunication, 14(1), 13-19.

1.4 Thesis Structure

The materials in this thesis are organized as follows:

Chapter 1 describes general background about this thesis, as well as the objectives of the thesis.

Chapter 2 provides literature survey about telematics. The chapter starts with defining what is telematics and what are the products and services based on telematics. It covers telematics applications, and the importance of telematics and its contribution to economic development.

Chapter 3 introduces vehicle telematics as a component of telematics systems and elaborates on the importance of VTMS in modern transportation development and planning, and its importance as a fleet management tool. Then some examples of vehicle telematics applications are presented from around the world.

Chapter 4 discusses in details the current vehicle telematics situation in Bahrain providing market analysis and data on potential market growth. The chapter concludes with a presentation of the main obstacles and challenges to the growth of vehicle telematics market in Bahrain.

In Chapter 5, a case study is conducted on Spatial Technology Solutions (STS) company as one of the companies in Bahrain for the development of vehicle telematics products and services and as a model for small companies venturing into this domain. This chapter will demonstrate STS business growth and the main obstacles and challenges surrounding their business. Moreover, in this chapter a detailed analysis was conducted to identify the strength, weakness, opportunities and threats of STS using the SWOT methodology.

Finally, chapter 6 is divided into three parts. The first part draws on the experience of STS (considering both its success and weaknesses), and lists the recommendations that will benefit start-ups entering the ICT market in Bahrain, and help them to maintain a successful business growth. The second part deals with recommendations related to government and policy making. Last but not least, the third part demonstrates some suggestions for future research work in the telematics field. This is followed by conclusions of the thesis in chapter 7.

Chapter 2: Literature Survey Related to Telematics

This chapter provides literature survey about telematics and starts with defining what is telematics and what are the products and services based on telematics. It covers telematics applications, and the importance of telematics and its contribution to economic development.

2.1 What is Telematics

Telematics typically is any integrated use of **telecommunications** and **informatics**, also known as ICT (Information and Communications Technology). ICT plays a major role in the economic development of countries (Mikulski, 2010). Basically, telematics is about the technology of sending, receiving and storing information via telecommunication devices (e.g. GSM/GPRS modem) along with controlling of remote objects/devices. Moreover, telematics includes but is not limited to Global Positioning System (GPS) technology integrated with computers and mobile communications technology in automotive navigation systems (Ekram, et al., 2010). Telematics refers to providing automation in vehicles such as emergency warning systems, GPS tracking & navigation, and hands-free communications. Telematics represents the convergence of wireless communication, location technology, and in-vehicle electronics that is being used to integrate the automobile into the information age. Today, the telematics market is being served by three major technologies: In-Vehicle Telematics, Portable Navigation Devices (PNDs), and Smartphone's. Each has shaped the market and is causing fragmentation as a result of market disruptions (Webb, 2010).

2.2 Products and Services Based on Telematics

This section demonstrates the variety type of products and services/application that are based on telematics.

2.2.1 Telematics Products

There are many available commercial products based on telematics' technologies. Examples include vehicle and personal tracking devices, personal navigation devices (PNDs), and Smartphone's (Hussain, Zainal, Elmedany, & Fakhr, November 2012).

a) Vehicle Telematics Devices

A vehicle telematics / tracking device is basically a combination of a GPS modem, GPS antenna and GSM/GPRS modem controlled by a Microcontroller (El-Medany, Al-Omary, Al-Hakim, Al-Irhayim, & Nusaif, 2010), (El-Medany, Alomary, Al-Hakim, Al-Irhayim, & Nousif, 2010), as shown in Fig. 2-1; this tracker will start transmitting GPRS packets (using internet protocols) through GSM network to a remote server/database. After that the user can monitor and track the movement of his fleet from his PC/web browser. The data which are received from the tracker will be turned into readable information by using reporting tools in combination with a visual display on computerized mapping software such as GIS – Geographical Information System.



Fig. 2-1: Vehicle tracking/telematics Devices and GPS/GSM antenna (Hussain, Zainal, Elmedany, & Fakhr, November 2012)

b) Personal Navigation Devices (PND)

Personal Navigation Devices (PND) also called Portable Navigation Devices is portable electronic devices which combine a positioning capability (such as GPS) with a routing application (Gpsdirectonline, 2011), (Kun, Paek, Medenica, Memarović, & Palinko, 2009). All PNDs work essentially the same way. They store map data locally on the device, which must be updated with some frequency (quarterly or annually) and support routing algorithms (the fastest route or the shortest route to destination) (Marfia & Roccetti, 2010). Some newer PNDs provide some real-time weather and traffic data via a data connection over a cellular network (see sample PND in Fig. 2-2) (Personalgps, 2012). Moreover, PNDs can be used as communicating tool between the driver and the call center when interfaced with the vehicle telematics/tracking device to dispatch jobs, monitor jobs and communicate with the driver by text messaging.



Fig. 2-2: Personal Navigation Devices (PND) (Personalgps, 2012)

c) Personal Tracking

GPS personal tracking are small tracking devices (similar to the vehicle tracker but without any external wiring) which can be carried in our pockets (Chew, Chong, Gunawan, Goh, Kim, & Soh, 2006). This type of trackers can be used for a number of useful applications, including children and elderly tracking, sales person tracking, animals tracking and tracking of out-patients.

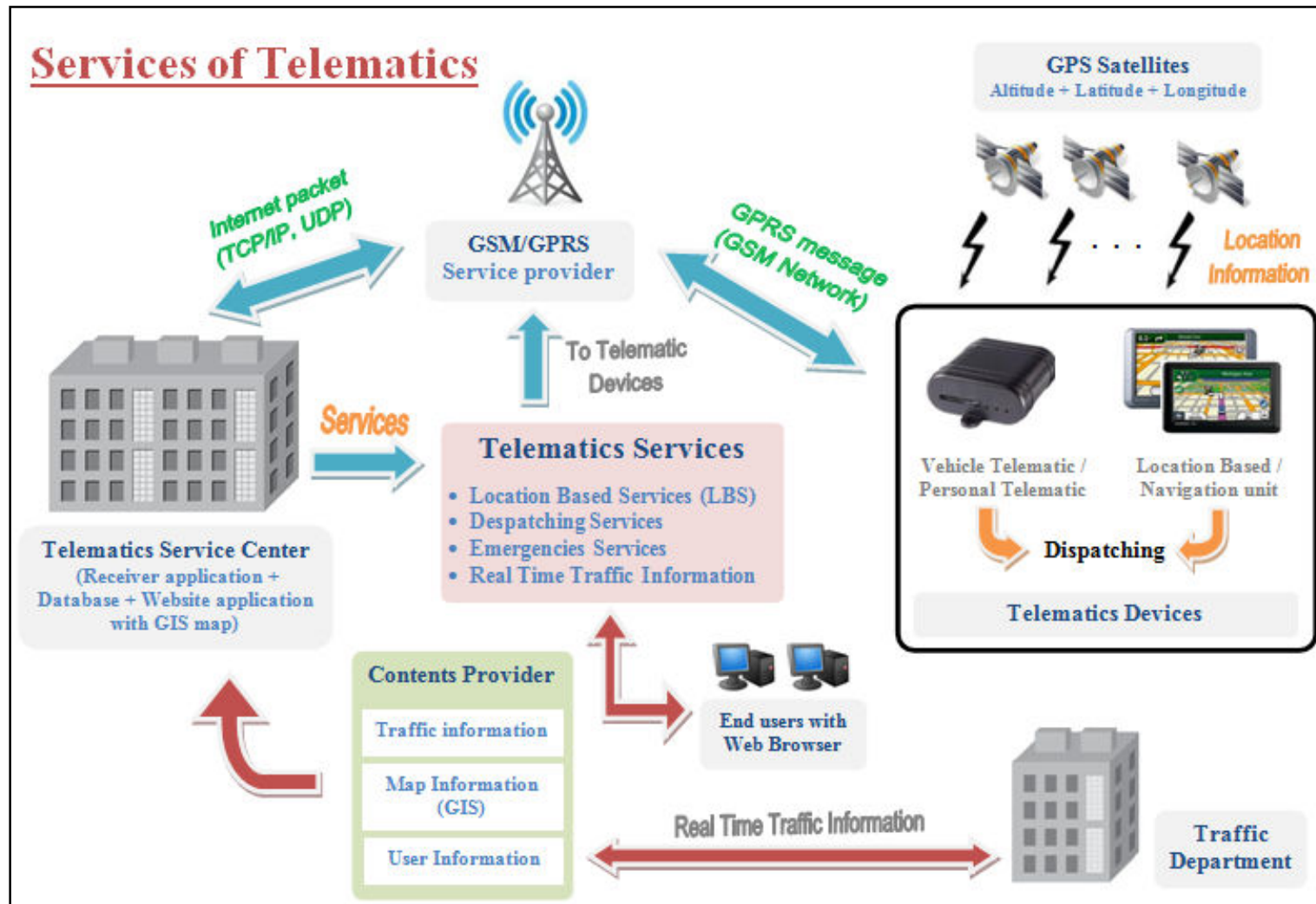


Fig. 2-3: Telematics-based services (Hussain, Zainal, Elmedany, & Fakhr, November 2012)

2.2.1 Services and Applications Based on Telematics

There are many commercial services based on telematics, most important being VTMS, Location Based Services (LBS), Dispatching and emergency services, as summarized in Fig. 2-3 (Hussain, Zainal, Elmedany, & Fakhr, November 2012). The following sections provide a brief description of each service.

a) Vehicle Telematics and Management Systems (VTMS):

VTMS are used for monitoring the location, movements, status and behavior of a vehicle or fleet of vehicles remotely, thus providing many benefits to the vehicle owner and the driver as well (Hussain., Zainal, Elmedany, & Fakhr, December 2012), (Abulleif & Al-Dossary, 2012). VTMS are becoming increasingly important in modern transportation to increase reliability, safety and security of both vehicles and drivers, increase fleet operational efficiency and reduce fuel usage. In addition, they provide the following benefits (Thong, Han, & Rahman, 2007):

- Assist and locate lost/stolen vehicles.
- Reduce employee down time.
- Reduces stress on dispatch personnel.
- Better management decisions.
- Better maintenance management.
- Reduce wear and tear on fleet.
- Eliminate excessive idle time.
- Minimize unauthorized use and after-hours use of company assets.
- Optimize fleet vehicles usage.

b) Dispatching and Emergency Services:

This type of solution is recommended for critical transport operations such as ambulance fleet management, taxi dispatch, and emergency repair dispatch. The system consists of the same vehicle/telematics units mentioned earlier integrated

with a Personnel Navigation Device (PND) as shown in Fig. 2-4. In this system, a two-way communication is enabled between the control room operator using the tracking application, and the in-car dash-board mounted navigator (via text messages). This will ensure that the drivers are automatically routed to the precise customer location, and provide the call center with up to the minute status information on their progress (Pinpointers, 2011). So when the call center agent for instance receives a call for an emergency situation, he/she can select the nearest available vehicle to the reported incident and can send the incident information with the address directly to the driver using the online dispatch application. The incident information will then appear on the screen of the in-car PND, enabling the driver to instantly start routing to the exact location of the incident by voice guidance.

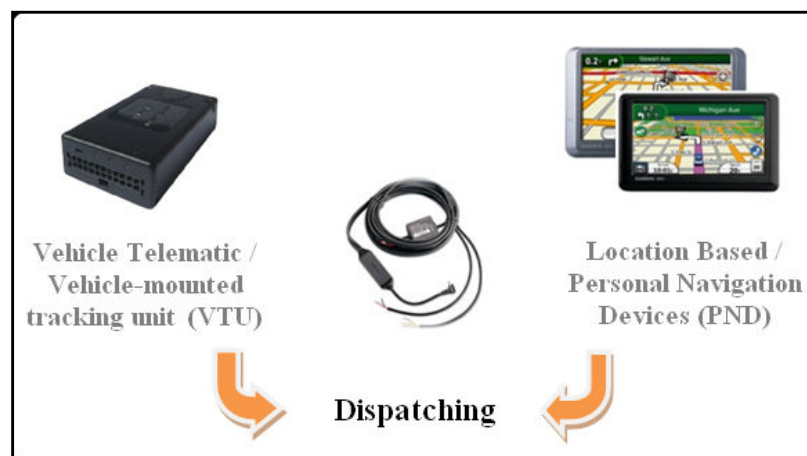


Fig. 2-4: Main hardware components of the Dispatch system (Hussain, Zainal, Elmedany, & Fakhr, November 2012)

Such real-time scheduling and dispatching technologies could provide improved services in high density urban and low density rural areas (Mulleya & Nelsonb, 2009).

c) Telemetry

Telemetry is an online solution using GSM/GPRS data telecommunication network to transmit data from any remote electronic device back to the office, with

a back-end server application to process the “real-time” incoming data into processed information (Miami University Libraries, 1999). Furthermore, the processed data can be integrated with the GIS to show the location of the remote devices on the maps (in their actual geographical coordinates). Fig. 2-5 and Fig. 2-6 show real Telemetry System applied to measure the Water Flow and Pressure in pipes. In simple terms the device (i.e. the Water Flow and Pressure meter) will measure the water flow and pressure in the pipe; which will then be transmitted through the interfaced GSM/GPRS modem to a remotely hosted server for analysis.

Telemetry systems are applied in modern automobiles as well, whereby it is used to monitor the vehicle’s engine performance, notify the driver of any problems, and recommend a nearby vehicle services center (if the vehicle is equipped with an in-car GPS system). This will increase reliability, safety and security of both vehicles and drivers.

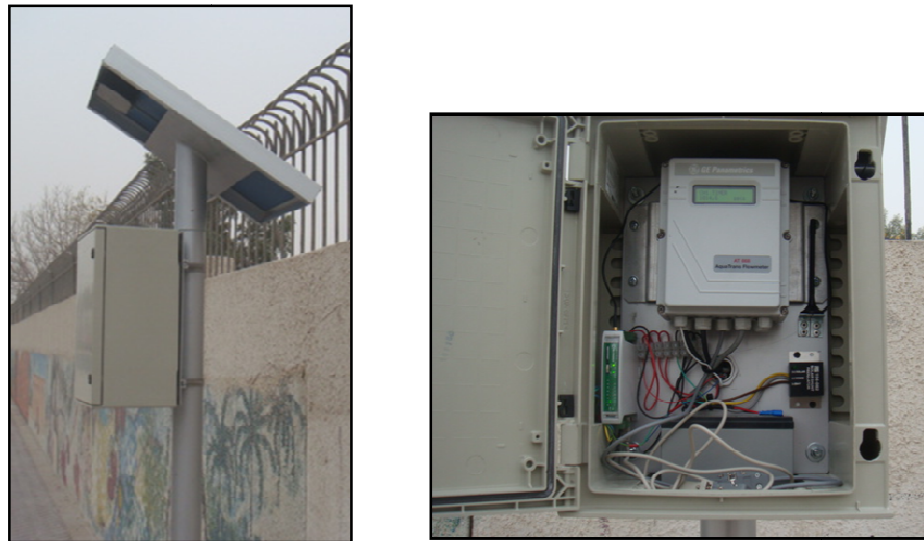


Fig. 2-5: Water Flow and Pressure meter telematics powered by solar energy (Hussain, Zainal, Elmedany, & Fakhr, November 2012)



Fig. 2-6: Water flow and pressure sensor fitted on a water pipe (Hussain, Zainal, Elmedany, & Fakhr, November 2012)

d) Real Time Traffic Information (Traffic Telematics):

With the rapid growth of road networks and total numbers of cars on the road, traffic problems seem inevitable with urbanization. With the advanced development of information and communications technologies (ICT) and telematics, people can plan their routes in order to save their driving time and avoid areas of congested traffic and reach their places easily and conveniently (Lina, Hsiehb, & Tzengb, 2010).

To receive correct and real time traffic information, the driver should have a vehicle telematics/tracking device interfaced with a PND communicating with the traffic administration telemetry network. This will help drivers realize the immediate road conditions, and comply with traffic signals. Such system can support emergency vehicles (e.g. ambulance, electricity, water and fire brigade and police). Real-time traffic information is already available as a service to motorists in North America and Europe, but has not been implemented in our regions yet.

e) Insurance (New Application Area of Telematics Services):

Motor insurance is another important application for vehicle telemetry, which is gaining increasing attention in the western countries. The idea is based on distance

charging. Distance-based insurance converts insurance to a variable cost with respect to vehicle travel, so insurance premiums are directly affected by annual mileage. The more you drive the more you pay and the less you drive the more you save. The implementation of distance-based insurance pricing can help reduce total insurance costs, reduce road accidents and traffic congestion, which will ultimately lead to save energy consumption and reduce pollution. A feasibility study conducted by Victoria Transport Policy Institute indicated that distance-based pricing is technically and economically feasible, and can provide significant benefits to motorists and society (Litman, 2011).

The adoption of telematics in insurance offer significant benefits to multiple constituents as summarized in Table 2-1. Moreover, the studies indicated that measuring the drivers' behaviors in terms of speeding and harsh braking, can significantly improve insurance premium charging when combined with traditional rating factors (i.e. driver age and credit-based insurance score).

TABLE 2-1: Benefits of adopting telematics in the insurance market

Benefits to society	Benefits to Consumers
✓ Reduce accident frequency and severity (e.g., via driver incentives and education). ✓ Reduce accident response time. ✓ Track and recover stolen vehicles. ✓ Establish fault to improve equity in settling claims. ✓ Reduce driving, pollution, traffic congestion and energy consumption.	✓ Reduce premiums. ✓ Demonstrate safe driving habits following an accident. ✓ Enjoy value-added services, including: ○ Teen driver monitoring. ○ Emergency services. ○ Navigation/infotainment. ○ Stolen vehicle recovery. ○ Vehicle diagnostics.
Benefits for Insurers	Benefits to Fleets owners
✓ Correct risk misclassifications. ✓ Enhance pricing accuracy. ✓ Attract favorable risks. ✓ Retain profitable accounts. ✓ Fight fraudulent claims. ✓ Reduce claim costs. ✓ Enable lower premiums. ✓ Replace proxy variables with intuitive variables directly related to loss exposure. ✓ Differentiate brand. ✓ Market environmentally friendly programs.	✓ Optimize routing ✓ Enhance customer service (on-time delivery and appointments) ✓ Reduce payroll ✓ Save fuel ✓ Reduce maintenance costs ✓ Reduce towing and repair costs via preventive diagnostics ✓ Monitor and improve driver safety ✓ Reduce premiums and self-insurance costs: ○ Auto liability ○ Auto physical damage ○ Workers compensation ○ Inland marine ✓ Dispute parking and speeding tickets

2.3 Structure of Telematics Systems

Telematics systems in general require the following components for their operations: GPS Satellites, telematics unit/modem, GSM/GPRS Service provider, internet connectivity hosting platform, database and applications, as shown in Fig. 2-7 (Hussain., Zainal, Elmedany, & Fakhr, December 2012). A brief description follows:

a) GPS Satellites:

Global Positioning System (GPS) is a satellite-based position determination system that provides location and time information for any point on earth (Batarlienea, 2007), (Ta, 2011). It is freely accessible to anyone with a GPS receiver to read the coordinates (latitude, longitude, and altitude), date/time, speed vector and angle.

b) Telematics Unit/Modem:

Is a black box integrating GPS engine with GSM/GPRS mobile communicator. This black box will process the GPS signals received from the GPS satellites, and send the readings through the GSM/GPRS wireless network to the hosting server. In vehicle telematics, this will be the tracking device that is installed inside the vehicle.

c) GSM/GPRS Service Provider:

Almost all the commercial telematics devices depend on the public GSM networks for data communication, usually through GPRS. General Packet Radio Services (GPRS) is a packet-data technology that allows GSM operators to initiate wireless data services within the GSM network infrastructure using IP (Internet Protocol) based packet data switching (Ghribi & Logrippo, 2000). GPRS enables more efficient and cost saving transmission of data through TCP (Transmission Control Protocol) or UDP (User Datagram Protocol) transport protocols depending on the application it is going to be used for (Samjani, 2002), (Ermel, Müller, Schueler, Schweigel, & Begain, 2002). This service is essential to link the remote telematics unit/module with their remote servers.

d) Internet Connectivity:

Internet access is the second essential transmission media required to complete the telematics system. The GSM/GPRS Service provider will forward the IP (Internet

Packet) received from the telematics unit/module to the internet, and then the internet will route it to its destination IP address (Bauer, Berne, & Maitland, 2002).

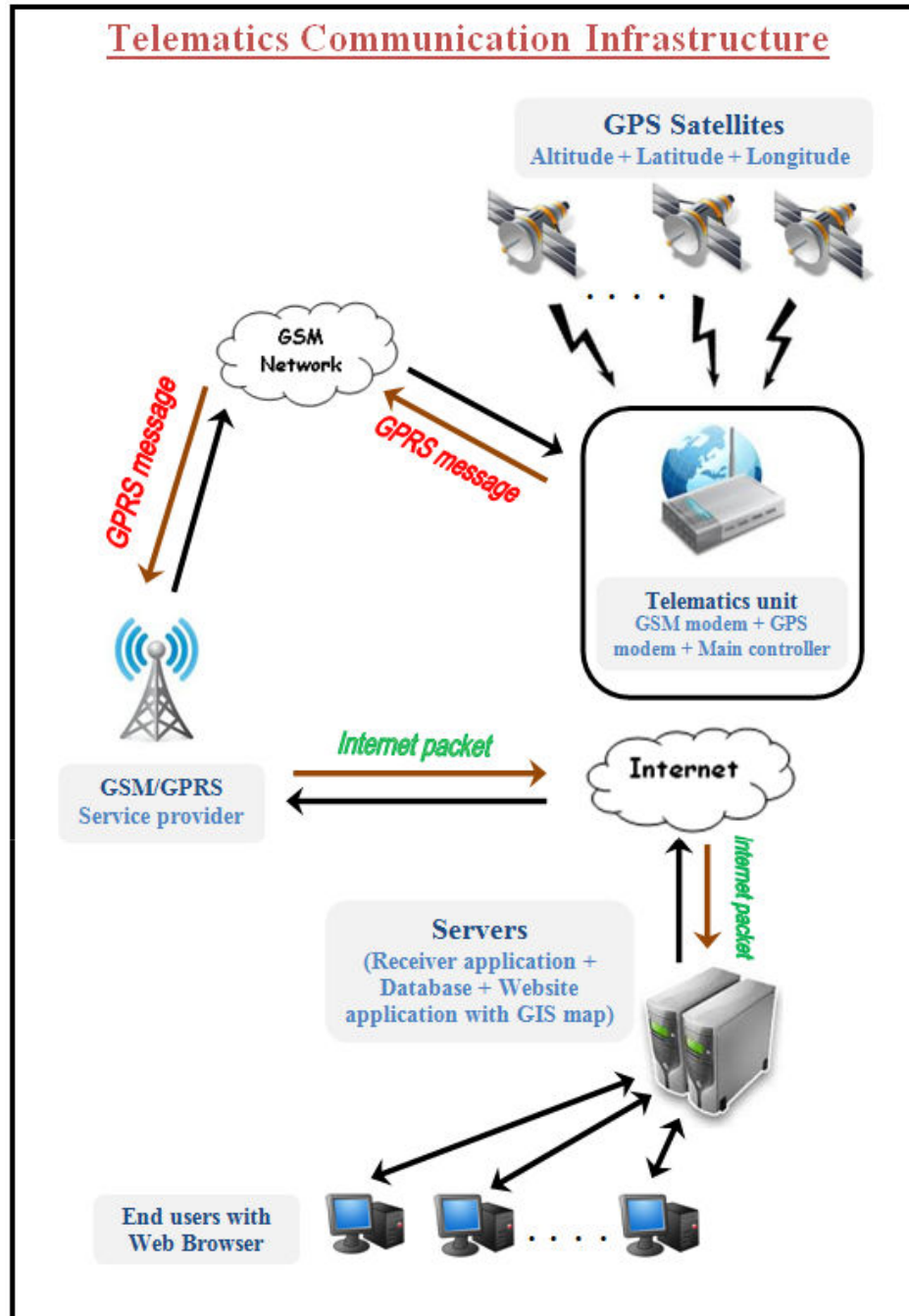


Fig. 2-7: Main components of a telematics system

e) **Hosting Servers:**

This is the back-end server hosting the application that will receive the TCP or UDP message packets sent by the telematics communication module, and save them in the database. Each server will have fixed IP address and opened TCP or UDP ports for receiving the data packets. Moreover, these servers host the applications that will allow the user to retrieve the saved records and process them through a GIS-based application.

2.4 Importance of Telematics and its Contribution in Economic Development

The expansion of ICT and the growth in wireless connectivity has changed the way people live and work (Kramer, Jenkins, & Katz, 2007). New knowledge and the use of new ICT technologies have resulted in the creation of new products, services, and jobs. At the same time, trade agreements and the reduced costs of communication and transportation have increased the flow of capital, goods, services, knowledge and jobs between countries. The result has been significant worldwide economic growth (Kozma, 2005). At the industry level, it has been noticed that firms using ICT have faster growth, higher productivity and faster employment growth. Moreover, ICT helped in growing individual economic opportunity and enabled people to enhance their knowledge and skills. Also, it helped individuals to use their income more wisely and manage their own businesses efficiently (Kramer, Jenkins, & Katz, 2007).

As mentioned earlier, telematics is about the technology of sending, receiving and storing information via telecommunication devices (GSM/GPRS) along with controlling of remote objects/devices. Therefore, telematics has the following main characteristics (Song, Kim, Yu, Lee, & Lee, 2012):

- ***Timeliness***, by providing users with immediate access to information anytime.
- ***Mobility***, by providing services anywhere.
- ***Individuality***, by providing services reflecting the user's geographical location and demand.
- ***Convenience***, by providing useful information and services.

The main types of services that can be offered through telematics are listed in Table 2-2. There are various stakeholders or key players in the telematics industry, which can be classified into three categories; software, hardware and service providers (GSM network included). The "service provider" provide users with the Internet or telematics services such as web browsing, vehicle location, e-mailing, and advertising.

TABLE 2-2: Major types of services offered through telematics (Song, Kim, Yu, Lee, & Lee, 2012)

Category	Types	Examples
Drivers	Traffic	Real time traffic information (route information, traffic jam, parking, etc...).
	Safety	Driving logs, driving surveillance/warning, emergency support systems, emergency calls
	Lifestyle	Weather information, events/occasions, local information, and points of interest (POI) on GIS map
Vehicle	Management	Enhance efficiency and utilization of vehicles
	Security	Anti-theft systems, remote open/close control, vehicle location tracking, stolen vehicle recovery
Unit installation	Customer relationship management	Driving records, vehicle maintenance, auto insurance, diagnostic services
Passengers	Entertainment	Music, movies, games, internet, remote education

Another software related player is called the "contents provider" which provides the user with contents and data. Basically, software related providers are operated by automakers, auto dealers, internet service providers, advertisement firms, digital map distribution firms, or several other facilities (Shimizu, 2004).

Hardware related players are automakers, consumer's electronics firms, communication equipment firms, and in-vehicle device suppliers which provide the car navigation systems. In addition, vendors of mobile phones and PNDs (Portable Navigation Devices) are also becoming hardware related players in this field, as many smart phones also come with integrated GPS.

Network related players provide network infrastructure such as mobile communication infrastructure, wireless LAN, and ground station digital TV broadcasting, which are essential technologies for telematics. Telecommunication companies, broadcasting companies, and IT solution vendors which connect telematics to other businesses can be categorized as service providers and in some cases listed as network related players (Shimizu, 2004).

Therefore, all those players will play a role in the telematics value chain, and hence contribute to the economical development as illustrated in Fig. 2-8 (inCode Telecom Group, 2001):

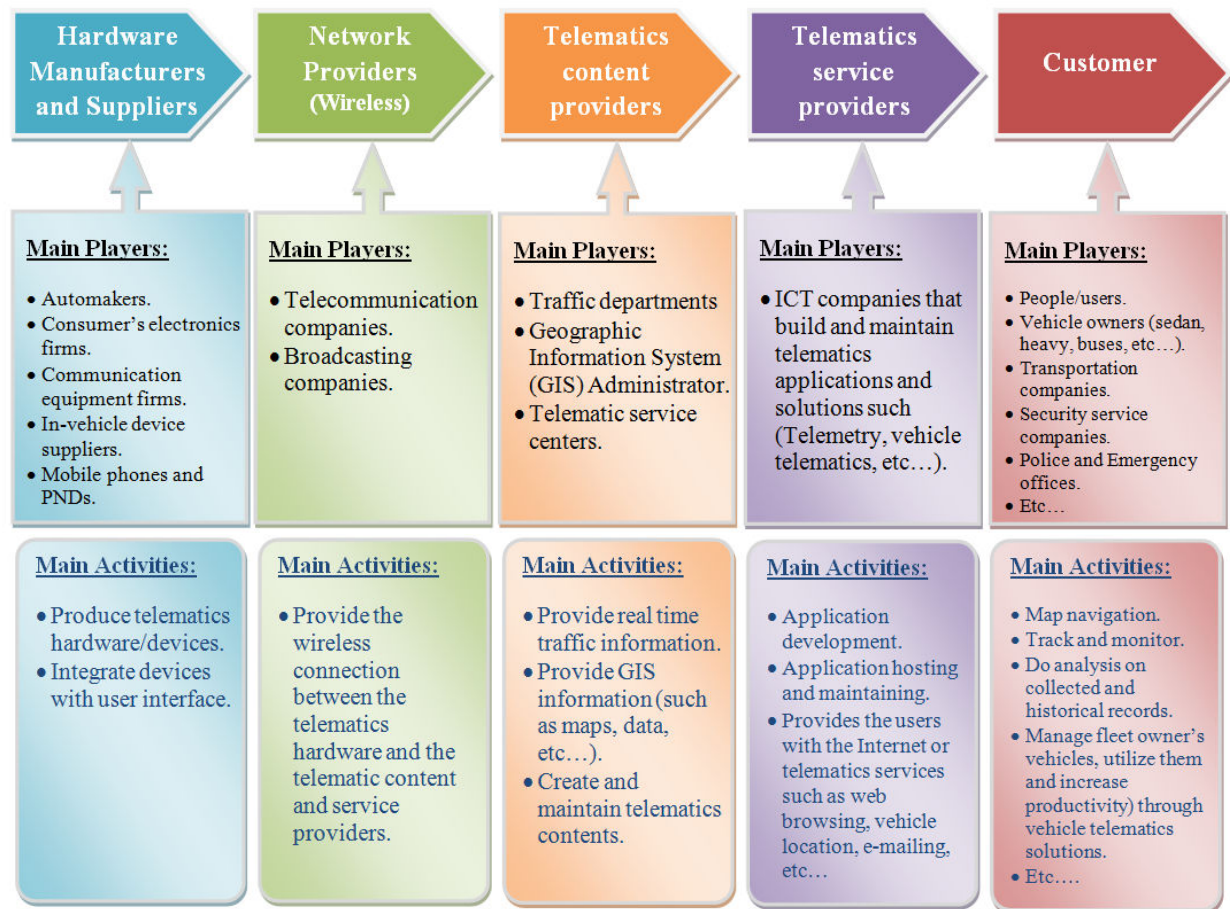


Fig. 2-8: Telematics Value Chain (inCode Telecom Group, 2001)

2.5 Telematics Applications Examples From Around the World

Telematics R&D started in the 1980s in the U.S. and Japan, whom have invested heavily in establishing telematics services. Automobile manufacturers have played an essential role in installing and providing telematics equipment and services. In particular, they have employed telematics to manage and retain their customers and to enhance their brand image. GM, Ford, Daimler, and Toyota are representative firms leading the development of the global telematics market (Cassias & Kun, 2007). The telematics industry in the U.S., which started with GM's OnStar in 1997, has attracted an increasing number of customers because of the law calling for emergency vehicle safety for the mobile phone firms since the September 11, 2001 terrorist attacks. It is noteworthy that security and safety services have been developed mainly with automobile manufacturers. The U.S. market, which has expansive regions and massive sales networks, requires high standards and demands strict safety requirements (Hutchinson, 2004).

Today, in the U.S. the primary value to the consumer has been limited to an intangible feeling of comfort from knowing that in case of an emergency, help is just a push of a button away. Moreover, the evolution of U.S. consumer demand for telematics services has reached beyond safety and security considerations. Today the focus is on providing the consumers with information to support their productivity, internet content and entertainment services as illustrated by Fig. 2-9 (inCode Telecom Group, 2001).

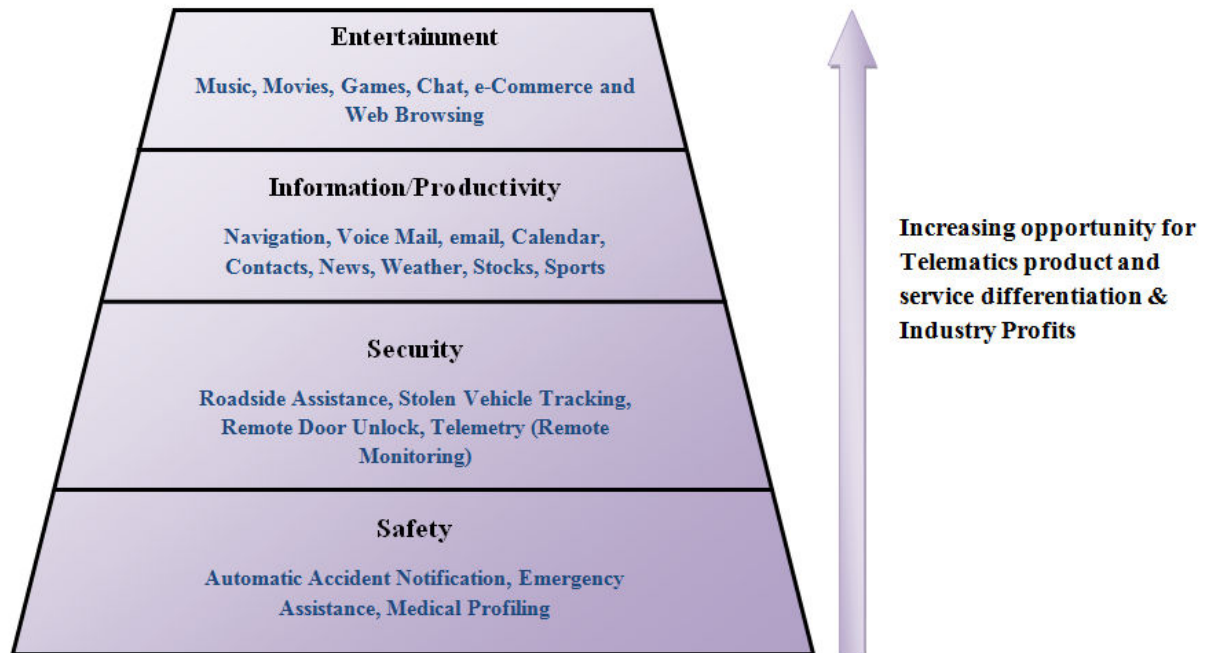


Fig. 2-9: Evolution of Consumer Telematics Interests (inCode Telecom Group, 2001)

In Europe, telematics services are mainly available in Germany, France, U.K., and Italy, and as in the US, it is led mainly by the automotive industry. The 48 countries of Europe have been slower in offering telematics services than other markets, because for one thing any pan-European telematics systems must accommodate multiple-languages. In addition, there have been issues with technical specifications, standardization of wireless communications, and higher usage fees. However, the market is expected to grow sharply in the future because European consumers pay considerable attention to navigation and traffic information (Shimizu, 2004).

It is noteworthy that telematics applications in European countries are not limited to the automotive industry. Other applications are being studied or developed for monitoring water and air pollution, for medical informatics and health care, and for distance learning. Many European countries are developing uniform policies to integrate telematics applications into government, business and education.

Korea and China have witnessed significant economical development in recent years, mainly as a result of their technological development in the areas of ICT and its related

semiconductor technology. Today, a significant percentage of all telematics-based hardware (including GPS receivers) is manufactured in China, Taiwan and Korea.

A recent study from Korea concluded that, the country's telematics market is expected to become an important part of the global telematics industry (Song, Kim, Yu, Lee, & Lee, 2012).

In China the government selected the telematics industry as one of China's three main growth engines and invested more than RMB 10 billion to produce more than 200 million cars with telematics technology by 2020. Since then, many stakeholders including those in the automobile industry have regarded the telematics industry as an important symbol of advancement, innovation, and value added; thus, they have focused on developing and providing a wide range of telematics products and services. In recent years, Korea and China, taking advantage of their geographical proximity, have engaged in bilateral negotiations and trade to expand their telematics presence (Song, Kim, Yu, Lee, & Lee, 2012).

In conclusion, the telematics industry has received increasing attention by users. However, there are still many issues surrounding the telematics industry that need to be addressed both academically and economically. For one thing the industry is still in its initial life cycle stage, and there are still substantial development gaps between countries. But the future potential is very promising. On average, the global telematics industry has grown 37.8% per year since 2006, and it is expected to reach USD 119.4 billion (Song, Kim, Yu, Lee, & Lee, 2012). In the future, it is expected that almost all cars in the world will have some form of telematics device. According to Allied Business Intelligence (ABI research - specialized in global technology markets), the global shipments of commercial telematics' products is expected to reach 6.4 million by 2016 (ABI Research, 2011). Indeed, industry forecasts suggest that fleet management and tracking systems will experience an annual growth rate of 27% every year until 2016 (ABI Research, 2011).

Chapter 3: Vehicle Telematics

In this chapter we are going to introduce and focus on vehicle telematics as a component of telematics systems, and elaborate on the importance of VTMS as a fleet management tool. Finally, some examples of vehicle telematics applications will be presented from around the world.

3.1 Introduction about Vehicle Telematics

Vehicle telematics is the use of computing, sensing and telecommunication technologies to provide services in an automotive environment to enhance the functionality, productivity and security of both vehicles and the drivers. Vehicle telematics services include navigation, remote diagnostics, fleet management, safety, information access, and mobile commerce. Supporting these services requires unique hardware and software architectures (Cassias & Kun, 2007), as it was illustrated under section 2.3.

In addition, vehicle telematics gives a fundamental solution to various issues concerning transportation which includes road accidents, traffic congestion, managing road usage (intelligent transportation systems), and environmental pollution. This ICT link between the users/driver, vehicles and roads will enhance the security and safety for both drivers and vehicles, and will utilize the existing transportation network, as summarized in Fig. 3-1 (Shimizu, 2004).

Moreover, vehicle telematics systems are used for vehicle tracking, recovering stolen vehicles, pricing auto insurance, providing automatic collision notification, and for providing remote diagnostics of vehicles' engines. Fig. 3-2 summarizes the objectives and benefits of applying VTMS.

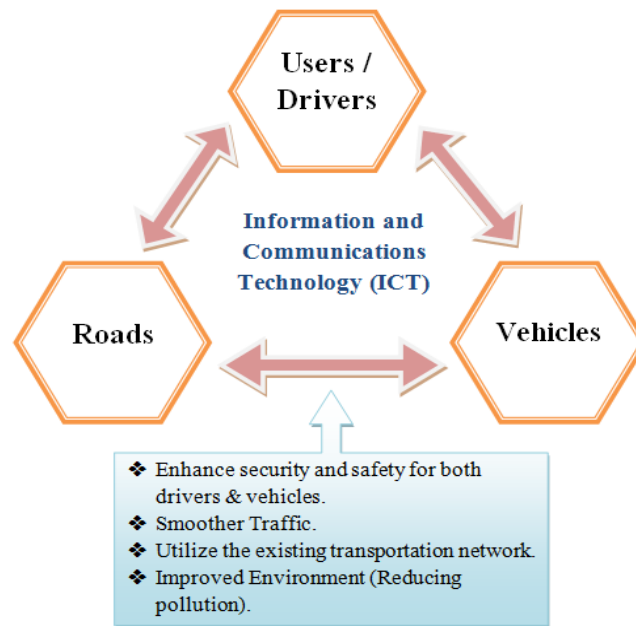


Fig. 3-1: Concept of Vehicle Telematics Management Systems (Shimizu, 2004)

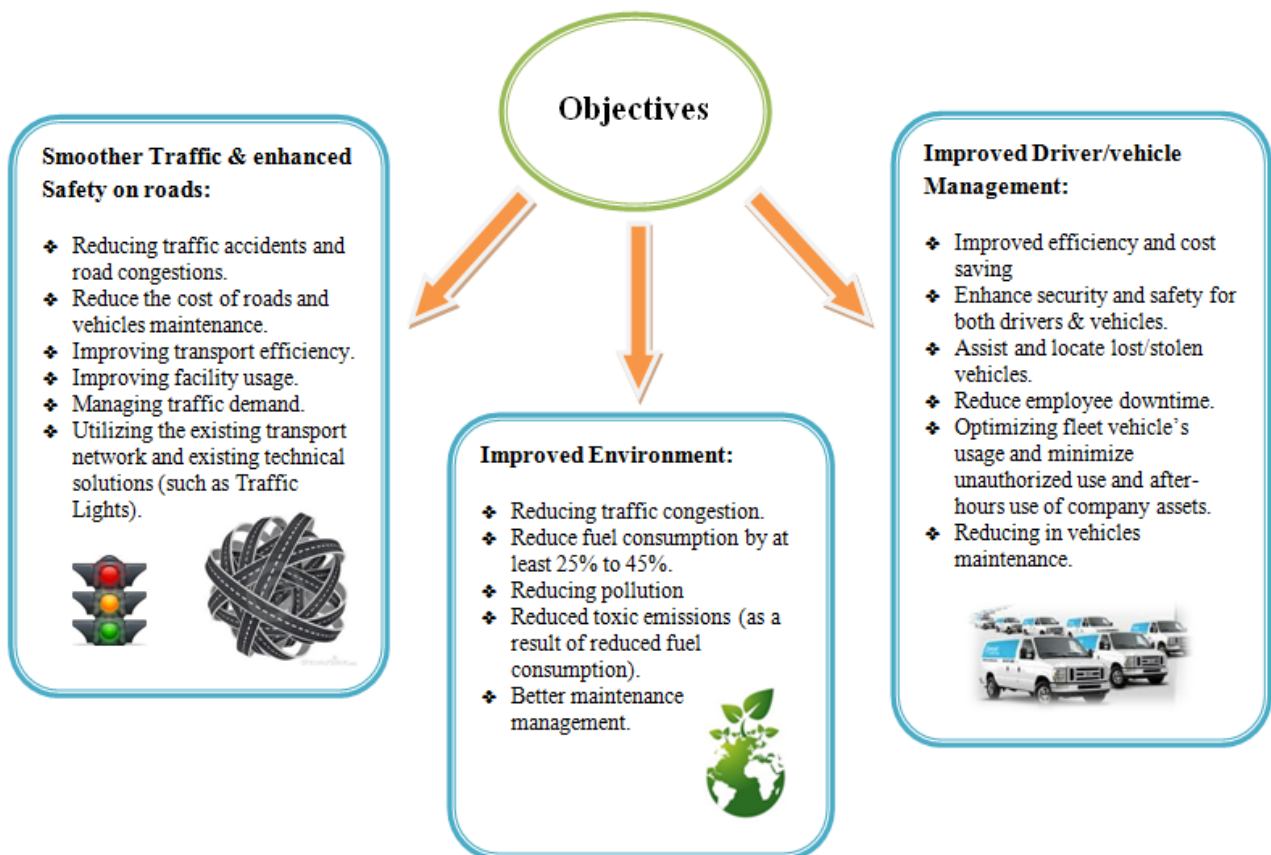


Fig. 3-2: Objectives of VTMS

3.2 Role of VTMS in Modern Transportation Development and Planning

As mentioned earlier, VTMS received increased attention from consumers and manufactures in recent years. Moreover, the increase in car ownership and traffic density, combined with the high penetration of mobile technology has boosted the VTMS development (Hutchinson, 2004).

Design and development of VTMS in transport systems represents a new approach to solving transportation problems. Telematics offers large opportunities to strengthen the positive features of transport (e.g. availability and mobility) while minimizing its negative impacts (e.g. environmental pollution, energy consumption, traffic congestion, and accidents). The modern VTMS offers the transport users a revolutionary opportunity to effectively utilize its transportation services (Mikulski J. , 2012). Fig. 3-3 summarizes the opportunities and expected benefits for industry, government and community from applying VTMS (National Transport Commission (NTC), 2011).

3.3 Importance of VTMS as a Fleet Management Tool

Fleet management services typically utilize vehicle location and diagnostics capabilities for the remote monitoring and management of vehicle assets. Fleet management is purposed to improve the logistics, scheduling, reliability and availability of services supported by vehicle fleets such as, emergency vehicles (e.g. ambulance, electricity, water and fire brigade), delivery cars, carrier trucking, car rental, construction vehicles, taxis, waste collection and buses. The demand for advanced logistics services has increased in recent years due to the following reasons: increased demand for transportation services, the need for higher quality services, and the increased competition in the transport industry (Cassias & Kun, 2007), (Giannopoulos & Boulougaris, 1994).

The dispatching operations for large vehicle fleet services such as construction vehicles, taxis and rental cars can benefit from the adoption of fleet management services. Dispatching will help to overcome inefficiencies in traditional radio paging dispatch systems for taxis and will improve accuracy and efficiency of work (Liao, 2001).

Opportunities for ...

The road freight sector:

- ❖ In-vehicle Telematic has the potential to improve the way industry operates. In the road freight sector it is an enabler of:
 - Supply chain productivity through:
 - ✓ Improved management and asset coordination
 - ✓ Better access to infrastructure
 - ✓ Visibility of inventory movements along the supply chain
 - ✓ Information to proactively manage driver behavior, vehicle speeds, loading, engine performance and fuel consumption.
- ❖ Better management of regulatory and compliance obligations.

Governments:

In-vehicle telematics opens up opportunities to achieve policy objectives through regulation, including:

- ❖ Improved road safety through more effective compliance monitoring (e.g. speed and driver weariness management).
- ❖ Better management and safer use of vulnerable infrastructure (e.g. matching vehicles with roads and bridges).
- ❖ Smart compliance tools to reward 'good operators' and identify non-compliant operators.
- ❖ Better management of the environment (e.g. low emission zones near communities heavily exposed to truck movements).
- ❖ Better access to infrastructure and resource-use efficiency (e.g. potential road pricing applications and higher axle weights).
- ❖ Reducing the expenditures and expanses on transport solutions and projects.
- ❖ Utilizing the existing transport network and existing technical solutions (such as Traffic Lights).



Benefits to the community:

Benefits from the use of in-vehicle telematics will flow through to the community. These could include:

- ❖ More cost-efficient freight transport, reducing the cost of goods and services.
- ❖ Controlling the traffic on roads which will result in reducing accidents and road congestions.
- ❖ Reduce the cost of road and vehicles maintenance.
- ❖ reduced road deaths and injuries through improved safety compliance and decreased exposure to crash risks
- ❖ Fewer truck trips will lower energy use and vehicle emissions as result from reducing in fuel consumption.

Fig. 3-3: Opportunities for industry, government and community achieved from applying VTMS (National Transport Commission (NTC), 2011)

Moreover, VTMS provides significant opportunities if used as a fleet management tool (Hussain., Zainal, Elmedany, & Fakhr, December 2012). These opportunities include:

- Enhancing security and safety for both drivers & vehicles.
- Improving customer service by recording arrival and departure times and dispatching the closest vehicle to destination.
- Improving efficiency and cost saving.
- Can be used as a routing planning tool.
- Enhancing driver management, by reducing employee downtime, eliminate excessive idle time and reducing the stress on dispatch personnel.
- Enhancing vehicle management, by assisting and locating lost or stolen vehicles, reducing in vehicles maintenance, optimizing fleet vehicle's usage and minimize unauthorized use and after-hours use of company assets.
- Detecting and isolating the faults in vehicles and automate the maintenance process before failures occurrence.

3.4 Vehicle Telematics Applications around the World

The main markets for telematics in the world are North America, Europe and East Asia. In Asia, Japan has the largest telematics market, but South Korea and Taiwan's telematics market are also growing rapidly (Lee, 2012). The rate of telematics usage is increasing globally and more number of vehicles is being fitted with these systems every day. The telematics market includes navigation systems, in-car infotainment and features for security, and remote diagnostics. Advanced telematics systems are in place in countries like Japan and Korea (Lee, 2012).

In the United State, roughly 26% of new vehicles are currently sold with a telematics solution that includes an embedded cellular device (IHS iSuppli Market Intelligence, 2011). By the end of 2018 the percentage of new vehicles sold in the U.S. with embedded telematics will grow to 80%. Similar ratios exist for developed European markets as well. Globally, the percentage of new vehicle sold with embedded telematics will grow from 14% today to 46% by the end of 2018 (IHS iSuppli Market Intelligence, 2011).

In Europe, fleet management/telematics is an ambiguous term used in reference to a wide range of solutions for different vehicle-related applications. Berg Insight's definition of a fleet management solution is a vehicle-based system that incorporates data logging, satellite positioning and data communication to a back-office application (Berg Insight AB, 2012). The history of fleet management solutions goes back several decades. On-board vehicle computers first emerged in the 1980s and were soon connected to various satellite and terrestrial wireless networks. Today mobile networks can provide ubiquitous online connectivity at a reasonable cost and mobile computing technology delivers very high performance, as well as excellent usability. All of these components combined enable the delivery of vehicle management, transport management, driver management and mobile workforce management applications linking vehicles and enterprise IT systems.

Commercial vehicle fleets play an essential role in the European economy. According to official statistics there were 35.5 million commercial vehicles in use in 2008. Berg Insight is of the opinion that the European fleet management market has entered a growth

period that will last for several years to come. Individual markets may however suffer temporary setbacks, depending on the local economic developments. The number of fleet management systems in active use is forecasted to grow at a compound annual growth rate of 17.9 percent from 2.5 million units at the end of 2011 to 5.7 million by 2016. The penetration rate in the total population of non-privately owned commercial vehicles is estimated to increase from 8.8 percent in 2011 to 20.1 percent in 2016 (Berg Insight AB, 2012).

In China, the urban per capita area of paved roads only approximates 10.6 square meters, far lagging behind other countries which boast 15-20 square meters of paved road per capita (ResearchInChina, 2012). Meanwhile, the urban vehicle ownership is ballooning at a growth rate of 15%, while the growth rate of road areas only reaches around 3%. Therefore, intelligent transportation system (ITS) and VTMS have become important means to improve the efficiency of road use and reduce the imbalance between traffic supply and demand.

According to the plans of Science & Technology Division of the Ministry of Transport of P.R.C., China will complete the implementation of a major road telematics project by 2015, allowing drivers to obtain travel plans and real-time travel information, at any time and from any location. Moreover, China will carry out the monitoring of vehicles transporting dangerous goods, buses, taxis and rail traffic through the whole travel cycle (ResearchInChina, 2012). Vehicle telematics application is also spreading in other developing countries, including GCC, but obviously at a lower rate than those of North America, Europe and the Far East. Unfortunately, published data on telematics market in the GCC is scarce, and the author was not able to get any data for the GCC region. This is one area that requires further research in the future.

It can be seen from the above discussions that government regulation is an important driver in telematics development. For example, in China the government is taking an active role in economic planning and development and the industry as a whole, with many supply chain players wholly or partially state-owned, looking to the government for guidance and funding. There is a great initiative from the government in China as it sees telematics as a new venue of GDP growth (IHS iSuppli Market Intelligence, 2011).

Chapter 4: Vehicle Telematics in Bahrain

This chapter will discuss in details the current vehicle telematics situation in Bahrain providing market analysis and data on potential market growth. The chapter concludes with a presentation of the main obstacles and challenges to the growth of vehicle telematics market in Bahrain.

4.1 Introduction

This section will start with introducing the current Bahrain geography, population growth and economical development and ending with the current transportation situation in Bahrain.

4.1.1 Bahrain Geography and Economy

The Kingdom of Bahrain comprises an archipelago of thirty-three islands in the Arabian Gulf, situated close to the shore of the Arabian Peninsula. The islands are about twenty-four kilometers from the east coast of Saudi Arabia and twenty-eight kilometers from Qatar. The overall inland area of Bahrain expanded to 765.3 square kilometers in 2011, up from 759 square kilometers in 2010. Six years ago, the area of Bahrain was 741.1 square kilometers before expanding to top 757.9 square kilometers in 2009 (Central Informatics Organization, 2012). The increase is considered normal, especially since the Kingdom is witnessing a boom as a result of urban development and increasing housing projects.

The Bahraini population growth over the past years has been almost constant at around 6%. The total population as of 2011 is reported to be around 1.195 million as shown in Fig. 4-1 (Central Informatics Organization, 2011). The 2011 population was made up of 584,688 Bahrainis and around 610,332 non-Bahrainis.

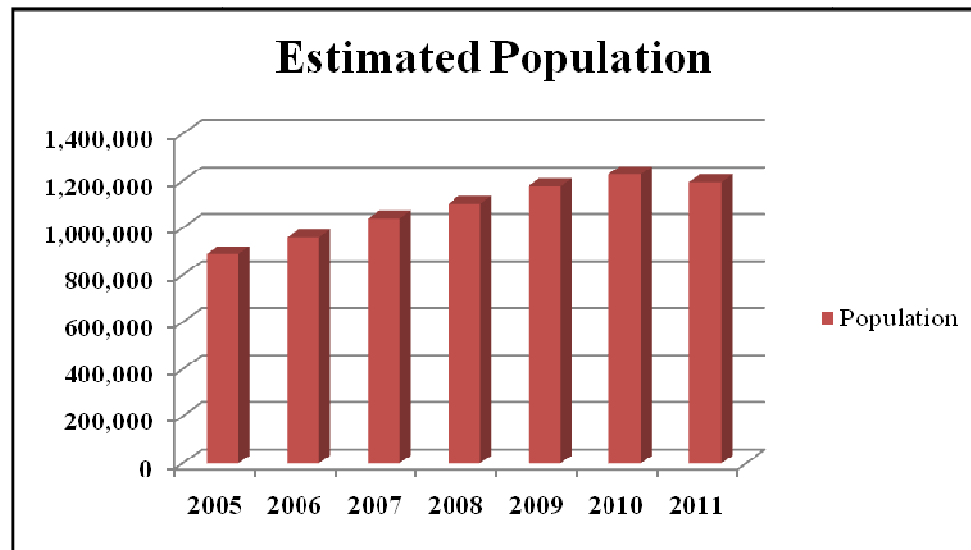


Fig. 4-1: Estimated population of the Kingdom of Bahrain (Central Informatics Organization, 2011)

On the economic front, Bahrain has been witnessing an unprecedented economic growth over the past few years. Between the years 2005 and 2011 Bahrain's public spending continued to grow in response to a growing population and an expanding economy, except in 2009 where it declined due to the effect of the global recession and the real state crash. The Gross Domestic Product (GDP) for 2005-2011 is shown in Fig. 4-2 (Central Bank of Bahrain, 2012):



Fig. 4-2: Bahrain GDP at Current Market Prices (Central Informatics Organization, 2012)

However, the economy of Bahrain, as with the rest of the GCC is mainly oil-based. The Economic Development Board (EDB) in Bahrain reported that the economy is highly reliant on oil, which in recent years has accounted for more than 75% of the government revenues. Moreover, they stressed on the importance for Bahrain to diversify its revenue base away from oil, and to manage the government debts, which has continued to grow over the past few years (Bahrain Economic Development Board (EDB), 2012).

Bahrain has always led other GCC members on many fronts, not the least of which is education, penetration and use of technology, economic diversification, and modernization. Moreover, despite its small population relative to Kuwait, Saudi Arabia, and the UAE, the kingdom has one of the highest growth rates in the penetration of computers and mobile phones, reflecting the constant need by the population and the economy for the use of advanced technology and services. It is hoped that with these positive factors combined, the expected economic growth over the next few years should be healthy, despite the effect of the world economic crisis and the political situation of 2011.

4.1.2 Transportation in Bahrain

With the increasing economic activity and the rapid population growth the Kingdom of Bahrain is experiencing traffic congestion along majority of the transport arteries. Several road network improvement/capacity are being undertaken to support the rising traffic demands. However, there has been a growing concern to achieve sustainability in transport infrastructure development and protect the quality of environment (Ministry of Works).

Ministry of Works (MOW) concluded a comprehensive study to develop an Integrated Transport Strategy (ITS) for the Kingdom of Bahrain. At the heart of the vision for 2030 is a comprehensive public transport network comprising six transit lines with four types of transit technologies (Light Rail Transit, Mono Rail, Tramway

and Bus Rapid Transit) supported by an efficient feeder services system, for implementation in a phased manner by 2030 (Ministry of Works).

Bus is the only significant public transport mode. “CARS Transportation”, a contract agency under Ministry of Transportation, is operating buses on 12 different routes covering various regions of the Kingdom. These routes have limited coverage and lacks connectivity to offices, retail outlets and leisure facilities and do not comply with the standard norms of public transport accessibility to the people. With the average headway of 40 minutes, waiting times are excessively high. Extreme weather conditions, unfriendly design of bus stops, absence of comfortable seating arrangements on-board are some of the other factors strongly limiting the use of public transport facilities in the Kingdom (Ministry of Works). As a result the number of vehicles in the Kingdom has been growing at average rate of 6.7% between 2005 and 2011. The total number of vehicles on Bahrain roads reached a high of over 475,000 by the end of 2011 as illustrated by Fig. 4.3 (Central Informatics Organization, 2011). This increase in number of vehicles has caused to increase the traffic congestion, road accident, energy consumption and environmental pollution. Moreover, it has caused to increase the road and vehicle maintenance cost.

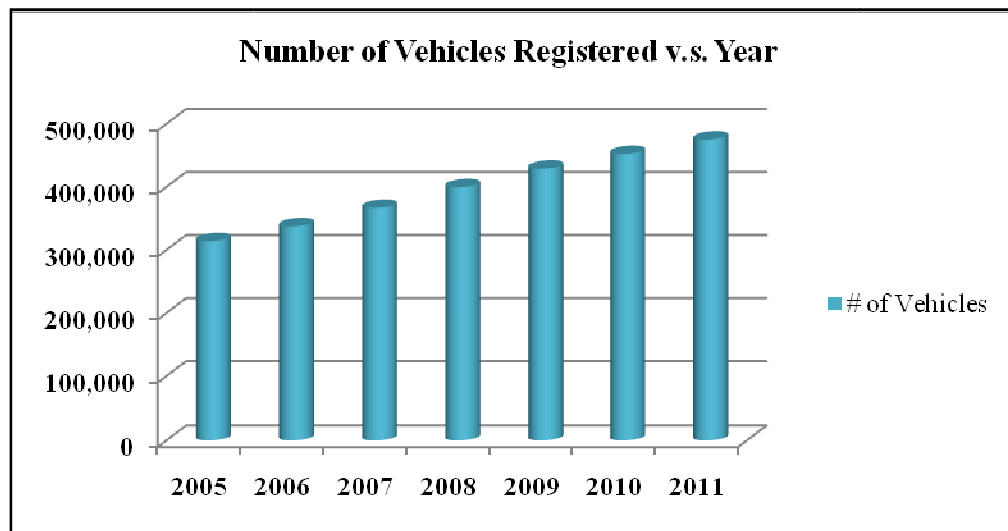


Fig. 4-3: Number of vehicles registered and in use (2005- 2011) in Kingdom of Bahrain (Central Informatics Organization, 2011)

4.2 The Importance of VTMS for Bahrain

We can conclude from the previous sections that VTMS is one of the solutions that can help in reducing the problems associated with traffic conjunction, accident reductions, passenger time savings, and helps reduce wear and tear of roads as a result of better control on heavy vehicles. Moreover, VTMS helps in reducing fuel usage, and ultimately will result in reducing air pollution and toxic car emissions. The total number of traffic violations from 2005 and 2011 are given in the charts shown in Fig. 4-4 and Fig. 4-5, which demonstrates a general increasing trend (Central Informatics Organization, 2011).

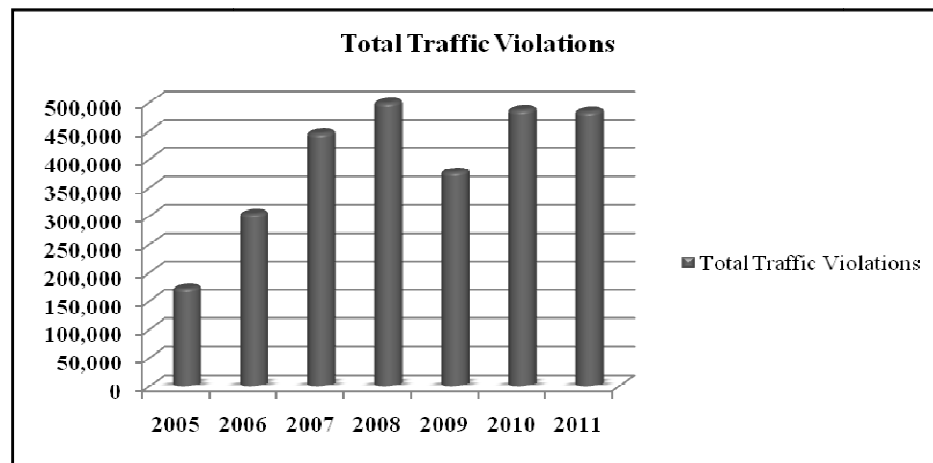


Fig. 4-4: Total Traffic Violations (2005 to 2011) in Bahrain (Central Informatics Organization, 2011)

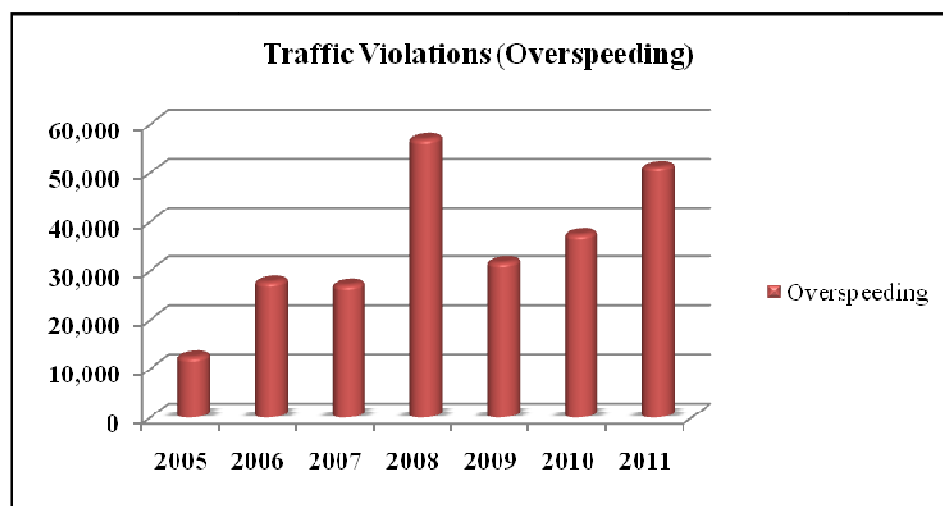


Fig. 4-5: Total Overspeeding Violations (2005 to 2011) in Bahrain (Central Informatics Organization, 2011)

4.3 VTMS Market in Bahrain

This section will discuss VTMS customers, potential market size, and obstacles and challenges to market growth.

4.3.1 Who are VTMS customers

VTMS customers are mainly vehicle fleet owners who belong to any of the following categories:

- Government organizations.
- Heavy vehicles (trucks and lorries).
- Constructions companies.
- Maintenance companies.
- Mechanical and electrical contracting companies.
- Delivery vehicles.
- Emergency vehicles.
- Busses
- Transport vehicles
- Waste collection vehicles.
- Taxi cars.

The above list constitutes the most likely customers who are normally interested in tracking services for their vehicles. Privately or individually owned cars are not considered potential customer targets for obvious reasons. The same applies to the privately owned cars used by family drivers, who are still reluctant to spend money on tracking.

4.3.2 Market trend and market potential

In 2005 Geomatec (a commercial arm of the dissolved Bahrain Center for Studies and Research) was the only VTMS service provider in Bahrain. This was due to the fact that Geomatec had its own in-house application with its own map data (both being core requirements for VTMS), and which no other companies in Bahrain had access to. However, the proliferation of online application services, and the “free available” access to online maps through Google, made it possible for small companies and resellers to enter into this market, by offering ready online solutions hosted by other suppliers from outside Bahrain. With this in mind, the market in Bahrain witnessed a drastic increase in the number of VTMS providers between years 2006 to 2012 as summarized in Fig. 4.6. These numbers were obtained from STS marketing records, and ministry of commerce (Hussain M. R., Zainal, Elmedany, & Fakhr, 2013), (Ministry of Industry and Commerce), and also from a telephone survey conducted by the author.

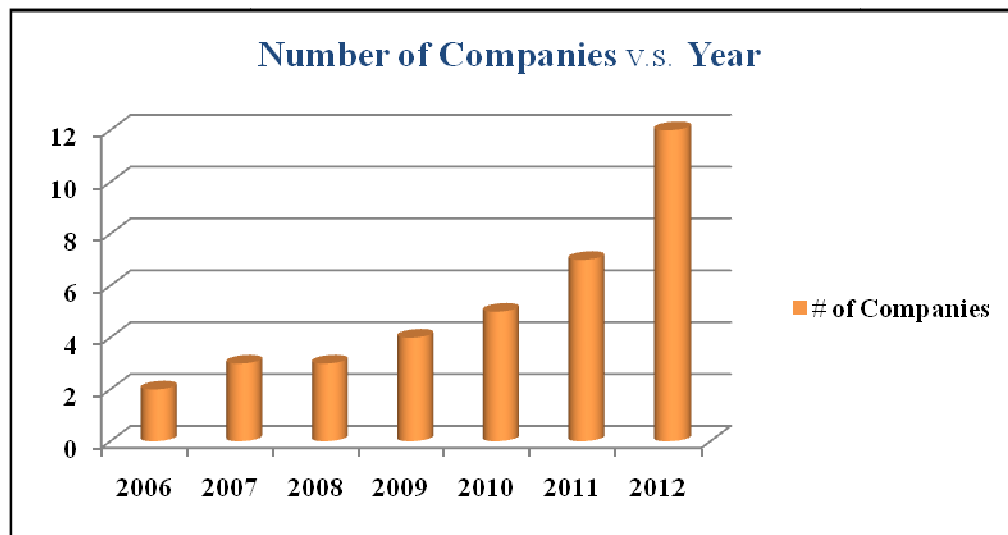


Fig. 4-6: Number of VTMS service providers in Bahrain (2006-2012) (Hussain M. R., Zainal, Elmedany, & Fakhr, 2013)

To assess the potential market for this service, we have analyzed the existing VTMS installations in comparison with the numbers of registered vehicles in Bahrain.

The approximate numbers of VTMS units installed by service providers in Bahrain between 2006 and 2012 are presented in Fig. 4-7. This information was obtained from the following sources:

- a) Telephone survey.
- b) Ministry of Commerce.
- c) Unpublished market data collected by STS.

The telephone survey was conducted by the author with the help of a colleague, and involved all the known VTMS service providers in Bahrain in 2012. This method was used (instead of a formal questionnaire) because from experience local companies do not respond to questionnaires, especially when they are related to their business and customers. Obviously such a survey method is not the most accurate, but it serves the purpose for the market study, and the information was also cross-checked with the market information available at STS. In the telephone survey, the respondents were asked to answer the following questions:

- a) Year started operation.
- b) Number of customers.
- c) Number of installations.
- d) Is the application and map data made in-house?
- e) The prices.

The data collected by the survey was used in the analysis. However, the individual records are not mentioned here because of the confidentiality surrounding the sources of data.

It is important to stress the point that these numbers are very approximate figures, but still they give a good indication of the market size and market growth. It can be seen that despite the growing number of companies and the increasing number of registered vehicles, the overall number of vehicles with mounted tracking devices remain very small (approx. 4,750 vehicles in 2012). Even if we consider an error margin of $\pm 20\%$, the resulting figure will be very small compared to the potential vehicle market capacity, as will be demonstrated next.

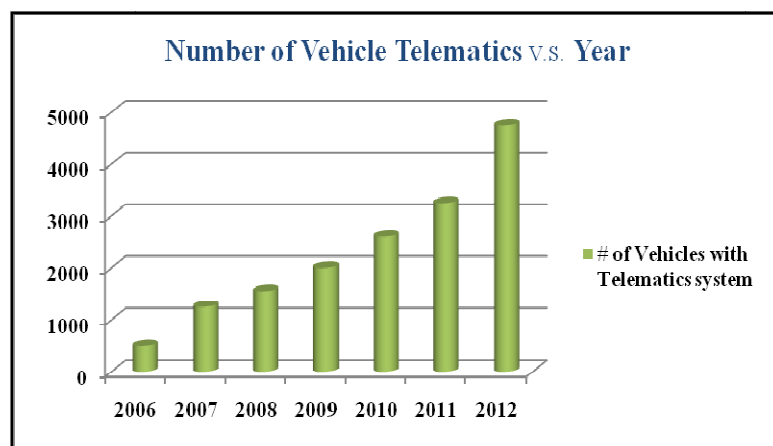


Fig. 4-7: Approximate Number of vehicles with mounted Tracking units in Bahrain (2006 to 2012).

Based on official data provided by the Central Informatics Organization and the Traffic Directorate, the total number of vehicles registered in Bahrain in December 2011 was 475,150, distributed among the categories summarized in Table 4-1 (Central Informatics Organization, 2011):

TABLE 4-1: Number of Vehicle Registered in Bahrain and in use (2011) (Central Informatics Organization, 2011)

#	Item	# of Vehicles	% of total	% VTMS Potential	Total potential per category
1	Private	342,218	72.0	0	0
2	Private Personal Transport (Buses Only)	10,621	2.2	0	0
3	Motor Cycles	8,120	1.7	0	0
4	Private Vehicle to Transport Passengers	1,106	0.2	0	0
5	Consulate Diplomat	831	0.2	0	0
6	Taxi on Request	58	0.0	0	0
7	Private Goods Vehicle (Pickup, Lorry)	39,760	8.4	100	39,760
8	Private Hire	37,616	7.9	30	11,284
9	Double Cabin Private (Pick-up)	21,811	4.6	60	13,086
10	Professional Use	8,944	1.9	100	8,944
11	Taxi	1,420	0.3	20	284
12	Semi -Trailer	1,378	0.3	100	1,378
13	Combined Double Cabin Pick-up	610	0.1	100	610
14	Public Transport (Government)	532	0.1	100	532
15	Public Transport Local (Buses)	125	0.0	100	125
Total		475,150	100		76,003

Note: The % potential figures for the different categories are assumptions based on market experience and market information obtained from STS, which excludes the % of individual registrations assumed for each category.

Based on this data, and if we exclude all categories which are currently not considered potential targets for the VTMS business owners (indicated by the 0% potential in table 4-1), we estimate that at least 76,000 vehicles (approx. 16% from the total number of registered vehicles in 2011) are potential target customers for VTMS business owners. This is the sum of the total number of vehicles in all the remaining categories that have the potential to become VTMS customers (i.e. categories number 2, 9-15).

Therefore, if we compare the approximate total number of installed VTMS units in year 2012 (being less than 5000) with the above total of approximately 76,000, we can see that only 6.5% of potential vehicles have currently deployed VTMS. This is an indication that the business growth potential for VTMS is still large despite the small market of Bahrain. And if we take into consideration the annual increase in the number of new vehicles, the potential becomes even higher.

In summary there are several factors which have contributed recently in the proliferation of VTMS as a business in Bahrain, which applies elsewhere as well. The main factors are:

- The availability of online “free” maps (e.g. Google) which was not available before.
- The availability of low cost hardware “vehicle telematics modules/units” from China.
- The availability of low cost cloud hosting (where the application is hosted outside by other service providers).
- The availability of GSM/GPRS wireless communication coverage all over Bahrain with low monthly charges.

All the above factors made it easier for general trading companies, not having expertise in IT and mapping, to enter into this business. However, as mentioned

earlier under section 4.3.1 that despite the growing number of companies and the increasing number of registered vehicles in recent years, the overall number of vehicles with mounted tracking devices remains very small. On one hand this is good news for business owners, because it shows that there is a potential for growth. On the other hand, the low market penetration, with only 6.5% of the total numbers of “potential” registered vehicles having VTMS, indicates that there are certain issues and obstacles that need to be addressed. These issues are discussed in the next section.

4.3.3 Obstacles and Challenges to VTMS Market Growth in Bahrain

This section will discuss the main obstacles and challenges facing the VTMS market development in Bahrain. Actually, there are many reasons contributing to the slow growth of the telematics business in Bahrain. Some of these are due to local market conditions, while other factors can be attributed to government policies, which have hindered the development of the ICT industry, not only in Bahrain, but in many developing countries in general. The issues discussed below are based on collective discussions held with Spatial Technology Solutions (STS) company management, and with two other experienced ICT business officials in Bahrain; Dr. Ghulum Bakiri (Bakiri, 2013) and Mr. Abdul Rahman Al Sindi (Sindi, 2013). The points are also summarized and illustrated in the Cause-and-effect Diagram in Fig. 4-8:

- Small market size. The small market size of Bahrain (both in terms of geography and population) poses a challenge for business growth, not only for telematics, but for other business as well. This is a major concern in general for any company thinking of investment in the local market. The small geographical area of Bahrain (compared to other GCC countries) poses an additional obstacle for VTMS, because the fleet sizes will be smaller. This becomes obvious when we compare for example the average fleet sizes of construction companies in Bahrain (50 to 70) compared to those in KSA (in the hundreds).

- Lack of market awareness about the benefits of vehicle telematics. The fact still remains that many consumers (i.e. fleet owners and operators in both the private and government sectors) are still not aware of the benefits that fleet telematics can bring to their business. The interest has increased in the last two years or so, but there are still a large number of them who have not been approached or still need to be convinced about the benefits of VTMS. The service providers are to be blamed in this because it shows that they lack proper marketing and sales. This was evident during recent exhibitions held in Bahrain, where many of the visitors to the STS company stand mentioned that they were not aware of the VTMS services in Bahrain and of their benefits.
- Low Level of ICT Penetration in the Small & Medium Size Industry (SME): Compared to the government and large private sector companies, the level of ICT penetration in the SME sector is still low. Many of the SME business owners are still not ready to spend on advanced technology. This is indicated also in the Global Information Technology Report 2010-2011 (Dutta & Mia, 2011) which have ranked the business ICT readiness of Bahrain in the 67th place among the countries of the world. The trend however is changing with the younger generation taking control of their family businesses. Moreover, the recent launch of the Technical Support Scheme by Tamkeen (Takaniya) is also expected to increase the ICT penetration in the SME sector. Through this scheme, Tamkeen covers 80% of the cost of new ICT implementation for SME companies.
- The political unrest: The political situation which started in Bahrain in 2011 has negatively impacted the local economy pushing new investors away. In addition to that many existing fleet owners and potential clients (especially in the construction companies) are still reluctant to spend money on VTMS, or on other new projects under the circumstances.
- Lack of local ICT talents. The banking and real estate boom during the last decade, coupled with a relatively low pay in the ICT industry has prompted most of the local students to study banking and finance-related subjects, with

fewer students majoring in ICT and engineering. In fact, what made matters worse, is that for the same reasons many of the talented young graduates (many with engineering and ICT backgrounds) went to work for financial institutions who offered them much higher pay and benefits, and many of them changed their field for that purpose. As a result of this, the private sector, and particularly small companies suffered in the process, and had to settle for less capable ICT graduates, or to depend on foreign cheaper labors to fill the gap. The government has not done much to help in this regards. In fact, and in some ways they made matters worse for the private sector by competing with them in attracting whatever ICT skills were left (since the government was able to pay them higher salaries at the expense of the economy). The result is that the ICT sector (especially in the small and medium sized companies) lacks sufficient local young talents that can contribute to the development of the industry with new ideas.

- Destructive competition from non specialized re-sellers. These are mostly companies or re-sellers not specialized in the ICT field, whose main objective is to make a quick financial gain, without much attention to quality. They rely on low cost off-shore solution providers (mostly from China) and become their resellers, without making much investment in the system, or in the after-sales support. These companies can harm the market, because they sell their services at a low price (as they have very low overhead cost), and in doing so they put pressure on the market price (especially in our market conditions where customers are very price sensitive). Many of these companies have a very small customer base as they are unable to expand and reach large and educated customers, and many of them would eventually close down this service, but only after having negatively impacted the market.
- Lack of funding channels: Lack of funding for start-ups (e.g. venture capital), have discouraged the technologically capable companies from investing into developing quality products and services, and this has obviously contributed to lack of innovation in the private sector. This is a common problem in many developing countries (particularly many Arab countries) in which there is no

funding channels available (from government or private) for ICT start-up companies. Bahrain Development Bank (BDB) has funding programs for start-ups (as soft loans), but is not directed to ICT development, and does not cover R&D. Tamkeen also has some good schemes to support small and medium size companies (including marketing schemes, soft loans, and partial funding of equipments) but again they do not have any special schemes to fund ICT initiatives, and nothing is directly committed to R&D.

- Lack of ICT/Telematics Research and Development programs at the University level. In fact there are no research institutes in Bahrain specialized in development or funding of ICT/Telematics programs. It is noteworthy that there are some applied research activities related to telematics undertaken by students as part of their senior projects (e.g. Computer Engineering Department in University of Bahrain (El-Medany, Al-Omary, Al-Hakim, Al-Irhayim, & Nusaif, 2010), (El-Medany, Alomary, Al-Hakim, Al-Irhayim, & Nousif, 2010), but they are done on individual basis most of the time, and lack the financial support needed to grow.
- Weak link between universities and the private sector: In many large universities in the west, they have ongoing R&D projects funded by the private sector. This is a win-win situation for both sides. The university gets funding and builds its reputation, while the funding company benefits from the outcome of the R&D, and may get tax deductions in some countries. Another important byproduct from this cooperation will be the market knowledge and experience gained by both the university staff and students, which will be beneficial to the industry. Graduate students who work on such R&D projects are more likely to continue in the same field, and will get better chances in employment, and some of them may become entrepreneurs. There have been some initiatives locally to forge links with the private sectors, but with little commitments from either side, and with very limited success. Even the founders of the newly formed Bahrain Technology Companies Society "BTECH" failed to recognize the importance of collaboration between industry and Academia, and did not even include the need to forge a link with the

universities, as an objective of the society. Much more efforts are needed from the universities before university R&D is taken seriously by the private sector. The recent announcement of establishing the “Research valley” at the University of Bahrain is a major positive step in this direction.

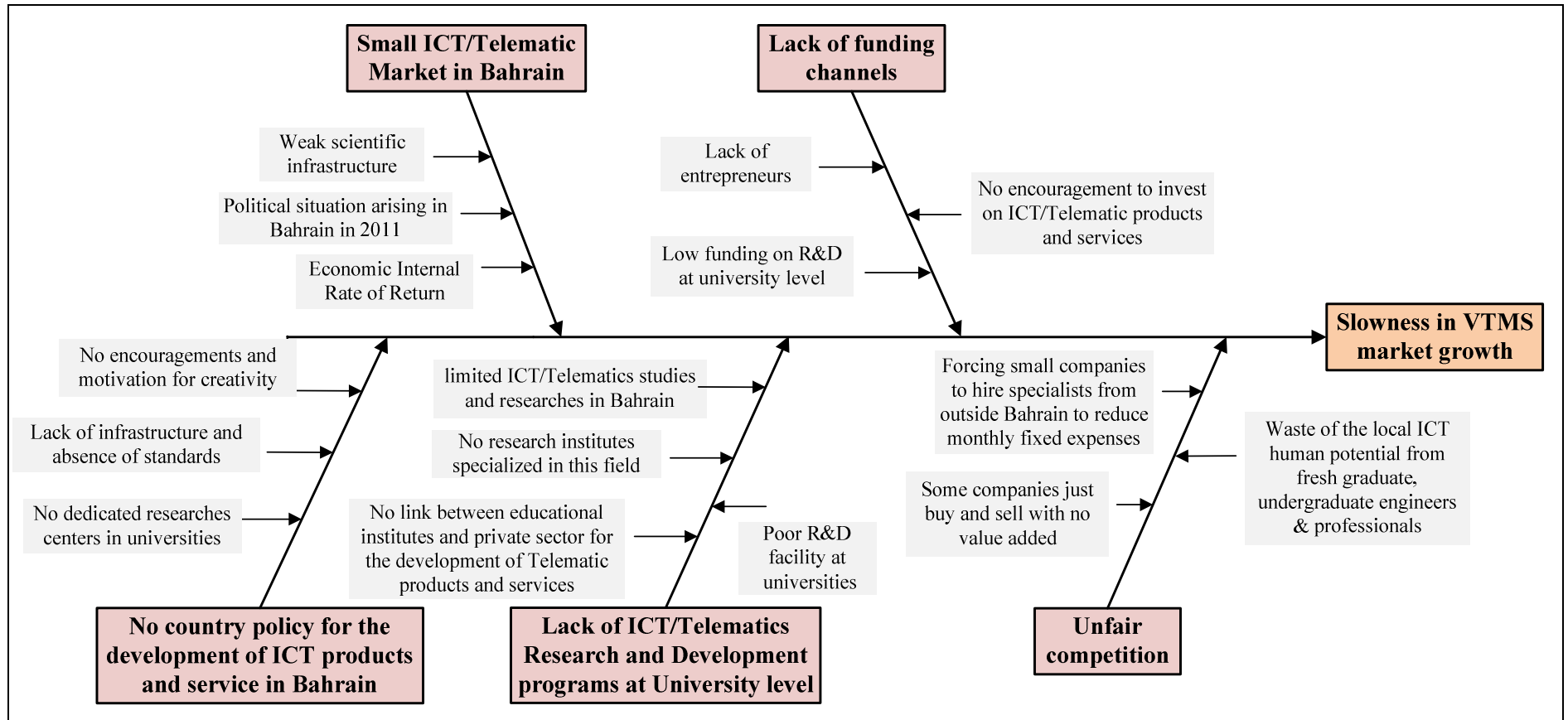


Fig. 4-8: Cause-and-effect diagram for the analysis of VTMS market growth in Bahrain

Chapter 5: STS as a Case Study for Bahraini Market

In this chapter a case study is presented based on the input and experience of Spatial Technology Solutions (STS) company, being one of the local market leaders in the VTMS business. This chapter will also demonstrate STS business growth and the main obstacles and challenges surrounding the business. Last but not least, this chapter also analyzes the strength and weaknesses of STS using the SWOT methodology.

5.1 Introduction

Spatial technology Solutions (STS) is good example of a newly established ICT company in Bahrain, with a clear business objective, striving to find a success path in the challenging local and regional market environment. STS was selected as a case study, due to the following reasons: first of all, it is small company just over two years old, with clear vision, focusing on VTMS. Secondly, STS has a very experienced management team both in the technical and business areas, with more than 10 years experience in the field. Last but not least, STS managed to become profitable in a relatively short period of time, achieving more than 100% return on investment in 2 years. However, despite that, the total revenue of STS Company has not met its target set by the company's management. Moreover, there are certain threats and weaknesses surrounding the business, which must be dealt with in order to reduce business risk and reach a sustainable growth level. These issues will be dealt with in this chapter which starts with a presentation of STS products and services, followed by a description of the company's competitive advantages. The chapter concludes with a detailed SWOT analysis with the objective of identifying the Strength, Weakness, Opportunities and Threats surrounding the business of STS.

5.2 STS Profile

STS is a privately owned ICT company based in the middle of Manama city in the Kingdom of Bahrain. STS began operation in January 2011 as an establishment under Zainal Trading, and in March 2012 it became a fully registered WLL company. The company specializes in providing wireless GPS-based solutions to both public and private sectors, using advanced ICT technology tools. Moreover, STS provides consultancy and conducts R&D in relation to the utilization of such technologies for commercial applications (Zainal, 2011).

5.3 Description of Products and Services Offered by STS

STS offers diversified mix of geospatial products and service in ICT/telematics field; Vehicle Telematics and Management system “**SmartTrack**”, In-car navigation solution (GPS) and GPS-based vehicle dispatching “**SmartTrack–Dispatch**” are the core products. In addition to that STS also offers customized navigable road maps for Bahrain, and provides consultancy in the area of telematics applications.

5.3.1 “SmartTrack” Vehicle Tracking & Management Solution

This is the flagship telematics products offered by STS. SmartTrack is a complete web-based fleet tracking and management solution, which comes with a wide array of standard and optional features to suite every customer needs. SmartTrack is built around proven hardware and software technologies from leading technology providers in the world including Microsoft (for the back-end server), ESRI  GIS for the mapping software (Zeiler, 2000), and leading GPS engine suppliers. The three main components of SmartTrack are the following (Hussain M. R., Zainal, Elmedany, & Fakhr, 2013):

- ***Vehicle-mounted tracking unit (VTU)***: a black box integrating a GPS engine with a GSM/GPRS mobile communicator to communicate with the SmartTrack online server. STS does not restrict itself to one supplier of VTU’s. In-fact

SmartTrack can be integrated with multiple types of VTU's from different suppliers, including major suppliers from the U.S, Taiwan and China. The different modules have different capabilities, and different costs catering for different customer needs. This is one advantage that STS can offer its customers in Bahrain.

- ***SmartTrack Vehicle Tracking Application:*** a web-based application that offer the users the ability to track their vehicles live, and to obtain historical reports giving details of their vehicles movements and status at any given time. SmartTrack is more than a vehicle tracking tool. The company considers SmartTrack to be fleet tracking and “management” solution, since it contains many features and reports that helps the fleet owners to manage and control their fleet operations. These include tools such as the following:
 - Driver/Vehicle Management,
 - Email reporting (allows customer to receive automatic reports on their vehicles by email),
 - Vehicle registration and driver license renewal notifications,
 - User management tools (allows customers to control application access by their users, and to assign different access levels to different users),
 - Monthly fleet statistical report,
 - Fleet Performance Index report (provides a standardized index of the performance for each vehicle/driver based on the calculation and comparison with the statistical mean and standard deviation of the monthly fleet movement data).

Some sample screenshots from SmartTrack application are illustrated in the Appendix.

- ***SmartTrack Hosting platform:*** This is the back-bone servers' platform which host the applications and mapping engine of SmartTrack.

5.3.2 In-car navigation solution (GPS)

STS also offers a complete in-car GPS solution based on the (GARMIN ) Personal Navigation Devices (PND) (GARMIN, 2013). The advantage that STS brings to the products is its detailed and updated navigable road maps which cannot be found in any other competing products. The customers targeted are large organizations interested in more detailed and updated Bahrain maps to assist their field crews find their destinations/assets (e.g. Electricity and Water Authority). This is not a large market segment but is very promising when combined with other related technologies.

5.3.3 GPS-based vehicle dispatching “SmartTrack–Dispatch”

This solution offers the client both a fleet tracking solution (for the control centre) and a stand-alone in-car GPS guided navigation device (GARMIN). This type of solution recommends for critical transport operations such as ambulance fleet management, taxi dispatch, and emergency repair dispatch. In this solution, a two-ways communication is enabled between the control room operator using tracking application, and the in-car dash-board mounted navigator and driver display device (via text messages). By using this system, the operator is able to dispatch a driver to an address, send, and receive preset commands to and from the driver. Two screenshots from SmartTrack-Dispatch application are also included in the Appendix.

5.3.4 Customized navigable maps

STS builds and maintains its own map data, giving it a unique advantage as discussed in the next section. One of the applications for this is the customized navigable maps used in Garmin in-car navigation PND. STS has signed an MPLC agreement with Garmin International in 2011, giving STS the license to produce map

products for Garmin devices in Bahrain. STS provides customized Garmin map products to major government organizations such as the Electricity and Water Authority, LMRA and Ministry of Works.

5.4 Competitive Analysis of STS

The term “competitive advantage” can be defined as the “advantage” that a firm has over its competitors, allowing it to generate greater sales, and/or retain more customers than its competition. According to Investopedia, a major online financial and investment site (Thompson, Strickland, & Gamble, 2010), there can be many types of competitive advantage attributes, including the firm's cost structure, product offerings, distribution network and customer support. A comparison between different companies that offer telematic services in Bahrain is given in Table 5.1, this comparison based on five main factors; business specialization, type of VTMS, application development source, map source, and customer care. Most of the companies in this comparison, they use Google map and they use outsourced application, in addition each of them offers only a few types of VTMS. STS on the other hand uses in-house map, and offers in house development, in addition to that it has more types of VTMS compared to the other companies.

STS management believes that the combination of the following attributes, which the company has developed and strives to maintain, gives it a competitive advantage in the local market:

- ***Diversified telematics products and Services:*** STS has a diversified mix of telematics products and services, such as **SmartTrack** VTMS, In-car navigation solution (GPS), and GPS-based vehicle dispatching “**SmartTrack–Dispatch**”. Moreover, SmartTrack is offered in two versions, with two pricing structure, giving it more flexibility and potential to reach a wider customer base (both small and large). In addition, STS also provides navigable GIS data products, and can provide consultancy in the telematics field.
- ***In-house map data production:*** STS map data is updated in-house by their team as a geographical database, and contains street address details (i.e. road

name/numbers and block numbers). This factor is crucial for generating informative and accurate location-based records for your fleet movements (i.e. records show vehicles' movements tagged with street address details). Most other competitors provide only the free version of Google Maps (as a background image) which does NOT make it possible to record the street address details in the fleet reports. Moreover, and compared to the quality of Bahrain map data used by Google (and other companies) STS maps are more accurate and updated, and they are ready to demonstrate this at any time. This (according to STS) gives "SmartTrack" products and services a technological edge over competitors.

- ***In-house Application development:*** The core applications including "SmartTrack" and the "SmartTrack-Dispatch" are developed and hosted in-house giving the company a total control over the applications and their customizations. This gives STS the advantage of being able to understand and respond to customers' needs and special requirements much faster and in a more professional manner.
- ***Customer Care Focused:*** STS is customer focused, and continuously enhances its products and services from customers' feedbacks. STS listens to the needs and requirements of its customers, and incorporates them into its products' development plans.
- ***Experienced local resources:*** STS strategy relies on developing and maintaining local manpower resources, who are expertise in the field of ICT/VTMS. In addition to that STS has access to highly trained and experienced VTMS and GIS professional who are employed by STS on part-time basis. Moreover, STS has a very experienced management team who possess both the technical know-how and the business knowledge of telematics and GIS applications.
- ***Introducing Latest Technologies:*** STS continuously researches the latest developments in the telematics field (both hardware and software), and acquires the latest and most cost-effective products that suit the local market needs. New

hardware technologies are thoroughly tested and evaluated (internally and by customers) before launching them into the market.

TABLE 5-1: Comparison between different companies that offer telematics services in Bahrain

#	Company Name	Business Specialization	Type of VTMS	Application Development source	Map Source	Customer Care
1	Hi-Net Bahrain (Hi-Net Bahrain, 2013)	• Advertising + IT solutions • GPS Tracking System	• GPS Tracking System	Unknown	• Google	Yes
2	Bukhari Salam Technologies (Salam, 2013)	• Fleet Management & Vehicle Tracking • Access control + Parking management	• Vehicle Tracking • Fleet Management	Outsourced Application	• Google	Yes
3	iCol (iTrack21) (iCol, 2013)	• RFID solutions + Security • Wireless and networking • Vehicle Tracking System	• Vehicle Tracking System	In-house Development	• Google • Navteq (licensed version of Google)	Yes
4	Mantech (Mantech, 2013)	• Hardware and Software solutions • Security solutions • GPS Tracking system	• GPS Tracking system	Outsourced Application	• Google	Yes
5	Bin Hindi (Bin Hindi, 2013)	• Computers and Mobiles • Cars, trucks & Construction equipment • GPS Fleet Tracking	• GPS Fleet Tracking • Personal Tracking	Outsourced Application	• Google	Yes
6	Signal Commercial Services (Signal, 2013)	• Cables • GPS Tracking system	• GPS Tracking system	Outsourced Application	• Google	Yes
7	King Phone & Electronic EST	• Radio, Mobiles & Electronics • GPS Tracking system	• GPS Tracking system	Outsourced Application	• Google	Yes
8	Vehicle Trackers (Vehicle Trackers, 2013)	• Cleaning Contracts • GPS Tracking system	• GPS Tracking system	Outsourced Application	• Google	Yes
9	E. K. Kanoo Group (Security 1) (Kanoo, 2013)	• Access Control & Security systems • GPS Tracking/Vehicle management	• GPS Fleet management	Outsourced Application	• Google	Yes
10	Abs Network S P C Owned By Mohd Fakhri	• Produce and Distribution Of Cinema, TV, Broadcast And Theatrical • GPS Tracking	• GPS Tracking	N/A	• N/A	N/A
11	Aziz IT and Telecom Company (Aziz, 2013)	• Applications & Solutions for telecom Infrastructure and Network Solutions • Vehicle Tracking system	• Vehicle Tracking system	Outsourced Application	• N/A	Yes
12	Spatial Technology Solutions (STS) (STS, 2013)	• Developing geo-spatial information and technological solutions • Vehicle tracking solutions	• Vehicle Telematics and management system (VTMS) • Dispatch system + Personnel tracking • In-car Navigation + Navigable data • Integrated Hand-held Mobile Solutions	In-house Development	• In-house Map update • Google map for satellite image	Yes

5.5 STS Business Growths

STS started with one major customer in January 2011. At present time (May 2013) STS has approximately 2000 vehicles representing nearly 40 private customers and government organization. When the study was conducted last year, STS had 1700 vehicles representing 35% market share of the estimated 4,750 total installed devices in Bahrain (see section 4.3).

Parallel with the increase in the customer base, STS has managed to become profitable in a relatively short period of time, achieving more than 100% return on investment in 2 years. However, it remains to say that the business is still small (in terms of total revenue). Moreover, there are serious challenges and threats surrounding the business, which makes it risky. Also, there are some weaknesses in the business which need to be addressed, in addition to external obstacles relevant to the market which needs to be discussed and dealt with in order for such a business to grow successfully. All these issues are discussed in the next sections by applying the SWOT analysis.

5.6 Strength and Weakness of STS (SWOT Analysis)

As illustrated earlier and given the market challenges described under section 4.3.2, STS has been relatively very successful in the 2+ years since its creation. However, the challenges and obstacles faced continue to hamper STS's ability to excel and expand its business and profitability.

Therefore, in order to analyze these business limiting factors further, we have conducted a SWOT analysis. The SWOT analysis is a business method used to evaluate the Strength, Weakness, Opportunities, and Threats involved in a business venture or project (Houben, Lenie, & Vanhoof, 1999). This tool helps in identifying the weaknesses and threats for a particular business, and how they can be turned into strength and opportunities. The SWOT analysis for STS is discussed below and the results summarized in Fig. 5-1:

5.6.1 Strengths

- Long technical and management experience in the domain. The management of STS and the key technical staff involved in the operation has more than 10 years of experience in the VTMS and GIS/GPS domain.
- In-house produced digital navigable road maps used in various applications and services (this is a competitive advantage which also lowers the cost of services) and gives “*SmartTrack*” solution and other location-based services an edge over competitors.
- Diversified range of VTMS products and services (from geospatial data production, to consulting and telematics application development under one roof).
- Customer care focused, putting always the customer ahead.
- In house application development allowing STS to respond and fulfill to customers special requirements.

5.6.2 Weaknesses

- On the “Internal” front, STS being a small company has limited human resources, which creates a business risk should any of the executives departs.
- Succession planning is non-existent at STS due to lack of adequate operational funding and tight headcount.
- At present, STS lacks dedicated research and development capabilities, which have to be undertaken by the existing staff (in-between other tasks).
- Moreover, lack of defined sales and marketing function and plan. The absence of these essential functions (marketing, sales and R&D) is the result of lack of funding which has prevented the creation and adequate staffing needed for these important functions.

- In addition, STS does not have clear and comprehensive quality documentation and procedures for its business processes which might affect the total quality management in the company.
- On the “External” front STS has no consistent source of funding to rely on for funding its R&D and strategic growth requirements. The lack of funding also means that STS cannot invest into R&D, and has prevented STS from recruiting dedicated sales and marketing staff.

5.6.3 Opportunities

- The increasing market awareness about the benefits of telematics (especially vehicle telematics), GIS and GPS in recent years provides good opportunity for increasing demands on vehicle telematics (GPS and GIS-based) products and services.
- The extensive local experience combined with the good reputation, would provide STS with a competitive advantage over its competitors in Bahrain.
- The increasing number of vehicles and fleets on Bahrain roads (see section 4.1.2), drives the need for more fleet management services and this provides excellent opportunity for revenue growth from this sector.
- The success of earlier large pilot projects with major customers, such as Electricity and Water Authority “EWA”, Bahrain Post, Public Transportation “CARS”, construction companies, etc..., provide an excellent opportunity for obtaining new large projects, with substantial revenue growth potential.

5.6.4 Threats

- Increasing competition from non-specialized re-sellers which may force price to go down.

- The current economic downturn could force new and existing customers to cut-down on new projects expenditure.
- The political situation arising in Bahrain in 2011 has caused the economy to slow down and although the tension has been reduced, but it is not yet fully resolved.
- No government protection or any incentives for local technology based services offering companies such as STS. Moreover, there is no encouragement to invest on ICT/telematics products and services, lack of funding channels, lack of entrepreneurs, and weak scientific infrastructure in this field.
- The local market place is very small by any standard, and hence the future growth of STS is totally dependent on local economic growth, support by government agencies, and also on its success to penetrate the regional market.

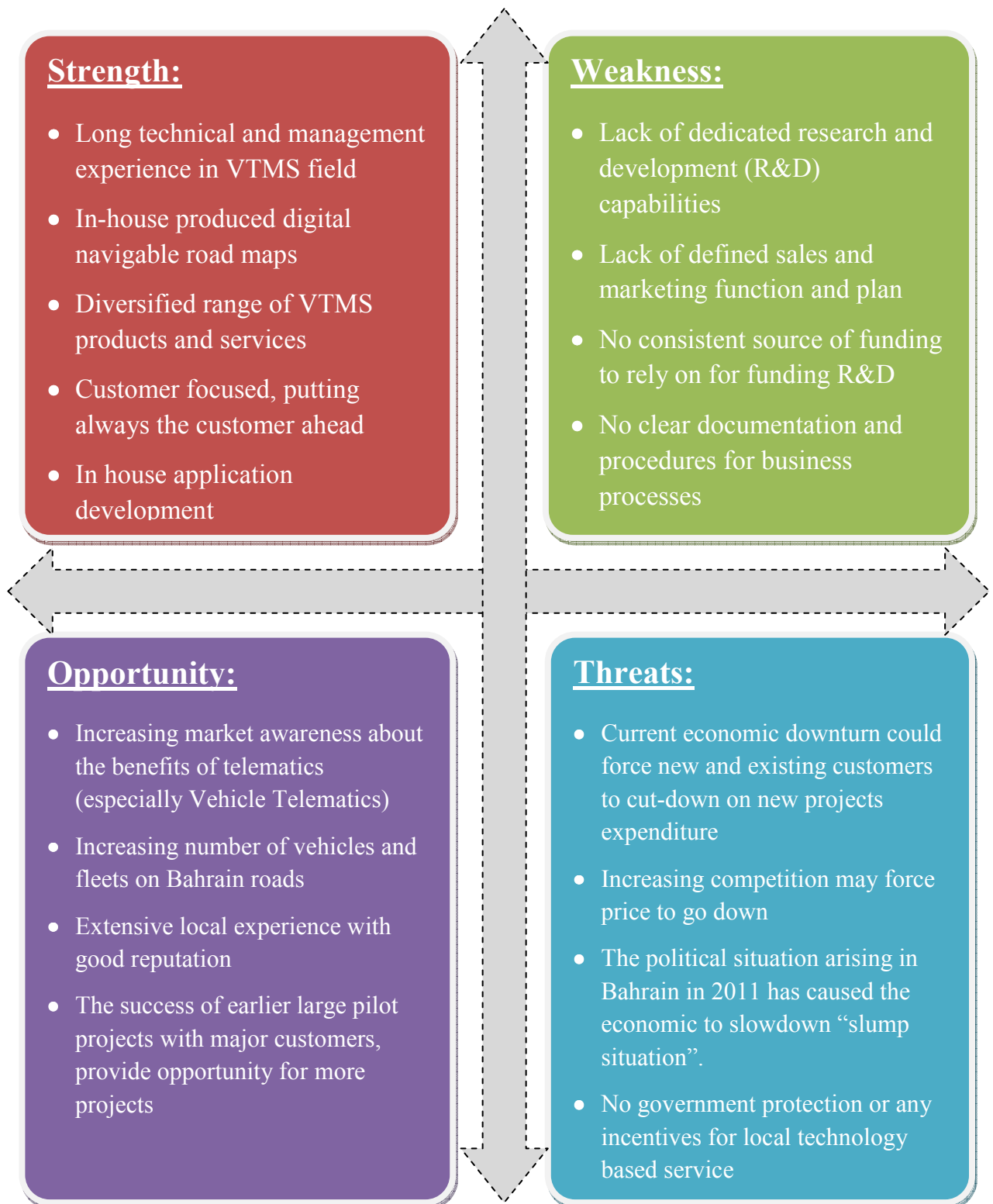


Fig. 5-1: SWOT Analysis Summary

Chapter 6: Recommendations

The recommendations are divided into three parts. The first part draws on the experience of STS (considering both its success and weaknesses), and lists the recommendations that will benefit start-ups entering the ICT market in Bahrain, and help them to maintain a successful business growth. The second part deals with recommendations related to government and policy making. Finally, the third part demonstrates some suggestions for future research work in the telematics field.

6.1 Recommendations for Start-ups

- To have clear business vision: the new company must have a clear business vision as to what it wants to achieve and where it wants to be.
- Product development strategy: it is important to have a “Product Development Strategy” to help the company in developing new products and services of potential interest to the existing market. Fig. 6-1 demonstrates Ansoff’s useful framework for detecting new intensive growth strategies, that can support the company’s management who are looking for the new opportunities to increase their sales and profits (Kotler & Keller, 2009).
- To have diversified products and services: this is particularly important in small markets. Companies should think of offering a diversified set of ICT products and service that complement each other, and provides value for customers. Some of the new VTMS emerging products and services which were mentioned under chapter 2, and deserve attention are the following:
 - Distance-based insurance applications.
 - Real-time traffic information. This needs to be addressed in collaboration with the concerned government authorities.
 - Personal tracking (in partnership with a third party company to manage the individual accounts).

- To have competitive advantage: the new company should strive to develop some attributes that will give it a competitive advantage. This can be a combination of attributes or strength areas that the company can develop by time, such as technology features, staff skills, quality of services, pricing, market reach and others.
- To apply Total Quality Management (TQM) for continuously improving the quality of products and processes, by providing quality training, process improvement, employee empowerment, benchmarking, and executive commitment which can produce advantage and meet or exceed customer expectations. Moreover, TQM is a potential source of sustainable competitive advantage (Powell, 1995).
- To expand into the GCC market: this is always a logical step to take for expanding the business, but needs to be done at the right time and with the right approach. For one thing it will require a large investment (for setting up the business) especially if the intention is to expand into KSA and UAE where the market and the geographical area are much larger. The best way forward for a small company like STS will be to expand through a partnership or joint venture with a local company or investors in those countries, who are ready to fund the setup and operation. Obviously this kind of regional joint-venture will be possible only after the start-up company has locally established itself successfully.
- To collaborate with the universities: ICT companies can collaborate with the universities and benefit from university students in doing certain projects and research for them.
- To allocate dedicated sales and marketing resources: the company must have dedicated sales and marketing resources. Also, it is important to concentrate on marketing and sales efforts by targeting high potential organizations in the private sector (e.g. companies with large fleet of vehicles). This is also one area that university students can be hired on part time basis, thus strengthening the

link with the university, and providing market experience to students in the ICT domain.

- To participate in local and regional events: it is important to participate frequently in local and regional events, as a way of increasing the awareness of the market about the VTMS technology on one hand, and promoting the company on the other hand.

	Current Products	New Products
Current Market	1. Market-penetration strategy (lowering price to increase market share in current market)	2. Product development strategy (Introduce new product to its current market)
New Market	3. Market-development strategy (develop new market with the current products)	4. Diversification strategy (Develop new products and services for new markets)

Fig. 6-1: Three Intensive Growth Strategies (Ansoff's-Market Expansion Grid)

6.2 General Policy Recommendations

- The government of Bahrain should take a more leading role to support the development of local ICT and telematics industry, through the following channels: Create policy for supporting innovation; the government should encourage innovative ideas and quality services by providing financial incentives and grants to local/small companies which have ideas based on sound business plans. Encourage R&D in ICT by providing financial support for companies which have innovative ideas and good business plans. This can be added as one of the schemes under Tamkeen programs.

- Create a center for ICT research and studies preferably under one of the related government branches or institutes such as University of Bahrain.
- Provide financial incentives for ICT university graduates to work for small and medium size companies in the private sector (same as in Kuwait) to compensate them for the better job security and higher salaries and benefits received in the government sector.
- Encourage and help to enable business links between the universities and private sector companies in developing ICT products and services, and giving the students and staff alike real experience of the market.
- The government should encourage private and public organizations to use ICT/telematics products and services for their fleet; this will lead to reduced fuel usage and reduce traffic congestion and air pollution on the roads. It can also play a major role in facilitating the implementation of traffic telematics since real-time traffic data is only available with the government authorities. Last but not least, published data on telematics industry in the GCC is very scarce. Future studies are needed to assess the telematics market in the GCC countries.
- The government of Bahrain needs to have an ICT strategic plan that can contribute to the economic and social development of the country. The plan should set clear goals to increase the use of the ICT in the SME, support SME to be regionally more competitive, increase R&D, increase the usage of the E-Gov services, increase collaboration between government and private sector, and between universities and private sector. The establishment of a research center specialized in ICT should be one of the goals.
- More research and studies are needed in the ICT market to fill the information gap. Studies on the ICT market in general, and the VTMS industry in particular is important for government planners and the private sector as whole. New studies should focus on VTMS and ICT contribution to the economy, government policies, market awareness about VTMS, level of ICT (including VTMS) penetration into SME, and ways to increase the awareness and market penetration.

6.3 Future research work

The following are suggestions for future research work in the telematics field:

- To study and investigate the feasibility of adopting vehicle telematics (based on the concept of *Distance-Based Insurance*) for vehicle insurance in Bahrain by involving consumers and insurance companies as well.
- To study the feasibility of implementing *Real-time Traffic telematics* in Bahrain covering all issues related to technical, economical, government role, and collaboration.
- To conduct studies on developing *Driver Behavior Monitoring* applications and integrate them with vehicle telematics systems. This will help in offering real time feedback to the driver so that they can instantly change their driving style as well as providing complete back office analysis of the driver behavior for the fleet owners, such as hard acceleration, braking, turns and speed.

Chapter 7: Conclusion

Many countries around the world have benefitted from the increasing demands for telematics products and services, allowing their private sectors and service providers to develop and thrive, thus contributing to their economical development. Locally, Bahrain market has also witnessed an increasing demand for telematics products and services, particularly in the last six years. However, despite the large growth potential for VTMS, the market growth has been very limited.

Based on the case study used, the thesis has attributed this slowness in market growth to the following main obstacles and challenge:

- Small Local market size.
- Lack of funding channels for start-ups (e.g. venture capital).
- Lack of R&D (hence no innovations in new products and services).
- Lack of market awareness about VTMS.
- Low Level of ICT Penetration in the Small & Medium Size Industry (SME).
- Weak link between educational institutes and private sector (i.e. the market).
- Destructive competition from non specialized re-sellers.

Spatial technology Solutions (STS) is a good example of a newly established VTMS service providing company in Bahrain, which was able to acquire the largest customer base in Bahrain, and achieving 100 % ROI in less than two years. However, despite this success, its total revenue remains small and the business has several weaknesses. A SWOT analysis was conducted on STS business revealed that the main areas of strength are in the quality of products and services offered (SmartTrack application features and maps) and the technical experience of its key staff and management. The main weaknesses identified were lack of dedicated research and development (R&D) resources, lack of defined sales and marketing function and staff, lack of funding to rely on for funding R&D and no clear documentation and procedures for business processes. The main threats facing STS and other ICT businesses in Bahrain in general are related to the

increasing competition from non-specialized re-sellers, and the current economic downturn which could force new and existing customers to cut-down on new projects expenditure as a result of the political situation in the country. Also, lack of government incentives for encouraging innovative ICT companies, and lack of a national ICT plan.

The thesis recommends that in order for an ICT businesses or a start-up company to succeed and grow in Bahrain, they should:

- Have clear business vision.
- Focus on the competitiveness of the company by offering unique and diversified products and services at competitive pricing.
- Find sources of funding for developing innovative solutions (Tamkeen existing funding schemes can help in this to some degree).
- Establish a link with the main universities, and use students in projects to help in development of new products.
- Allocate dedicated sales and marketing resources.
- Apply Total Quality Management (TQM) by involving all employees in the continual improvement of the company business processes.
- Participate in promoting the market awareness about VTMS in the media, and by participating and taking active part in local events.
- Expand into the GCC market through partnership, or joint venture with regional companies.

Finally, the government should take the responsibility to support the growth of local ICT and telematics industry and have an ICT strategic plan that can contribute to the economic and social development of the country. This can be done through a number of channels, e.g. creating schemes for supporting innovation, encourage R&D by providing financial support for innovative companies, creating a center for ICT research and studies, encourage and help to enable business links between the universities and private sector companies, encourage private and public organizations to use ICT/telematics products and services for their fleet, and last but not least by providing financial

incentives for ICT university graduates to work for small and medium size companies in the private sector.

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APPENDIX

Sample Screenshots from SmartTrack online application:

❖ SmartTrack live page:

The screenshot shows the SmartTrack live page interface. On the left, there's a 'Select Vehicle(s)' panel with checkboxes for 'Select All (4)', 'OBD', 'STS', 'KIA', 'TEST-1', and 'TEST-2'. Below it are 'View Options' including 'Sort By' (Date, Name), 'Refresh Every' (1 Minute), 'Fix Zoom Level', and 'Show Geofence'. The main area displays a map of Manama, Bahrain, with vehicle locations marked. A 'Summary Result' table is shown below the map.

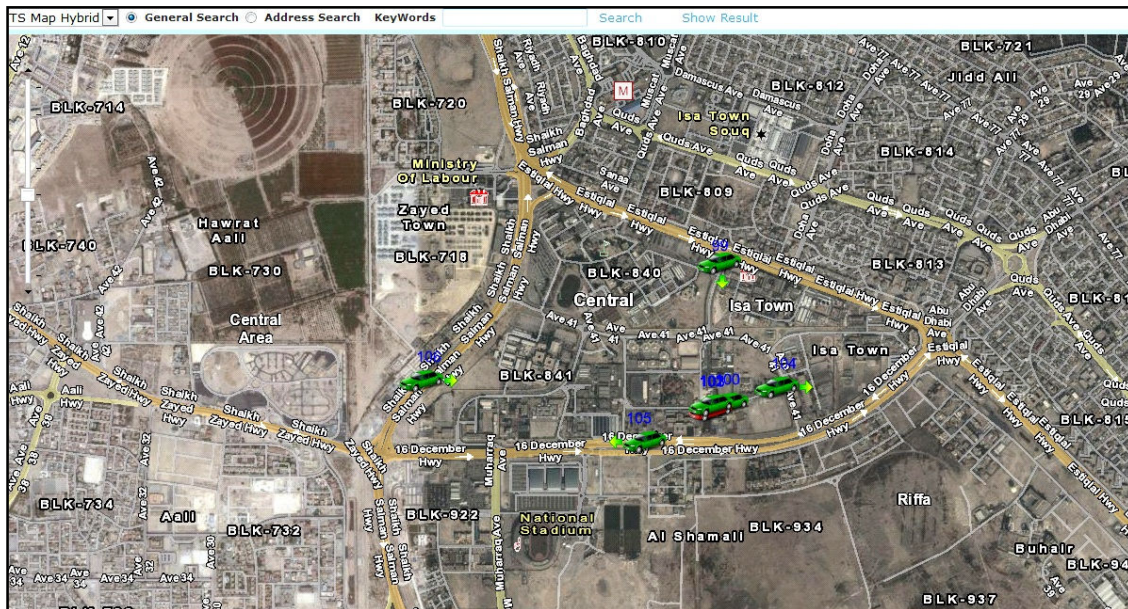
Vehicle	Driver Name	Date & Time	Location Block/Road	Veh Speed km/hr	Vehicle Status	GPS Signal
TEST-1	Mohammed	07/06/2013 23:06:32	Central Manama 306 / 641	0	Ignition Off	Strong
TEST-2	Ali	08/06/2013 06:39:19	Bu Ghazal 330 / 3007	0	Ignition Off	Good
STS_KIA	Sideeq	08/06/2013 06:51:42	Muharraq Town 207 / N/A	0	Running	Strong

❖ Live Vehicle information retrieved by clicking on the vehicle icon on the map:

The screenshot shows a close-up of the map area with a vehicle icon selected. A pop-up window titled 'TEST-2' displays the following information:

Vehicle	TEST-2
Driver Name (mob no)	Ali ()
Date & Time	08/06/2013 06:39 AM
Area (block)	Bu Ghazal (330)
Road Name (speed limit)	3007 (30)
Veh Status	Ignition Off
Veh speed (km/hr)	0 kmh

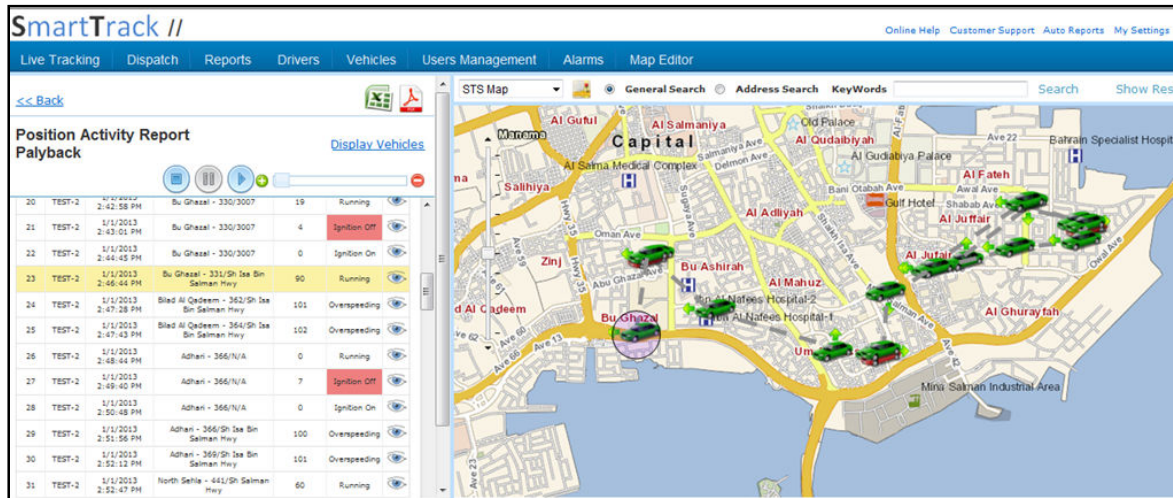
❖ Vehicles shown on Google satellite imagery back-ground:



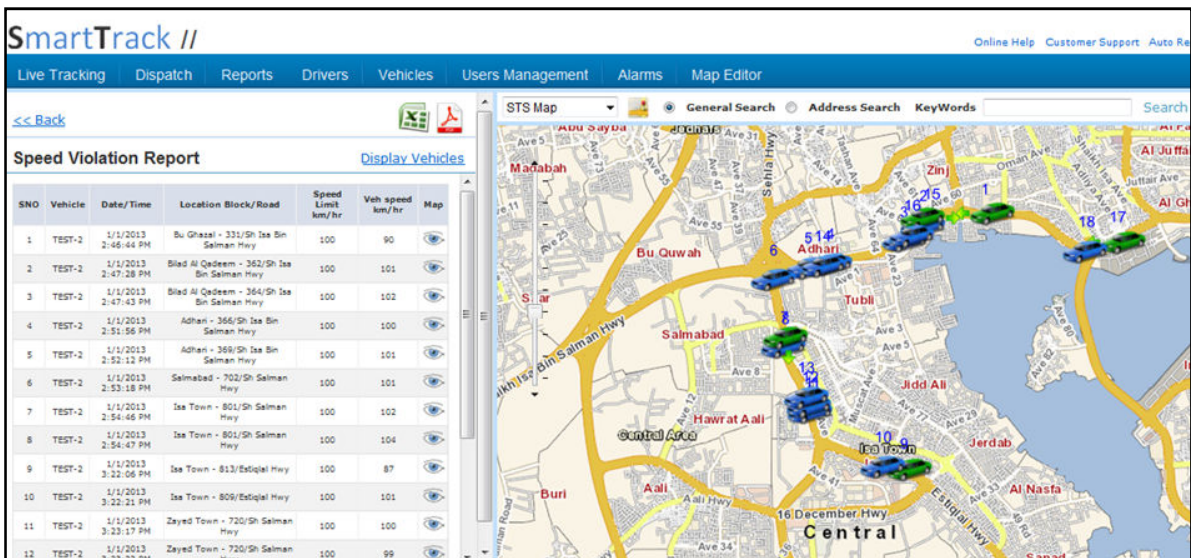
❖ A Sample of the vehicle historical routes from the Trip Report:

SmartTrack Trip Report										
Period: From 04/01/2013 12:00 AM To 04/01/2013 11:59 PM										
Vehicle: TEST-2										
Trip ID	Driver Name	Trip Start		Trip End		Total			Max Speed (km/h)	Stoppage Time
		Date - Time	Location Block/Road	Date - Time	Location Block/Road	Drive (Time)	Distance (km)	Idle (Time)		
1	Ahmed	04/01/2013 02:27 PM	Al Fateh 324 / 2437	04/01/2013 02:30 PM	Al Jufair 341 / 40	00:02:44	1.127	00:00:00	14	00:00:00
2	Ahmed	04/01/2013 02:32 PM	Al Jufair 341 / 40	04/01/2013 02:55 PM	Al Hoorah 318 / Maan Bin Zaedah Ave	00:22:49	9.656	00:00:00	60	00:01:48
3	Ahmed	04/01/2013 04:25 PM	Al Hoorah 318 / Maan Bin Zaedah Ave	04/01/2013 04:45 PM	Um Al Hassam 337 / 3711	00:19:10	5.794	00:00:00	38	01:30:42
4	Ahmed	04/01/2013 05:10 PM	Um Al Hassam 337 / Um Al-Hassam Ave	04/01/2013 05:29 PM	Al Fateh 324 / 2437	00:19:00	6.759	00:00:00	60	00:25:30
Total						01:03:43	23.34	00:00:00		01:58:00
Average						00:15:56	5.83	00:00:00		00:29:30
Notes:										
1. The "Stoppage Time" represents the duration of the stoppage time between the end of the first trip and the start of the next trip. 2. To view the trips' break-down (every two minutes) please refer to the "Position Activity" report.										

- ❖ Playback tool showing the driving route of a vehicle on a selected date from the position activity report:



- ❖ A sample output from the Speed violation report:



❖ A Sample output from the Monthly Summary Report:

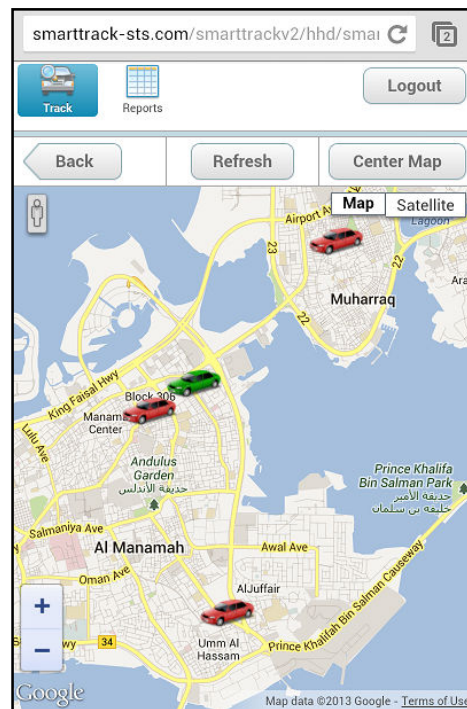
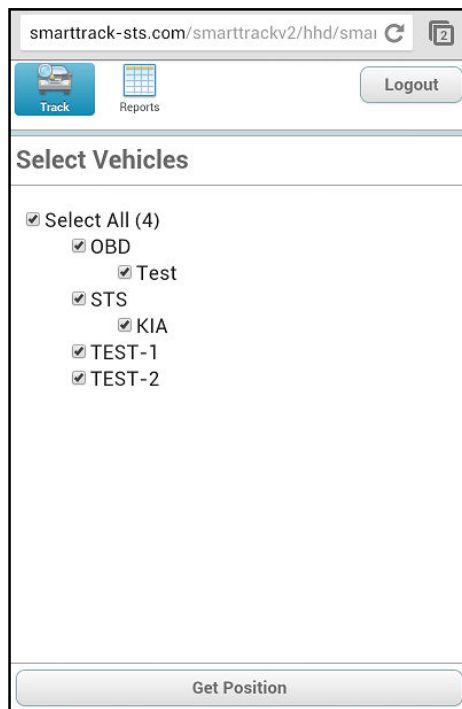
Monthly Summary Report for Oct 2012 (Daily Values)																				
SNO	Vehicle	Dist Traveled (km)				Operating Time (hrs)				Stoppage Time (hrs)				Idle Time (hrs)				Working	In Service	None Working
		Max	Min	Avg	Total	Max	Min	Avg	Total	Max	Min	Avg	Total	Max	Min	Avg	Total	Days	Days	Days
1	Test-1	133	26	67	1827	10.46	01.24	04.55	133.08	21.23	04.42	12.15	331.11	00.49	00.00	00.16	07.34	27	0	4
2	Test-2	156	9	62	1674	10.30	01.27	04.04	110.06	15.26	04.11	09.48	264.52	00.50	00.00	00.06	02.58	27	0	4
Fleet Statistics		144	17	64	1750	10.38	01.25	04.30	121.37	18.25	04.26	11.02	298.02	00.50	00.00	00.11	05.16	27		
STND Deviation		4				00.36				01.44				00.07						
Total No Of Vehicles 2																				

❖ The main dispatch application menu:

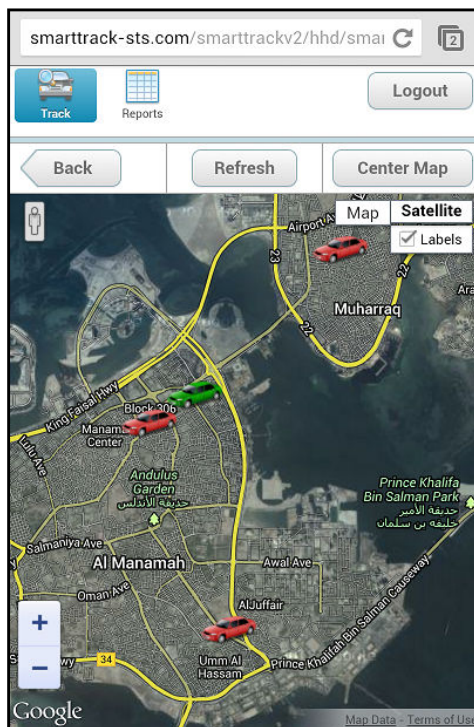
❖ A Sample of the Dispatch application output report:

Job #	Vehicle	Destination	Status/time	EST	Map
Job Status On 21-10-2012					
888	Test_MT_Gu	Ar:Al Hoor Rd:1807 Blk:0318	Pending	02:07 PM	N/A
Job Status On 24-04-2012					
258	Test_MT_Gu	Ar:Isa Town Rd:1204 Blk:0812	Pending	08:32 AM	N/A
Job Status On 15-02-2012					
4	Test_MT_Gu	Ar:Bu Ashirah Rd:3223 Blk:0332 Bld:01095	Job Stopped	15-02-2012 02:29 PM	02:24 PM
Job Status On 28-12-2011					

❖ **SmartTrack on mobile:**



❖ **SmartTrack on mobile (continue):**



TEST-2				
SNO	Status	Speed	Date & Time	Location Block
28	Ignition On	0	4/1/2013 5:10:30 PM	Um Al Hassan
29	Running	36	4/1/2013 5:12:29 PM	Um Al Hassan
30	Running	15	4/1/2013 5:14:29 PM	Um Al Hassan
31	Running	0	4/1/2013 5:16:29 PM	Al Adliyah - 33
32	Running	0	4/1/2013 5:18:29 PM	Al Adliyah - 32
33	Running	0	4/1/2013 5:20:29 PM	Al Adliyah - 33
34	Running	0	4/1/2013 5:22:29 PM	Um Al Hassan
35	Running	26	4/1/2013 5:24:29 PM	Al Juffair - 340
36	Running	60	4/1/2013 5:26:29 PM	Al Juffair - 340