THE UNIVERSITY OF HULL

TRAFFIC ACCIDENTS IN SAUDI ARABIA : A STUDY OF THEIR CAUSES AND ASSOCIATION WITH DRIVER BEHAVIOUR, WITH SPECIFIC REFERENCE TO THE EASTERN REGION

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DEDICATION

This work is dedicated with affection to my nephews and nieces, and to my sons and daughters:

Nawaf
Nayf
Majed
Talal
Hala
Anwar
Mohammad
Racan
Faisal
Majd
Maya
Dhari

ABSTRACT

A high incidence of road accidents has been recorded in Saudi Arabia in recent years (Traffic Department Statistics 1991). Various factors might have accounted for this high rate of road accidents; the aim of this research, therefore, was to examine what factors contribute to road accidents in the country.

In pursuit of this aim, a review of relevant literature on factors related with road accidents in many countries of the world was undertaken. Through this review, a list of road, vehicle and driver-related variables was selected for investigation in this study.

The target population for the study was 4,100 drivers in Eastern Saudi Arabia who had been involved in road accidents in the period. Out of this population, a sample of 600 drivers was selected. The instrument used to collect data for the study was a questionnaire which requested demographic information on factors which had caused them to have an accident, and questions analysing habitual driving behaviour. Drivers were also tested on their knowledge of road signs. Returns were received from 484 drivers, 81% of the study sample.

Two statistical techniques, chi square and correlation coefficient Spearman Brown formula, were utilised to test the relationship between the independent variables and the dependent variable – the number of road accidents.

The findings of the study show that certain variables were significantly associated with road accidents in Saudi Arabia. Among the significant variables were the age of the driver, education level, profession, violation record, vehicle ownership, joy-riding, poor eye sight, sun haze, sand storm, long hours driving, non-observance of speed limit, emerging and exiting from roads without signals, presence of stray animals, non-

marking of the road, non-familiarity with the road, lack of regular checking of vehicles, lack of regular servicing of vehicles and driving under medication.

The variables that were not significant include marital status, non-possession of a licence, mechanical fault, reversing, non-alertness to others' errors, use of high beam lights while driving, non-lighting of the roads, passengers' behaviour, ear disorder.

Conclusions were drawn as to deficiencies in driver training in Saudi Arabia and inadequacies of supervision by the law enforcement agents. It is recommended that policy makers should make intensive efforts in organising training programmes and seminars for drivers and curriculum of driving schools should be expanded. Measures for improving enforcement of traffic regulations are made, and it is suggested that an Islamic insurance policy for vehicles should be introduced in the country. Finally, suggestions are made for further research.

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LIST OF ABBREVIATIONS

Aramco	Arabian American Oil Company
DETR	Department of Environment Transportation Research
ETSC	European Transport Safety Council
GCC	Gulf Co-operation Council – Countries
GDP	Gross Domestic Product
GMC	General Motor Company
MOC	Ministry of Communication
MDQ	Motor Driver Questionnaire
MEED	Middle East Economic Digests
MOI	Ministry of Interior
NHTSA	National Highway Traffic Safety Administration
NSW	New South Wales
OECD	Organisation for Economic Co-operation and Development
PDE	Public Driver Education
RTA	Road Traffic Authority
SALPD	Saudi Arabia Loss Prevention Department
Saptco	Saudi Arabia Public Transport Company
SPSS	Statistical Package for the Social Sciences
SR	Saudi Riyal
TD	Traffic Department
TRL	Transport Research Laboratory

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1. Background

Development achieved by modern civilisation brings with it an increase in population and in the size of major cities. Development also necessitates social and economic changes, including the human need to move from place to place quickly, without difficulty, to pursue our interests and achieve our unlimited ambitions. Transport has become a daily human necessity, due to factory production of cars, trucks and buses and due to the independence of firms and businesses that force them to relocate to the heart of cities. Asp and Lundin (1981) suggest several reasons for increased use of the car: the separation of housing and work; economies of scale in shopping and distribution, creating a trend towards out-of-town supermarkets rather than local shops; increased work rate with more women entering the work force; increased amounts of leisure time, leading to more recreational trips; increased standard of living; and scale economies in education and public services, so more people now have to travel to school or to large, centralised hospitals etc.

With the increasing number of cars on the roads, however, comes an increasing number of road accidents, which have become a serious public concern in many societies, because of their devastating personal, social and economic consequences. The cost of road accidents is not only measured in damage to property, injury and loss of life; they bring trauma and tragedy to victims and their families, and for society as a whole, they create a massive waste of economic resources, health services and human energy. Motor vehicle accidents are the number four cause of death, over heart attacks, cancer and smoking, according to Bach (1992). The average cost of accidents in most countries is now at least 1% of the GDP, and it is estimated that crashes cost underdeveloped countries as much as the aid they receive (Brown, 1998).

Human factors have been shown to be responsible for the majority of accidents (Wright and Baker, 1979; Kemp et al., 1972; Quimby and Watts, 1981). The factors playing the largest part in accidents were errors of perception, lack of skill, errors in executing manoeuvres, and impairment (Jacobs and Sayer, 1983).

It has been suggested that the incidence of motor car accidents is related to the stage of driving maturity of the society; as societies get used to the car, accident rates and death rates decline due to improvement in road engineering and vehicles, legislative changes and collective change in driver behaviour and medical developments linked to accidents. In the U.K., for example, the death rate per vehicle is now about 30 times less than it was at the beginning of the century, while in the United States, the present rate is more than 90% less than what it was in 1921, an average decline of about 3.5% per year (Faith, 1997).

Differences in death rate per vehicle can, of course, be explained in terms of many factors, including improvements in speed of response to accidents and the standard of medical care. But there is evidence, also, of a decline in the number of accidents in recent years. In the U.K., for example, the number of accidents reached a peak (266,000) in 1977, then declined steadily to 1981. During the 1980s, the accident figures fluctuated somewhat, but have been declining again since 1989, to 230,000 in 1996, and the accident rate for all roads (per 100m vehicle kilometres) dropped from 75 in 1986 to 53 in 1996 (Department of Environment, 1997). In the U.S.A., the number of on-road motor accidents has dropped from a peak of 19.3 million in 1985 to 10.7 million in 1995 (National Safety Council, 1996). In many countries, by contrast, the process is still in its early stages. In Europe, for example, by far the worst accident record is in Portugal which, according to the head of the official Portuguese road safety organisation (interviewed by Faith, 1998), has a bigger percentage of new drivers.

The situation is even worse in developing countries, which, although they have only a small percentage of private car ownership, compared to the rest of the world, represent some 76% of all traffic accidents (Hussein, 1993).

Young drivers in developed countries have in many cases, received more driver education and been involved in training programmes. In the case of the USA, driver programmes start in high school. Schemes of this nature are, however, often not available in developing countries.

This study is concerned with one developing country, Saudi Arabia, which is relatively young as a driving society, and has a particularly high incidence of road traffic accidents.

1.2. Statement of the Problem

Cars have not long been used for transport purposes in Arab countries in comparison with developed countries. The latter started using cars over half a century before the former. The extensive use of cars in Arab countries happened and spread so suddenly that car users have not had the chance to develop cultural awareness or benefit from educational programmes about road safety.

During the last two decades, the Saudi community has witnessed a substantial increase in different means of transportation. However, cars have become the main method of transportation for many reasons, some of which are:

- The vast size of the area (2.5 million square km), the long roads between cities and between the facilities of the cities and the countryside, necessitating long journeys for work, educational and social purposes.
- The hot climate, which in cities and on long roads makes movement without a car very difficult;
- The absence of other forms of transportation like railways. A major railroad connects Riyadh and Dammam, but the number of people travelling by rail is modest, increasing from 117,000 to 187,000 between 1970 and 1984. The route is dominated by freight deliveries (Rashid and Shaheen, 1987). There are buses, but relatively few, and services are irregular. The Saudi Arabian Public Transport Company (SAPTCO) was founded in 1979, with a fleet of 700 buses. SAPTCO operates within the towns and larger cities providing mainly commuter services and transport facilities for pilgrims visiting the Holy places in the Kingdom (Rashid and Shaheen, 1987). Buses are also not popular for cultural reasons. It is difficult, for example, for women to use public transport, given the traditional and religious insistence on the segregation of the sexes, which results in women and children being restricted to a cramped section of the bus partitioned off for their use. Public transport is by many people perceived as not "respectable", and manuals such as the MEED Guide (O'Sullivan, 1993) tend to advise foreign visitors and workers, especially women, not to use it. Self-drive rental cars can be hired in most towns in Saudi Arabia on production of a valid Saudi driver's licence or, in the case of non-residents, a current driver's licence of their country or an International Licence (Saudi Embassy, London, no date).
- The average increase in individual earnings and ability to buy a car, particularly with the rapid prosperity brought to the Kingdom since the discovery and exploitation of oil;

- The increase of tarmac roads; this, too, can be related to Saudi Arabia's role as an oil-producing state, as the discovery of oil both created a need for roads to serve the new petrochemical industry and provide revenue which enabled the Saudi government to embark on an ambitious series of national development plans which have included extensive infrastructure projects.

  The road network connects the four corners of the Kingdom with modern express highways reminiscent of those encountered in America or Western Europe. A public national company was formed to build at designated distances, modern facilities for lodging, restaurants, emergency services and industrial maintenance.

  In addition, large sums have been invested in developing a network of asphalted rural roads, albeit in difficult terrain. Bridges and by-passes have been built in attempts to alleviate traffic congestion in the major cities (Rashid and Shaheen, 1987).

- The increase in the size of cities and the density of population in cities.

- The most common vehicles for family use in the Kingdom are large passenger vehicles such as the GMC Superban, which carries 9 people, and vans. Such vehicles are needed because of the large size of families in Saudi Arabia. Pickups and trucks are also widely used in work and for marketing. Among dessert dwellers, pickups, trucks and jeeps are the main vehicles used. Interestingly, Saudi Aramco, based on experience in the U.S., commented in a special traffic issue of its safety magazine, *Panorama* (ARAMCO 1996) that larger vehicles are safer than smaller ones. On the other hand, the large carrying capacity of those vehicles and the large size of families in Saudi Arabia means that a collision between two vehicles could involve as many as eighteen people.

It is worth noting certain other unique features of the Saudi environment which have an impact on traffic conditions. One is that, because of its young population structure and small indigenous workforce (the latter is in part attributable to the fact that education, particularly in technical fields, has a relatively recent history in the Kingdom), the country has historically relied extensively on expatriate workers, who have been brought into the Kingdom in huge numbers. According to the first detailed census in the Kingdom, completed in 1992, the total population of Saudi Arabia is 16,929,294, of whom 27.3% are foreigners. Whereas the Saudi population is almost equally divided between the sexes (males 50.4%, females 49.6%), the great majority of foreigners (70.4%) are male (Elmadari, 1997). Many of these male expatriates are employed as drivers, either for companies or in private households. An indication of the main nationalities employed for this purpose is given by Table 1.1., though these statistics do not cover all foreign drivers but only those driving limousines.

Table 1.1.

Limousine Drivers in Saudi Arabia, by Nationality

Country	**%**
Pakistan	57.75
Bangladesh	15.75
India	10.5
Egypt	8.5
Sudan	3
Somalia	2
Sri Lanka	.5
Eritrea	1.25
Djibouti	.5
Ethiopia	.25
TOTAL	**100**

Alzahrani, S. (1994)

Limousines in Saudi Arabia are similar to taxis in the U.K. They are part of a company fleet, available for private hire, are metered and can pick up only one fare at a time. Saudi taxis, in contrast, are often operated by a single vehicle owner, are unmetered, and will carry several fares at once, picking up en route.

An indication of the kind of vehicles used for this purpose is provided by Table 1.2. Most of the vehicles are Japanese, the exception being the Caprece, which is American. Saudi Arabia does not have its own car industry, but imports vehicles from Japan, the U.S. and Europe.

Table 1.2

Taxi Accidents in Riyadh City per Vehicle Model, 1993

Make of Car	**% of all taxis**	**Accident %**
Toyota Cresida	56	68.2
Laural	13	6.4
Altema	8	13.4
Cederec	16	4.4
Crown	3	3.2
Caprice	1.7	1.5

Rogaiba, A. (1999).

Another important feature is that, as the location of the two holy cities of Islam, Mecca and Medina, Saudi Arabia attracts vast numbers of pilgrims every year. In 1998, for example, according to the Saudi Embassy in Washington, more than two million Muslims gathered in Makkah to perform the pilgrimage to the Holy Mosque between March 29 and April 6. Approximately 1.13 million Muslims from more than 100 countries travelled to Saudi Arabia to undertake the pilgrimage.

In Saudi Arabia, there is no insurance for car drivers, so any driver can drive in Saudi Arabia with only a licence, and without insurance. In this respect, Saudi Arabia differs from the other GCC countries, like Kuwait, Bahrain, Qatar, UAE and Oman, where no driver can drive without insurance, as a legal requirement. The same applies in other Arab countries such as Egypt.

Finally, it should be mentioned that in Saudi Arabia, unlike the other Gulf countries or Arab countries such as Egypt, women do not drive. For this reason, many families employ chauffeurs. Women also rely heavily for transport on male relatives; there is therefore pressure for males to learn to drive and acquire a car at a very young age, in order to help in transporting their mothers and sisters to the shops, hospital, school or college.

All these factors have led to an increase in the usage of cars, resulting in more accidents and an increase in the rate of fatalities, injuries and financial losses.

An important point to note about law in the Kingdom is that the use, manufacture and sale of alcohol are strictly forbidden. Detection of alcohol on a person's breath may result in imprisonment and other penalties. Possession of alcohol or driving while under the influence of alcohol are also very severely punished (O'Sullivan, 1993). In this situation, drink-driving would not be expected to be a significant cause of road accidents in the Kingdom.

It has been claimed that traffic accidents are the second largest medical problem in Saudi Arabia, and also the leading cause of death among young adults (Mufti, 1983).

Compared to other developing countries, Saudi Arabia, Qatar and Libya have extremely high fatality rates (Jacobs and Cutting, 1986).

The total number of accidents for the period of 1971 to 1992 was 500,000, resulting in 50,000 fatalities and 380,000 injuries. The financial losses incurred as a result of those accidents is some £355,930,446 annually, as shown in statistics (1988) by the General Directorate of Traffic, MOI.

These financial losses are the result of loss of productivity by people rendered disabled or injured by accidents and the cost of emergency services, provision of hospital beds, administrative expenditure, road recovery cost and property damage costs.

According to Abu Adel (1997), in 1996, more than 167,000 road accidents occurred in Saudi Arabia, causing more than 3,000 fatalities. This represents an increase of approximately 33% on the number of accidents in the previous year. Over the ten years from 1986 – 1996, the increase in the number of accidents was more than 400%.

In developing countries, a number of major issues relating to traffic safety and confronting researchers and policy makers, in addition to the problem of reducing the incidence of traffic accidents. One such issue is concerned with the nature of road traffic accidents. While there exist numerous articles, reports and books discussing road safety in developed countries, the nature and pattern of traffic accidents in many developing countries are not academically focused on.

It is important to understand the nature of the traffic accident problem in each developing country, as there may be differences between them attributable to variances in environmental and socio-economic factors. The relationship between road traffic accidents and some environmental and socio-economic factors has been investigated in some developed and developing countries, but the usefulness of such research - especially research conducted in a particular developed country - to a developing country such as Saudi Arabia is questionable, on account of Saudi's unique nature. A number of reservations should therefore be made before applying research findings and traffic accident counter measures that originated in developed countries to states such as

Saudi Arabia, as the nature of the problem may differ considerably and those counter measures may prove ineffective within the new environment to which they are translocated. Moreover, there may be financial considerations which render counter measures from developed countries inappropriate in developing states. (Hills and Jacobs, 1981).

The difference between developing and developed countries in trying to establish an order of priorities in road safety programmes was highlighted by the study of Jacobs and Sayer (1983), who found that major differences exist in the accident patterns. For example, 44% of fatalities in Great Britain in 1977 occurred on roads in non built-up areas, while the equivalent figure for West Malaysia at the same period was 61%, with a further 26% occurring in villages and only 12% occurring in towns. From this, it would appear appropriate to devote more resources to rural accidents in West Malaysia that would be the case in Great Britain.

Another obvious example of differences between countries relates to weather conditions. In the West, for example, driving hazards may be created by rain, frost, ice and snow. In a country like Saudi Arabia, this is obviously not the case. On the other hand, weather conditions which may interact with road factors to create hazardous driving situations include intense heat, sun haze or blowing sand causing poor visibility, and lack of traction. These are common hazardous environmental factors for driving in Saudi Arabia and cause particular difficulty for less experienced drivers.

Such examples demonstrate clearly that any attempt to improve driving safety must be based on knowledge of the specific social and environmental conditions of the individual country concerned.

In order to address the problem of road traffic accidents in Saudi Arabia, therefore, it is necessary to have a base of statistical information on the nature and causes of road accidents in the Kingdom, whether in terms of road conditions or driver characteristics and behaviour. Unfortunately, such information is so far not available.

The Ministry of Communications has started to produce Annual Accident Reports but, as the Ministry itself admits, they are of limited statistical value due to the small number of accidents reported and inadequate data recording by the police. For example, in 1992, only 1289 accidents were reported and, of those, only 112 were reported with complete location data which would be needed, for example, to identify accident blackspots (Ministry of Communications and SWE Road, 1992). Moreover, there has been little or no study of driver behaviour by previous researchers in Saudi Arabia. This study, therefore, represents an attempt to fill some of the information gaps related to causes of road traffic accidents in the Kingdom.

1.3. Aims and Objectives of the Study

The aim of this study is to identify factors which directly or indirectly lead to the driver's loss of control of the vehicle and, hence, occurrence of road traffic accidents, in Saudi Arabia. In pursuit of this aim, it seeks to achieve the following specific objectives:

1. To describe conditions for drivers in Saudi Arabia;
2. To identify causes of road traffic accidents, based on a review of the literature;
3. To carry out an empirical survey of drivers involved in road traffic accidents across Saudi Arabia, concerning their personal characteristics; factors which had caused them to have an accident; habitual driving behaviours; and recognition of road signs;

4. To examine, in the light of the empirical survey, driver-related factors associated with loss of vehicle control in Saudi Arabia;
5. To examine road and other factors associated with car accidents in Saudi Arabia;
6. To put forward recommendations which will help to increase road safety in Saudi Arabia and reduce the number of car accidents, with all their adverse physical, psychological, social and economic effects.

1.4. Significance of the Study

This study is original and makes an important contribution to knowledge, in that so far, little is known about the causes of road accidents in Saudi Arabia; as indicated earlier, present reporting systems are inadequate and there has been little previous research in this field. Information about causes of driving accidents in the country is vital, as a basis for improving the traffic system and its safety. In addition to the obvious benefits of so doing, at the personal level, such improvement would have vital significance at the national level. Just as transportation is in some ways a function of development, as indicated earlier, it is also a contributor to it. Transportation in its broadest sense is the circulatory system of a culture whose life force passes through its roads and other transport facilities. Thus the transportation system may be regarded as a key factor in development and vital for the future achievements of the country. Any information which helps in improvement of the transportation system can only be to the benefit of the country as a whole.

The information provided by this study will, it is hoped, provide valuable insights into the nature of road safety problems in the Kingdom. In so doing, it will provide a basis on which planners and policy makers can consider the Kingdom's future needs as regards road engineering, driver education and so forth, and make the necessary provisions. The findings will also be of interest to traffic police, in highlighting areas where supervision and enforcement activities may need to be strengthened, and to driver trainers, in highlighting issues to which more attention may need to be given in driving programmes.

1.5. Scope of the Study

It is a known fact that accidents can occur anywhere both at home and outside the home. There are many types of transport-related accidents, such as rail accidents, air accidents, and water accidents. The most common type of transport accident in Saudi Arabia is the motor accident. In this regard, this study has been restricted to road traffic accidents involving private cars in Saudi Arabia. The study was carried out in the Eastern province of Saudi Arabia, among drivers who had been involved in one or more car crashes. The research covers the period from September to November 1997. This period was necessary to obtain a sufficiently large sample, representative of the whole region, as this involved travelling to nine different cities, spending several days in each one. In each city, drivers had to be approached in various locations. Moreover, there were three instruments to administer to each driver (see Chapter 5 for details). Thus, data collection was a time-consuming process.

1.6. Methodology

A detailed account of the hypotheses developed for this study and the methods used for testing them, is given in Chapter 5. Here, the intention is simply to provide a brief summary of the study methodology, sufficient to give a preliminary understanding of its purposes and scope.

The empirical research took the form of a questionnaire survey carried out among drivers in six major cities of the Kingdom's Eastern province. Some 600 drivers were approached, all of whom were selected as having been involved in a driving accident (this was achieved with the co-operation of the officers at the Traffic Stations where accidents are reported). Drivers were asked about the contribution of various road, vehicle and driver-related factors in the circumstances of their accident, and aspects of their habitual driving behaviour. They were also tested on their knowledge of road signs. Brief demographic details were obtained on all respondents, who were also asked in how many accidents (one, two, three or more) they had been involved. Correlational statistical analysis was carried out to explore which, if any, of the various social, behavioural and environmental variables investigated, were significantly associated with the incidence of driving accidents among the sample.

1.7. Outline of the Thesis

The remainder of the thesis is divided into seven chapters, as follows:

Chapter Two provides a profile of conditions for drivers and driving behaviour in Saudi Arabia. It considers the geographical and historical factors which have shaped the transport system in the Kingdom, the development of the road network, and the unique characteristics of the Saudi driving environment.

In Chapter Three, the reader is presented with an overview of the legislation relating to driving in Saudi Arabia, including such matters as vehicle registration, driver licensing and penalties for violations of traffic regulations.

Chapter Four contains a review of the literature in the field of road traffic accidents and associated factors. It considers accidents related to the road, the vehicle, and the driver, which are thought to contribute in causing road accidents. Consideration is also given to measures which have been taken in some countries to improve road safety, which may provide some useful models from which Saudi Arabia could learn.

Chapter Five is devoted to an explanation of the empirical survey carried out for this study: the survey location and sampling methods are described and an account is given of the development of the data collection instruments, and their administration.

Chapter Six presents the results obtained from the survey. The first section analyses the significance of drivers' personal characteristics, while the second uses correlational analysis to test several hypotheses regarding the association of personal behaviour and environmental variables with the dependent variable, road accidents. Drivers' knowledge of road signs is also reported, using descriptive statistics.

Finally, in Chapter Seven, a summary of the study is presented, showing how each of the research objectives has been achieved; conclusions are drawn, and recommendations are made for measures which it is believed would contribute to a reduction in the problem of road traffic accidents in Saudi Arabia.

CHAPTER TWO

TRAFFIC CONDITIONS AND DRIVER BEHAVIOUR IN SAUDI ARABIA

2.1. Introduction

In order to appreciate the context in which the present study is undertaken, it is necessary to have some understanding of the driving environment in Saudi Arabia.

The chapter begins by explaining the geographical, topographical and climatic features and conditions which constrain the development of the road network in the Kingdom and affect the day-to-day road conditions which drivers face.

Consideration is then given to the historical development of road transportation in the Kingdom. Saudi Arabia has a long history of transportation, resulting from ancient trade routes and the fact that the country is the location of the two holy cities of Islam and therefore, receives massive influxes of pilgrims every year. Another influence on road development has been the discovery and exploitation of oil, which necessitated a large network of roads to serve this industry.

The fourth and fifth sections of the chapter present a picture of the current road network, in terms of an account of recent developments in the road system and an explanation of the road classification.

Finally, after presenting brief data on developments in the number of driving licences and vehicle registrations, the chapter reviews the limited information available on driving behaviour and the incidence and causes of road accidents in the Kingdom.

2.2. Geographical Background

Saudi Arabia has a surface area of 2,250,000 square kilometres, which amounts to the combined area of France, Italy, Spain, West Germany and Norway. It covers almost the whole Arabian Peninsula from the Arabian Gulf on the East to the Red Sea on the West. The coastline, both east and west, extends approximately 2,410 kilometres. The contours of this vast area vary widely, encompassing large deserts, high mountains, valleies and plains. As the country's terrain varies, so does the climate, with wide temperature variation, strong winds in places and area of high humidity. The Kingdom's geographical location, between the three continents of Asia, Africa and Europe, affects its weather (Ministry of Communications, 1986).

Thus, the Ministry of Communications is confronted with the huge problem of creating an extensive network of roads to connect the Kingdom's different areas in spite of widely varying conditions. Additional pressure on the country's transportation network is created by the location within its boundaries of Makkah and Medinah, making the region a place of pilgrimage to millions of Muslims (see map 1).

The construction and maintenance of Saudi Arabia's road network are constrained by topographical and climatic features. The topography varies considerably. In the extreme west there is a narrow coastal plain called Tihama, which is dominated by a dramatic escarpment to the immediate east. This escapement rises in places to an altitude of more than 2,500 metres within just a few kilometres. This presents a tremendous barrier against easy land access. The Asir region in the southern part of the Kingdom has the highest mountains of Saudi Arabia. These rise to over 3000 metres in height. Large areas of the Kingdom are covered with sand. In the north the Great Nafud is characterised by numerous sand dunes. A narrow strip of sand, Ad-Dahna,

المملكة العربية السعودية
KINGDOM OF SAUDI ARABIA
وزارة المواصلات
MINISTRY OF COMMUNICATIONS
خريطة الطرق
ROAD MAP
LEGEND
اصطلاحات
Expressways/ Dual Carriageways
طرق سريعة ومزدوجة
Asphalted Highways
طرق مسفلتة مفردة
IRAN
IRAQ
ARABIAN GULF
ARABIAN SEA
RED SEA
JORDAN
EGYPT
SUDAN
ETHIOPIA
ARAB REPUBLIC OF YEMEN
KUWAIT
Al Bahrain
Qatar
Doha
Abu Dabi
Dubay
Ajman
Ras Al Khaymah
Al Buraymi
Riyadh
Dammam
Al Hufuf
Jeddah
Makkah
Madinah
Taif
Tabuk
Buraidah
Unayzah
Hail
Al Jawf
Sakakah
Arar
Qurayat
Turayf
Rafha
Al Kharj
Khamis Mushait
Abha
Jizan
Najran
Sharurah
Al Wadiah
Layla
Yanbu
Rabigh
Al Wajh
Duba
Haql
Al Baha
Al Qunfudhah
Al Lith
Sadah

runs north from Al-Nafud and connects to the largest sand desert in the world, Al Rub' Al-Khali, which covers most of the south-eastern region of Saudi Arabia.

The climate of most of the Kingdom is generally dry and extremely hot during the summer, except for the coastal regions where it is moderately hot but extremely humid. The annual rainfall averages 100mm, but when it does rain, devastating floods may result. These conditions have an adverse effect on the transport network, particularly the bridge surfaces (Ministry of Communications, 1988).

Despite these constraints, considerable advances have been made in linking the Kingdom's settlements with roadways, from the first trade routes to the advanced motorways now being constructed with the most up-to-date technology, as will be seen in a later section.

2.3. Historical Background

The Arabian Peninsula has a long transportation history. It has long been and still is a key link between the continents of Europe, Asia and Africa. The stone remnants of early way-stations can still be seen and evidence remains of the trails caravans followed for hundred of years.

Major links of the current motorway network evolved from these early trails. The trade period, in which commercial routes were established, came first. The city of Makkah Al Mukarramah became a prosperous centre of trade. It also became a religious centre centuries before the coming of Islam. However, since the coming of Islam in the seventh century AD, Makkah Al Mukarramah and Al-Madinah Al Munawwarah became the destination of all able Muslims who travelled to these holy cities to perform the pilgrimage of Hajj. Consequently new routes were added to the old ones.

These developments, together with the transport plans instigated by King Abdulaziz, and the role of the oil companies in contribution to the network, are traced below.

2.3.1. Trade Routes in Ancient Arabia

Many of the cities in Saudia Arabia owe their origins to the commercial activity that took place on the Arabian Peninsula in ancient times. The demand for incense gave rise to a flourishing trade between the Peninsula and her neighbours. The Peninsula's major overland trade route ran north from Yeman, roughly following the coastal mountain range until it veered to cross the Peninsula and eventually reach Syria and the Mesopotamia region. Towns sprang up at oases along the route where caravans stopped and where customs were paid for passage of merchandise. Other cities, such as Jeddah, developed at coastal sites where natural harbours provided commercial ports.

Donkeys and mules were initially used as the beasts of burden on the ancient trade routes. The trade caravans were small, slow and irregular, and usually meandered from water hole to water hole. The effective domestication of the camel and the advent of the camel caravan system revolutionised trade. Camels have the unique capability to conserve water and can move at a relatively fast pace, especially on level ground which offers a stable footing. Thus, caravans moved across the plains and through the valleys, avoiding mountainous terrain for which the camel is not suited. The alignment of the early trails reflects the camel's characteristics and limitations.

2.3.2. Pilgrimage Routes in Arabia

The coming of Islam in the seventh century was the beginning of a new and prosperous era resulting in tremendous economic, social, and intellectual advances in the Arabian Peninsula. In less than 150 years, much of the known world, from Spain through North Africa and the Middle East to parts of China and India, became part of the

Islamic world. The development of transportation and communications systems linking these diverse lands was a priority for Muslim leaders.

The religious heartland of Arabia, where the holy cities of Makkah Al Mukarramah and Al-Madinah Al Munawwarah were located, had a central role. Of particular importance was the development of a road network for use by pilgrims. The Quran (the Holy Book of Islam) declared:

> **"Proclaim the pilgrimage to all people they will come on foot and on the backs of swift camels from the distant quarters of the earth."**
> **The Holy Quran, S.XXII = VV27-30**

Hajj, or pilgrimage, is the fifth pillar of Islam, and able Muslims are required to make the trip once in their lifetime. For this reason, the roads to this holy area were given special attention throughout Islamic history.

Road improvement programmes were undertaken by the successive Kings and Caliphs of the Islamic empire. However, one road stands out because of its significance and importance to the Hajj traffic originating from Iraq and the East. This road was called Darb Zubaydah, a 1140 km road between Kufah in today's Iraq and Makkah Al Mukarramah. The road was dotted with rest areas spaced at distances equivalent to one day's travel. It was 18 metres (58ft) wide and covered with soft sand where it crossed lava fields. The road was "the most impressive engineering achievement in the ancient Islamic world and rivals the great roads of the Roman Empire" (Ministry of Communications, 1988).

Another significant route for the pilgrims from Palestine, Jordan, Lebanon, Syria and the north was the Hijas Railway. This line connected Al-Madinah Al-Munawwarah to Istanbul, where the "Orient Express" railroad from Paris terminated. The railroad link to Al-Madinah Al Munawwarah opened in 1908, and was a significant engineering achievement. It was aligned close to the trail made by generations of pilgrims. From Ma'an, in Jordan, the route went south through Tabuk and into Al-Madinah Al Munawwarah.

2.3.3. Transport Development during the Reign of King Abdulaziz Al-Sa'ud (1902 – 1953)

It was King Abdulaziz who truly initiated the modern transportation era in Saudi Arabia. Through hampered by a severe shortage of funding, he made an impressive start in several modes of communication and transportation.

Transportation-related goals were established by King Abdulaziz that have continued to this day. His primary transportation goals included unification of the Kingdom, security for travellers and increased accessibility to the holy places. The annual pilgrimage to the holy places continues to be a dominant transportation activity in the Kingdom, as hundreds of thousands of Moslems travel to the Kingdom to perform Hajj every year.

Travel was slow in the early days before the automobile and roadways era. It is reported that when King Abdulaziz was young, the trip from Riyadh to Hofuf, a distance of only 328 kms, took about 8 days. Travelling from the Arabian Gulf to the Red Sea, a distance 1,320 kms, took a month (Ministry of Communications, 1988).

As a result of the King's initiative, several asphalt roads were constructed. These include the Taif-Al Hawiah road, the Jeddah-Makkah Al Mukarramah road, the Hofuf-Ain Dar road and the start of the Makkah Al-Mukarramah-Jeddah-Al-Madinah Al Munawwarah motorway. Also, steel bridges were constructed (Ministry of Communications, 1988).

King Abdulaziz was concerned with the institutional development that would be necessary to accomplish his goals. In 1935, he established the Works and Mineral Authority, which reported to the Ministry of Finance. This authority supervised all public works projects, particularly the roads.

When the Kingdom's organisations and agencies were reorganised in 1935, related functions were integrated into separate ministries. The Ministry of Communications came into existence, with the main task of managing the communications and transportation sectors. Its first task was to construct a network of modern motorways to connect regions, cities, villages and other settlements throughout the Kingdom. The success of its endeavours will be made apparent in a later section.

2.3.4. The Oil Industries' Role in Transport

When ARAMCO began operations in 1933 to explore for petroleum, there were no roads in the areas it wished to explore. Some early explorations were carried out using camel, but the geologists found automobiles could be used in many areas even without roads. The early oil explorers learned to modify cars and trucks for desert travel and developed the use of high-flotation tyres that allowed heavy loads to be moved across the desert. Following the discovery of major oil fields several years later, there was a requirement for oil-field roads to be built. These were not modern public motorways but often started as gravelled and oil tracks leading to the facilities concerned. As these upgraded roads became more heavily used, the surfaces were paved.

As there were no other motorways, the public began to use the oil field roads, and for many years these roads carried more public traffic than ARAMCO vehicles. During the early 1970s, it is estimated that ARAMCO constructed some 1,250 kms of paved roads and some 600 kms of unpaved roads. The Ministry of Communications constructed connecting roads from these oil-field networks to various cities and towns in and around ARAMCOs operating area (Ministry of Communications, 1988).

An important example of this early oil industry construction is the Tapline Road, built by ARAMCO's subsidiary the trans-Arabian Pipe Line Company (Tapline). The road adjoins the oil pipeline to Sidon on the eastern Mediterranean coast, when Saudi oil was exported to European markets. At the time of its completion in 1950, this pipeline was the world's largest.

Tapline built a graded but unpaved road paralleling the pipeline to maintain the pipeline and its manned pump stations. This graded earth track soon came to be used as an international commercial motorway, opening a road route from the Mediterranean to Saudi Arabia's Eastern Province and Riyadh. The existence of the road also fostered the growth of towns and cities along its route. Tapline subsequently paved and improved the road, and today it is maintained and is being further improved by the Ministry of Communications.

2.4. Modern Development in Road Construction and Improvement

Road construction has played a major role in the Kingdom's development. Whenever new development projects for public services, agriculture or industry are undertaken, the Ministry of Communications has participated in such projects with the construction of necessary roads. Main roads and feeder roads have facilitated commercial trade among the Kingdom's towns and villages, and impressive achievements have been made in modernisation of the road network.

2.4.1. Roads in the Development Plans

Road development has been emphasised in all of the Kingdom's Five Year Plans and indeed has been considered a basic factor in the success of the plans. Based on studies, statistics and clear objectives, the development plans express the Kingdom's development goals. The Ministry's general roads programme has included three stages (Ministry of Communications, 1988).

The first stage involved the linkage of principal regions, towns and villages of the Kingdom with the necessary roads, taking into account that the roads should pass through the largest possible number of towns and villages.

In the second stage steps were taken to cope with the expected traffic increases on main roads by expanding existing roads and constructing motorways and divided motorways.

The third stage, which is now underway, aims at developing services and safety features. These included the addition of traffic signs and signal, landscaping suitable to the environment, and rest areas with car services, restaurants and hotels.

The third stage is also concerned with expanding and paving roads shoulders; constructing wider bridges, adding striping to road edges; erecting traffic and warning signs, erecting km signs and improving maintenance of stripes and signs. This stage also contains a plan for controlling vehicle weights by implementing a programme to weigh vehicles at various points throughout the Kingdom, and to enforce speed, weight and size limitations.

2.4.2. Motorway Programmes

The goals of the primary Road Programme based on the Kingdom's Five-Year Plans, are:

- To develop the various sectors of the country including agriculture, industry, health, education and social services. Transportation costs should be minimised to promote economic and social activities.
- To support national and regional economic development by linking all villages of more that ten thousand people.
- To cope with growth in traffic at the least possible cost by balancing road maintenance cost, vehicle usage and replacement, travel time and travel costs.

The road programme adopted by the Ministry consists of the following:

- Reconstruction of old roads.
- The Primary Construction Programme undertaken with the help of foreign expertise.
- The Secondary Construction Programmed undertaken by the technical teams at the Ministry.
- Development of Agricultural Roads.
- Maintenance.

Based on experience with previous projects, a practical policy has been developed (Ministry of Communications, 1986).

- Suitable design standards for every road should be applied in accordance with expected uses and traffic volumes. In general, high-level specifications increase costs and low-level specifications reduce costs. However, lower specifications often result in increased operational and maintenance costs. Thus, the Ministry has chosen model road specifications to achieve its objectives while balancing construction and maintenance costs.

- The applied design specifications were re-evaluated at the beginning of the Fifth Development Plan (1990-1995) to improve motorway safety. Road shoulders were paved and widened from 2 to 2.5 metres. The slope of shoulders was increased. Bridge widths should be equal to that of the road and shoulders. Drainage facilities, necessary to maintain the road in good condition, should be strong enough to bear anticipated traffic loads over the plan period.
- Based on studies of the development, usage and growth of the motorway network, it is possible to determine the required number of lanes for future road projects. Construction feasibility, locations and appropriate technology can all be analysed.
- The maintenance sector has been developed as part of the Ministry's ongoing activities. Suitable technical specifications for maintenance have been developed, including manpower and equipment requirements. Regulations have been issued to regulate traffic and specify allowable loads for various types of vehicles. Load limits have been established to balance road maintenance costs with the economic benefits to the Kingdom of vehicle transport.

2.4.3. Achievements To Date

Achievements in road construction have been truly impressive. In 1954 total paved roads were only 237 kilometres. By 1970, when the first Five-year development plan was introduced, the network had increased to 8,440 kilometres and jumped again to about 21581 kilometres of paved roads and 24,186 kilometres of agricultural roads in 1980, with the construction of thirteen thousand kilometres. This is a significant rate given the difficulties posed by the natural terrain in the Kingdom, which have been overcome by the use of advanced technology to such an extent that some projects are regarded as unique models in their design and execution.

The continued rapid rate of growth in road building is shown in Table 2.1, which shows road construction progress in the Kingdom of Saudi Arabia during the period from 1970-1985. This indicates that between the start of development planning in 1970 and the end of the third plan period in 1985, the network of gravel agricultural roads increased almost fifteen fold, to 50,655km, with a particularly sharp rate of increase during 1980-1985. Significant, though more steady progress, was also made in the construction of paved/asphalt roads.

Table 2.1

Road Construction Progress in the Kingdom of Saudi Arabia (1970-1985)

Year	Agricultural Roads (gravel)		Paved Roads	
	K.M	Progress: %	K.M	Progress: %
1970	3,487	100	8,440	100
1971	4,174	199.7	8,994	106.6
1972	4,963	142.3	9,350	110.8
1973	5,742	164.7	9,980	117.1
1974	6,770	194.2	10,836	128.4
1975	8,510	244.1	12,167	144.2
1976	11,193	320.9	14,101	176.1
1977	13,307	381.6	16,046	190.0
1978	16,948	486	18,246	216.4
1979	20,119	576.9	20,138	238.6
1980	24,186	363.6	21,581	255.7
1981	28,987	831.3	22,498	266.6
1982	33,310	955.3	23,740	281.3
1983	38,649	1,108.2	26,043	308.6
1984	46,836	1,343.2	27,895	330.5
1985	50,655	1,452.7	29,655	351.4

Ministry of Communications, 1988

Table 2.2 provides a more detailed breakdown of the length of road network in various categories. It can be seen that, although the vast majority of agricultural roads are of the gravel type, between 1974 and 1986, progress in providing asphalt roads in some agricultural districts was made. There was a thirty seven-fold increase on the divided primary roads, almost a three-fold increase in primary roads, a similar rate of increase in secondary roads, and a ten-fold increase in the total length of feeder roads.

Table 2.2

Length of Road Network

	LENGTH OF ROAD NETWORK							AGRICULTURE ROADS (KMS)	
	Divided Primary	SINGLE ROADS				Total		Asphalt	Gravel
		Primary	Secondary	Feeder	Total				
1970	106.0	5,014.0	2,726.5	593.5	8,334.0	8,440.0		-	3,487.0
1971	106.0	5,386.0	2,841.5	660.5	8,888.0	8,994.0		-	4,174.0
1972	106.0	5,620.0	2,932.8	691.0	9,243.8	9,349.8		-	4,963.0
1973	108.0	6,000.7	3,138.7	732.8	9,872.2	9,980.2		-	5,743.0
1974	129.0	6,317.0	3,579.3	904.2	10,800.5	10,929.5		-	6,770.0
1975	158.5	6,956.0	3,823.7	1,225.2	12,004.9	12,163.4		4.0	8,510.0
1976	249.8	7,695.1	4,305.6	1,815.9	13,816.6	4,066.4		34.9	11,193.0
1977	362.1	8,622.2	4,695.0	2,299.9	15,617.1	15,979.2		62.2	13,307.0
1978	533.2	9,605.7	5,047.7	2,992.2	17,650.6	18,183.8		62.0	16,948.0
1979	849.3	10,273.3	5,507.3	3,446.0	19,226.6	20,075.9		62.0	20,119.0
1980	1,045.1	10,984.5	5,743.1	3,746.7	20,474.3	21,519.4		62.0	24,186.0
1981	1,234.1	11,195.6	6,006.9	3,998.4	21,200.9	22,434.9		123.9	28,978.0
1982	1,809.1	11,365.3	6,240.3	4,235.6	21,841.2	23,650.3		526.4	33,310.0
1983	2,658.8	11,873.4	6,561.4	4,711.3	23,146.1	25,804.9		1,179.7	38,644.0
1984	3,180.2	12,511.9	6,879.2	5,063.4	24,454.5	27,634.7		2,133.4	46,836.0
1985	3,616.2	13,080.2	7,207.6	5,394.2	25,682.0	29,298.2		2,533.7	52,226.0
1986	3,794.8	13,266.3	7,375.7	5,734.7	26,376.7	30,171.9		2,758.9	57,502.0
1986	3,913.3	13,505.5	7,547.4	5,929.0	26,981.9	30,895.2		2,953.4	61,500*

(MOC, 1988)

According to the latest data available (December 1994), the network has further increased, to the following:

Motorways and divided motorways	5330 km
Primary, secondary and feeder roads	37673 km
Gravel road (agricultural)	84863 km
Total	**127866 km**

The Kingdom's network of multilane motorways stretches from Dammam port in the east across the central plateau to the holy cities of Makkah Al Makarramah and Al-Madinah Al Munawwarah in the West. Route 40 cross-country motorway terminates at Jeddah Islamic port.

The total length of motorways and dual carriageways constructed by the Ministry to the end of 1992 reached 4,400 kms. These roads were designed and constructed according to the latest international standards. The road system includes advanced bridge and interchange design, and all necessary safety devices and fencing. These roads have significantly facilitated transportation and reduced inter-urban transportation costs. The various routes within the motorway network and the facilities provided, are indicated in Table 2.3.

Table 2.3

Routes and facilities in the motorways network

Motorway	Route No.	Speed km/H	Length km	Lanes	Interchanges	Camel Crossing	Towns and Villages served
Dammam-Riyadh	40	120	382	6	14	6	9
Riyadh-Makkah	40	120	810	6			
Makkah-Jeddah	40	120	60	8	6		
Makkah-Madinah	15	120	421	6	25		
Riyadh-Sediar-Al-Qassim	65	120	317	6	22	8	30

(M.O.C 1988)

Distances in kilometres between major cities are shown in Table 2.4.

Table 2.4

Tables of Distances Between Major Cities of the Kingdom

(in kms and for the shortest diatance)

City	Riyad	Makka	Madina	Edda	Dammam	Taif	Abha	Tabou	Bouraid	Hail	Jizane	Najrane	Jouf
Riyad	-	870	848	949	395	782	1064	1304	330	640	1272	950	1309
Makka	870	-	358	79	1265	88	627	1037	876	790	685	912	1271
Madina	848	358	-	344	1243	446	985	679	518	432	1043	1270	912
Jeddah	949	79	344	-	1343	167	625	1024	863	777	710	905	1258
Dammam	395	1265	1343	1343	-	1177	1459	1725	715	1035	1667	1345	1225
Taif	782	88	446	167	1177	-	561	1204	936	957	763	864	1359
Abha	1064	627	985	625	1459	561	-	1649	1488	1042	202	280	1999
Tabouk	1304	1027	679	1024	1729	1204	1649	-	974	664	1722	1929	504
Bouraida	330	876	518	863	725	936	1488	974	-	310	1561	1280	1277
Hail	640	790	432	777	1035	957	1402	644	316	-	1475	1590	1208
Jizane	1272	685	1043	710	1667	963	202	1722	1561	1475	-	482	1956
Najrane	950	912	1270	905	1345	864	280	1929	1280	1590	482	-	2163
Taid	1333	1582	1224	1569	1302	1670	2209	815	1742	1656	2267	2494	402
Baha	998	304	662	383	1393	216	245	1341	1152	1094	447	525	1575
Yanbu	1090	405	242	326	1485	493	1054	964	760	674	1256	1728	1150
Jubail	488	1358	1336	1436	93	1270	183	1640	818	1128	1760	1438	1136
Sail	560	1130	1409	1128	956	1064	503	1865	891	1201	705	395	1870

Source: MOC, 1988.

The Ministry has also constructed ring roads around major cities to facilitate travel. Such roads are provided with bridges, interchanges and underpasses as well as service roads, lighting, planting and all necessary safety measures. The ring roads minimise traffic congestion within the cities and contribute accidents and air pollution to the reduction in traffic levels (MOC, 1988).

The location and length of the Saudi ring roads are shown in Table 2.5.

Table 2.5

Location and Length of the Saudi Ring Roads

Ring Road	km
Riyadh	130.5
Al-Madinah intermediate ring road	27.1
Makkah	8.5
Buraidadh - Algassim	62.0
Abha	20.2
Al-hada	5.0
Jeddah	102.0

(MOC, 1988)

2.5. Classification and Numbering of Roads

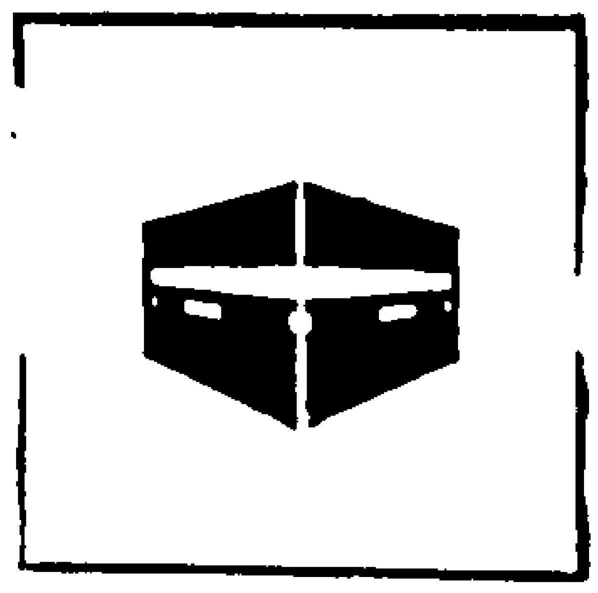
An examination of the road network shows clear distinctions between roads with regard to their types, location and complexity. A technical classification has been established according to their type, their roles, and their importance in the road system in each region, on the one hand, and the road network in the Kingdom on the other.

The classification and numbering of the roads is basic to a number of purposes including road planning, proposing budgets and cost programmes and mapping. Classification is also important for placing traffic signs, controlling traffic, promoting safety measures and facilitating maintenance management, as well as project management.

The roads supervised by the Ministry of Communication have been classified in the light of technical characteristics into three groups (MOC, 1988).

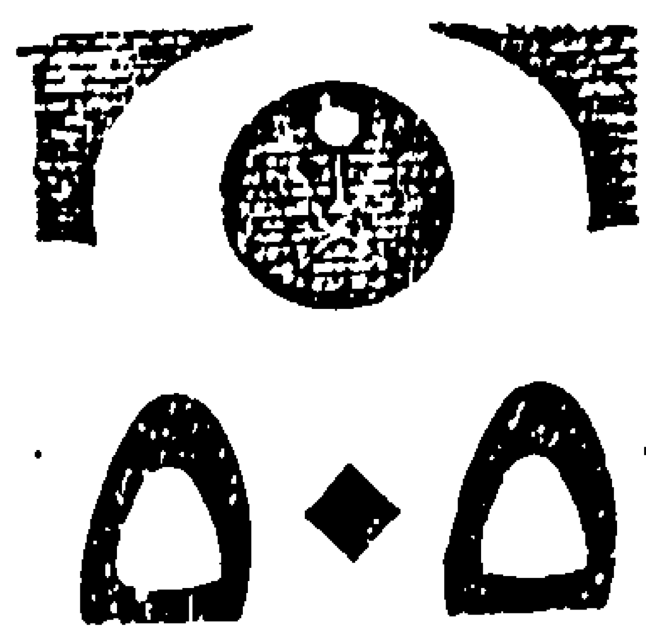
The First Group:	Main Roads
The Second Group:	Secondary Roads
The Third Group	Sub-Roads

1. Signs of holy places.



2. The main roads, that connect the major cities in the Kingdom, are identified with one or two figures.

2. The secondary roads, that connect towns and then join the main road network, are identified with three figures.



3. Feeder roads, that connect villages, hijars and farms with either roads, are identified with four figures.

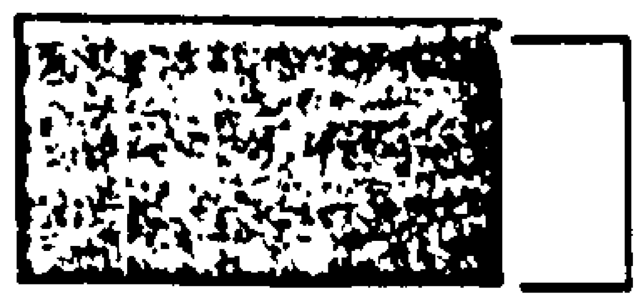
2.5.1. Road Signs

Road signs are colour-coded. Directional and information signs outside cities are blue, while road number signs are in green.

Guide signs inside cities are in various colours, according to their nature:

1. White is used for local street news and the destinations inside the cities.

2. Green is used for the main streets inside cities.

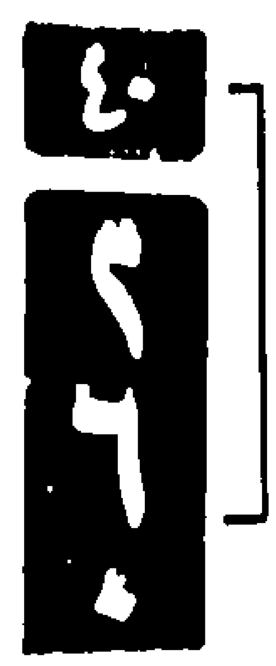


3. Blue is used for main roads and for destinations outside cities.

This colour-coding is intended to facilitate identifications of the right route to the intended destination.

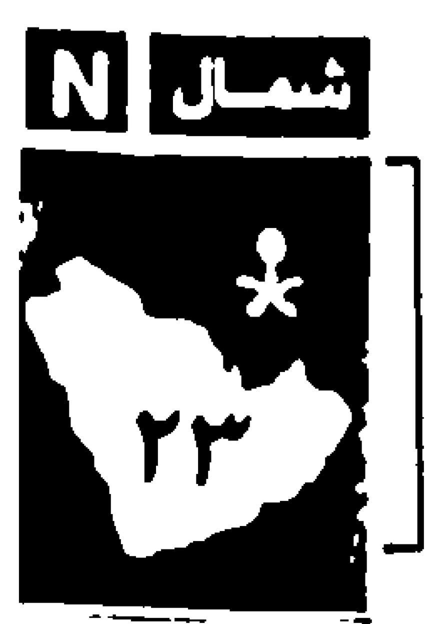
Signs of road numbers are usually placed on separate posts at the road side or placed on direction signs of main directions (north. east. south and west) used along with road number signs to clarify the main road direction.

1. Type of road numbering signs used to identify the distances on the roads.



2. Directions signs:

   -Signs of road numbers and main directions of public roads are classified and numbered as follows:



This classification follows basic principles of classification and serves other related government ministries. concerned parties and the users of these roads.

The following are the most important of these principles:

- Orderly long-term road development in the context of priorities and construction plans.

- Grouping of similar roads so the drivers can expect similar standards of design, operation, and maintenance.
- Basic road classification as a basis for improving traffic systems and raising performance levels.

Many factors were taken into account at the time of drafting the classification system. Some of these factors are:

- Type of service provided
- The facilities at the end-points of the roads, such as at the international borders,
- seaports, and cultural centres.
- Traffic and level of service.
- Classification criteria such as length of each road group with respect to the total length of the network.
- Utilisation criteria such as the number of kilometres to the total traffic on the network.

Applying the above principles, roads have been classified and specification selected for the characteristics and criteria of shoulder; size and location of culverts, trenched, traffic obstructions, traffic lights, and signs; traffic safety programmes (including accident rate;) and dangerous locations. The driver can, by using the classification and numbering method, recognise the nature and type of the road in use.

2.6. Development in the Number of Drivers and Vehicles

In the last two or three decades, Saudi Arabia has witnessed tremendous increases in the number of vehicles and drivers in the country, which is not solely a function of increase in the size of the population. Table 2.6 shows the increase in the number of people and vehicles for each year between 1971 and 1992. It can be seen that the increase in the number of vehicles has far outstripped that in population. Whereas the population, between 1971 and 1992, increased some 2.3 times, the number of vehicles increased approximately 36.5 times, indicating a significant increase in the proportion of the population owning vehicles, and probably considerable numbers of families owning more than one vehicle.

Table 2.6

The Increase in Number of People and Vehicles in the Kingdom of Saudi Arabia

Year	Population (per million persons)	Vehicles (per thousand vehicles)
1971	7.60	144.8
1972	7.90	180.2
1973	8.22	243.0
1974	8.55	355.0
1975	8.94	515.4
1976	9.34	774.4
1977	9.76	113.0
1978	10.20	1433.0
1979	10.66	1723.0
1980	11.14	2069.5
1981	11.64	2467.9
1982	12.16	3018.8
1983	12.71	3569.0
1984	13.15	3920.9
1985	13.61	4144.3
1986	14.09	4281.0
1987	14.58	4428.0
1988	15.09	4574.0
1989	15.60	4768.0
1990	16.02	4950.0
1991	16.50	5117.4
1992	17.00	5280.0

Zahrani, A. (1994)

Table 2.7 shows the number of registered vehicles for selected Arab countries for the year 1995. Two points can be made with regard to this table. The first is that Saudi Arabia has more vehicles than any of the countries represented, except Algeria. Secondly, the number of vehicles credited to Saudi Arabia is considerably fewer than that reported by Al Zahrani (1994). The discrepancy may be due to the fact that the later table refers only to registered vehicles; in other words, there may be a large number of unregistered vehicles in the country. It also highlights, however, the difficulty of obtaining accurate information on which to base plans and policies, in a country where statistical data are difficult to obtain, often out of date, and may be of doubtful reliability. This, of course, reinforces the need for studies of the present kind.

Table 2.7

Registered Vehicles, 1995

Country	Vehicles
Algeria	2,400,000
Saudi Arabia	2,052,934
Morocco	1,360,500
Libya	1,157,211
Iraq	1,035,459
Syria	542,267
Jordan	321,373
Bahrain	169,318

Al-Bakri, 1998.

Finally, Table 2.8 shows the number of drivers' licences issued in Saudi Arabia over a 10 year period from 1985 to 1994. The types of driving licence are explained in the following chapter, Section 3.2.2. At this point, however, it is worth noting that the category designated 'mechanical' in the table refers to coaches and light goods vehicles. Statistics on the number of heavy goods vehicle licences issued are not available.

However, these vehicles do not use public roads. In the Saudi context, heavy vehicles refers to certain agricultural machinery and to cranes and the like used within industrial compounds or at the industrial ports. Such vehicles do not need to travel on the public roads, since industrial sites tend to be located away from commercial and residential areas; freight between the major industrial cities of Jubail and Yanbu travels by sea; and if heavy vehicles must travel across country, they can use desert routes. Whilst the number of licences in all categories has fluctuated from year to year, it can be seen that the number of private licences, in particular, has always been high and has increased every year from 1991 onward.

Statistics on the demographic profile of drivers in the Kingdom, in terms of, for example, age and nationality, are unfortunately not available, though data are available in relation to drivers involved in accidents (see Section 2.7.1.).

Table 2.8

Number of Drivers' Licences Issued in Saudi Arabia during the Period from 1985 to 1994

Year	Private	Public	Mechanical	Motorcycles	Total
1985	290370	46650	1159	2154	340333
1986	151874	42271	872	1152	196169
1987	157950	31768	788	564	191070
1988	168124	36011	1403	788	206326
1989	146608	37038	1015	442	203103
1990	158241	37420	1519	622	197802
1991	149217	42600	1525	644	193959
1992	181845	59410	2650	370	244275
1993	225290	60496	3814	633	29233
1994	232989	59046	2114	744	294893
Total	1862508	452710	16859	8113	2358163

TD (1995)

2.7 Driving Behaviour and Road Accidents in Saudi Arabia

Despite driving regulations which are very much in line with general world traffic codes, and major improvements in road quality, there is a serious problem in Saudi Arabia of a particularly high incidence of driving accidents. This section presents some statistics on the level of the problem, before reviewing the limited information available on driver behaviour and causes of accidents.

2.7.1. Incidence of road accidents

According to Al-Ghamidi (1998) in the Gulf States, some 5,000 people annually die in road accidents, and the average death rate per 100,000 drivers is 33 – compared with 18.4 in the U.S.A., 8.1 in England and only 3.6 in Germany. In the latter countries, as indicated in Chapter 1, road engineering, driving tests, vehicle factors and medical response have brought significant reduction in both accidents and fatalities.

Al-Massaiah (13 July1998) claimed that 81% of the death rate in Saudi Arabia is due to road accidents and put the cost of such accidents at 30 billion Saudi riyals a year.

Table 2.9 shows the number of accidents, injuries and fatalities in the Kingdom for each year from 1871 to 1994. It can be seen from the table that there have been steady increases in all three categories. The number of accidents has risen particularly steeply, the incidence in 1994 being some 30 times that in 1971. On the other hand, the proportion of accidents resulting in injury or fatality has actually fallen. Whereas in 1971, approximately one in seven accidents resulted in a fatality, in 1994, only one in 30 accidents were fatal. There may be a number of explanations for this decrease in fatality rate, such as improvements in the standard of road engineering and marking, the impact of driving school programmes, which were introduced in 1979 (see Chapter 3, Section 3.5.3) and improvements in the speed and effectiveness of medical response.

This does not mean, of course, that the number of fatalities is no longer a problem. It is still very high in absolute terms and represents untold misery and hardship for the families of victims.

Table 2.9

The Increase in the Number of Accidents, Injuries and Fatalities in the Kingdom of Saudi Arabia

Year	Number of Accidents	Number of Injuries	Number of Fatalities
1971	4147	5483	570
1972	7197	6530	834
1973	9808	7901	1058
1974	10897	8771	1154
1975	13475	10532	1594
1976	15709	11606	1975
1977	15785	11413	2032
1978	18051	14824	2378
1979	17743	16832	2871
1980	18758	16218	2731
1981	17897	15872	2427
1982	21597	18616	2953
1983	24594	21475	2499
1984	29148	22850	3338
1985	29053	22630	3277
1986	32092	22602	2703
1987	32024	23723	2814
1988	32584	23059	2585
1989	35744	23278	2646
1990	35799	23526	2697
1991	37127	25516	3232
1992	40076	27385	3495
1993	85277	34880	3719
1994	125324	32133	4077

Zahrani, A (1994).

Table 2.10 shows the levels of accidents, fatalities and injuries in selected Arab countries for 1995, showing that Saudi Arabia far outstrips all other countries as regards the number of accidents, though it has lower fatality and injury ratios than many of the others. Referring to the previous section, the higher level of accidents in Saudi Arabia may be at least in part attributable simply to the large number of vehicles and, bearing in mind the country's geography and the large distances between towns, it is likely that vehicle miles driven will be greater in Saudi Arabia than in neighbouring countries. When accidents per 100,000 persons are compared for a selection of Arab countries, it is found that Saudi Arabia is ranked fifth out of the eight countries represented. Interestingly, other Gulf countries where, unlike Saudi Arabia, women are allowed to drive, appear both above and below Saudi Arabia in the table. The other Gulf countries also differ from Saudi Arabia in respect of the insistence on driver insurance.

According to statistics provided by the Ministry of Information (1992), more than three quarters of driving accidents in Saudi Arabia involve the collision of two vehicles. In 6.3% of accidents, a car hits a stationary object, and 7% of accidents involve running over a pedestrian. In only 5% of cases is the vehicle in bad condition. More than 60% of accidents occur in the day-time, and almost 80% in cities. Accident rates are similar for most days of the week, but are highest on Wednesdays and lowest on Friday, the day of religious observance when fewer car journeys are made.

Table 2.10

Accident Fatalities and Injuries, 1995

Country	Accidents	Fatalities	Injuries
Saudi Arabia	167,265	3,123	26,115
Morocco	41,552	3,323	60,922
Algeria	19,075	3,621	26,768
Syria	15,649	1,524	7,191
Libya	8,419	1,296	7,703
Iraq	5,223	1,717	4,232
Lebanon	3,722	335	3,423
Qatar	1,703	99	1,318
Bahrain	1,690	53	2,594

Al Bakri, 1998

Table 2.11

Number of Accidents for every 100,000 persons – 1995

Country	Accidents
Qatar	1,959
Kuwait	1,799
U.A.E.	961
Jordan	494
Saudi Arabia	224
Syria	134
Iraq	101
Sudan	35

Al Bakri, 1998.

Regarding the profile of drivers involved in accidents, Abu Adel (1997) reports that in 1996, 10% of drivers involved in accidents were "youngsters". Official statistics for 1981 show that, of 29,018 drivers involved in accidents, 2,341 were under 18, while the majority, 10,325, were in the 18-30 age group (Traffic Department, 1982).

As regards nationality, in 1996, 53% of the 227,628 drivers involved in accidents were

Saudis and 47% expatriates. In 1997, the ratio was almost identical: 54% Saudi, 46% expatriate (Traffic Department, 1997). These figures are relatively close to each other, even though according to Abu Adel (1997) there has been a great increase in the number of Saudi drivers, compared to expatriates. Bearing in mind that according to census statistics (see Chapter 1), non-Saudis make up only 27% of the population, it seems that they are disproportionately represented in road accidents. The same appears to be true of violations. In 1997, 55% of the reported 2,028,248 violations involved Saudis and 45% were committed by non-Saudis. This disproportionate representation of non-Saudis may be partly because a higher proportion of the expatriate than the Saudi population is male and so eligible to drive, and also because, as indicated in Chapter 1, many expatriates are employed as chauffeurs or in other jobs that involve driving.

2.7.2. Procedures in the Event of Accident

In the event of a minor accident, it may be possible for the parties involved to settle the matter amicably without recourse to higher authority. If this cannot be done, a police report will have to be made. If someone has been seriously injured, those determined to be at fault will often be jailed or kept in hospital until the full extent of injuries is determined. Compensation will normally be demanded from the culpable party and criminal penalties may also be levied if traffic regulations have been violated. If someone is killed in an accident, "blood money" will have to be paid to the relatives by those deemed at fault. The blood price is now SR 100,000 (O'Sullivan, 1993).

2.7.3. Causes of Road Accidents

According to the Ministry of Transport Statistics, there was an estimated figure of more than one million traffic violations during 1994 (Ministry of Transport 1994). This is a very high figure which indicates a high rate of drivers' disregard of traffic regulations (Al Naffi and Al Sayf, 1988). Current statistics released by the Ministry of Information and that of the Ministry of Interior Statistics revealed that errors committed by drivers could be due to the following factors:

1. High speed
2. Passing through a red light
3. Overtaking another vehicle
4. Driving on the wrong side of the road
5. Changing lanes
6. Overtaking close to a bend or on a hill
7. Insufficient care when entering the road or emerging from it
8. Violations of traffic instructions and guidance

Speeding is, according to the National Commission for Traffic Safety (quoted by Abu Adel, 1997), the main cause of road accidents, accounting for 46% of accidents between 1986 and 1990. Running red lights is reported to be the second most common violation.

O'Sullivan (1993) warns travellers to Saudi Arabia of the hazardous driving behaviours which are commonplace in the Kingdom:

- According to a recent study by the Ar. Riyadh Development Authority, the average speed in the city is 43 kph (25 mph), the highest average speed for a major city in the world.

- The speed limit on most highways is 100 kph, but it is widely ignored.

- Unlike major highways in many Western countries, where the far left lane is for passing and the far right lane for slower vehicles, in Saudi Arabia, drivers go any speed in any lane.

- Tailgating is routine.

Al-Maeena (1997), reporting on the high incidence of car accidents in the Kingdom, suggested that part of the problem is the lack of any coherent "driving culture" in Saudi Arabia, since there are drivers of many different nationalities on the roads, who have come from different driving systems and have different characteristics.

Another factor that has been blamed for the problem is the large number of sons of rich families, who are given fast cars as presents and according to Al-Maeena (1997) drive with "extreme arrogance and total lack of caution and consideration." (There are no women drivers in the Kingdom; see Chapter 1, Section 1.5, and Chapter 3, Section 3.2.2.)

Research about driving in Saudi Arabia has concerned itself mainly with observing human errors, numbers of road and other accidents, fatalities and injuries. However, there has so far, been little investigation of the attitudes or behaviour of accident drivers.

A study was carried out by Karam Allah Ali Abdul Rahman (Karam Allah, 1982). This was an analytical study of road accident statistics to the end of 1981.

The study showed that the most common cause of accidents are: driving without due care and attention; inexperience; excessive speed; ignoring traffic lights; and overtaking and sudden stopping. Of these, speeding accounted for 78% of cases, while failing to stop and red traffic lights accounted for 9%.

It was revealed that there had been a continuous increase in speeding. Forty-four percent of all accidents were caused by speeding in 1977, but this had increased to 78% by 1981. It was also revealed that drivers were aware that speeding was one of the causes of accidents, but they often ignored the speed limit.

This study was based solely on traffic accidents statistics and did not seek to analyse or take into account drivers' attitudes towards driving, nor their state of mind at the time of an accident.

A brief study was carried out in Makkah Al-Mukarramah by a team of psychologists from Umm Al-Qura University (Faheim and Colleagues, 1985). The aim of this study was to understand drivers' behaviour and their habits which affect other drivers, and to analyse the pattern of this behaviour. The researchers also tried to find out the relationship between this behaviour and age, educational level and driving experience.

The study was carried out on a sample of drivers from Makkah Al-Mukarramah, using a questionnaire devised by the researchers. It revealed that the drivers' most common annoying or dangerous habits were:

1) Not driving at a safe distance from the car in front
2) Shouting and arguing when an accident occurs
3) Cursing and swearing
4) Stopping in the middle of the street to watch an accident
5) Sounding the horn in an annoying way when overtaking
6) Speeding and driving without due care
7) Under-age driving
8) Skidding
9) Not reducing speed near schools and in congested areas

10) Sounding the horn near schools and hospitals

11) Giving inappropriate signals when turning

12) Overtaking without giving due regard to other drivers

13) Not using a safety belt

The study revealed that driving behaviour varies according to age. Older drivers were more aware and understanding of driving regulations. They were also more careful when driving. The study also revealed that drivers with greater driving experience had a general respect for other drivers.

This study was mainly concerned with identifying annoying behaviour. It did not focus on the causes of accidents, and it was only based in Makkah. This was the first published attempt to study drivers' behaviour in Saudi Arabia. However, Karam Allah's study is both limited and inconsistent. It is limited because the sample was taken from only a single city in Saudi Arabia, i.e. Makkah, so it cannot be considered representative. It is also inconsistent, because it confuses phenomena such as under-age driving with attitudes. Generally, the study suffers from bias and lack of precision.

A study was carried out by Dr Abdalla Al-Naffi' and Dr Al-Sayf in 1985, entitled "Analysing the Psychological and Social Characteristics of Drivers".

It showed that the rapid economic development in Saudi Arabia during the previous ten years had enabled many Saudis to obtain a car. It also made it easy for anyone over sixteen to own and drive a car. The car had become the main source of transport between cities and villages. Cars were also purchased by parents and used to reward their teenage children, who started driving with very little understanding of the highway code. Driver inexperience was, thus, identified as a major problem.

The study proved that 83% of drivers learnt to drive in a haphazard way, by themselves or with the help of friends of relatives and not with a driving school; and that the 17% who learnt to drive through a driving school did not learn about traffic and driving safety. (Driving school programmes are outlined in Chapter Three of this study). They learnt to confront actual traffic situations by observing and imitating other drivers.

The above study was mainly conducted as a psychological analysis. It is full of statistics but lacks a thorough evaluation of the attitudes of drivers involved in accidents.

Other Saudi research concerned itself with other factors which may contribute to road accidents such as vehicular factors. Al Ghamidi's article published in Alyamamah (46), 1996, gives an estimate showing that the average age of vehicles in Saudi Arabia is four years while it is ten and eight years in the USA. It also shows that in the last ten years, a vehicle inspection programme has been established by law in Saudi Arabia for all vehicles more that two years old (Inspection Law by order of the Minister of Interior, no. 7042, dated 6-7-7/1406 (1986)). It notes that in practice this is only being implemented and enforced in the main cities, and not in the smaller towns and rural areas.

Generally, local Saudi research tends to concentrate on road accidents in major cities such as Riyadh, Makkah, Jiddah and Damman. When it comes to comparisons of these accidents with cities in developed countries, this local research sometimes overlooks references to primary sources.

For instance, Arrukaibah and Al Sharif (1994) in "Traffic Accidents in Riyadh", did not mention the American primary source in their discussion of safety belt use.

Finally, in this section, it may be of interest to note evidence on an issue which, although it is not in itself a cause of road accidents, may well contribute to the levels of fatalities and injuries. That is, that according to statistics produced by the National Committee of Road Safety in King Abdulaziz City of Science and Technology, only 5% of Saudi drivers use safety belts. They estimate that if this proportion could be increased to 25% (which is still a relatively low percentage), the cost of road accidents in Saudi Arabia could be reduced by 5 million Saudi riyals annually; and if 75% of drivers used seat belts, the saving could be as much as 7.1 billion riyals each year (Al-Massaiah, 23 May 1998).

2.8 Traffic Safety Awareness Activities

Although traffic safety awareness activities exist, they are very limited, being infrequent or available only to particular groups of people. For example:

2.8.1. Traffic Week

Traffic week began as a week of high-profile police enforcement activity, held once each year, during which the Police Traffic Department would set up check-points and which they would stop car drivers and check their driver's licence, vehicle registration and the age of the driver, as well as focusing on a particular violation. These campaigns were held for several years, but had little beneficial result; drivers who held no licence or vehicle registration, whose documents were invalid, or who were under age, simply stopped driving during Traffic Week, even if it meant being absent from work or school. Drivers would be extra careful during Traffic Week, but return to their normal behaviour as soon as the level of surveillance and enforcement returned to normal.

Later, in 1983, the Police Traffic Department decided to try using Traffic Week in a new way, as an opportunity to give safety information by distributing advisory leaflets. The first campaign of this new type was held in 1984, and campaigns have been held annually ever since, in all GCC countries. Each year, a particular theme is chosen (see Table 2.12).

GCC countries' schools participate by discussing the Traffic Week theme, and incorporating it into written and art work. Some government departments hold seminars and publish leaflets or books urging co-operation in safety programmes. The media, radio/TV/newspapers and magazines participate by running special articles and programmes, and interviewing personnel from the traffic and transportation administration.

Table 2.12

Traffic Week themes for each year from 1984

YEAR	TRAFFIC WEEK
1984	Safety belt
1985	Pedestrian safety
1986	Speed limit
1987	Road signs
1988	Care about the road
1989	Vehicle safety
1990	Child safety
1991	Avoiding accidents
1992	Traffic safety is our goal
1993	Defensive driving is safety
1994	Speed kills
1995	Pedestrian safety is everyone's responsibility
1996	Ignoring red traffic lights is dangerous

2.8.2. Panorama Magazine

Saudi Aramco's Loss Prevention Department issues a quarterly magazine, *Panorama*, in English and Arabic, to increase awareness of safety issues, including traffic safety. A recent Special Traffic Issue (S.A.L.P.D. 1997), for example, highlighted intersection driving rules, the danger of driving when drowsy, the use of child restraints, desert driving, the effect of emotions on driving behaviour, and the need for regular vehicle maintenance. The articles are short, written in simple language, copiously illustrated with photographs, and full of stories of real or hypothetical cases which reflect everyday life and common driving situations, in order to convey clear, direct messages. The magazine is available free of charge to ARAMCO employees and, in theory at least, to others with an interest in road safety. Nontheless, a magazine, however simply and clearly written, presupposes a level of literacy which many of the population do not have. Moreover, people other than ARAMCO employees would have to know about the magazine and write to ARAMCO in order to receive it. Thus, it will reach only a very limited sector of the population.

2.9 Conclusion

Driving conditions in Saudi Arabia are affected by the vastness of the country and the huge length of its roads, some of which cross the desert, while others traverse ranges of hills and mountains. The country is also a centre of pilgrimage, which gives rise to traffic congestion because of the large number of vehicles used.

Despite these constraints, the country has achieved remarkable advances in the creation of a modern road network, and car ownership continues to increase at a dramatic rate. However, these developments have been accompanied by a severe toll in the form of road accidents.

The road accident rate in the Arab countries is very much higher than that of the developed countries. In Saudi Arabia, for example, the rate of accidents per 100,000 people is more than four times that of the U.K. and almost 10 times that of Germany (Al-Ghamidi, 1998).

One of the few studies concerned with driving in Saudi Arabia, is Karam Allah's (1985) study. However, this study is based solely on traffic accident statistics, limits itself to one city in Saudi Arabia and is inconsistent that it mixes up phenomenon with certain drivers' behaviour.

Another study, this time a field study, conducted by Faheim and colleagues of Umm Al-Qura University was mainly concerned with identifying annoying behaviour. It was the first published attempt to study drivers' behaviour in Saudi Arabia, but it does not attempt to shed light of accidents, and is, moreover, confined to a single city, which limits its usefulness.

A third study by Dr. Al-Naffi and Dr. Al Sayf in 1985 entitled Analysing the Psychological and Social Characteristics of Drivers was mainly conducted as a psychological analysis. This study is replete with statistics concerning general behaviour of drivers. However it lacks an analytical evaluation of the attitudes of drivers involved in accidents.

Thus, existing research does little to explain the reasons for the high incidence of road accidents in Saudi Arabia, and so does not provide a basis on which counter-measures can be devised.

CHAPTER THREE

TRAFFIC REGULATIONS IN SAUDI ARABIA

3.1. Introduction

To assess properly the behaviours of drivers in Saudi Arabia., it is important to look into the regulations governing driving in the country. These comprise the driving licence, driving instruction, tuition programmes, vehicle inspection and provisions relating to driving behaviour, including penalties for violations.

Before the seventies, members of the public did not make use of organised schools of motoring or tuition programmes. However, because of the increase in numbers of drivers and accidents during the seventies, a system of licensing was introduced.

The Saudi driving regulations are in fact, not dissimilar, to traffic codes in other parts of the world. However, there are specific additions because of special circumstances such as the introduction of male temporary licences (see section 3.2.2), due to the fact that females are not allowed to drive in Saudi Arabia.

3.2 The Driving Licence

3.2.1 Function and Contents

The driving licence is a local or foreign official document issued by the Saudi motoring authorities, or the motoring authorities of another country. It entitles the holder to drive motor vehicles in one or more categories. Based on this, article (2) of the Motorway Code states the following:

It is not allowed for anyone to drive any vehicle without a valid driving licence which shows the category and power of the vehicle. It must be issued by the motoring authorities according to the prescribed rules. The same is also applicable to the international driving licence, in case the driver is a foreign visitor.

The driver must carry his driving licence when and while driving a vehicle.

The military authorities must issue the drivers of military vehicles with a military driving licence.

Military drivers may not drive a civilian vehicle unless they hold a civilian driving licence.

The licence must include and show the following details:

Full name and picture of the driver.

Date and place of birth.

Residential address.

Nationality.

Blood category.

Dates of issue and expiry of the driving licence.

In the case of foreign motorists visiting Saudi Arabia, Article (9) of the Motor Code, resolution issued by the Ministry of the Interior, The Executive Regulation of the Motorway Code, Decree of the 20/7/1395 AH, 1975 AD states that:

Those who hold an international driving licence issued according to the 1978 Convention of Vienna, those who hold a driving licence issued in their home country or in any another country, after having registered with the motoring office, can use their driving licence until its expiry date or until the period of residence expires, whichever occurs sooner. However, the driving licence expiry date must not go beyond the period of one year from the coming of the visitor to the country.

3.2.2 Types of Driving Licence

There are six main types of driving licences, which are classified as follows:

Private driving licence:

This type of driving licence entitles the holder to drive vehicles which do not exceed over 3500 kilograms in weight. It is valid for 5 years from the date of issue.

2. Public driving licence:

This driving licence is of two categories:

Public driving licence for Saudi citizens.

Public driving licence for non-Saudi citizens.

This driving licence, which is valid for 2 years, entitles the holder to drive taxis which do not exceed 3500 kilograms, and the capacity of which is not over 9 people.

3. Licence to drive light trucks. This licence is granted after the applicant has held a public driving licence for a minimum period of 2 years. It entitles the holder to drive vehicles the weight of which does not exceed 5 tonnes, including coaches with a capacity of more than 15 people.

4. Licence to drive heavy weight vehicles. These vehicles do not use the public roads; see Chapter 2, see Section 2.6. The validity of this licence is 3 years. It is granted after successful completion of a special driving test. The test can be held by industrial schools, professional institutions or by the traffic authorities or private institutions, which provide such vehicles.

5. Licence to drive motorbikes.

The validity of this driving licence is 5 years. It entitles its holder to drive any motorcycle.

6. Military driving licence.

This is granted by the relevant authorities to the military personnel and all those who work in or are affiliated to the military sectors. The licence is awarded after successful completion of training given by specialised institutions. The categories of vehicle for which the licence is valid must be specified on the driving licence. The photograph of the driver, wearing official uniform, must be attached to the licence. Ref. Traffic Executing Regulations (1979).

In addition to the above mentioned driving licences, article (3) issued by the Executive Board of Motoring has granted the right to some civilian drivers to hold a public driving licence to drive cars which they would not, in normal circumstances be allowed to drive. This driving licence must be issued in accordance with the following conditions:

The request for the driving licence must be made by the authority to which the employee belongs. Normally, such licence is not granted to military or civilian drivers, because they are not allowed to carry on business transactions, as this is against the nature of their work.

Those who are granted this licence must sign a written undertaking not to drive any taxi or transport vehicles.

The licence must hold the name of the authority to which the employee belongs. Upon the completion or termination of his work contract, the holder of the driving licence may request the authority for which he worked to cancel his written undertaking after submitting the necessary proofs.

There is also a temporary driving licence which can be issued to applicants at the age of 17, i.e. one year before they could hold a full licence. These licences were introduced in recognition of the fact that, since women do not drive, the young males of the household often play an important role in providing transport for its female members.

The temporary licence is valid until the holder reaches 18 years of age, at which time he receives his full driving licence.

These regulations are embodied in the following legislation:

1. Article (4) of the Executive Board of Motoring.
2. Article (16) of the organising Board of the School of Motoring.
3. Article (3) of MOI (Traffic Regulations).

3.2.3 <u>Driving Licence Conditions</u>

The motoring authorities have set certain conditions for the acquisition of a driving licence. These conditions vary from one category to another.

However, age limits are set for the holding of a driving licence, the ages for various categories of licence are:

For a Motorcycle licence, the candidate must be 16 years old or over.

To drive private cars, the candidate must be 18 years or over. Those who hold a provisional driving licence are exempted from this rule, provided they have reached 17 years old.

A public driving licence can only be obtained from age 21 and over.

It is also necessary to submit a driving licence application, which comprises the following documents:

Full name.

Category of licence applied for.

Place and date of birth.

A personal identification card or passport to show the candidates personal details.

Three passport size photographs.

The applicant must be free from any serious illness which might interfere with the driving of the vehicle applied for. This can be ascertained by taking a medical test at the motoring office or at one of its branches. Alternatively, the applicant can provide a certificate issued by an official medical body. Such certificate is only valid for three months from the issue date (Motorway Code, article 40).

According to article 10 of the Motor Code, handicapped people can hold a driving licence, provided they pass a physical medical test which shows their ability to drive. The car must be fitted with the appropriate requirements and adjustments to make its driving possible.

The handicapped driving licence must state the special requirements of the driver and all the fittings needed for his car. It must also show that the driver is prohibited from driving any other car, except when the necessary adjustments have been made.

The applicant must have a valid residence permit in Saudi Arabia. Residence permits issued by Saudi Arabia embassies abroad for those who want to work or visit are considered valid, as long as the candidate has legally entered the Kingdom.

No driving licence, regardless of its category, can be given to an alcoholic or a person who has been convicted by a legislative court for committing a drinking offence twice or more. In such a case the candidate must demonstrate his repentance for this offence, and must support this repentance by a valid certificate issued by the police which testifies that he has not been convicted of a similar offence in the last calendar year. He must also provide a reference document attesting to his good conduct, signed by at least two people, and validated by a legal authority.

A driving licence, regardless of its category, can not be given to a person who takes or deals with drugs in any form, except after a five years penalty.

The candidate must pass a driving test, regardless of the category of the driving licence he is applying for; this driving test includes theoretical, practical and road-driving tests. The conditions set by the traffic office or any of its branches, where applicable, must be observed. However, there are exceptions to this rule for those who:

Hold a valid international driving licence which entitles them to drive the vehicle they are driving.

Hold a valid foreign driving licence issued in their respective countries.

Hold a valid military driving licence.

Diplomatic personnel are exempted from the submission of documents, which can be replaced by a letter issued by the head of department of their respective bodies. This letter must be stamped and validated by their Foreign Office. Then it must be submitted with three passport size photographs.

3.2.4 Renewal and Replacement of the Driving Licence

On expiry, any of the aforementioned driving licences may be renewed at the driving licence office or at any other traffic authority. A medical test and the payment of fees are required.

If and when licence is damaged or destroyed, it is legal to renew it according to the previous information held on the old one. The new licence will show exactly the same information as the old one, and will be delivered after the payment of fees.

When a driving licence is lost, the holder can have it replaced by a "lost licence replacement". The replacement licence is granted after careful checking, recording of loss on the local register and payment of fees. If the original licence is found, it must be returned to the traffic office. (Ref. Traffic Executing Regulations (1979)).

3.3. Driver Training

3.3.1 Driving Instruction Schools of Motoring

From 1920 to 1930, the acquisition of driving skills in Saudi Arabia was done on an individual, informal basis and was not supervised by any institution. The idea of initiating motoring schools was put forward in 1930. These schools of motoring were later incorporated in general and public schools.

Saudi Arabia was among the first Arab countries to open schools of motoring. This was done after the Vienna Convention of 1968. The First Arab Traffic Conference held in Cairo from 20th May until 25th May, 1972, announced the opening of motoring schools with up-to-date facilities to teach people driving tectonics with the most recent equipment's. A driving licence was then given to all those who attended these schools.

In 1979, the Minister of Motoring set a complete driving instructor's course which was in accordance with the standards of most modern international schools of motoring. This course was based on the following fundamentals:

Teaching correct and safe driving to all those who want to learn.

Providing technical and practical information on cars and how to drive them.

Teaching the Motorway Code.

Introducing a theoretical and practical course adequate for the nature and category of the required driving licence.

Providing audio and visual material for the illiterate and those who do not understand Arabic.

Determining an appropriate time-table for the courses, according to the driver's circumstances.

On 20/7/1295 A.H., 1975 A.D. the Minister of the Interior issued the first decree for the Executive Regulations of the Motorway Code, article 12 the first school of motoring was opened in Jeddah in 1975. At the end of 1995, the number of motoring schools in Saudi Arabia was 24. In areas where there is a driving school, all applicants for drivers' licences must attend the driver education programme. However, in the many cities and rural areas which do not have such programmes, young drivers rely for tuition on a friend or relative (Sanyour, 1989).

3.3.2 Personnel

In order to fulfil the goal for which the motoring schools were created, which is to prepare the driver psychologically and technically, to drive cautiously and safely, the Minister of the Interior considers that it is imperative to choose the best possible personnel to ensure the smooth running of the motoring school.

The administration and teaching committee must comprise the following personnel:

A Saudi Director to ensure, at a high level, the running of the school. He will deal with the relevant traffic authorities or with any of their branches.

Specialised instructors in practical driving.

Specialised instructors in mechanical engineering.

Instructors to teach the Motor Code.

Car Technicians.

Administrative Workers.

The names and qualifications of staff, and any changes in circumstances, must be reported to the General Traffic Administration with 30 days.

3.3.3 Tuition Programmes

Driver training programmes include lectures and practical training. If an applicant for a driver's licence in an area with a driver education programme has already learned to drive, he is still required to take the lecture part of the course.

There are four courses to be undertaken by private and public driving licence candidates which are as follows:

A. Regular Programme for the Private Driving Licence

This programme is one month in duration. The candidate will study 2 hours per day; one hour theory, and the other hour practising driving. The study takes place inside and outside the training circuit, according to the following categories of provision:

15 hours are reserved for practical training on the training circuit. These 15 training hours include driving at night, and two hours driving outside the circuit.

6 hours of the programme are allocated for practical training on electric vehicles (simulators).

7 hours of the programme are allocated for the study of road signals.

12 hours of the programme are allocated for the study of the code of crossing and the usage of the road.

14 hours of the programme are devoted to the study of vehicle maintenance.

3 hours of the programme are reserved for the study of first aid and emergency rescue, including extinguishing car fires.

3 hours of the programme are spent watching driving safety videos.

B. Regular Programme for the Public Driving Licence

The length of this course is one and a half months, during which the candidate learns all the requirements of a public driver of a light vehicle. The average time is two hours daily, one hour for theory and the other for practice. The potential driver will also have the chance to practise driving light carriage vehicles both inside and outside the circuit. The course includes the following components:

8 hours for practical training on electric vehicles (simulator).

20 hours for practical training on public vehicles.

15 hours for study of road signals.

16 hours for study of the code of crossing and usage of the road.

25 hours for the study of vehicle maintenance.

3 hours for the study of first aid and emergency rescue, including extinguishing car fires.

3 hours for watching driving safety videos.

C. Regular programmes for the part-time public driving licence

This programme can only be joined by those who are already able to drive. Its duration is 9 hours, which can be taken consecutively or spread over a period. In this programme, the student will learn the international road signal's first/emergency aid and car mechanics, according to the following recommendations:

1. 2 hours for study of road signals.

2. 3 hours for study of car mechanics.

3. 2 hours for study of road signs.

4. 1 hour for study of first aid.

5. 1 hour for watching driving videos.

D. Driving licence programme for part-time candidates

Anyone holding a valid Saudi driving licence with a minimum of two years driving experience, and those who are working for the motoring institutions and their affiliated branches, can join this scheme.

The programme comprises;

1. 6 hours driving practice on public vehicles;

2. 4 hours for the learning of road signs;

3, 4 hours for the learning of road etiquette;

4. 4 hours to learn vehicle maintenance;

5. 1 hour for watching of defensive driving videos.

3.3.4 <u>Description of the Training Circuit</u>

Each school of motoring has its own training circuit which simulates different driving situations, to help the candidate to develop a good sense of conduct and driving skills. There are 18 exercises to be performed on the circuit. Each training circuit must meet the following conditions:

- Its length must not be less than 137 metres and it must not be less than 107 metres wide.
- It must be on level ground (except for the uphill exercises).
- Clear indications and marking must be provided to allow candidates to carry their exercises.
- A wall must be built around the circuit to safeguard the candidates when training.
- Parking must be available for the vehicles used for training.
- It must have all the road indication signs (prohibitive and informative) and also, traffic lights.
- In each course, there must be a traffic light.

- There must be, in each course, a special place for the instructors and examiners.
- A hall with mechanical equipment to teach vehicle mechanics must be provided.
- A hall to teach traffic signs and signal charts;
- A projection hall;
- Vehicles for practical training.

3.3.5 Content of Driving Programme

The programme consists of the following:

1. The Car and its Components and Method of Driving:

Vehicle parts, the function of each part and how different components relate to each other.

Different measuring units.

Hydraulic and manual breaks.

Daily maintenance.

Light and request break downs and how to fix them.

2. Fundamental rules for driving:

What should be done before getting in the car.

What should be done before starting driving.

Starting up the vehicle.

Driving the vehicle.

3. Correct Driving Method.

Driving in the centre of the lane.

Changing lanes.

Stopping and getting ready to turn, either right or left.

Speed control, according to road indications.

4. Study of Road Signs.

Learning the different road signs: informative, directive and prohibitive.

Learning the meaning of the traffic lights and the road marking.

Learning the road signs, the penalties and the offences.

Learning the consequences of car accidents.

Learning about human loss and damages.

Learning reasons for accidents and what causes them.

5. Preventive Driving

The candidate is taught the following:

The distance to be left between vehicles.

Correct rules of overtaking.

Reversing.

Parking on a slope.

Rules of night driving in the country side.

Unexpected break down.

Blockage of the accelerator.

Damaged tyre(s).

Engine fire.

6. First aid

This component of the course includes:

Introduction to the first aids and its rules.

Conditions which require bandaging; fractures and burns.

Emergency action case of loss of consciousness; artificial respiration

Ability to use fire extinguishers.

Psychological effects of accidents.

3.3.6. Evaluation of Driver Training Programme

Sanyour (1989), comparing the knowledge, driving behaviour and attitudes of young people who had and had not attended driver education programmes, found few statistically significant differences between the groups. In particular, he found alarmingly high levels of speed violation among both groups. In other words, the driver education programme failed to improve the knowledge of drivers or to alter their behaviour in terms of reducing the frequency of violations.

Attendees of driver education programmes surveyed by Sanyour (1989) did not rate them highly in terms of interest or helpfulness. Lectures were considered to be boring. Practical training, especially on simulators, was considered more helpful and relevant than theoretical training.

3.4 The Driving Test

After completion of the driving course, candidates must take a driving test which will determine their ability in handling both the driving and its requirements. A testing board must be formed for this purpose, composed of a representative from the Traffic Office and another from the school. In case of a disagreement, the view of the representative from the Traffic Office will be final.

3.4.1 The Theoretical Test

Each and every driver must know the following:

The road signs, whether informative, prohibitive or directional ones.

The road traffic lights, and the meaning of the red, amber and green lights.

Preparation before starting driving.

Basic principles of driving, including the correct behaviour when taking a round-about, turning, and so on.

The geography of the place in which he lives or to which he travels. This test is to be passed by all driving candidates.

Any candidate who does not understand Arabic, is tested practically only, with an emphasis on the meaning of traffic lights and other international signs.

3.4.2 Practical Test

Upon completion of the theoretical test for the required vehicle category, the candidate must also take a practical exam involving driving both outside and inside the training circuit.

The candidate for a private driving licence must score not less than 75% and those who are aiming for a public driving licence must score not less than 90% of the general average.

The candidate must be capable of carrying out the following manoeuvres:

To starting up the vehicle and driving it on a straight or curved line.

Carrying out an emergency stop.

Overtaking and encountering another vehicle.

Turning right or left in junctions.

Stopping and driving away in very curved roads.

Negotiating road crossings, and junctions.

Stopping and driving away in very curved roads.

Making the right signals at the right time and place, using both the indicators and the hands.

Following the signals given by the traffic officials and also those given by other drivers.

Reversing a car and parking it.

Using the mirror.

Using the extinguishers and warning triangles.

In case of test failure; the candidate can take another exam, provided one calendar month has passed. If the candidate fails again, he may take another exam six months after the second exam or he may join the school of motoring again.

3.5. Mechanical Inspection

According to Saudi laws, motor vehicles of all types are subject to periodic mechanical inspection at the competent agency of the Traffic Department. In the case of private vehicles, inspection is due annually, after three years from the date the vehicle was first put into service. Details of the inspection are recorded in the vehicle's registration booklet. Operation of a vehicle without such a document is prohibited by law.

3.6. Speed Limits

Not all roads in Saudi Arabia have sign-posted speed limits, though the traffic regulations (Article 79) specify maximum limits for roads where no limit is posted, as follows:

30 km.p.h. for large motor vehicles within city limits.

50 km.p.h. for small motor vehicles within city limits.

70 km.p.h. for large motor vehicles outside city limits.

100 km.p.h. for small motor vehicles outside city limits.

Other countries make clear the driver's responsibility to reduce speed below the allowable maximum at night or in adverse weather conditions, and to drive at "a reasonable speed" such that he is "in full control of his vehicle" and can bring it to a complete stop from "a sufficient distance beginning at the point where he can see an obstacle or stop sign." However, the vagueness of the term "reasonable speed" and the failure to specify what constitutes a "sufficient" stopping distance means that there is ample scope for individual interpretation, and whether the driver has full control of the vehicle will often be judged with hindsight, when an accident has occurred.

3.7. Penalties for Violations and Accident Culpability

Traffic violations are divided into three categories, labelled A, B and C (see Appendix A). Category A violations are punishable by imprisonment from 5 days to one month or a fine of SR 50-300 or both; Category B violations by imprisonment from three to fifteen days or a fine of SR 30-150 or both; and Category C by imprisonment for a maximum of 10 days or a fine not exceeding SR 100. The violator may, however, avoid imprisonment or payment of more than the minimum fine by paying a fine of ST 30 for each violation in Category A, SR 20 for each violation in Category B, and SR 10 for each violation in Category C, provided that the fine is paid at the traffic station within whose jurisdiction the violation was committed, within ten days from the date of the offence. In addition to these penalties, commissioners appointed to investigate violations may impose additional measures, such as confiscating the vehicle (until any fines imposed have been paid) or withdrawal of either the registration booklet or the driver's licence, or both.

Culpability for accidents causing illness, injury, disablement or death is punishable by a term of imprisonment, ranging from two weeks, for accident resulting in illness or disability lasting up to ten days, to six months to two years for an accident resulting in a fatality. In the case of fatal accidents, a recurrence within five years from the first such accident carries a minimum penalty of one year imprisonment. Accidents leading to fatality, amputation, permanent disability or disfigurement, or work disability for a period exceeding one month must be reported to the Ministry of the Interior.

3.8. Conclusion

Driving regulations in Saudi Arabia are similar to other world regulations, and are intended to promote safe driving, as is the limited driver education available in the country. There are, however, some aspects of driving legislation which are unique to Saudi Arabia, such as the prohibition on women drivers and the absence of insurance. Provision exists for driving licences to be granted to expatriates as well as Saudis, though no specific statistics on the proportion of non-Saudi drivers is available. Nor are licence statistics available for drivers of heavy goods vehicles who, in Saudi Arabia, do not use the public roads. In theory at least, penalties for violations are strict, though those who can afford to pay additional fines can escape imprisonment. However, it was noted in Chapter 2 that the incidence of accidents in Saudi Arabia is still soaring. This suggests that, either the current licensing, training and enforcement provisions are insufficient to achieve the desired result in terms of driver behaviour, or that there are other, environmental factors which are not conducive to driving safely. Accordingly, it is imperative to look into circumstances allowing poor driving behaviour to take place or otherwise creating driving hazards. Before researching this stage, a thorough assessment of previous research on road accidents should be made. This is the purpose of the following chapter.

CHAPTER FOUR

TRAFFIC ACCIDENTS AND ASSOCIATED FACTORS : A REVIEW OF THE LITERATURE

4.1. Introduction

The transportation system consists of the movement of people and goods from their original starting point to their destination by means of transportation through certain routes. Movement by vehicle, for example, entails driving from one place to another. The driving process requires three elements: driver, vehicle and road. However, the driving process may be interrupted for any number of reasons relating to these three elements. Thus, road traffic accidents occur because of a break in the driving process.

Whereas car transportation contributes greatly to convenience and enjoyment of life, the breakdown of the driver-vehicle-road/motorway system, resulting in congestion and accidents, is a major problem. The factors leading to the breakdown are numerous and the relationships among them and their contributions to accidents are very complex in that the driver had to interact with vehicle, road and environment. Research on the extent of the traffic accident problem and possible causative factors has been conducted by researchers for various reasons, one of the main ones being to establish information on the basis of which new counter measure policies and programmes could be designed and implemented. In fact, the classification of road accidents and casualty types occurring in a country are important indications of the general strategy required in dealing with the country's road safety problem. Analysis of the pattern of road traffic accidents in a given country, and the understanding it produces, assists policy makers in establishing priorities both for the application of safety programmes and for research.

This chapter, therefore, reviews previous research on road accidents and associated factors, as a basis for postulating possible causes of road accidents, for testing empirically in the Saudi context. After a brief overview of the nature of the road traffic accident problem, the chapter discusses vehicle, road and driver-related factors which appear to be significantly associated with road accidents and considers the types of measures which some countries have introduced in an effort to reduce the toll of road accidents.

4.2. The Nature of the Traffic Accident Problem

Road traffic accidents, and the injuries and deaths that result from them, have become a major social concern to many countries. According to Al-Ghamidi (1996), in 1993, for example, 42,000 Americans died in traffic accidents and a further 2,000,000 were injured.

Traffic accidents cause not only human loss and suffering, but also economic loss to the family, society and the state. Crashed vehicles have to be recovered. Additional health care resources are needed to treat accident victims. The family breadwinner may be temporarily hospitalised, or left permanently incapacitated, leaving his family dependent on welfare payments. Production is lost when workers are absent through injury. Some idea of the seriousness of the problem can be gained if we consider that in 1985, the economic losses resulting from road accidents in the U.K. were put at £2,820 million, while in 1993, the total cost of accidents in the United States was said to be $167.3 billion (Al-Ghamidi, 1996).

Of particular concern in this respect is the differential between developed and developing countries.

Whereas road death ratios in developed countries have been declining for some 30 years, in most cases down to under five in 10,000 registered vehicles a year (only two in

Japan and Australia), the position in developing countries is very different. According to Tickell (1998), Asia, Africa and South America have more than twice as many road accident deaths as Europe and North America combined, despite having fewer vehicles.

Tickell puts the incidence of road deaths a year, per 10,000 vehicles, as 40 for India, 77 for Bangladesh, 111 for Ghana and 192 for Ethiopia. Seventy percent of road deaths now occur in developing countries (Brown, 1998).

The disparity in the traffic-accident death toll, between developed and developing countries, can be seen in Figures 4.1 and 4.2, which present statistics from a number of countries in Europe, the Americas, the Middle East and the Pacific region. As the Figures clearly show, the lowest death rates are in the developed countries of Northern Europe. Within Europe, the highest death tolls are in the poorer countries of the former Soviet block (e.g. Poland and Hungary) and the South (notably, Portugal). High death tolls are shown for the countries of the Middle East, and of South-East Asia (particularly South Korea), where rapid socio-economic development in recent years is likely to have led to an upsurge in levels of vehicle ownership.

This disparity may be in part due to differences in road engineering, legislation, medical care and so on. It seems, however, that developing countries also experience a disproportionate number of accidents, in relation to the number of vehicles.

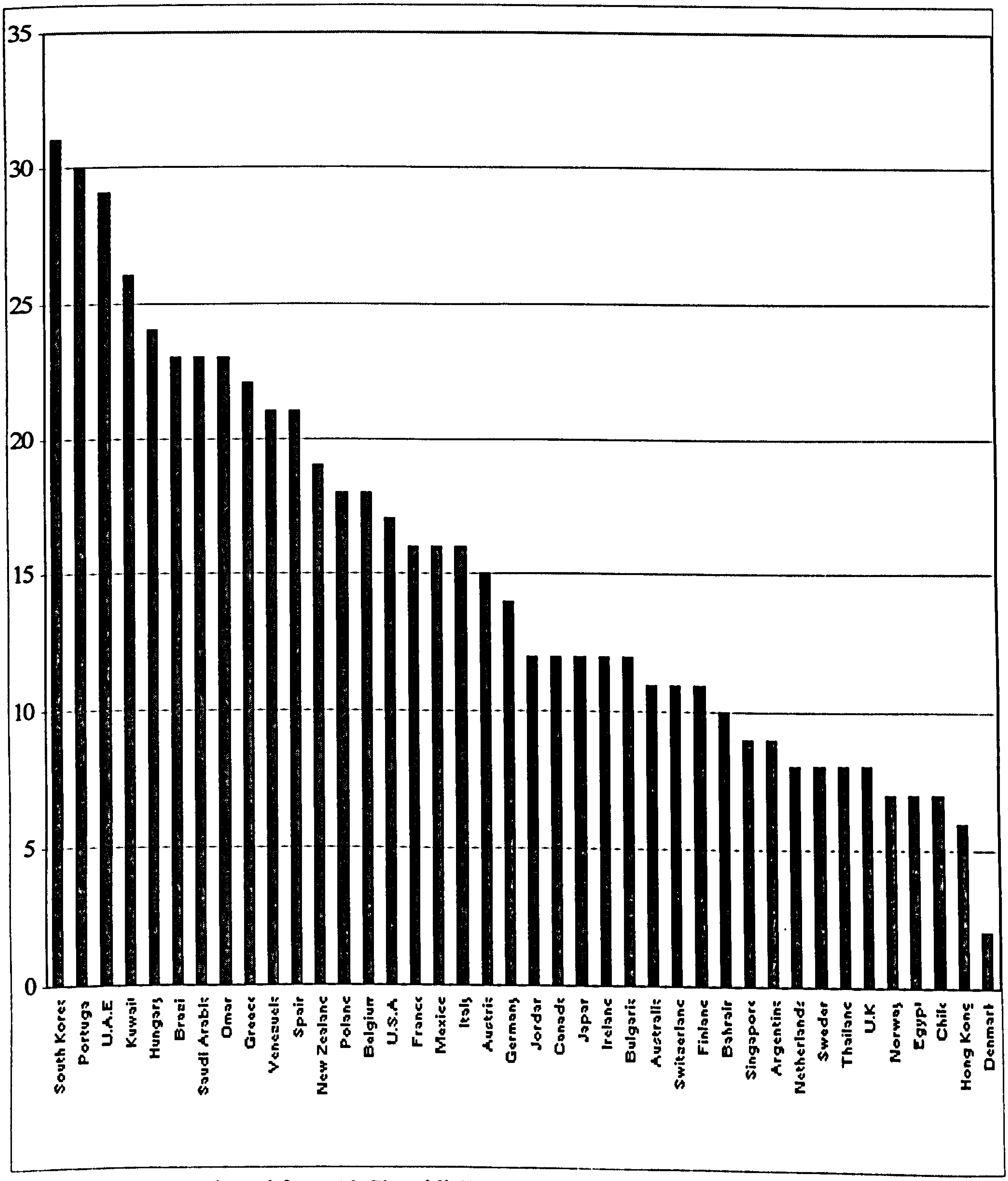
In Vietnam, for example, between 1995 and 1996, while the number of cars and motor cycles rose by 17%, the increase in road accidents was 23%.

It is obviously important to try to determine the causes of road accidents in order to implement appropriate counter-measures, and considerable previous research has been directed to this end. Perhaps inevitably, given their longer driving history, most of these studies come from Europe and the United States. The insights they afford will be reviewed in the following sections.

FIGURE 4.1.

Accident Fatality Rates in Selected Countries

Death average per 100,000 persons

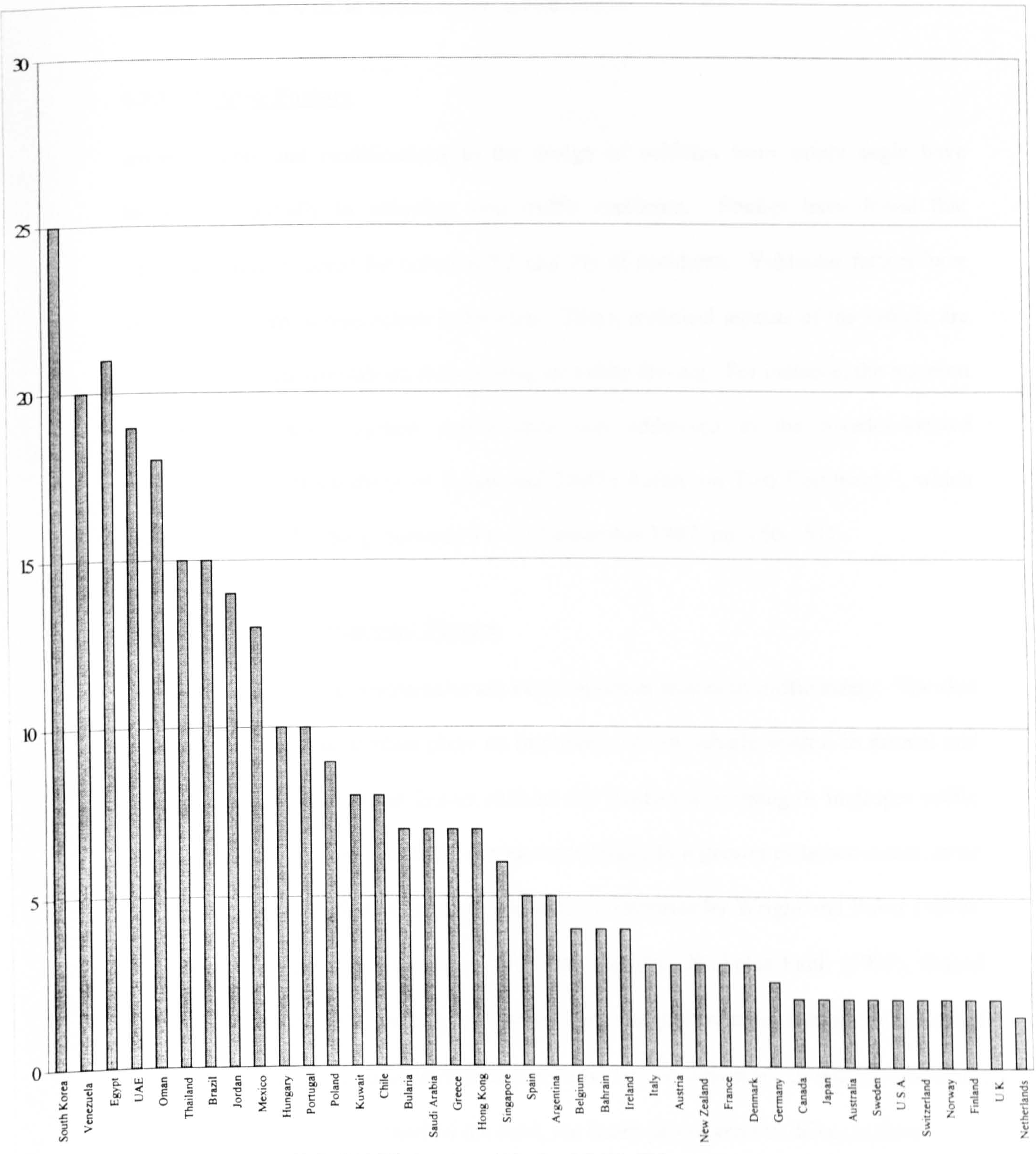


Source: Adapted from Al-Ghamidi (1996).

FIGURE 4.2

Accident Fatality Rates in Selected Countries

Death average per 100,000 vehicles



Source: Adapted from Al-Ghamidi (1996).

4.3. Factors Associated with Road Traffic Accidents

Evidence from previous research suggests that factors related to the vehicle and others related to the road or driving environment contribute to the incidence of road traffic accidents. Some of those factors are reviewed below.

4.3.1. Vehicle Factors

Improvements and modifications to the design of vehicles from safety angle have helped substantially in reducing road traffic accidents. Studies have found that vehicular faults account for between 2.3 and 7% of accidents. Vehicular factors have been the concern of researchers in Sweden. There, technical aspects of the vehicle are discussed in order to establish their bearing on safety driving. For instance, the question of anti-lock braking system performance was addressed in the Sweden-located symposium of "Proceedings of Roads and Traffic Safety on Two Continents", which took place in Gothenburg, between 9 to 11 September 1987 (pp. 150-151).

4.3.2. Road/Environmental Factors

Road conditions and characteristics are very important factors in traffic safety. The skid resistance of the road surface plays an important role in vehicle control in normal and hazardous situations. Road factors such as wet roadways, missing or improper traffic control devices or poor geometric design were found, to a greater or lesser extent, to be responsible for one third of the total accidents investigated by Wright and Baker (1979). On the other hand, in an interview with the journalist, Nicholas Faith (1997), Gerald Wilde, Professor of Psychology at Queens University, Kingston, Ontario, commented that even "good" road engineering can have adverse consequences, in that the smoother, broader and more clearly marked the road, the faster people tend to drive, as their perception of risk is reduced.

The kind of roadway, the lighting, the weather conditions and the type of object with which the vehicle collides are all important factors in fatal accidents (N.H.T.S.A., 1986). Statistics reveal that in 1986 in the U.S.A. 616 fatal accidents occurred in construction and maintenance zones in 1986. The largest proportion of these fatal accidents took place on interstate (28.1%) and arterial (26.6%) roads. In rural areas, most fatal accidents occurred at intersections controlled by stop signs (1,650), followed by areas which lacked any type of control device (1,206). More fatal accidents occurred on rural roads than in urban roads. The fewest fatalities occurred on freeways, expressways and interstates. More than a third of accidents took place on the roadway and away from junctions. Most fatal accidents occurred during dry weather and surface conditions; only 11.9% of fatal accidents occurring during the daytime took place under adverse atmospheric conditions (rain, snow, fog etc.), perhaps because people are less likely to drive under such conditions or drive more carefully when there are obvious weather hazards (N.H.T.S.A., 1986).

This is not to deny the importance of weather conditions, which can interact with road factors to create hazardous driving situations. Rain, snow etc. usually reduce the skid resistance of road surfaces, which become slippery. Skidding on wet or icy road surface often results in loss of vehicle control. Inexperienced drivers may become particularly susceptible to accidents when confronted by some of the less common weather conditions which result in poor visibility, such as fog or the icing-up of windscreens (Sattewaite, 1976). In a climate such as that of Saudi Arabia, adverse weather conditions can take a different form: sun glare – early in the morning or late in the afternoon, when the sun is low in the sky, the driver can suddenly find himself unable to see the road ahead.

Poor visibility is another factor which can contribute to accidents. To perform the driving process requires a great amount of information, over 90% of which, it is estimated, is acquired visually (Quimby and Watts, 1981). Previous research has shown that visual activity is significantly related to accident histories (Quimby and Watts, 1981; Burg, 1967).

Often, drivers involved in a collision say they did not see what they hit. Driving safely depends on the acquisition of enough visual information to allow navigation without conflict with other vehicles, pedestrians or debris. During times when the acquisition of sufficient visual information for the driving task might be difficult, such as driving at night, accident rates increase (Phillips, et al., 1990).

Research in Sweden (Nilssen and Roosmark, 1976), revealed that accident rates varied according to road conditions and that on a clear road surface, accident rates for dark, night-time conditions were about twice as high as those for daylight conditions.

The incidence of accidents also tends to vary with the day of the week and the time of the year, with weekends and holidays seeing a marked increase in the number of accidents. In the U.S.A., for example, almost half of all fatalities occur at weekends, with more fatal accidents on Saturdays than any other day of the week. Fatalities are at their lowest in January, rising throughout the spring and summer to reach a peak in August. There are also significant rises around Christmas and Thanksgiving, and on Independence Day (July 4) and Labor Day (the first Monday in September) (N.H.T.S.A., 1986). Such fluctuations are attributable in part to variations in the number of vehicles on the road at peak times. They may also interact, however, with human factors such as stress and alcohol impairment. These and other human factors associated with road accidents are considered in the next section.

4.4. Human Factors Associated with Road Traffic Accidents

The role of human factors in road traffic accidents has received great attention in past studies. On the spot accident investigations in the USA, the UK and other countries have shown that human factors are responsible for the majority of accidents (Wright and Baker 1976). In a study by Sabey and Slayghton (1975), it was shown that human factors contributed to nearly 95% of accidents and were the sole contributor in 65%. Those factors playing the largest part in accidents were errors of perception, lack of skill, and errors in executing manoeuvres and impairment (Jacobs and Sayer, 1983). Similarly, in a limited study in five developing countries the police highlighted the high incidence of road user errors (Jacobs, Downing and Sayer 1976, 1981).

Human factors research is related to drivers' demographic characteristics, knowledge, psychological factors and behaviour. The role of these factors as they relate to road traffic accidents may vary from one country to another.

It should also be recognised that these groups of factors interact and cannot be seen in isolation. Knowledge, for example, may be in part a function of age; behaviour may be affected by gender differences or psychological factors. For the purpose of this review, however, it is convenient to discuss each group separately.

4.4.1. Demographic Characteristics

Two demographic variables which have attracted particular attention in research on accidents and driving behaviour are gender and age.

4.4.1.1. Gender

Road traffic accident involvement rates in the U.K. show that younger males are over-represented in accidents (Dorn, 1992). In Ireland, males are much more often killed in road accidents then females (Lesley and Rooney, 1996).

According to a report by Cerelli (1996), in the U.S., whereas male drivers accounted for 50.4% of all licensed drivers in 1996, they accounted for 62.8% of the total travel in the same year. 60.8% of the drivers in police-reported crashes were male, while for fatal crashes, the proportion rose to 74.4%. On the other hand, in a later report, Cerrelli (1997) noted that between 1980 and 1997, the number of male drivers involved in fatal crashes had decreased by 20%, while female involvement had increased by 28%.

The difference in accident and fatality rates between males and females seems to be due to differences between the genders in driving behaviour and attitudes. Dorn (1992) presents evidence suggesting that young male drivers assess their personal risk and driving abilities less realistically than other groups. They drive faster, overtaken more often and commit "more high risk" overtaking than do other age and sex groups. Similarly, Laapotti and Keskinen (1998) found that high-risk driving habits played a bigger role in male drivers' accidents than those of female drivers; this was especially the case for loss-of-control accidents.

Such findings may go some way to explaining the high accident rate in Saudi Arabia, where all drivers are male (though as indicated in Chapter 2, some of the other Gulf countries where women are allowed to drive have a higher ratio of accidents per 100,000 persons than Saudi Arabia).

4.4.1.2. Age

Age is an important factor in many road traffic accident events (Thygerson, 1977; Quimby and Watts, 1981). Each age group in the driver population has different road safety problems. Accidents among young drivers in Saudi Arabia have been mainly related to misuse of the car, reckless driving, or driving without a licence (Lee, 1986).

However, it is generally accepted that the mental sensory and psychomotor requirements for safe driving exist among young drivers.

For elderly drivers, the source of the problem is different, for an increase in age is usually accompanied by changes in hearing, vision and the central nervous system. These changes usually cause many difficulties. The hearing response, which can act as an alarm system, loses the capacity for stimulation. The role it plays in balance can also be affected. This is especially important for pedestrian behaviour. The bulk of information that the road user needs to get around, as we noted above, is transmitted visually. At around the age of forty-five, the onset of far-sightedness (presbyopia) occurs (Smith, 1987). The capacity for detecting moving objects may be impaired. Visual acuity in twilight is reduced and sensitivity to dazzle increases. Deterioration is also observed in dynamic perception of distance. Among the elderly, there is reduced sensitivity for a given level of luminosity, delayed perception and increased response time to a light signal. Night-time driving becomes particularly difficult. The situation is worse if glaucoma or cataracts are present. Certain systems of sight correction may act as a filter, distorting or restricting the perception of reality (OECD, 1986). Diminished peripheral vision means that the driver cannot see sideways so well, and has to turn his or her head more often than normal to check blind spots (ARAMCO, 1996).

Despite the greater likelihood of physical impairment among older drivers, however, the research findings show that in general, older drivers are at less risk of involvement in a road accident than young drivers, perhaps because they drive less frequently and for shorter distances, or because any impairment is compensated by increased experience. Certainly, the majority of studies show that it is the youngest drivers who are the highest risk group.

Inexperienced and particularly young drivers also account for a very high proportion of road accidents (Hedlund et al., 1984). In fact, young drivers up to twenty-five years of age have three to four times the average accident rate (OECD, 1986). In the UK, the highest accident rate (total number of accidents to distance travelled) is for the seventeen to nineteen age group, and is three times that for the over sixty-five age group (Moore and Sedgley, 1982). Similarly in the US, the death rate from road accidents is at least twice as high for drivers aged between twenty and twenty-four as for older drivers in their mid-forties (Thygerson, 1977). This fact remains valid, even after exposure to traffic conditions. Petz and Schuman (1971) found that young males aged eighteen or nineteen had substantially more crashes that did men either younger or older, and those differences remained after traffic exposure. These researchers found that, regardless of whether young men learned to drive early or late, they still showed a clear peak at around the age of eighteen or nineteen (Thygerson, 1977). Compared with other causes of death, traffic accidents are the principal cause of death from one to thirty-four (Haight, 1985). In addition to the accident problem, young drivers aged eighteen and nineteen commit more traffic violations and receive more tickets and warnings than others (OECD, 1986). The majority of these infringements relate to speeding. Also, young drivers are over-represented at all time periods and all levels of severity of accidents (OECD, 1986).

According to statistics in the U.S. (Cerrelli, 1996), the number of involvements in fatal motor vehicle accidents decreases steadily with the age of the driver. The risk of being involved in a crash drops sharply from about 265 crash involvements per 1,000 licensed drivers in the 16 and under age group, to less than 40 for drivers above the age of 60.

In both Northern Ireland and the Republic of Ireland, male deaths are strongly linked to age, with those of 18-24 years being most at risk (Lesley and Rooney, 1996).

Thompson (1996) claimed that in the U.S.A., the automobile is the number one cause of death among young people between 14 and 24 years of age.

A study in Western Australia (Ryan et al., 1998) revealed that drivers aged under 25 years were involved in 35% of crashes, compared with only 3% for drivers 70 years and over. There were also age-related patterns in the movement associated with those crashes. For drivers under 30, crashes were associated with swerving and swinging wide, drivers 30-39 were disproportionately often stopped at the time of the crash, while drivers over 60 tended to have more crashes associated with turning movements. The authors concluded that there are changes in exposure to risk of crash involvement with age, and also with changes in ability, experience and psychological function which are themselves age-related.

A study by Moore and Sedgley (1982) found an interesting variation of the road accident situation in relation to the age of drivers. Elderly drivers have a higher than average risk of accident involvement for right turn movements at junctions and at rural junctions generally. For some other kinds of accidents, such as certain types of single vehicle accidents, elderly drivers have a lower that average risk of involvement in all kinds of accidents studied (Moore and Sedgley, 1982). In this study of 110 recorded accidents at rural cross-roads it was found that, on average, drivers on the minor roads were ten years older than the drivers on the major road with whom they collided. Another study by Faulkner (1975) showed that for the special intersections from minor roads, accidents per vehicle-kilometre are higher for drivers aged between forty-five and fifty-four than for that next lower age group, twice the average for all ages for drivers between that ages of fifty-five and sixty-five, and five times that average for drivers aged sixty-five and older (Moore and Sedgley, 1982).

Age-related differences in driving accidents have important implications for policy-making. For example, in the United States, Koshal (1976) concluded that, all else being equal, 12.5 percent increase in the driving age, from sixteen to eighteen, would be accompanied by a reduction of about 11.1 percent in the accident rate per vehicle mile, 13.9 percent in the accident rate per capita, and 15.4 percent in the accident rate per motor vehicle.

Accident rates among older people could be tackled by different measures. Stamatiada (1990) in a study of the relationship between driver, roadway, environmental considerations and accidents at road intersections found evidence to support the view that elderly drivers experience a reduced ability to handle traffic situations appropriately, due to a reduction in the basic skills required for safe driving. He noted the increased difficulty experienced by elderly drivers as the complexity of the design and traffic control device application increases, indicating that a major contribution to safety may be made by measures affecting the driver, such as licensing and training.

4.4.2. Road Users' Exposure and Experience

Exposure and experience are important factors in analyses and comparisons of the accident rates of different age groups or drivers. The differences in accident rates may contribute to differences in exposure to the risk of accidents and/or differences in experience. Therefore, it is important to control these two factors when comparing the accident rates of different age groups (OECD, 1975). The concept of exposure deals with the extent to which a driver is exposed to the risk of accident involvement (OECD, 1975). Different ways have been used to measure and define driver exposure.

Carrol (1973) discussed the various definitions of exposure presented in previous studies. He concluded that exposure can be defined as the frequency of traffic events which create a risk of accidents. The measures can be categorised in two groups, direct and indirect. Direct measures include driving distance, mileage, driving time and traffic volume, while indirect measures include such factors as petrol prices, car insurance premiums, miles of roadways, vehicle registration and mileometer readings (OECD, 1975; Carrol, 1973). However, most of these measures are not appropriate ways to address the question of the difference in exposure between drivers of different ages. Vehicle miles driven is the measure most often used to measure driver exposure (Carrol, 1973). Many studies have found that young drivers usually have lower exposure values than older drivers (Foldvary, 1969). Foldvary showed that mileage increases up to the age of approximately fifty, after which there is a decrease in exposure. Similarly, Burg (1967) found that mileage increases until the age of fifty-five for males and seventy five for females. Pelz and Schuman (1971), however, found an average of four annual mileage increases only up to the age of twenty, after which it remains more or less stable (OECD, 1994).

The OECD's report of 1994 and other studies have concluded that lack of driving experience, particularly among young drivers, is a key factor in a large number of traffic accidents. Studies have also shown that as driving experience increases, the accident rate in relation to mileage driven decreases accordingly (Harrington and McBride, 1970; OECD, 1994).

There is some interesting research about the new developments in vehicle/road systems (Charles 1995), However it is too early to summarise any significant conclusions as to the effect of the "Intelligent vehicle Highway Systems" on road safety on the one hand and attitudes of drivers on the other. The obvious reason is that this is a new technology that would need some time to have a bearing on road safety methods.

4.4.3. Psychological Factors

Research has identified a number of "Psychological Factors" which appear to have a bearing on driving behaviour and, hence, accidents. These can be classified into three basic types: personality characteristics, attitude towards driving, and temporary psychological disturbances such as inattention or stress.

4.4.3.1. Personality Characteristics

The dispositional psychological view lends its idea of "types" of personalities or behaviour patterns (Liebert and Speigler, 1990).

Olsen (1993) identified two basic personality types, Type A and Type B. The Type A personality tends to be aggressive and highly stressed, often having high blood pressure and coronary problems. The Type B individual, by contrast, is calm, considerate, contented and patient, and can handle stress well.

These basic personality types are reflected in different styles of driving behaviour. The Type A person drives aggressively. Aggression can be manifested in many ways, from sounding the horn and making insulting gestures, to driving close to the car in front, pushing into spaces, and, at the most extreme, "road rage" attacks. The aggressive driver is more likely to defy regulations and ignore traffic signals. Type B driver, in contrast, drives defensively, respecting laws and signals, keeping within speed limits, focusing on safety and comfort and being courteous and considerate to other road users.

Other writers interested in personality factors associated with driving accidents have focused on the fact that, for many people, driving appeals to the lust for power. It gives a sense of freedom, mastery and control (Professor John Whitelegg, interviewed by Faith, 1997). The most obvious and dangerous symptom of the need for power, manifested in driving, is excessive speed (Faith, 1997).

4.4.3.2. Road User Attitudes

A distinction needs to be drawn between road users' attitudes and their behaviour. Attitudes are concerned with what people think about, how they feel about certain things, how they would like to behave and how they think they should behave. However, their actual behaviour does not necessarily reflect these attitudes, as behaviour may also be influenced by social norms, habits (behavioural patterns to which they have become accustomed) and by the expected consequences of their behaviour (Poister, 1978).

Driver attitudes are of interest to policy makers, as they indicate an individual predisposition to act in a certain manner and they are important in determining driver behaviour. Driver groups usually express different attitudes towards driving in general. The attitude and feeling towards speeding, for example, is different among various groups. The study by Mostyn and Sheppard (date?) in the UK found that those who feel that speed is enjoyable or exhilarating are more likely to be aged seventeen to twenty-four; those who have been personally involved in an accident; and drivers who have been prosecuted for speeding. Those who feel fearful or negative about speeding are significantly more likely to be woman or drivers who cover less than five thousands miles per annum. Drivers who deny any feelings associated with speeding and claim they never speed are significantly more likely to be male, aged sixty-five or over, and with no personal experience of accidents. Research has shown that it is possible to bring about changes in attitude, and to identify in advance certain groups of high risk drivers, for insurance rating purposes (Thygerson, 1977). However, on the whole much more research is needed into driver attitudes and behaviour.

4.4.3.3. Temporary Psychological Disturbances

Inattention

As cars are designed to be quieter, more comfortable and more relaxing, and particularly with the advent of car stereos and radios, mobile telephones and so on, the driver becomes more removed from the outside environment and more prone to lapses of attention.

Redelmeir and Tibshirani (1997) in a study in Toronto, Canada, screened 5,890 persons who had been involved in a road collision causing significant damage and found that drivers were more likely to have made a mobile telephone call in the 10 minutes immediately before the collision, than in a similar interval on the day before the collision. Further investigation revealed that even when the driver was using a no-hands phone, or receiving an incoming call, rather than dialling out, the accident risk was still substantially increased. They concluded that the association of accidents with the use of mobile phones was attributable to the mental distraction of the driver, rather than to the fact that his hands were physically occupied with the telephone. In the U.K. the Department of the Environment, Transport and the Regions warns that it is unsafe for a driver to use a hand-held mobile phone and that making or receiving a call, even with a hands-free phone, can distract the driver's attention and lead to an accident. The law requires drivers to have proper control of the vehicle at all times. If the use of a phone causes the driver to drive in a careless or dangerous manner, he or she risk prosecution (DETR, 1998).

Stress

Road users may be subject to a number of stresses. They may bring to the driving situation stress caused by family or work problems, or they may experience stress when driving, due to congestion, others' driving too close and so on. Stress raises the heart-rate, blood pressure and endorphin levels, and can lead to a completely disproportionate reaction to a minor stressful incident.

Cartwright et al. (1996), in a survey of 236 drivers of a large car fleet operated by an international retailing organisation, found evidence that occupational stress is a factor in accident rates among company car drivers. They suggest the need for organisational initiatives aimed at stress or reduction and the improvement of individual coping skills as a contribution in reducing motor vehicle accidents.

Driving is getting more stressful in two ways. There is a greater mental load: drivers have to concentrate harder, there are more things happening and they are happening faster and faster.

Aggression, power and increasing frustration add up to that most typical of modern problems: road rage. Displays of hostility to other road users are becoming more frequent, ranging from mild gesticulation to actually using the car to threaten other drivers, either by getting up too close behind or getting into a space and denying that space to anyone else (Faith, 1997).

4.4.4. Tiredness

Fatigue, whether caused by physical exertion, intense mental activity, stress at work or at home, or lack of sleep, can impair reaction speed and accuracy (ARAMCO, 1993). A report by the U.K. Transport Research Laboratory (TRL, 1998) suggests that tiredness is a factor in about 10% of road accidents. Drivers whose accident rates were particularly affected by daytime sleepiness – particularly high time drivers driving company cars, had an accident rate between two and three times that of drivers not so affected. In New South Wales, Australia, driver fatigue is said to rank in priority after drink driving and speeding as a cause of accident trauma, accounting for 16% of fatal crashes. Surveys by the NSW Roads and Traffic Authority show that 3% of drivers report having had a crash due to fatigue, and 24% report having nearly had a crash due to fatigue (New South Wales RTA, 1998).

One cause of tiredness can be long hours driving. The fatiguing effects of long hours of driving are often combined over the length of the trip, with tiredness arising from time of day effect, monotony and even loss of sleep, if the driver has been awake a long time. Breaks from driving tend to delay the effects of tiredness. It is important to recognise, however, that, as many people are tired in their day-to-day lives, the risks of driver fatigue are by no means restricted to long distance trips. The survey cited above revealed that 62% of the fatigue crashes or near crashes occurred when drivers had driven for less than two hours, often on everyday trips near their homes, where most driving is done.

4.4.5. Driver Behaviour

The Driver Behaviour Research Group at the University of Manchester distinguishes three levels of aberrant driving behaviour: lapses, errors and violations. Lapses are embarrassing but not dangerous mistakes, such as trying to pull away from the traffic lights in the wrong gear. Errors are more serious mistakes of observation or judgement, such as failing to see a Stop or Give Way sign, misjudging an overtaking gap. A violation is the conscious and deliberate flouting of traffic regulations: speeding, drink-driving, or running through red traffic lights, for example. It is this latter category that the group find to be most associated with accidents (Faith, 1997).

In Victoria, Australia, the main causes of accidents were said to be speeding, driving under the influence of alcohol, and not observing road signs and traffic regulations

(Victoria Police Traffic Camera Office, 1997).

Two examples of driving violations, speeding and driving with impairment (by drugs or alcohol) are considered here.

1. Speed

Speed is cited by the European Transport Safety Council (ETSC, 1994) as a major cause of accidents. The Council estimates that a reduction of 5 kph in average speed could save over 11,000 deaths and 18,000 injuries in road accidents in the EU. Studies in Sweden (Nilsson, 1981) and at the Transport Research Laboratory in the U.K. (Baruya and Finch, 1994) suggest that accident frequency is correlated with speed.

It is acknowledged that speeding restricts a driver's ability to react to a dangerous situation. Moreover, it increases the force of impact in a collision. A collision at 60 kph results in an impact of 100 kph; at 85 kph, the impact force is 200 kph; and at 100 kph, the impact force is 280 kph. (Victoria Traffic Police Camera Office, 1997.)

A child or adult struck by a car at 30 mph could possibly be killed; at 40 mph, fatality is highly likely; and at 50 mph it's almost certain, according to a member of the West Midlands Police Accident Investigation Unit (Faith, 1997).

2. Driving with Impairment

Alcohol affects both driving skills and driving style. Deery and Love (1996) found that subjects with 0.05% blood alcohol took longer to detect hazards and responded to them in a more abrupt manner.

In an investigation of 24 out of 30 fatal road accidents occurring during a one year period in the district of Aarhus, Denmark, it was found that in one third of the accidents, alcohol was an important contributory factor. Medical drugs and narcotic substances played a lesser role (Hanson et al., 1996).

According to Lemoine and Chayon (1996), the range of drugs implicated in road accidents includes sedative medicines such as some antihistamines, anti-depressants, anti-hypertensives; and stimulants such as amphetamines, caffeine and codeine. The authors warned of the need of both prescribers and the public to be informed of these risks.

In less developed countries, the poor behaviour of drivers may, in part, be attributable to a lack of knowledge of road safety rules and regulations, or a lack of enforcement of those rules (Jacobs, Sayer and Downing, 1981). In order to bring about an improvement in this poor behaviour, two methods may be employed, often in combination with one another. One method is to focus on altering the ideas, feelings or objectives of drivers, and the other is to change the situation, thereby indirectly affecting their goals, ideas and feelings. Human behaviour may be influenced and modified to help reduce that number of accidents by various means:

- by conveying new information through education;
- by giving advice, the effectiveness of which varies according to the prestige of the source of that advice, its presumed experience and judgement;
- by giving commands that carry authority;
- by appealing to values and sentiments other than those invoked by position of authority;
- by giving inducements or offering something valued in return for compliance;
- by using coercion. Threat of harm, although the opposite of inducement, can be used as a form of inducement (if you do as I wish, then I will not do that which

you'd rather I didn't do);

- by using force with or without authority, the threat of force is coercion.

Specific measures which have been adopted in some countries, to attempt to reduce driving accidents and fatalities, are considered in the following section.

4.5. Measures to Improve Traffic Safety

In developed countries, road safety campaigns, driver training, better vehicle care, seat belt legislation and traffic management measures have been reducing crash deaths for 30 years, despite rising vehicle numbers (Brown, 1998).

In recent years, Britain, for example, has spent about one billion pounds a year (1980 prices) on road safety, which the Red Cross describes as a "cost-effective investment with a high rate of return." It argues that developing countries too, should commit serious resources to accident prevention measures such as better street lighting, safer junction designs, traffic calming and public education (Tickell, 1988).

This section reviews literature relating to accident counter-measures in terms of vehicle care, traffic management and measures to influence driver behaviour. Some community based traffic safety programmes are also reported.

4.5.1. Periodic Vehicle Inspection

As part of a wider action programme on traffic safety, Sweden introduced periodic inspection of all motor vehicles in 1965. Under the present rules, vehicles have to be inspected annually from the second year after their model year designation. The inspections are carried out at designated inspection centres operated by a specifically-formed state-owned company, the cost being met by fees, fixed by the government. The aim of the scheme is to detect and rectify safety defects which can lead to accidents.

Studies show that as a result, the useful life of passenger cars has increased by about 50%, and that the scheme contributes about 10% to the improvement in traffic safety (Svenson, 1988).

In addition to periodic vehicle inspection, occasional inspection campaigns have been used as an enforcement and accident prevention measure. As part of a major safety campaign during the summer of 1998, police in Devon and Cornwall, two of the most popular holiday venues in Britain, receiving about eight million visitors anually, performed rigorous safety checks on coaches bringing tourists into the region. In another campaign, checks were carried out on hundreds of goods vehicles, with the aim of taking dangerous vehicles off the road and putting pressure on haulage companies to meet safety standards. The owners of a number of faulty vehicles were given 10 days to make repairs and in the most serious cases, the vehicles were immediately taken off the road (Devon and Cornwall Police Authority, 1998).

4.5.2. Traffic Management and Speed Reduction

Mountain et al. (1998) found that factors affecting the proportions of accidents of various types include the method of function control, speed limit and traffic flow.

Al-Bakri (1990), in a study in Jordan, investigated the effect of transportation system management techniques and traffic enforcement levels on accidents at intersections. He estimated that additional enforcement levels were associated with a reduction in accidents of approximately 20% for one year, and that signalised intersections are safer than roundabouts, with the difference in safety depending on the speed limit of the approaching roads.

Speed reduction measures lead to a reduction both in the number of accidents and in the number of resulting injuries and fatalities (Armah, 1997).

Experiments in Finland proved that the number of accidents decreased the more the speed limits managed to reduce speeds. This was a function of the relative level of the speed limit. Too high a speed limit could also raise the level of speeds and increase the number of accidents, in adverse weather conditions, for example (Salusjärvi, 1988).

Nilsson and Roosmark (1976) reported that when speed limits were reduced in Sweden as part of a programme of trials of differentiated speed limits following the change to right-hand traffic, both the number of accidents and the damage resulting from accidents were reduced.

Whilst some studies have focused on the effects of speed reduction, others have looked at the effectiveness of specific measures to secure compliance with speed restrictions. For example, in Holland, a number of experiments have been carried out to investigate the effects of publicity campaigns and police surveillance strategies on drivers' speed limit compliance and attitudes towards speeding. It was found that a combination of publicity and police enforcement produced more lasting effects than either activity alone (Rothengatter, 1988).

Holland and Conner (1996) investigated the effectiveness of a police intervention on exceeding the posted speed limit on a target 40 mph limit road. The intervention consisted of a week in which "police speed check area" warning signs were put up on the road in question, followed by a week of active police presence, and a further week during which the signs remained. Fewer people broke the speed limit during the intervention than before, this effect lasting to a limited extent up to nine weeks after police activity ceased.

There is some evidence to suggest that the use of speed cameras to enforce speed limits can lead to a decrease in both speed violations and road accidents. In a questionnaire survey of 524 subjects in the U.K., it was found that the presence of speed cameras was effective in reducing the speeds adopted by some drivers and that this effect, to some extent, generalises to areas without cameras. Overall, drivers in this survey expressed more positive than negative views about the presence of speed cameras (Corbelt, 1995).

In Victoria, Australia, since 1989, new laws and legislation have been introduced to address excessive speed. Speed cameras were introduced and intensive, highly visible and publicised enforcement campaigns focused on deterrence of "high risk" behaviours. A concentrated media campaign has been mounted to educate the public. As a result of these initiatives, between 1989 and 1997, accident trauma cases were reduced by 43%. Since the introduction of speed cameras, collisions have been reduced by 22%, fatalities by 51% and serious injuries by 34%. The percentage of vehicles checked that were above the camera speed thresholds has declined steadily, from 23.9% in 1997 (Victoria Police Traffic Camera Office, 1997).

In addition to enforcement, speeding can be addressed through driver education. In a pioneering initiative in Cornwall, speeding drivers were given the option of paying a fine and receiving three penalty points, or attending a driver education programme. Those who chose the latter option were shown a hard-hitting video showing real-life crashes, showing the speed at which drivers were travelling at the point of impact. They also received expert advice on their driving habits. The operation was so successful it was later extended to other parts of the Force (Devon and Cornwall Police Authority, 1998).

4.5.3. Insurance

Views differ on the effects of insurance on road safety. In France, for example, at one time motor insurance was banned on the basis that if people could buy protection against the consequences of bad driving, they would allow themselves to drive badly. On the other hand, schemes that give major discounts in premiums for accident-free driving provide a strong motive for people to drive safely. In Massachusetts, U.S.A., the Safe Driver Insurance Plan aims to encourage safe driving by rewarding low-risk drivers and making sure high-risk drivers pay their fair share of insurance costs. Credits are earned for each year of incident free driving, up to a maximum of 6 credit points, that save the driver nearly 50% on certain coverages; conversely, surcharges can be accrued for poor driving that could more than double premiums for some coverages. It has been shown in Norway, for instance, that such schemes were effective in significantly reducing the accident rate (Faith, 1997). Even if insurance schemes do not actually reduce the number of accidents, they at least reduce the hardship resulting from them, by providing compensation to victims. In the U.K., the Motor Insurers' Bureau, funded by all motor insurers, exists to compensate the victims of road accidents caused by uninsured or untraced drivers. The Bureau receives approximately 45,000 claims per year, of which 7-8,000 will actually be insured; of the remainder, uninsured drivers account for approximately 80% and untraced drivers for the other 20% (personal communication from an official of the Bureau, 14/12/98). It is worth emphasising here that Saudi Arabia is the only country which does not insist on driver insurance; even other Islamic countries, such as the Gulf States, do so (see Chapter 3).

4.5.4. Driver Training

The most obvious way in which social habits could be changed has been in driver training. The amount of driver training considered necessary or desirable varies tremendously from country to country; in Libya, for instance, drivers do not need to take a test. Even in countries where driving tests are relatively strict, such as the U.K. and U.S., it is recognised that a single test can cover only a small, and not necessarily representative sample of the conditions that will be encountered in a lifetime's driving. Increasingly, moreover, calls are heard for compulsory re-testing of drivers after a serious accident or conviction for careless driving or worse; and that after the age of 65 years, drivers should be re-tested regularly (Faith, 1997).

A research study by the Insurance Bureau of Canada reported by PDE (1998), on how skill-related differences between novice and experienced drivers affect skill rates, led to a recommendation that driver training should be extended and more emphasis placed on critical skills and tasks and that driving tests be made more stringent.

4.5.5. Child Safety Campaigns

Given the high proportion of road accidents involving cyclists and pedestrians, especially children, many developed countries have initiated accident prevention campaigns aimed at children.

Education of children in road safety is one of the traffic safety counter measures taken in the U.K. to reduce traffic accident casualties and fatalities. Materials including Sign Colours, Shapes and Symbols; Mass, Speed and Control; and Safety Risk Management were developed and pilot tested in primary schools in Wiltshire. A t-test revealed statistically significant differences in performance between the experimental group, who received road safety instruction, and the control group, who did not, to the benefit of the former (Bouk, 1992).

4.5.6. Child Seats and Seat Belts

Karwachi and Barker (1979) found that the fatality risk for children younger than six months was twice that of one-year-olds and concluded that this was due to the tendency for infants to travel in the arms of their parents – a very dangerous way to travel.

Schertz (1981) reports that during the period 1970 to 1980, 148 children aged 0-4 years were killed in automobile accidents in Washington State, U.S.A. The fatality risk for children not restrained in safety devices was 1/227, while the risk for those using safety devices was 1/3,150. Thus, the study shows that the use of appropriate child restraints decreased the fatality risk to less than a fourteenth of the risk without such devices.

A study carried out by the National Transportation Safety Board in Washington (1983), which studied 53 accidents in detail, found clear evidence of the often dramatic life-saving and injury prevention benefits of safety devices for both infants and small children.

Agran et al. (1985) studied the accident and injury pattern of children younger than four years travelling in correctly installed infant carriers or child safety seats, compared with those travelling without a safety system. They found that children travelling in safety restraints had few injuries, if injured at all.

According to United States statistics for 1986, the incidence of fatality and the severity of injury to all passenger car occupants in fatal accidents are functions of restraint use. For example, 62.4% of drivers and 71.2% of passengers who suffered incapacitating injuries were not wearing restraints. Passengers using restraints were much less likely to have been thrown from their cars than were those who were not wearing restraints (National Highway Traffic Safety Administration, 1986).

4.5.7. Community Traffic Safety Programmes

In the U.K., Road Peace, a registered charity originally set up to represent and support those bereaved or injured as a result of road traffic accidents, also works to raise awareness of the dangers of the road and to encourage their reduction. Road Peace liaises with other organisations with an interest in road safety issues. It works to educate road-users about their responsibilities through the production and dissemination of papers and pamphlets, including materials targeted at schools, on such topics as drink-driving and speeding, and also disseminates road safety information via the Internet (information sent privately to the author by Road Peace Organisation).

In the U.S.A., the National Highway Traffic Safety Administration (N.H.T.S.A.) reports a number of community initiatives on traffic safety. Some are set up as official departments within town and district authorities; others are volunteer organisations. Funding comes from various sources, including government grants and sponsorship by local firms. Their activities include public education, encouraging use of child restraints and seat belts and schemes to reduce the number of alcohol or drug-impaired drivers.

In Mobile Country, Alabama, a highway safety countermeasure programme has been established as an integral part of the Sheriff's Office. The major focus of the programme, which has three full-time staff, augmented by community and Task Force volunteers, is on education. Current education and public information programmes cover pre-school to university, workplace, and the general public. With the aid of the programme, seat belt compliance was increased from 34% to 62% in 1992, and drink-driving fatalities in the Thanksgiving – New Year Period dropped from five in 1989 (prior to the programme, to one in 1990 and zero in 1991 (N.H.T.S.A., 1994).

In Plymouth, Massachusetts, a small department works closely with the police, schools, alcohol servers and the business community in a range of awareness, education and enforcement activities, including a Peer Leader programme whereby approximately 200 trained students serve as peer counsellors in schools, and the Safe Rides Programme, sponsored by a local law firm, whereby free town rides are provided to the alcohol-impaired during December. During the first three years of the programme, highway crash fatalities dropped 56%, from the level of the preceding five years (N.H.T.S.A., 1994).

In Albuquerque, New Mexico, an Action Team was set up, as a volunteer organisation, to combat alcohol and drug-impaired driving. Most of its programmes include public information and education components. The Action Team also directly provides press releases, media interviews, personal appearances on interview shows, public service announcements, billboards, posters and brochures (N.H.T.S.A., 1994).

An advantage of these schemes is that they can be tailored to the particular driving conditions and traffic safety problems of the region concerned, for example, targeting specific age groups, local weather conditions, common violations, and so on. Moreover, the location of such schemes within institutions which have authority and credibility in the local community (such as the Sheriff's office), and their involvement of key local organisations and personalities, help to gain support for the programmes among the local people.

4.6. Summary of key findings from the literature

The foregoing review of previous research suggests that there are certain factors which are particularly likely to contribute to road accidents.

The most striking and important message emerging from existing studies is that the majority of factors implicated in accident causation are human factors, whether demographic, psychological or behavioural.

At the demographic level, two significant variables identified have been driver's gender and age, with male drivers and younger drivers being more prone to aggressive, risky driving behaviours and, hence, to accidents. In the Saudi context, where all drivers are male, it is not possible to contribute further evidence on the relative safety of male and female drivers. The findings on gender do, however, suggest that an all-male driving environment may be one in which risk-taking, speed and the like are particular problems. Moreover, given the evidence on the interaction of gender and age, and the fact that young drivers are also more error-prone due to lack of experience, it would obviously be worth investigating the age of drivers involved in accidents in the present study.

At the psychological level, personality type has been claimed to affect driving style and so potentially be a contributory factor in road accidents. Whilst personality type itself may be difficult to assess, the behaviours to which it gives rise are directly observable. In particular, it has been suggested that the aggressive, power-seeking personality is most commonly manifested in driving, by excessive speed. Indeed, the research on driver behaviour presented in this chapter has indicated that violations, such as speeding, are major causes of accidents, and there is complementary evidence that traffic management and surveillance measures designed to reduce speed are effective in reducing the incidence of accidents. Thus, speed, as well as other violations such as tailgating and running red lights, are potentially important factors for investigation in the Saudi context.

Another major type of violation contributing to accidents in the West is driving with impairment, particularly through alcohol. Drink-driving would not be expected to be a major cause of accidents in Saudi Arabia, where alcohol is prohibited; but it is interesting to note that medication, too, can be a cause of impairment leading to accidents.

In addition to the human factors outlined above, the research evidence suggests that an important contributory role in accident causation may be played by road/environmental factors, such as weather conditions, particularly those which affect vehicle traction or reduce visibility. Because research into these factors has so far been carried out in the West, the concern has been with conditions such as rain, fog, snow and ice. These particular conditions are, of course, not relevant in the Saudi context. Nevertheless, the Saudi climate has features that also affect traction and visibility: severe heat, sun haze and sand storms. It thus seems possible that these may contribute to road accidents, just as ice and fog do in the West, and this possibility should be investigated in the present study.

The human and environmental factors summarised above appear to be among the major contributory factors in road accidents, and ones on which there is substantial agreement in the literature. There are, however, others for which there is as yet less evidence, or which appear to play a lesser role. There is little explicit evidence on behaviours such as eating, listening to music or using mobile telephones while driving, though such evidence as exists suggests that behaviours such as these may impair the driver's concentration, and to that extent may contribute to accidents.

Finally, there is the role of the vehicle itself. Whilst vehicle fault appears to account for only a very small proportion of accidents, there is, nevertheless, evidence that vehicle inspection schemes have contributed measurably to road safety. Mechanical fault is, then, a factor which is worth considering in investigating accident causation. There are also vehicle-related behaviours such as using seat-belts and using child restraints which may not in themselves prevent accidents, but certainly reduce their devastating consequences and feature heavily in road safety campaigns in the West. In Saudi Arabia, where the use of such restraints is uncommon, drivers who use them may be the more cautious and responsible motorists. Such factors as these, therefore, should also be taken into consideration in the present study.

4.7. Conclusion

As this chapter has shown, road traffic accidents constitute a major social problem in many parts of the world, with a huge cost in human misery caused by injuries and fatalities. Such accidents also place an economic burden on society, in terms of the cost of breakdown services, health care, and for bereaved families and the loss through injury or death of productive workers. The problem is particularly acute in developing countries, where accident rates are disproportionately high.

Driver behaviour is related to the driver's basic skills and personal abilities such as the ability to assess risk and perceive hazards in driving situations (Quimby and Watts, 1981). These abilities are considered to be important factors in safe driving, Emotional stress and anxiety which drivers experience in driving can have a strong relationship with drivers' behaviour on the road. For example, drivers who feel more threatened by road and traffic hazards might therefore tend to drive more slowly and engage in less risk than drivers more used to or more confident in driving (Quimby and Watts, 1981). In addition, certain atmospheric or climatic conditions may affect accident frequency by influencing human behaviour (Thygerson, 1977).

In the developed countries, insights such as these have been used as a basis for the planning and implementation of road safety measures, such as periodic vehicle inspection, improved road engineering, speed reduction and public education campaigns. It cannot, of course, be assumed that findings from one country can be generalised to others, or that road safety measures that are effective in one country will be effective in another. Climate, road conditions, driving experience and culture differ from country to country. Nevertheless, the research reviewed here provides useful insights into the types of variables that have been found in the past to affect road safety, on the basis of which we may develop hypotheses for testing in the empirical part of this study. These hypotheses, and the methods adopted for testing them in the Saudi context, are explained in the following chapter.

CHAPTER FIVE

METHODOLOGY

5.1 Introduction

This chapter explains the methodology adopted in order to accomplish the aims of the study. It begins by briefly re-stating the objectives of the study and outlines the hypotheses derived from the literature review, focusing on factors which may be involved in the causation of driving accidents. It goes on to explain the research design. The construction and piloting of the survey instruments, the sampling procedure, data collection process and methods of data analysis are all discussed.

In order to carry out this investigation, the researcher chose the sampling method as it has clear advantages compared to other methods, such as interviewing. One of these advantages is simplicity, in terms of the brief contents of each questionnaire, bearing in mind the fact that it was anticipated that many respondents would not be well educated. Another advantage is the friendly atmosphere which surrounds the process of meeting the respondents and explaining to them what is required. It is important to assure the respondent that he is secure and this can only be achieved through the questionnaires. Each of these three questionnaires is relatively short and comprises targeted questions reflecting issues emerging from the literature review.

The questionnaires were field tested in two areas in Saudi Arabia, i.e. Dammam and Al-Khubar. This pre-testing, which involved 35 jurors and respondents, led to the reformulation of a few of the questions, but showed that the structure of the questionnaire as a whole was satisfactory.

The 600 respondents, in the main field research, were all drivers belonging to different age groups. Respondents were both co-operative and perceptive of the importance and future results of this research.

The findings from the questionnaire survey were subjected to careful analysis.

These findings have been embodied in recommendations aiming at reducing the levels of driving accidents in Saudi Arabia, which could, if effectively applied, improve Saudi Arabia's record of safe driving.

5.2 Study Objectives

This study's main objectives were two-fold:

1. To investigate causes of driving accidents;
2. To recommend measures for safer driving.

The second objective was obviously conditional upon achievement of the first, since it was necessary to ascertain the causes of accidents, in order to decide what education, legislation or practical measures may be needed to prevent them.

In order to obtain the necessary information about accident causation, this study explored a number of potentially relevant factors related to the behaviour of the driver, the vehicle, and road conditions. These factors are detailed in the following section.

5.3 Hypotheses

The literature review has revealed that there are three principal components of traffic accidents: a) the driver; b) the road; c) the vehicle. Most traffic accidents in Saudi Arabia have been claimed to be due to drivers' errors and/or road conditions. Statistics show an estimated figure of more than one million traffic violations during 1994 (Chapter 2 - 2.7.3.). This is a very high figure which indicates a high rate of drivers' disregard of traffic regulations (Al Naffi and Al Sayf, 1988). Recent statistics released by the Traffic Department revealed that the most common errors committed by drivers resulting in accidents were as follows:

High speed

Passing through a red light

Overtaking another vehicle

Driving on the wrong side of the road

Changing lanes

Overtaking close to a bend or on a hill

Insufficient care when entering the road or emerging from it

Violations of traffic instructions and guidance

Obviously, the above errors are committed by the vehicle user. However, there may be a number of factors contributing to the commission of these errors. On the basis of the literature review, the researcher formulated the hypothesis that one or more of the following factors could be instrumental to accident causation. (Drivers are referred to as 'he' in these hypotheses, because in Saudi Arabia, only males are allowed to drive, as indicated in Chapter 3, p.1:

1. Driver starting his journey late, thus making an attempt to exceed speed limits to compensate for time loss.
2. Accompanying passengers' behaviour.
3. Driver's attention being distracted because the radio-cassette or telephone is on.
4. Driver being over-occupied by family and social problems.

5. Sickness, fatigue or lengthy driving.
6. Weather conditions, such as sun haze, fog, high-winds and dust, causing poor visibility.
7. Driver's failure to maintain sufficient distance between his vehicle and the one in front of him.
8. Being apathetic vis-à-vis traffic signs and guidance concerning safety.
9. Not being alert towards road and traffic dangers.
10. Psychological and other effects experienced during long periods of traffic congestion.
11. Smoking while driving.
12. Consuming food and drink while driving.
13. Poor vision (eye-sight)
14. Malfunction in the vehicle's instruments.

These factors were reflected in the construction of the questionnaire number two, (see Section 5.6).

To test the possibility of associations between the number of road accidents and drivers' personal characteristics and driving behaviours, the following null hypotheses were formulated:

1. There is no significant relationship between the educational level of the driver and motor accidents in Saudi Arabia.

2. There is no significant relationship between the age of the driver and motor accidents

in Saudi Arabia.

3. There is no significant relationship between the marital status of the driver and motor accidents in Saudi Arabia.

4. There is no significant relationship between the profession of the driver and motor accidents in Saudi Arabia.

5. There is no significant relationship between the driver's possession of driving licence and motor accidents in Saudi Arabia.

6. There is no significant relationship between driving violation on the part of the driver and motor accidents in Saudi Arabia.

7. There is no significant relationship between vehicle ownership and the number of motor accidents in Saudi Arabia.

8. There is no significant relationship between uncomfortable seats and the number of motor accidents in Saudi Arabia.

9. There is no significant relationship between mechanical fault on the part of the vehicle and the number of motor accidents in Saudi Arabia.

10. There is no significant relationship between traffic congestion and the number of motor accidents in Saudi Arabia.

11. There is no significant relationship between non-lighting of roads and the number of motor accidents in Saudi Arabia.

12. There is no significant relationship between non-marking of roads and the number of motor accidents in Saudi Arabia.

13. There is no significant relationship between inappropriate road engineering and the number of motor accidents in Saudi Arabia.

14. There is no significant relationship between presence of strayed animals and the number of motor accidents in Saudi Arabia.

15. There is no significant relationship between sun haze and the number of motor accidents in Saudi Arabia.

16. There is no significant relationship between excessive heat or cold and the number of motor accidents in Saudi Arabia.

17. There is no significant relationship between sand storm the number of motor accidents in Saudi Arabia.

18. There is no significant relationship between high beam lights and the number of motor accidents in Saudi Arabia.

19. There is no significant relationship between passengers' behaviours and the number of motor accidents in Saudi Arabia.

20. There is no significant relationship between ear disorder and the number of motor accidents in Saudi Arabia.

21. There is no significant relationship between eye sight and the number of motor accidents in Saudi Arabia.

22. There is no significant relationship between joy riding and the number of motor accidents in Saudi Arabia.

23. There is no significant relationship between frustration and the number of motor accidents in Saudi Arabia.

24. There is no significant relationship between non observance of speed limits and the number of motor accidents in Saudi Arabia.

25. There is no significant relationship between safe distance and the number of motor accidents in Saudi Arabia.

26. There is no significant relationship between over-taking and the number of motor accidents in Saudi Arabia.

27. There is no significant relationship between non-alertness to others' errors and the number of motor accidents in Saudi Arabia.

28. There is no significant relationship between reversing on the part of drivers and the number of motor accidents in Saudi Arabia.

29. There is no significant relationship between emerging from and exiting roads and the number of motor accidents in Saudi Arabia.

30. There is no significant relationship between non-familiarity with the roads and the number of motor accidents in Saudi Arabia.

31. There is no significant relationship between regular car servicing and the number of motor accidents in Saudi Arabia.

32. There is no significant relationship between regular car checking by drivers prior to driving and the number of motor accidents in Saudi Arabia.

33. There is no significant relationship between long hour driving and the number of motor accidents in Saudi Arabia.

34. There is no significant relationship between driving when tired and the number of motor accidents in Saudi Arabia.

35. There is no significant relationship between driving when sick and the number of motor accidents in Saudi Arabia.

36. There is no significant relationship between driving after taking medication and the number of motor accidents in Saudi Arabia.

37. There is no significant relationship between driving under psychological stress and the number of motor accidents in Saudi Arabia.

38. There is no significant relationship between use of seat belts and the number of motor accidents in Saudi Arabia.

39. There is no significant relationship between use of signals when changing lane and the number of motor accidents in Saudi Arabia.

40. There is no significant relationship between smoking when driving and the number of motor accidents in Saudi Arabia.

41. There is no significant relationship between eating or drinking when driving and the number of motor accidents in Saudi Arabia.

42. There is no significant relationship between observing traffic regulation and the number of motor accidents in Saudi Arabia.

43. There is no significant relationship between use of cassette and radio while driving and the number of motor accidents in Saudi Arabia.

44. There is no significant relationship between use of mobile telephone while driving and the number of motor accidents in Saudi Arabia.

45. There is no significant relationship between use of special seats for children and the number of motor accidents in Saudi Arabia.

46. There is no significant relationship between use of front and side mirrors and the number of motor accidents in Saudi Arabia.

47. There is no significant relationship between concentration on the part of the drivers while driving and the number of motor accidents in Saudi Arabia.

5.4 Research Design

This study's investigation of traffic accident causation in Saudi Arabia has two dimensions, theoretical and empirical. The theoretical component of the research took the form of an in-depth review of literature and documentary evidence relating to driving safety and the incidence and outcome of accidents, in Saudi Arabia and elsewhere (see Chapters 2, 3 and 4).

The second component of the research was a questionnaire survey carried out among drivers involved in accidents in the modern industrial cities of Dammam, Al Khobar, Dhahran, Qatif, Jubail, Hofuf, Khafji, Abqaiq and Ras Tanura. These cities are all in the Eastern Province. They are important centres of work and population, attracting migrants and visitors from all over the country. Moreover, with their busy, modern road networks, they were thought likely to reflect the increasing traffic problems experienced in the country as industrial and economic development continues. Further details of these cities are presented in Section 5.5. which follows.

5.5. Survey Location

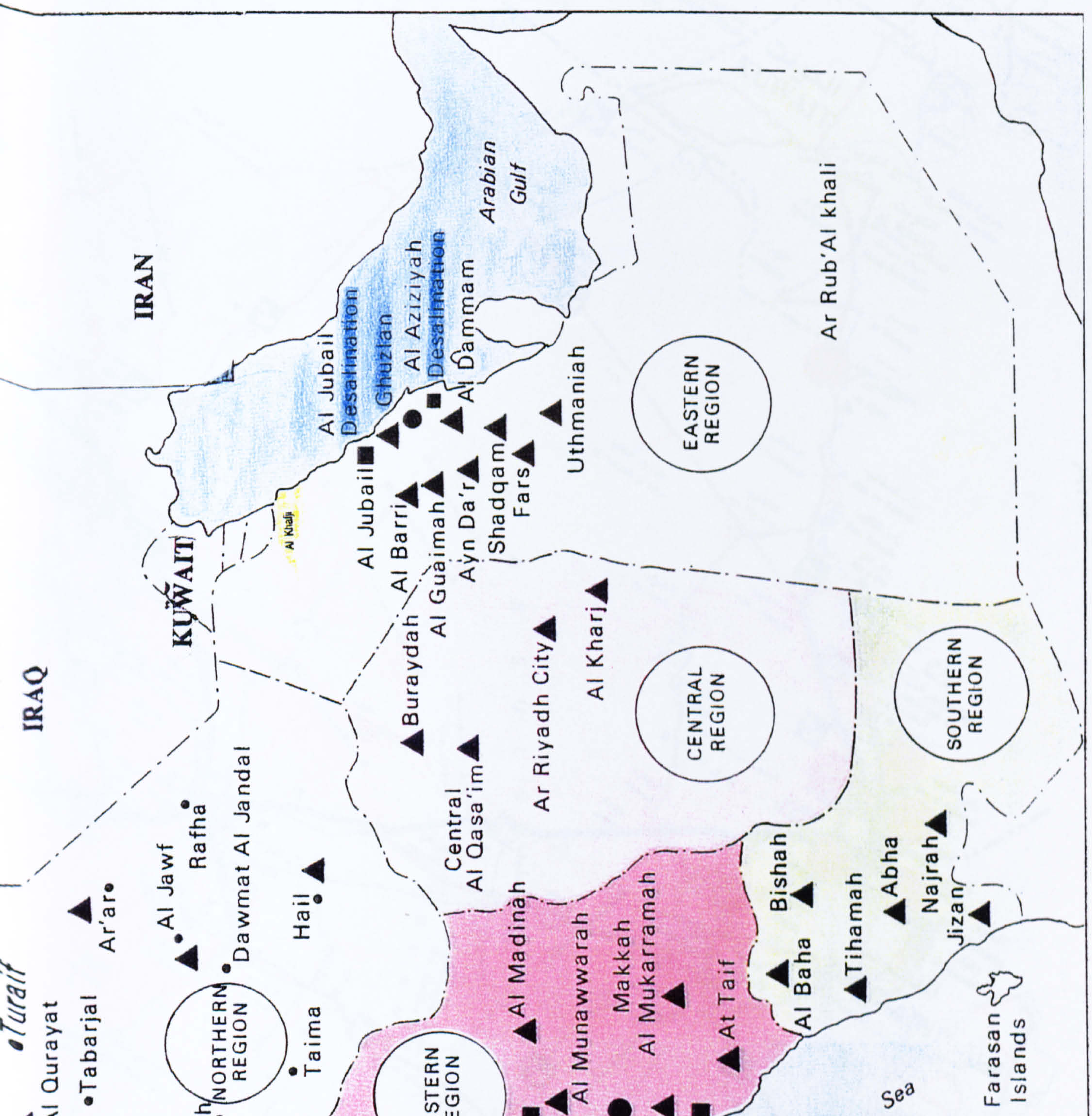
The study was carried out in nine cities of Saudi Arabia's Eastern Province (see Map 2). This section presents a brief overview of the nine locations in which the empirical survey was carried out. The cities concerned, and the road networks linking them, are shown in Map 3.

5.5.1. Dammam and Alkhobar

Dammam, the capital city of Eastern Province and its twin city Alkhobar were funded by a group of *ALDOWASSER* tribesmen (originally from the central Najd) who fled to the Saudi eastern coast from the village of *BUDAIYA'A* in Bahrain around the year 1923 after a misunderstanding with the British colonial administration of Bahrain.

Under special permission from King Abdulaziz Al-Saud, they established two fishing and pearling settlements in two different locations on the Gulf coast, some 25 kilometres away from each other.

Those two tiny settlements, which until 1935 had no more than 2000 houses in total made a palm fronds and sea rocks, are today the cosmopolitan cities of Dammam and Alkhobar.


IRAN
IRAQ
KUWAIT
Al Khafji
Arabian Gulf
Al Jubail Desalination
Ghuzlan
Al Aziziyah Desalination
Al Dammam
Al Jubail
Al Barri
Al Guaimah
Ayn Da'r
Shadqam
Fars
Uthmaniah
EASTERN REGION
Ar Rub'Al khali
Buraydah
Central Al Qasa'im
Ar Riyadh City
Al Kharj
CENTRAL REGION
SOUTHERN REGION
Turaif
Al Qurayat
Tabarjal
Ar'ar
Al Jawf
Rafha
Dawmat Al Jandal
Hail
NORTHERN REGION
Taima
Al Qalibah
Tabuk
Bi'r ibn Hirmas
Haql
Al Bad
Dhuba
WESTERN REGION
Al Madinah Al Munawwarah
Makkah Al Mukarramah
At Taif
Yanbu Desalination
Yanbu
Rabigh
Jeddah
Jeddah Desalination
Bishah
Al Baha
Tihamah
Abha
Najrah
Jizan
Farasan Islands
Red Sea

CITIES AND ROADS IN THE EASTERN REGION OF SAUDI ARABIA

Alkhobar, due to its proximity to Aramco's headquarters at Dhahran, was chosen by the oil company as a spot to construct the town's first pier for the purpose of shipping the early cargoes of crude oil to a refinery in Bahrain.

The pier, which was later developed and enlarged, was inaugurated in August 1938. It facilitated the import of many goods and appliances by traditional dhows from Bahrain, as well as the transportation of people and workers needed in those early days to help in the oil business.

Today Alkhobar, which is smaller than Dammam in size but a more relaxed and sophisticated city, attracts more expatriate personnel than its sister as a perfect place for residence.

The city is laid out in a rectangular grid pattern, and has many distinctive residential districts on its outskirts such as: *THUQBAH, AZIZIYAH, RAWDHA, GREEN BELT, GOLD BELT, and AQRABIYAH.* If offers some of the best hotels and restaurants, the choicest shops, and the biggest shopping malls and supermarkets in the region.

The 25 kilometres that *ALDOWASSER* left between their two settlements has been developed into large residential districts (such as *RAKAH* and the Municipal Housing Quarter), government buildings, private exhibition showrooms and stadiums.

5.5.2. Dhahran

When the American geologists first arrived in the eastern region in 1933 to explore the Kingdom's gigantic wealth of oil, Dhahran was a barren dome-shaped hill.

With Aramco (the oil company) getting more involved in its oil concession, Dhahran served as an operational base, and later when oil was discovered, it grew and expanded to serve as a headquarter for the company and living quarters for its senior and junior employees.

Today, with its American-style houses, roads, and signs, and its advanced facilities and recreation centres along with its humid climate and tall palm trees, the city reminds one of Florida's Miami.

Aside from the Aramco compound, which is itself a city dominating most of the area, Dhahran encompasses the King Fahad University of Petroleum and Minerals *(KFUPM)* and its campus, the U.S. Consulate-General, King Abdulaziz Air base and the International Airport. Each of these four entities has the size and facilities of a town.

5.5.3. <u>Qatif</u>

Qatif is a city located 15 kilometres north of Dammam, as well as an oasis which includes the following 15 towns and villages:

Safwa, Sehat, Alawjam, Umm Assahij, Anak, Aljesh, Umm Alhamam, Aljarodiyah, Mehaish, Alkhowaildiyah, Alshobaykah, Attobi, Almallaha, Alqedai'h and Alawamiyah.

The history of Qatif goes back to the third Millennium B.C., and its ruins and ancient names (Jiparro, Zara, Alkhatt) indicate its previous importance which attracted many foreign invaders such as:

- The Persians (between 226 and 610)
- Qarmatians (between 847 and 990)
- The Portuguese (between 1507 and 1553)
- The Turks (between 1553 and 1913)

The city is well known for its fascinating Souq Alkhamees (Thursday Market) where one can buy locally made mats, baskets, platters and food covers made of palm leaves, bowls, jars, vases, water pipes made of clay, Bedouin carpets and jewellery, birds and chickens.

Qatif is also known for preserving its Gulf-style buildings with the typical decorated wooden doors, windows, balconies and wind towers to catch the breeze and circulate it through the house.

5.5.4. Jubail

Bearing the same name as a Phoenician town on the Lebanese coast proves its links with the Phoenician civilisation in ancient times.

The city of Jubail (or Jubayl), which is located 80 kilometres north of Dammam city, started as a fishing and pearling village with a primitive harbour.

In 1977, it was chosen to be one of the two centres for industrialisation in the Kingdom, and since then it has grown and expanded in order to facilitate the Kingdom's exports of its hydrocarbon wealth.

Jubail Industrial City accommodates today thousands of locals and foreigners who work in oil refineries, steel mills, petrochemical and fertilisation plants, desalination plants (which pipe fresh water to Riyadh) and many other support industries.

5.5.5. Hofuf

Hofuf is located 75 kilometres away from the Gulf waters and serves as a capital city for the world's largest oasis, *ALAHSA*.

It is known for its many natural springs such as the famous *"AIN ANNAJIM"* and *"AIN UMM SAB'AH"* which were developed as bathing places.

The city is also famous for its *"JABAL QARAH"* (10 kilometres to the east) which is a soft rocky mountain with tunnels, caves, and hollows created by weathering.

One of the government's outstanding achievements in this portion of the Kingdom is the irrigation scheme with its 3000 kilometres of concrete channels that distribute water from more than sixty artesian wells to remote areas.

Hofuf's most attractive ruin is *"QASR IBRAHIM"* (Palace of Ibrahim) where the Ottoman Turks took refugs in 1913 during King Ibn Saud's siege of the city. It consists of two ancient mosques and a fortress.

Other places which attract visitors are: *"SOUQ ALKHAMEES"* (Thursday Market) where a variety of traditional handicrafts such as handmade brass coffee pots, wooden chests, rugs, daggers, and Bedouin jewellery are sold, and the nearby settlements of potters where one can purchase beautifully made jars and vases.

5.5.6. Khafji

Alkhafji is an oil and pastural town, located in what used to be "The Neutral Zone" which in 1970 was divided between Saudi Arabia and Kuwait. The town in 350 kilometres away from Dammam and 120 kilometres away from Kuwait city.

It started in 1960 as administrative and living quarters for the Japanese-owned "Arabian Oil Company". After the discovery of oil nearby, it expanded rapidly and many Saudis and Kuwaitis moved to live, work and seek business opportunities there. Today, the quiet coastal town encompasses 200 square kilometres where more than 30,000 people live. It has every kind of facility that one may need.

After the Iraqi invasion of Kuwait, its entire population was evacuated due to its proximity to the military operations. It became famous worldwide during operation

Desert Storm when the Iraqi invaders took hold of it for a day. It was liberated by the allied forces in less than 24 hours.

5.5.7. Abqaiq

Abqaiq is one of the three oil cities in the Kingdom alongside Dhahran and Ras Tanura.

The spot occupied by Abqaiq, 70 kilometres to the west of Dhahran, was without any importance until 1940 when oil was discovered. The well drilled was the third to give oil and gas in commercial quantities after "Dammam No. 7" and "Abu Hadriyah".

Later in 1948, the town became even more important due to the discovery of "Ghawar" oil field which is the largest in the world and located only 48 kilometres away.

5.5.8. Ras Tanura

Ras Tanura is a town consisting of three parts: the Oil Tanker Terminal, Rahimah and Najmah.

It is located 38 kilometres away from Qatif and 70 kilometres away from Dhahran. Its importance goes back to the year 1938 when Aramco used the port to ship its first cargo of crude oil. Beside its importance as a main oil tanker terminal, it has the Kingdom's major oil refineries.

5.6. Survey Instruments

Three questionnaires were devised to elicit information from respondents. The first covered personal background information on respondents; the second concerned their driving behaviour; and the third sought to test respondents' ability to understand traffic information. A description of each of the questionnaires follows:

5.6.1 Questionnaire for Basic Demographic Information

The questionnaire for basic demographic information consisted of ten closed-ended questions which asked for the main driver's personal details, such as his age, citizenship, academic level, civil status, employment, whether or not he had a driving licence, whether or not he had previously been involved in a road accident, what kind of offence had been committed, and whether or not he was the owner of the vehicle involved in the particular accident.

In the questionnaire, disclosure of the respondent's name was made optional, to respect confidentiality and so increase the likelihood of drivers being willing to cooperate with the survey and give accurate information.

The first of the ten-closed questions was about educational level. The respondents were asked to specify, what level of education they had attained. Education in Saudi Arabia, though available free of charge at all levels, is not compulsory. There is still a segment of the population who are illiterate, and others who have completed only primary education. It was thought that education may have a certain bearing on driving, for example, the ability to follow road signs.

Determining citizenship (Qn.2) was considered important, to see if there was any connection between nationality and accident involvement.

Age is suggested in the literature to be a significant factor in road accidents, and was therefore included in the questionnaire (Qn.3), starting with the age-group, between 18 to 25 which reflects the period when a driving licence can first be obtained, up to the beginning of maturity. In Saudi Arabia the licence is to be renewed once every five years on average. Thus, the limits set for the first age group would cover most of the first licence-holding period.

In the second age group, i.e. 26 to 40, it is assumed that the driver has gained more experience and this may mean less accidents. In the last age group, i.e. 40 and above, it was expected to see the relationship between more maturity and volume of accidents on the road. At the same time any deficiencies in driving relating to old age might be revealed in this group.

Whether a driver is married, single or divorced, in some cases, may give us an idea about the level of responsibility which he may have. Being married, for instance, may indicate a greater level of responsibility in driving, as this is linked to family relationship. This was made the subject of question 4.

The question about profession (question 5) is important in shedding light on the incidence of accidents related to each occupational group.

Having a driving licence or not (question 6), could be a determining factor in the occurrence of an accident as it reveals the level, if any, of drivers' previous training.

The number of previous accidents/offences may be linked with the personality of the driver. Respondents were asked about previous accidents and offences (question 7 and 8 respectively) to assess whether some drivers are more prone to accidents/offences than others.

The question regarding the ownership of a vehicle involved in an accident (Question 9) may indicate whether drivers are more or less careful when they own the vehicle concerned.

The last question (Question 10) is important to this research. It indicates the severity of accidents, and their consequences to the personal safety of drivers and others, as well as to vehicles.

Questions which would indicate the identity and address of the driver were not used, as this might have deterred respondents from co-operating with the survey. To facilitate replies, respondents were offered a choice of response categories and asked to indicate the appropriate one by ticking a box in each case.

5.6.2 Questionnaire on Driver Behaviour and Driving Conditions

Questions were carefully selected in order to obtain answers regarding the following main factors of driving:

a) Driver

b) Road

c) Car

d) Others

a) Driver

In this questionnaire, an attempt was made to assess behavioural components which might directly cause accidents or be contributory factors leading to them. At the top of these comes high speed. Non-observance of traffic regulations was the subject matter of some of the questions, i.e.:

- overtaking other cars without precaution (question 12)
- changing lanes without signal (question 35)
- not keeping a safe distance from the car in front (question 10)
- emerging onto or exiting from a road (question 18)
- non-use of front and side mirrors (question 32)
- use of high beam lights when confronting opposite traffic (question 4).

Psychological considerations also had to be addressed in this questionnaire. Therefore, questions were formulated to cover driver's psychological stress, whether resulting from traffic congestion or from other conditions (question 20 and 27). Non-alertness to other drivers' errors and practice, as well as concentration during driving were the subject matter of two questions (question 16 and 33 respectively).

Research (see chapter 4) indicates that some accidents could take place because of the driver's personal condition, such as having poor vision, being sick, tired or driving for long hours. The researcher, therefore, included these personal conditions in the questionnaire (questions 7, 26, 25 and 24, respectively).

This questionnaire also asked about habitual behaviour such as fastening or non-fastening seat belts (question 28), use or non-use of child seat (question 30), eating, drinking or smoking (question 34) and paying too much attention to radio and cassette players or using mobile phones (question 34).

b) Road

Traffic literature has shown that non-marked and non-lit roads are vulnerable to accidents. Questions 14 and 15 dealt with road conditions.

c) Car

Obviously, car malfunctioning and disorder could seriously cause accidents. Though this was only addressed in one question (question 21) it was a comprehensive question, which would encompass any defect of the car, whether mechanical, electrical, or related to the condition of the bodywork. Matters such as tyres, windshields, rust, malfunctioning, brakes, and steering were all embraced in this question.

d) Other factors

Beside the factors relating to the driver, road and car come other factors which could cause accidents or driving errors. Very high or low temperatures, sun-haze and other weather conditions could have a bearing on drivers' behaviour. Based on observation of the conditions in Saudi Arabia, the researcher chose sunhaze, high/low temperatures and sand storms to be the subject matters of questions nos. 8, 9 and 19.

The driver's concentration can be seriously weakened if he is being distracted by the passengers in his car. Question no. 33 addressed this issue.

As can be noticed from the structure of this questionnaire in Appendix B some questions were specific, while others were more general. Specific questions led to replies on direct accident causation. The generality of some of the questions, it was believed, on the one hand, would help to build trust in respondents, and also shed more light on conditions of driving on the other. The insight so gained might enable the researcher to make remedial recommendations concerning safety driving in Saudi Arabia. To facilitate respondents' replies, some questions required simply yes or no answers, while others were answered on a four or five point scale: (always), often, sometimes, rarely and never.

5.6.3 Questionnaire on Driver's Grasp of Traffic Information

This questionnaire was concerned to identify how well-informed drivers were regarding traffic signs, instructions, codes and road markings inside and outside cities. Traffic information covered by the questionnaire was selected on the basis of its importance and frequency of use.

The questionnaire concentrated on traffic signs which the driver can see most of the time on roads: at the entrance to cities; beside schools, hospitals, heavily populated areas, pedestrian areas and places where children are to be found; at cross-roads when giving way; when stopping, especially at the entrances and exits to main roads; at curves, turns, hilly and low-lying areas; at railway crossings, bridges and pontoons; at the presence of road works; where the road is slippery; at the presence of water or oil on the road; at stop signs; and at road markings which indicate no overtaking, such as broken or unbroken lines to define traffic lanes.

The questionnaire depicted thirty signs in their original colours. Below each sign were printed three response options, the correct identification of the sign, and two false answers. Drivers were asked to identify each sign, by placing a tick in the appropriate box.

5.6.4. Translation of Questionnaire

The questionnaire was originally written in English, but was then translated by the researcher in consultation with a specialist in Linguistics from the University of London into Arabic, the language of the respondents. Replies to the questionnaire had to be translated into English. This, also, was done by the researcher, with the help of the same language consultant.

5.6.5 Validation of Questionnaire

Before applying any test, it is necessary to ensure that it is a valid measurement tool and, therefore, there is a need to check the validity. Pidgeon and Yates (1968) defined a valid instrument as one that demonstrably measures what it was intended to measure. They went on to describe validity as a term used to indicate the acceptability of a test. Sudman and Bradburn (1983) and Gronlund (1985) defined validity as the extent to which an instrument fulfils the purpose for which it was designed, i.e. assesses or measures what it purports to assess or measure. Naturally, the more valid and reliable the instrument, the more reliable the results. In this regard, Gay (1978) points out that:

> "A valid test is always reliable but a reliable test is not necessarily valid. In other words, if a test is measuring what it is supposed to be measuring, it will be reliable and do so every time, but a reliable test can consistently measure the wrong thing and be invalid" (p. 136).

According to Kerlinger (1986), the commonest definition of validity is epitomised by the question: Are we measuring what we think we are measuring? In other words, the validity of an instrument can be judged in terms of the extent to which it measures what it is intended to measure. However, there is more than one kind of validity. The validity of a test or scale depends on the practical purpose of its user: for example to find out the nature of achievement in some field (content validity); to make predictions in relation to some criterion (criterion - related validity); or to explain individual difference in test scores in terms of a number of variable or constructs (construct validity).

In the present study, the researcher was interested in the content validity of the questionnaires, that is, their representativeness of the content of the property being measured. In particular, it was desired to assess whether Questionnaire 2 was representative of the field of causes of accident (whether related to the road, vehicle or driver).

Content validity is basically a matter of judgement. The items of the instrument must be studied and each judged for its presumed relevance to the property in question. This is usually done by referring the items to competent judges (Heyes, et al., 1986), who must be provided with specific directions for making judgements and specification of what they are judging.

In this study, the content validity of the questionnaires was ascertained by submitting them to a panel of expert referees, namely, ten traffic investigators, for their advice and comments. All held top administrative positions at the police investigation departments in Saudi Arabia. The researcher had worked with members of the panel as a colleague for a considerable number of years. He found them competent in English. Most importantly he also found them competent in investigating road and traffic accidents.

The researcher sent the panel in Saudi Arabia a formal letter together with Questionnaires 1 and 2, on 8 May, 1997. The covering letter (Appendix B1) explained to the panel the objectives of his research and the intentions underlying the questionnaire. The jurors were asked to look at each item of the questionnaires, and to indicate on the form provided, to what extent they found it relevant to the purpose of the investigation, by ticking one of four boxes marked, Not Relevant (NR), Minimally Relevant (MR), Fairly Relevant (FR) and Very Relevant (VR), (see Appendix B2). The panel were also asked to give their opinion on whether questions should be retained in their present form, rephrased or deleted. They were also invited to make any other suggestions which they felt would improve the validity of the questionnaire.

The researcher's objective, in sending the two questionnaires to the panel, was to test their validity and to obtain recommendations on the suitability of the questions to the overall objective of the research. Therefore, the panel were asked to give their opinion on whether questions should be retained in their present form, rephrased or deleted.

After obtaining feedback from the panel, the researcher ran a statistical analysis of the data collected which are all summarised in Appendix B3. The validity of questionnaire No.1 (personal questions for drivers involved in driving accidents) was established on the ground of the high percentage given to the category Very Relevant (VR). More than 50% of the responses were in this category, while the Not Relevant (NR), Minimally Relevant (MR) and Fairly Relevant (FR) categories together scored below 50%. It is also interesting that the Not Relevant (NR) category accounted for less then 10% of responses. In other words, there was an increase in percentage moving from the Not Relevant to the Very Relevant.

As for Questionnaire No.2 (Behaviour of drivers), the validity of all the questions was established on the same basis.

Regarding the panel's recommendations on the two questionnaires, Questionnaire No.1 was approved without any rephrasing or deletion. However, with regard to Questionnaire No.2, the panel suggested the following:

a) The panel approved questions 1-30, 32, 33 and 35 without any alteration.

b) They suggested altering two questions, namely questions 31 and 34. Each question should be divided into two questions. Question 31 should be divided into a question about "eating and drinking", and another one about "smoking". Similarly, question 34 should be divided into a question about "radio or cassette" and another one about "using a telephone inside the car".

c) The panel suggested adding three further questions to the questionnaire: i)road engineering, ii)checking the car before driving, and iii) taking medicine that causes drowsiness before driving.

d) No deletion of questions was suggested by the panel.

Questionnaire No. 2

The suggestions of the panel were implemented. Moreover, although not specifically recommended by the panel, the researcher also decided to re-order and re-organise the questions. It was felt it would be more useful to group the questions according to unified topics. This would aid the respondents' comprehension of questions as well as make the questions easy to follow by the respondents. Added to this is the benefit of focusing the respondents' attention on one topic at a time. The modified questionnaire II, was organised as follows:

1. Yes and No questions: 1-25

	Old	New
a) Others' behaviour	3,4,17	1-3
b) The vehicle	2,21	4,5
c) Road	5,11,14,15	6-9
d) Drivers' psychological state	1,7,20	10-12
e) Drivers' personal behaviour and attitude	6,10,12,13,16,18,22-24	13-22
f) Weather conditions	8,9,19	23-25

2. Questions with replies of "often, sometimes, rarely and never".

24-2 were changed to 26-28, and No. 27 became No. 30. (Question 29 is one of the additions included at the suggestion of the validation pane; see Section 5.65).

3. Questions with replies of "always, sometimes, rarely and never".

28-35 were changed to 31-40, adding questions 33 and 37 as suggested by the panel.

5.7. The Pilot Study

Rowntree (1981, p 217) defined the pilot study as a preliminary study undertaken prior to the major task, which like a feasibility study, can also be used to modify the proposed methods. Before carrying out the main study and distributing the questionnaires to the samples, it is important to make sure that the instruments are suitable for use with a particular sample. The main aim of piloting the instruments is to explore any possible problems within the questionnaires and solve them. The researcher felt that a pilot study would provide an important opportunity to test the reliability of the research instruments and so increase confidence in the research method selected and he recognised that Isaac and Michel (San Diego, California, pp. 34-35) had pointed out that pilot study offers a chance to test hypotheses; provide new ideas and to check procedures. It was felt that this pilot study would reduce error in the research approach, and act as a source of feedback, thereby saving time.

Youngman (1982) stated that the pilot concerns the questionnaire rather than the sample, so it normally involves a small sample of the main study. Consequently, between June and July 1997 the researcher conducted a survey in Saudi Arabia with a sample of twenty-five individuals chosen at random. The following sub-sections explain the manner in which the pilot study was carried out, and its outcomes.

5.7.1 Location

The research was carried out in the eastern province in Saudi Arabia due to its importance in connection with oil production and industry. The presence of oil companies in the province has attracted a large number of people for work. The province is one of the most densely populated provinces in Saudi Arabia with a heterogeneous number of nationalities. The total population in the province is 2.5 million, which is 18% of the total population in Saudi Arabia. The nine cities chosen for the main study (Section 5.5) are all located at the Gulf, and they are connected with other countries of the Gulf by a large network of roads.

It is customary in the pilot study to use a smaller sample from among the population who will be the focus of the main study. Therefore, the researcher piloted the questionnaires in two of the cities chosen for the main study, namely Dammam and Khobar. The procedure and outcome of the pilot study are described in the following

sub-sections.

5.7.2 Method of Pilot Study

The researcher sent three questionnaires to 25 drivers chosen randomly in the selected cities. Questionnaires were sent to respondents on 8 June, 1997 and were received back on 2 July, 1997. The drivers chosen had all been involved in driving accidents. The questionnaires sent to the drivers were of three types:

Questionnaire No.1 containing 10 demographic questions.

Questionnaire No.2 containing 40 questions related to behaviour of drivers.

Questionnaire No.3 containing traffic road signs; drivers are asked to identify the right answer to the signs within a multiple choice.

Each questionnaire was accompanied by a letter explaining the purpose of the study and giving instructions for the completion of the questionnaire.

5.7.3. Results

Data obtained from the pilot study questionnaire were fed into the computer for analysis (SPSS Program). Reliability was tested using Cronbach's alpha (see section 5.7.4.). The pilot study results, in percentages, are shown in Appendix C, Tables 1-13.

a) Demographic questions: (1-10)

Table 1 (p. 258) shows that the largest percentage of respondents were intermediate educated (37%) and university/college educated respondents accounted for making the smallest group. Regarding nationality, the highest percentage of respondents were Saudi nationals (65%), while 34% were non-Saudis (Table 2, p. 258). 29%, the lowest percentage, were those aged 40 and above. The 18-25 years age group was the highest (37%), (Table 3, p. 258). 46% of respondents were married and only 54% were single (Table 4, p. 258). General employees was the highest with 42%, and self-employed the lowest with 2% (Table 5, p. 258). 97% of respondents had driving licences, and 10% of them had held driving licences for more than 21 years (Table 6, p. 259). 42% had been involved in driving accidents three times or more (Table 7, p. 259). The vast majority (91%) of the respondents had been involved in traffic violations (91%) and 86% of them had committed 1-2 violations (Table 8, p. 259). 40% of respondents owned the cars they were driving at the time of the accident (Table 9, p. 259). Damage to vehicles was the main outcome of the accidents (91%) (Table 10, p. 260).

b) <u>Drivers' Behaviour (11-13)</u>

As indicated in Table 11 (p. 260), and according to our respondents' answers, the factor most frequently reported as having contributed to the accident was the driver's feeling uncomfortable in his seat (100%). All physical factors mentioned in the questionnaire (Table 11) were acknowledged by at least 50% of respondents as having contributed to the accident. Therefore, the set of questions (1-23) in Table 11 proved useful in indicating to the researcher some of the causes of driving accidents.

As for questions related to the driver's physical or psychological state, which are likely to cause him an accident, respondents' answers (Table 12, p. 261) show the combined answers of "often, sometimes and rarely" outweighed in percentage answers with "never". Therefore, the set of questions (24-27) in Table 12 were judged useful in providing the researcher with a cause effect link with driving accidents.

The set of questions in Table 13, p. 261 (28-35) related to respondents' observance of road safety principles and regulations reveal interesting results: the majority of respondents were neglectful of road safety rules. For example, questions 28, 29, 30, 32, 33 and 35, which all referred to good driving behaviour met with a high percentage of negative ("never") responses. Conversely, questions 31 and 34, which referred to bad driving behaviour, were met by respondents with an affirmative response ("always").

c) Traffic Road Signs

Respondents' test of traffic road signs revealed (Table 14, p. 262) that all had a good knowledge of traffic road signs. All respondents identified 12 signs correctly, 50% of respondents identified 16 signs correctly, and only 2 signs were identified correctly by fewer than half the sample.

5.7.4 Reliability Testing

Concern for reliability comes from the necessity for dependability in measurement. To the extent that measurement instruments contain errors of measurement, to that extent the date they yield will not be reliable. The definition of reliability can be approached in three ways. One is in terms of stability, dependability and predictability; if the same set of objects is measured again with the same instrument, will the same of similar results be obtained? Another is in terms of accuracy; are the measures obtained from the instrument the "true" measures of the property in question? The third is in terms of error of measurement; to what extent are variations in scores attributable to such factors as differences in interpretation of instructions or the meaning of test items, variations in the condition under the instrument is administered, and so on? (Kerlinger, 1986).

In formulating the questionnaires for the present study, care was taken to minimise the likelihood of error variance by checking that the items were worded clearly and unambiguously. Account was also taken of Kerlinger's (1986) advice that "more items increase the probability of accurate measurement". The pilot study contributed to reliability by giving the researcher an opportunity to assess the extent to which the questionnaires could be administered under standard, well-controlled and similar conditions.

In addition, the researcher tested the internal consistency of the driver behaviour questionnaire by calculating Cronbach's Alpha. Cronbach (1951) said that coefficient Alpha (α) is a general form of the K-R20 formula that can be used when items are not scored dichotomously, which was the case for the items in the second part of the behaviour questionnaire, i.e. that part dealing with habitual behaviours, which was scored using a Likert-type scale. Item total correlations for the 40-items of the driver questionnaire ranged from 0.36 to 0.53, the average being 0.41. All values are above the 0.35 criterion recommended by Borg and Gall (1992) as the threshold for inclusion. Alpha value for the 40-item instrument was 0.81. Alphas for the individual items ranged from 0.79 to 0.83 (see Table 5.1). These are useful values, which indicate that the instrument was acceptably homogenous and could be used with confidence as a measure of driving behaviour.

Table 5.1

Reliability of Driver Behaviour Questionnaire (N = 25)

The Items	Item total correlation	Alpha if item deleted
1. Has feeling uncomfortable in your seat ever caused you to have an accident?	0.49	0.81
2. Has a mechanical or other fault in your car ever caused you to have an accident?	0.43	0.81
3. Has traffic congestion ever caused you to have an accident?	0.41	0.80
4. Has non-lighting of roads ever caused you to have an accident?	0.46	0.82
5. Has non-marking of roads ever caused you to have an accident?	0.48	0.81
6. Has inappropriate road engineering ever caused you to have an accident?	0.50	0.80
7. Has the presence of stray animals on the road ever caused you to have an accident?	0.53	0.80
8. Has sun haze ever caused you to have an accident?	0.36	0.89
9. Has excessive heat or cold ever caused you to have an accident?	0.38	0.80
10. Has a sand storm ever caused you to have an accident?	0.41	0.80
11. Has use of high beam lights ever caused you to have an accident?	0.40	0.79
12. Has passengers' behaviour ever caused you to have an accident?	0.46	0.80
13. Has an ear disorder ever caused you to have an accident?	0.53	0.81
14. Has poor eyesight ever caused you to have an accident?	0.51	0.80
15. Has joy-riding ever caused you to have an accident?	0.52	0.81
16. Has being frustrated while driving ever caused you to have an accident?	0.49	0.81
17. Has non-observance of speed limits ever caused you to have an accident?	0.46	0.80
18. Has not keeping a safe distance between you and the car in front ever caused you to have an accident?	0.42	0.80
19. Has over-taking another car ever caused you to have an accident?	0.39	0.81
20. Has non-alertness to others' errors ever caused you to have an accident?	0.43	0.80
21. Have you ever been involved in an accident when reversing your car?	0.39	0.83
22. Has emerging from or exiting a road ever caused you to have an accident?	0.40	0.82
23. Has non-familiarity with the road ever caused you to have an accident?	0.43	0.81
24. Do you service your car every six months?	0.47	0.80
25. Prior to driving, do you check your car?	0.43	0.81
26. Do you continue driving for long hours?	0.39	0.80
27. Do you drive when you are tired?	0.43	0.81
28. Do you drive when you are sick?	0.42	0.82
29. Do you drive after taking medication causing drowsiness?	0.36	0.81
30. Do you drive when under psychological stress?	0.39	0.80
31. Prior to driving, do you fasten your seat belt?	0.41	0.80
32. Do you use signals when changing lanes?	0.41	0.80
33. Do you smoke while driving?	0.42	0.83
34. Do you eat or drink while driving?	0.41	0.82
35. Do you observe traffic regulations?	0.39	0.81
36. Do you use a cassette or radio while driving?	0.40	0.81
37. Do you use a mobile telephone while driving?	0.43	0.80
38. Do you use a special seat for children?	0.37	0.80
39. Do you make use of front and side mirrors?	0.44	0.81
40. Do you concentrate while you are driving?	0.43	0.80

5.7.5. Final Changes to instruments as a result of the pilot study

In the light of the pilot study experience, changes were made in questionnaire I, motivated by two factors:

a) technical reasons, related to computer processing of data

b) aiding respondents' comprehension of questions

These changes are explained in detail below.

Questionnaire No.1

1. Column 3 should be removed from the questionnaire because it was not needed for the SPSS Program.

2. In question 2, related to specifying nationality, the respondents gave many nationalities, even though there were only 35 respondents. The researcher was therefore given many variables that would make analysis in the main study with a larger number of respondents, more difficult to process. Therefore, the researcher added four boxes in column 2, row 2 classifying respondents: Arab, Asian, European and American respectively. In this way, the researcher limited possible answers to nationality, to a manageable number.

3. In question 3, the researcher considered it more appropriate to divide age groups more precisely according to age development. The changes were as follows:

   1) 18-25 to 18-24

   2) 26-40 to 25-30

   3) 40 and above to 30-39

4) followed by 40 and above

4. Question 4 (civil status) needed to be more inclusive by adding a further box for widowers.

5. In line with question 4, question 5 needed to be more inclusive by adding another box for "self-employed" drivers.

6. In question 6, the researcher saw a need to be more precise in identifying the span of years a driver had held a licence. The researcher added a further three boxes: 1-3 years, 4-19 years and 10 and above.

7. The question "have you been involved in an accident before?" had to be altered since the researcher had selected respondents who had actually been involved in a driving accident. A more precise and appropriate question was "how many driving accidents have you been involved in?" Moreover, the researcher needed to add three boxes in the second row labelled: one, two, and three or more.

8. In question 8, the researcher also felt the need to be more specific about the number of respondents' traffic violations. The addition was: 1-2, 3-4 and 5 or above.

5.8. The Main Study

As a staff member of the traffic authority in Saudi Arabia, the researcher met colleagues and employees working in traffic stations in Dammam, Al-Khubar, Dhahran, Al-Qatif, Al-Jubail, Ras Tannura, Ibqiq and Khafji and obtained their full co-operation in carrying out the survey. The procedure for conducting the study is explained below.

5.8.1 <u>Survey Sampling and Questionnaire Administration</u>

The survey population for this study was defined as drivers in Saudi Arabia who had been involved in an accident. The sample was not confined to drivers responsible for the accident in which they were involved.

The distribution of questionnaires took place between September and November 1997. Nine cities were visited, for periods ranging from four to ten days. The average length of stay at each city was one week.

In each of the cities visited, drivers who had been involved in road accidents were contacted and invited to fill in the questionnaire. Drivers were contacted in several different ways, drawing on the researcher's professional experience as a traffic investigator, which gave him knowledge of where drivers were most likely to be found. Some were seen at the police traffic stations where drivers had been injured in road accidents were seen in the Accident and Emergency department of the local hospital, some were met in the Islamic law courts. Other drivers who were being held in custody were interviewed in jail. Some contacts were made in workplaces, or in city centres. In Daharan, the researcher met some drivers at the Police Academy Training centre.

In each location, the researcher was assisted in the distribution of questionnaires by a colleague. The researcher and his colleague remained with the drivers while they completed the questionnaire, and answered any questions the respondents might have with regard to the purpose of the questionnaire or the meaning of any of the questionnaire items. On average, each questionnaire took 20-25 minutes to complete.

5.8.2. Reliability of the Questionnaire in the main study

In the main study, a two stage procedure was adopted to ensuring the reliability of the survey. The first stage was to examine all completed response forms and discard those whose manner of completion gave rise to doubts about their reliability. The second stage involved testing the internal consistency of the Driver Behaviour Questionnaire, using Cronbach's Alpha, as had been done in the pilot study. Details of these procedures follow.

a) Examination of response forms

In all, 600 questionnaires were distributed as planned. However, on collection of the questionnaires, it was found that some had not been completed in full. These were excluded from the analysis. Also discarded were responses which were suspected to be unreliable. In research of the present kind, there was obviously a danger that some drivers might answer questions untruthfully, in order to avoid admitting their own culpability in the road accidents in which they were involved. Certain questions in Part 2 of the questionnaire served as a check on reliability. These particularly related to habitual behaviours such as servicing the car, checking the car before a journey, wearing a seat belt and using child seats; behaviour which are not expected to be directly related to accident causation, but which are not expected to be directly related to accident causation, but which help to differentiate the more cautious and responsible driver from drivers who are less careful. It is known, for example, that use of seat belts in Saudi Arabia is very low, and use of child seats almost unknown. Drivers who claimed "correct" behaviour in such matters would be suspected of giving misleading answers. It should be emphasised that drivers' veracity was not judged on the basis of their answer to any one question. Careful note was taken of the pattern of their answers in general, and of the consistency between them. Where drivers' unrealistically high number of claims to "correct" behaviours, such as always using child seats or never listening to the radio when driving, was such as to raise doubts as to the reliability of the responses, their questionnaires were discarded and their responses not counted in subsequent analysis. Also discarded were questionnaires where drivers had simply ticked down one column, apparently without reading the questionnaires carefully or giving any considered response. After discarding these questionnaires, a total of 484 usable responses remained for analysis, a response rate of 81%, which may be considered a high level of response for a questionnaire survey. Table 5.2 shows the numbers of questionnaires distributed and completed, by city.

Table 5.2

Questionnaire Response Rate, by City

City	Number Distributed	Completed Responses	%
Dammam	100	83	83
Khubar	100	77	77
Qatif	100	68	68
Ras Tanaura	50	47	94
Dhahran	50	43	86
Hafuf	50	33	66
Jubail	50	44	88
Khafji	50	31	62
Abqeiq	50	38	76
TOTAL	**600**	**484**	**81**

b) Statistical testing of reliability

Item total correlations for the 40 items of the driver questionnaire ranged from 0.36 to 0.49, the average being 0.39. All values are above the 0.35 criterion recommended by

Borg and Gall (1992) as the threshold for inclusion. Alpha values, as for the main study, ranged from 0.75 to 0.83, the overall value being 0.77, a very high value which justifies confidence in the reliability of the instrument (see Table 5.3).

Table 5.3

Reliability of Driver Behaviour Questionnaire in the Main Study (N = 484)

The Items	Item total correlation	Alpha if item deleted
1. Has feeling uncomfortable in your seat ever caused you to have an accident?	0.43	0.81
2. Has a mechanical or other fault in your car ever caused you to have an accident?	0.38	0.83
3. Has traffic congestion ever caused you to have an accident?	0.41	0.80
4. Has non-lighting of roads ever caused you to have an accident?	0.36	0.82
5. Has non-marking of roads ever caused you to have an accident?	0.36	0.80
6. Has inappropriate road engineering ever caused you to have an accident?	0.38	0.80
7. Has the presence of stray animals on the road ever caused you to have an accident?	0.41	0.80
8. Has sun haze ever caused you to have an accident?	0.36	0.80
9. Has excessive heat or cold ever caused you to have an accident?	0.41	0.82
10. Has a sand storm ever caused you to have an accident?	0.39	0.80
11. Has use of high beam lights ever caused you to have an accident?	0.39	0.81
12. Has passengers' behaviour ever caused you to have an accident?	0.38	0.81
13. Has an ear disorder ever caused you to have an accident?	0.42	0.79
14. Has poor eyesight ever caused you to have an accident?	0.35	0.80
15. Has joy-riding ever caused you to have an accident?	0.36	0.81
16. Has being frustrated while driving ever caused you to have an accident?	0.42	0.75
17. Has non-observance of speed limits ever caused you to have an accident?	0.36	0.82
18. Has not keeping a safe distance between you and the car in front ever caused you to have an accident?	0.39	0.81
19. Has over-taking another car ever caused you to have an accident?	0.40	0.83
20. Has non-alertness to others' errors ever caused you to have an accident?	0.43	0.82
21. Have you ever been involved in an accident when reversing your car?	0.39	0.81
22. Has emerging from or exiting a road ever caused you to have an accident?	0.36	0.80
23. Has non-familiarity with the road ever caused you to have an accident?	0.41	0.80
24. Do you service your car every six months?	0.42	0.81
25. Prior to driving, do you check your car?	0.39	0.80
26. Do you continue driving for long hours?	0.43	0.82
27. Do you drive when you are tired?	0.42	0.80
28. Do you drive when you are sick?	0.39	0.81
29. Do you drive after taking medication causing drowsiness?	0.38	0.82
30. Do you drive when under psychological stress?	0.41	0.83
31. Prior to driving, do you fasten your seat belt?	0.42	0.83
32. Do you use signals when changing lanes?	0.36	0.80
33. Do you smoke while driving?	0.49	0.81
34. Do you eat or drink while driving?	0.48	0.81
35. Do you observe traffic regulations?	0.36	0.80
36. Do you use a cassette or radio while driving?	0.42	0.82
37. Do you use a mobile telephone while driving?	0.45	0.81
38. Do you use a special seat for children?	0.40	0.82
39. Do you make use of front and side mirrors?	0.41	0.80
40. Do you concentrate while you are driving?	0.40	0.81

5.8.3 Data Analysis Procedure

In analysing the collected data, the researcher first obtained frequencies and percentages for the items of each questionnaire separately, and then correlated the replies to the three questionnaires together.

Computer analysis, using SPSS facilities, was used to facilitate accurate calculation and create the necessary explanatory tables. SPSS is claimed to be a complete tool kit of statistics, graphs and reports. These can be used in a large number of applications of different nature in commercial, academic and governmental institutions. Applications can cover surveys, marketing and sales analysis including various levels of research and decision making aids. In surveys and questionnaire analysis, the software has the ability to represent and analyse data in various ways. Different tests can also be set for such types of data as well as the known tests of hypotheses and estimation. The product is widely available within the academic institutions and is under continuous development.

Two statistical tests were used in analysing the data obtained from the survey. In analysing the demographic data, cross-tabulation chi-square was used to test for the possibility of a significant relationship between these variables, as independent variables, and the dependent variable – the number of road accidents experienced by respondents.

The chi-square is a test of statistical significance; it allows the researcher to ascertain the probability that the observed relationship between two variables may have arisen by chance; for example, as a result of sampling error. The statistic is calculated by comparing the observed frequencies in each cell of a contingency table, with those that would occur if the variables being examined were randomly distributed in relation to each other; in other words, the chi-square test entails comparing actual with expected frequencies (Bryman and Cramer, 1997). The chi-square test does not convey information about the strength of the relationship between variables; it tells us how confident we can be that there is a relationship between them. It is an appropriate test where either both variables are nominal (categorical) or when one is nominal and the other is ordinal, as in the case of the demographic analysis in this study. In conducting the chi-square tests, the level of significance was set at 0.05.

In the analysis of the driver behaviour questionnaire responses, correlation was used. Unlike chi-square, correlation indicates both the strength and direction of the relationship between a pair of variables. The most common measure of correlation is Pearson's Product Moment Correlation Coefficient, often referred to as Pearson's r. Pearson's r varies between –1 and +1, indicating a perfect relationship, negative or positive respectively, between two variables. The closer r is to 1 (whether positive or negative), the closer the relationship between the variables. In addition to Pearson's r, the Spearman Brown formula was used to correct the correlation determined by the Pearson r and give a higher estimate of the relationship.

5.9. Conclusion

This chapter has explained the study objectives and hypotheses, and the research design. The construction of the research instruments, namely a questionnaire for driver personal data, a questionnaire on driver behaviour and driving conditions and a test of the driver's grasp of traffic information was described. A pilot study was carried out to test the validity and reliability of the research instruments and to try out the data collection procedures. It has been explained how this study was conducted and how the results were used to refine the questionnaire to make it more understandable for respondents.

The chapter ended by outlining the procedures for sample selection and data collection in the main fieldwork, carried out in nine Saudi Arabian cities. The results will be presented in the next chapter.

CHAPTER SIX

DESCRIPTION AND ANALYSIS

6.1. Introduction

In the previous chapter, the methodology applied in this research was explained, and the techniques to be used in the analysis of data was described. In this present chapter, the survey of data will be presented. In analysing the demographic data, the cross tabulation subprogramme within the SPSS was utilised, to cross tabulate the variables, and the chi square statistic was used to determine whether or not the variables have a significant relationship with the criterion variable, that is, the number of road accidents experienced by respondents.

Kinnear & Gray (1994) described crosstabs as a programme which "generates contingency tables from nominal or ordinal categorical data." Berenson & Levine (1979) also described crosstabs in SPSS as a sub-programme which determines "whether or not there is a relationship between variables." The chi square statistic, on the other hand, was described by Kinnear & Gray (1994) as a technique which is used to determine "the presence of an association between two qualitative variables." This comment supports the remarks made by Welkowitz et al (1976) that the chi square is a statistical technique which tests "the significance of a relationship between two variables when data are expressed in terms of frequencies of joint occurrence."

In testing the null hypotheses regarding driver behaviour and driving conditions, the Pearson correlation coefficient was used the while the Spearman-Brown formula was utilised to determine the significance of the relationship between each pair of variables.

The correlation coefficient, denoted as 'r', has been described by Kinnear and Gray (1995 p.131) as a statistical technique used for the purpose of measuring the strength or degree of association between two variables. According to them the "Pearson correlation coefficient is a measure of a supposed linear relationship between two variables." Greene and Oliveira (1982) pointed out that the Pearson test is designed to test whether high scores on one variable tend to be found with high scores on the other variable, low scores with low scores and so on. The test does not take into account the actual values of scores when calculating the amount of correlation between variables (Greene and Oliveira, 1982). The statistical value reflects the amount of correlation as a number between -1 (perfect negative correlation) through 0 (no correlation) to +1 (perfect positive correlation).

Norusis (1991, p.325) too, described the Pearson correlation coefficient and Spearman Brown coefficient as statistical techniques that can be used for numeric data only. While the Pearson correlation coefficient gives the correlation between the two variables being tested, however, the Spearman Brown coefficient tends to step up the relationship. Hence, Gay (1996 pp.148-149) reported that the Spearman Brown is a statistical technique which can be used to correct the correlation determined by the Pearson 'r' and it gives a higher estimate of the relationship.

In presenting the results of the test of drivers' knowledge of road signs, descriptive statistics (frequency and percentage) are used.

The description of data is presented in four sections. Section one will embrace the description of respondents' personal data; section two focuses on respondents' reports as to whether or not certain behaviours had caused them to have accidents; section three concerns aspects of respondents' habitual driving behaviours; and section four presents data with regard to respondents' knowledge of road sign information.

6.2. Hypotheses related to demographic factors

6.2.1. Educational Level

HO: There is no significant relationship between educational level and the number of motor accidents.

The educational level of the drivers was cross tabulated with the number of road accidents they had had. Educational levels embraced those drivers without education at all, those with primary school education, those with intermediate education, those with secondary education, and those with university or college education.

In doing the cross tabulation, the chi square statistic was utilised to test for the relationship between the two variables. The chi square statistic was used because it makes no assumption about the distribution of the data. Hence, it is an appropriate statistical technique for the determination of the relationship between the two variables. The findings from the cross tabulation are shown in Table 6.1.

Table 6.1

Cross Tabulation between Educational level of Drivers and the Number of Road Accidents

	Educational Level						
Total Number of Accidents	Non Educ	Primary	Intermediate	Secondary	University/ college	Total	%
1	16	34	70	43	40	203	42
2	12	24	42	39	37	154	31.8
3	11	60	23	16	17	127	26.2
Total	39	118	135	98	94	484	
%	8.1	24.4	27.9	20.2	19.4		100

Chi-Square	Value	DF	Significance
Pearson	14.35	6	.04

As indicated in Table 6.1, there was a significant relationship between the educational level of the drivers and the number of road accidents they had had. The chi square shows that the probability was .04, indicating that there was a significant association between the two variables.

6.2.2. Age of the Driver

HO: There is no significant relationship between the age of driver and the number of motor accidents.

The age of the drivers was also cross tabulated with the number of road accidents they had had, and the chi square was used to test the relationship. The findings are shown in Table 6.2.

Table 6.2

Cross Tabulation between the Age of the Drivers and the Number of Road Accidents

	Age of Driver					
Total Number of Accidents	18-24	25-30	31-39	40+	Total	%
1	35	81	55	32	203	41.9
2	22	69	42	21	154	31.8
3	71	25	22	10	127	26.3
Total	127	175	119	63	484	
%	26.2	36.2	24.5	13.0		100

Chi-Square	Value	DF	Significance
Pearson	12.19	5	.05

Table 6.2 shows that there was a significant relationship between the age of the driver and the number of road accidents. The chi square value was 12.19 while the probability was .05, indicating that the variables are associated.

6.2.3. Marital Status

HO: There is no significant relationship between marital status and the number of motor accidents.

The marital status of the drivers was cross tabulated with the number of road accidents they had had. The chi square statistic was utilised to determine the relationship between the two variables. The findings are shown in Table 6.3.

Table 6.3

Cross Tabulation between the Marital Status of the Drivers and the Number of Road Accidents

	Marital Status of the Driver					
Total Number of Accidents	Married	Single	Divorced	Widowed	Total	%
1	146	51	5	1	203	41.9
2	110	41	3		154	31.8
3	46	75	6		127	26.3
Total	302	167	14	1	484	
%	62.4	34.5	02.9	00.2		100

Chi-Square	Value	DF	Significance
Pearson	9.0	5	.17

As indicated in Table 6.3, the chi square value was 9.00 while the probability was .17. This shows that there is no significant relationship between the marital status of the drivers and the number of road accidents.

6.2.4. Profession of the Driver

HO: There is no significant relationship between profession of the driver and the number of motor accidents.

Cross tabulation was carried out between the profession of the drivers and the number of road accidents they had had, while the chi square was used to test the relationship between the variables. The findings are shown in Table 6.4.

Table 6.4

Cross Tabulation between the Profession of the Drivers and the Number of Road Accidents

	Profession of the Driver					
Total Number of Accidents	Employee	Student	Professional Driver	Self Employed	Total	%
1	172	11	14	6	203	41.9
2	130	17	3	4	154	31.8
3	62	30	31	5	127	26.3
Total	364	58	18	15	484	
%	75.2	11.10	09.9	03.1		100

Chi-Square	Value	DF	Significance
Pearson	19.73	5	.03

Table 6.4 shows that there was a significant relationship between the profession of the drivers and the number of road accidents they had had. According to the table, professional drivers had the least number of road accidents while employees of various organisations had the highest number of road accidents. The probability was .03, indicating that there was a significant association between the profession of the drivers and road accidents in Saudi Arabia.

6.2.5. Possession of Driving Licence

HO: There is no significant relationship between possession of driving licence and the number of motor accidents.

Respondents' possession of a driving licences was cross tabulated with the number of road accidents they reported having. The chi square statistic was used to determine the relationship between the two variables. The findings are shown in Table 6.5.

Table 6.5

Cross Tabulation between the Drivers' Possession of a Driving Licence and the Number of Road Accidents

	Drivers' Possession of Driving Licence			
Total Number of Accidents	Yes	No	Total	%
1	166	20	186	38.8
2	119	22	141	29.4
3	55	98	153	31.8
Total	340	140	480	
%	70.8	29.2		100

Chi-Square	Value	DF	Significance
Pearson	1.83	2	.40

Table 6.5 reveals that there was no significant relationship between the possession of a driving licence and the number of road accidents. The chi square value was 1.83 while the probability was .40 indicating that the two variables are independent of each other.

6.2.6. Driving Violations

HO: There is no significant relationship between driving violations and the number of motor accidents.

The number of driving violations was cross tabulated with the number of road accidents. The chi square test was used to determine any possible relationship between the two variables. The outcome is indicated in Table 6.6.

Table 6.6

Cross-Tabulation between Driving Violations and the Number of Road Accidents

	Driving Violations			
Total Number of Accidents	Yes	No	Total	%
1	141	62	203	42.8
2	115	39	154	32.4
3	104	14	118	24.8
Total	350	115	475	
%	73.7	24.3		100

Chi-Square	Value	DF	Significance
Pearson	12.92	2	.03

As shown in Table 6.6, the chi square value was 12.92 while the probability was .03. This indicates that there was a significant relationship between road violation among drivers in Saudi Arabia and the number of road accidents.

6.2.7. Vehicle Ownership

HO: There is no significant relationship between vehicle ownership and the number of motor accidents.

The variable, ownership of the vehicle, was cross tabulated with the number of road accidents. The chi square statistic was utilised to test for the relationship between the two variables. The outcome is shown in Table 6.7.

Table 6.7

Cross Tabulation between Vehicle Ownership and the Number of Road Accidents

	Vehicle Ownership				
Total Number of Accidents	Owner	Hired	Driver Only	Total	%
1	157	10	32	199	41.5
2	116	27	6	149	31.0
3	55	3	74	132	27.5
Total	328	40	112	480	
%	68.3	08.3	23.4		100

Chi-Square	Value	DF	Significance
Pearson	28.98	4	.03

Table 6.7 shows that there was a significant association between the ownership of the vehicle and the number of road accidents in Saudi Arabia. The cross tabulation shows that private vehicle owners recorded more road accidents than those who had hired the vehicles and those who were drivers. The chi square value was 2.98 while the probability was .03. This shows that there was a significant relationship between the two variables.

6.3. Hypotheses Related to Environmental and Behavioural Factors

6.3.1. Uncomfortable Seats

HO: There is no significant relationship between uncomfortable seats and the number of motor accidents.

This hypothesis was also tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was also used to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.8.

Table 6.8

Correlation Analysis in respect of Uncomfortable Seats and Number of Road Accidents

	Road Accidents	Uncomfortable Seats	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.92				
Std Dev	.73	.27				
			-.16	P=.00	-.15	P=.00

Correlation Coefficients 2-tailed Significance at 0.05 level

Table 6.8 shows that the Pearson 'r' correlation coefficient was -.16 while the probability was .00. The Spearman Brown formula also shows a correlation coefficient of -.15 and a probability of .00. These values are statistically significant ($p < 0.05$) leading to rejection of the null hypothesis. There was a significant relationship between uncomfortable seats in motor vehicles and the number of motor accidents, suggesting that the type of seat in motor vehicles can affect the pattern of driving of drivers and hence increase the risk of road accidents.

6.3.2. Mechanical Fault

HO: There is no significant relationship between mechanical faults on the part of the vehicle and the number of motor accidents.

The Pearson correlation coefficient was utilised to test this hypothesis. The Spearman Brown formula was also used to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.9.

Table 6.9

Correlation Analysis in respect of Mechanical Fault and Number of Road Accidents

	Road Accidents	Mechanical Fault	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.86				
Std Dev	.73	.35				
			-.11'	P=.03	-.09	P=.08

Correlation Coefficients 2-tailed Significance at 0.05 level

According to Table 6.9, the Pearson 'r' correlation coefficient was -.11 while the probability was .03. As shown in the Table, the Spearman Brown formula correlation coefficient was -.09 while the probability was .08. Hence the null hypothesis was accepted (p>0.05). Meaning that there was no significant relationship between the existence of a mechanical fault in the vehicle and the number of motor accidents.

6.3.3. Traffic Congestion

HO: There is no significant relationship between traffic congestion and the number of motor accidents.

The Pearson correlation coefficient was also utilised to test this hypothesis. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.10.

Table 6.10

Correlation Analysis in respect of Traffic Congestion and Number of Road Accidents

	Road Accidents	Traffic Congestion	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.69				
Std Dev	.73	.46				
			-.16	P=.00	-.15	P=.00

Correlation Coefficients 2-tailed Significance at 0.00 level

As shown in Table 6.10 the Pearson 'r' correlation coefficient was -.16 while the probability was .00. The Spearman Brown correlation coefficient was -.15 while the probability was .00. Hence the null hypothesis was rejected (p<0.05). This indicates that there was a significant relationship between traffic congestion and the number of motor accidents.

6.3.4. Non-lighting of Roads

HO: There is no significant relationship between Non-lighting of Roads and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was employed. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.11.

Table 6.11

Correlation Analysis in respect of Non-Lighting of Roads and Number of Road Accidents

	Road Accidents	Non-Lighting of Roads	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.30				
Std Dev	.73	.53				
			.05	P=.33	.03	P=.50

Correlation Coefficients 2-tailed Significance at 0.50 level

Table 6.11 shows that the Pearson 'r' correlation coefficient was.05 while the probability was .33. The Spearman Brown correlation coefficient was .03 while the probability was .50. Hence the null hypothesis was accepted (p>0.05). This indicates that there was no significant relationship between the non-lighting of roads and the number of motor accidents.

6.3.5. Non-marking of Roads

HO: There is no significant relationship between non-marking of roads and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was employed. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.12.

Table 6.12

Correlation Analysis in respect of Non-Marking of Roads and Number of Road Accidents

	Road Accidents	Non-Marking of Roads	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.80				
Std Dev	.73	.40				
			-.16	P=.00	-.16	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.12, the Pearson 'r' correlation coefficient was -.16 while the probability was .00. The Spearman Brown correlation coefficient was -.16 while the probability was .00. Consequently, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant association between the non-marking of roads and the number of motor accidents.

6.3.6. Road Engineering

HO: There is no significant relationship between inappropriate road engineering and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.13.

Table 6.13

Correlation Analysis in respect of Inappropriate Road Engineering and Number of Road Accidents

	Road Accidents	Inappropriate Road Eng.	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.78				
Std Dev	.73	.42				
			-.17	P=.00	-.16	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.13, the Pearson 'r' correlation coefficient was -.17 while the probability was .00. The Spearman Brown correlation coefficient was -.16 while the probability was .00. Hence, the null hypothesis was rejected ($p<0.05$) indicating that there was a significant relationship between inappropriate road engineering and the number of motor accidents in Saudi Arabia. A badly designed road network tends to lead to more road accidents.

6.3.7. Stray animals

HO: There is no significant relationship between presence of strayed animals and the number of motor accidents.

The Pearson correlation coefficient was employed to test this hypothesis while the Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.14.

Table 6.14

Correlation Analysis in respect of Presence of Strayed Animals and Number of Road Accidents

	Road Accidents	Presence of Strayed Animals	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.78				
Std Dev	.73	.41				
			-.13	P=.01	-.11	P=.02

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.14 shows a Pearson 'r' correlation coefficient of -.13 and a probability of .01. It also shows a Spearman Brown correlation coefficient of -.11 with a probability of .02. Consequently, the null hypothesis was rejected (p<0.05). This indicates that there was a significant relationship between the presence of strayed animals and the number of road accidents. Most of the respondents (484) claimed that a great number of road accidents in Saudi Arabia are caused by animals staying onto the road.

6.3.8. Sun Haze

HO: There is no significant relationship between sun haze and the number of motor accidents.

The Pearson correlation coefficient was also employed to test this hypothesis while the Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.15.

Table 6.15

Correlation Analysis in respect of Sun Haze and Number of Road Accidents

	Road Accidents	Sun Haze	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.88				
Std Dev	.73	.33				
			-.14	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.15, the Pearson 'r' correlation coefficient was -.14 while the probability was .01. The Spearman Brown correlation coefficient was -.13 while the probability was .01. As such, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between sun haze and the number of road accidents among the sample. Since Saudi Arabia is located in the Arabian desert, sun haze is a common feature in the country and 483 of the drivers (99.8%)claimed that sun haze had caused them to have a road accident.

6.3.9. Heat or Cold

HO: There is no significant relationship between excessive heat or cold and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.16.

Table 6.16

Correlation Analysis in respect of Excessive Heat or Cold and Number of Road Accidents

	Road Accidents	Excessive Heat or Cold	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.90				
Std Dev	.73	.30				
			-.10	P=.04	-.10	P=.05

Correlation Coefficients 2-tailed Significance at 0.5 level

According to the findings in Table 6.16, the Pearson 'r' correlation coefficient was -.10 while the probability was .04. The Spearman Brown correlation coefficient was -.10 while the probability was .05. Hence, the null hypothesis was rejected ($p<0.05$) indicating that there was a significant relationship between excessive heat or cold and the number of road accidents. Heat and cold are natural phenomena which in Saudi Arabia can reach extremes. They had contributed to road accidents, according to 482 drivers (99.6%).

6.3.10. Sand Storm

HO: There is no significant relationship between sand storm and the number of motor accidents.

The Pearson correlation coefficient was also employed to test this hypothesis while the Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings are shown in Table 6.17.

Table 6.17

Correlation Analysis in respect of Sand Storm and Number of Road Accidents

	Road Accidents	Sand storm	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.86				
Std Dev	.73	.35				
			-.13	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.17 shows that the Pearson 'r' correlation coefficient was -.13 while the probability was .01. The Spearman Brown correlation coefficient was -.13 while the probability was .01. Consequently, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between sand storm and the number of road accidents; in other words, sand storms may be a contributory factor in road accidents in Saudi Arabia.

6.3.11. High Beam Light

HO: There is no significant relationship between high beam lights and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was used. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings are indicated in Table 6.18.

Table 6.18

Correlation Analysis in respect of High Beam Lights and Number of Road Accidents

	Road Accidents	High Beam Lights	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.77				
Std Dev	.73	.42				
			-.07	P=.14	-.06	P=.23

Correlation Coefficients 2-tailed Significance at 0.5 level

As shown in Table 6.18, the Pearson 'r' correlation coefficient was -.07 while the probability was .14. The Spearman Brown correlation coefficient was also -.06 while the probability was .23. Hence, the null hypothesis was accepted (p>0.05) indicating that there was no significant relationship between high beam lights and the number of road accidents.

6.3.12 Passengers' Behaviour

HO: There is no significant relationship between passengers' behaviour and the number of motor accidents.

The Pearson correlation coefficient was utilised to test this hypothesis while the Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are shown in Table 6.19.

Table 6.19

Correlation Analysis in respect of Passengers' Behaviour and

Number of Road Accidents

	Road Accidents	Passengers' Behaviour	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.50				
Std Dev	.73	.50				
			-.09	P=.07	-.09	P=.07

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.19 shows that the Pearson 'r' correlation coefficient was -.09 while the probability was .07. The Spearman Brown correlation coefficient was -.09 while the probability was .07. As such, the null hypothesis was accepted (p>0.05). This shows that there was no significant relationship between passengers' behaviour and the number of road accidents.

6.3.13. Ear Disorder

HO: There is no significant relationship between ear disorder and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.20.

Table 6.20

Correlation Analysis in respect of Ear Disorder and Number of Road Accidents

	Road Accidents	Ear Disorder	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.96				
Std Dev	.73	.20				
			-.10	P=.05	-.08	P=.10

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.20 shows that the Pearson 'r' correlation coefficient was -.10 while the probability was .05. The Spearman Brown correlation coefficient was -.08 while the probability was .10. Hence, the null hypothesis was accepted (p>0.05). This indicates that there was no significant relationship between ear disorder and the number of road accidents.

6.3.14. Eye Sight

HO: There is no significant relationship between eye sight and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.21.

Table 6.21

Correlation Analysis in respect of Eye Sight and Number of Road Accidents

	Road Accidents	Eye Sight	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.94				
Std Dev	.73	.25				
			-.12	P=.01	-.12	P=.02

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.21 shows that the Pearson 'r' correlation coefficient was -.12 while the probability was .01. The Spearman Brown correlation coefficient was -.12 while the probability was .02. Hence, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between eye sight and the number of road accidents. As many as 482 of the drivers (99.6%) claimed that poor eye sight on the part of many drivers causes road accidents in Saudi Arabia.

6.3.15. Joy Riding

HO: There is no significant relationship between joy riding and the number of motor accidents.

The Pearson correlation coefficient was employed to test this hypothesis while the Spearman Brown formula was used to test for the significant relationship between the two variables. The findings are indicated in Table 6.22.

Table 6.22

Correlation Analysis in respect of Joy riding and

Number of Road Accidents

	Road Accidents	Joy riding	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.88				
Std Dev	.73	.32				
			-.25	P=.00	-.22	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

As shown in Table 6.22, the Pearson 'r' correlation coefficient was -.25 while the probability was .00. The Spearman Brown correlation coefficient was -.22 while the probability was .00. As such, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between joy riding and the number of road accidents in Saudi Arabia. Out of the 482 drivers who gave a response to this question, 56 said yes while 426 said no. This shows that even though the relationship between the variables is significant, the majority of the drivers were not of the belief that joy riding is a major cause of road accidents.

6.3.16. Frustration

HO: There is no significant relationship between frustration on the part of the driver and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.23.

Table 6.23

Correlation Analysis in respect of Frustration on the Part of the Driver and Number of Road Accidents

	Road Accidents	Frustration among Drivers	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.86				
Std Dev	.73	.35				
			-.12	P=.02	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

According to Table 6.23, the Pearson 'r' correlation coefficient was -.12 while the probability was .02. The Spearman Brown correlation coefficient was -.13 while the probability was .01. Hence, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between frustration among drivers and the number of road accidents. Although the relationship between the variables was significant, it was found that 67 of the drivers (13.9%) said yes while 415 said no (86.1%) in response to the question about frustration. This shows that frustration is not a major cause of road accidents in the country.

6.3.17. Non-observance of speed limits

HO: There is no significant relationship between non-observance of speed limits and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.24.

Table 6.24

Correlation Analysis in respect of Non-Observance of Speed Limits and Number of Road Accidents

	Road Accidents	non observance of speed limits	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.67				
Std Dev	.73	.47				
			-.14	P=.01	-.14	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.24 shows that the Pearson 'r' correlation coefficient was -.14 while the probability was .01. The Spearman Brown correlation coefficient was -.14 while the probability was .01. As such, the null hypothesis was rejected (p<0.05). This indicates that there was a significant relationship between non-observance of speed limits and the number of road accidents in Saudi Arabia. 207 of the drivers (42.9%) gave a yes response to this question while 276 of them (57.1%) gave a no response. This indicates that the non-observance of speed limits is not a cause of road accidents in Saudi Arabia.

6.3.18. Safe Distance

HO: There is no significant relationship between observing a safe distance and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was used. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.25.

Table 6.25

Correlation Analysis in respect of Safe Distance and Number of Road Accidents

	Road Accidents	Safe Distance	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.72				
Std Dev	.73	.45				
			-.00	P=.09	-.01	P=.05

Correlation Coefficients 2-tailed Significance at 0.5 level

According to Table 6.25, the Pearson 'r' correlation coefficient was -.00 while the probability was .09. The Spearman Brown correlation coefficient was -.01 while the probability was .05. Consequently, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between the variable, safe distance and the number of road accidents among the sample.

6.3.19. Overtaking

HO: There is no significant relationship between Over -taking on the part of drivers and the number of motor accidents.

The Pearson correlation coefficient was utilised to test this hypothesis. The Spearman Brown formula was used to determine the significant relationship between the two variables. The findings of the analysis are contained in Table 6.26.

Table 6.26

Correlation Analysis in respect of Overtaking and

Number of Road Accidents

	Road Accidents	Over-Taking	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1. 50				
Std Dev	.73	.50				
			-.09	P=.04	-.09	P=.04

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.26 shows that the Pearson 'r' correlation coefficient was -.09 while the probability was .04. The Spearman Brown correlation coefficient was -.09 while the probability was .04. Hence, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between over-taking on the part of drivers and the number of road accidents.

6.3.20. Non-alertness to others' errors

HO: There is no significant relationship between non alertness to others' errors and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.27.

Table 6.27

Correlation Analysis in respect of Non alertness to others' errors and Number of Road Accidents

	Road Accidents	Non alertness to others errors	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.57				
Std Dev	.73	.50				
			-.07	P=.15	-.06	P=.23

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.27 shows that the Pearson 'r' correlation coefficient was -.07 while the probability was .15. The Spearman Brown correlation coefficient was -.06 while the probability was .23. As such, the null hypothesis was accepted (p>0.05). This shows that there was no significant relationship between the variable, non alertness to others' errors, and the number of road accidents in Saudi Arabia.

6.3.21. Reversing

HO: There is no significant relationship between reversing by drivers and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.28.

Table 6.28

Correlation Analysis in respect of Reversing by Drivers and Number of Road Accidents

	Road Accidents	Reversing	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.72				
Std Dev	.73	.45				
			-.06	P=.22	-.07	P=.17

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.28 shows that the Pearson 'r' correlation coefficient was -.06 while the probability was .22. The Spearman Brown correlation coefficient was -.07 while the probability was .17. Hence, the null hypothesis was accepted ($p>0.05$). This indicates that there was no significant relationship between reversing by drivers and the number of road accidents.

6.3.22. Emerging from or exiting road

HO: There is no significant relationship between emerging from or exiting road and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was employed. The Spearman Brown formula was used to test for a significant relationship between the two variables. The findings of the analysis are shown in Table 6.29.

Table 6.29

Correlation Analysis in respect of Emerging from or Exiting Roads and Number of Road Accidents

	Road Accidents	Emerging from or exiting road	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.75				
Std Dev	.73	.43				
			-.13	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.29, the Pearson 'r' correlation coefficient was -.13 while the probability was .01. The Spearman Brown correlation coefficient was -.13 while the probability was .01. As such, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between emerging from or exiting a road and the number of road accidents reported by the respondents.

6.3.23. Non-familiarity with road

HO: There is no significant relationship between non familiarity with the road and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was utilised to determine the significant relationship between the two variables. The findings of the analysis are contained in Table 6.30.

Table 6.30

Correlation Analysis in respect of Non familiarity with the road and Number of Road Accidents

	Road Accidents	Non familiarity with the road	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.86				
Std Dev	.73	.35				
			-.19	P=.00	-.18	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.30 shows that the Pearson 'r' correlation coefficient was -.19 while the probability was .00. The Spearman Brown correlation coefficient was -.18 while the probability was .00. Hence, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between the variable, non familiarity with the road and the number of road accidents.

6.4. Hypotheses Related to Habitual Driving Behaviours

6.4.1. Car Servicing

HO: There is no significant relationship between regular car servicing and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.31.

Table 6.31

Correlation Analysis in respect of Regular Car Servicing and Number of Road Accidents

	Road Accidents	Regular Car Servicing	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.90				
Std Dev	.73	.30				
			-.34	P=.00	-.36	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

According to Table 6.31, the Pearson 'r' correlation coefficient was -.34 while the probability was .00. The Spearman Brown correlation coefficient was -.36 while the probability was .00. As such, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between regular car servicing and the number of road accidents.

6.4.2. Car checking

HO: There is no significant relationship between regular car checking and the number of motor accidents in Saudi Arabia.

The Pearson correlation coefficient was utilised to test this hypothesis. The Spearman Brown formula was used to determine the significant relationship between the two variables. The findings of the analysis are contained in Table 6.32.

Table 6.32

Correlation Analysis in respect of Regular Car Checking and Number of Road Accidents

	Road Accidents	Regular Car Checking	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.88				
Std Dev	.73	.33				
			-.38	P=.00	.40	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.32 shows that the Pearson 'r' correlation coefficient was -.38 while the probability was .00. The Spearman Brown correlation coefficient was .40 while the probability was .00. In this regard, the null hypothesis was rejected ($p<0.05$). This shows that there was a significant relationship between regular car checking and the number of road accidents.

6.4.3. Long hours driving

HO: There is no significant relationship between long hours driving and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the correlation analysis are contained in Table 6.33.

Table 6.33

Correlation Analysis in respect of Long Hours Driving and Number of Road Accidents

	Road Accidents	Long Hours Driving	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	2.14				
Std Dev	.73	.85				
			-.11	P=.02	-.10	P=.04

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.33, the Pearson 'r' correlation coefficient was -.11 while the probability was .02. The Spearman Brown correlation coefficient was -.10 while the probability was .04. Hence, the null hypothesis was rejected (p<0.05). Thus, there was a significant relationship between long hours driving on the part of many drivers and the number of road accidents in Saudi Arabia.

6.4.4. Driving when tired

HO: There is no significant relationship between driving when tired and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.34.

Table 6.34

Correlation Analysis in respect of Driving when Tired and Number of Road Accidents

	Road Accidents	Driving when Tired	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	2.87				
Std Dev	.73	.98				
			-.17	P=.00	-.18	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.34 shows a Pearson 'r' correlation coefficient of -.17 and a probability of .00. It also shows a Spearman Brown correlation coefficient of -.18 and a probability of .00. Hence, the null hypothesis was rejected (p<0.05), indicating that there was a significant relationship between the variable driving when tired and the number of road accidents reported by respondents

6.4.5. Driving when sick

HO: There is no significant relationship between driving when sick and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.35.

Table 6.35

Correlation Analysis in respect of Driving when sick and

Number of Road Accidents

	Road Accidents	Driving when Sick	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	3.23				
Std Dev	.73	.90				
			-.16	P=.00	-.17	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.35 also shows that the Pearson 'r' correlation coefficient was -.16 while the probability was .00. The Spearman Brown correlation coefficient was -.17 while the probability was .00. Consequently, the null hypothesis was rejected ($p<0.05$) indicating that there was a significant relationship between driving when sick and the number of road accidents.

6.4.6. Driving after medication

HO: There is no significant relationship between driving after taking medication and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The significance of the relationship was tested with the use of the Spearman Brown formula. The findings of the analysis are contained in Table 6.36.

Table 6.36

Correlation Analysis in respect of Driving after taking Medication and Number of Road Accidents

	Road Accidents	Driving after taking Medication	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.68				
Std Dev	.73	.75				
			-.17	P=.00	-.17	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.36, the Pearson 'r' correlation coefficient was -.17 while the probability was .00. The Spearman Brown correlation coefficient was -.17 while the probability was .00. As such, the null hypothesis was rejected (p<0.05). This shows that there was a significant relationship between driving after taking medication and the number of road accidents.

6.4.7. Driving under stress

HO: There is no significant relationship between driving under Psychological stress and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was used. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are shown in Table 6.37.

Table 6.37

Correlation Analysis in respect of Driving under Psychological Stress and Number of Road Accidents

	Road Accidents	Driving under Psychological Stress	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	293				
Std Dev	.73	1.06				
			-.12	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.37 shows a Pearson 'r' correlation coefficient of -.12 and a probability of .01. It also shows a Spearman Brown correlation coefficient of -.13 and a probability of .01. As such, the null hypothesis was rejected (p<0.05). This indicates that there was a significant relationship between driving under psychological stress and the number of road accidents among the sample.

6.4.8. Use of seat belts

HO: There is no significant relationship between the use of Seat belts and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was used. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are shown in Table 6.38.

Table 6.38

Correlation Analysis in respect of use of Seat belts and Number of Road Accidents

	Road Accidents	Use of seat belt	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	3.14				
Std Dev	.73	1.50				
			-.10	P=.04	-.10	P=.04

Correlation Coefficients 2-tailed Significance at 0.5 level

According to Table 6.38, the Pearson 'r' correlation coefficient was -.10 while the probability was .04. The Spearman Brown correlation coefficient was -.10 while the probability was .04. Hence, the null hypothesis was rejected (p<0.05), indicating that there was a significant relationship between the use of seat belts and the number of road accidents in Saudi Arabia.

6.4.9. Signalling when changing lane

HO: There is no significant relationship between the use of signals when changing lanes and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.39.

Table 6.39

Correlation Analysis in respect of Use of Signals when Changing Lanes and Number of Road Accidents

	Road Accidents	Use of signals when changing lane	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1. 76				
Std Dev	.73	1.05				
			.11	P=.02	-.14	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.39 shows that the Pearson 'r' correlation coefficient was -.11 while the probability was .02. The Spearman Brown correlation coefficient was -.14 while the probability was .00. As such, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between the use of signals when changing lanes and the number of road accidents in the country.

6.4.10. Smoking

HO: There is no significant relationship between smoking when driving and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are shown in Table 6.40.

Table 6.40

Correlation Analysis in respect of Smoking when Driving and Number of Road Accidents

	Road Accidents	Smoking when Driving	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	3.65				
Std Dev	.73	1.63				
			-.12	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

As shown in Table 6.40, the Pearson 'r' correlation coefficient was -.12 while the probability was .01. The Spearman Brown correlation coefficient was -.13 while the probability was .01. Hence, the null hypothesis was rejected ($p<0.05$), indicating that there was a significant relationship between smoking when driving and the number of road accidents in Saudi Arabia.

6.4.11. Eating or drinking

HO: There is no significant relationship between eating or drinking when driving and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.41.

Table 6.41

Correlation Analysis in respect of Eating or Drinking and Number of Road Accidents

	Road Accidents	Eating or Drinking when Driving	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	3.36				
Std Dev	.73	1.14				
			-.16	P=.00	-.14	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.41 shows a Pearson 'r' correlation coefficient of -.16 and a probability of .00. It also shows a Spearman Brown correlation coefficient of -.14 and a probability of .00. As such, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between eating or drinking when driving and the number of road accidents in the country.

6.4.12. Observance of regulations

HO: There is no significant relationship between observance of traffic regulations and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was employed. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.42.

Table 6.42

Correlation Analysis in respect of Observance of Traffic Regulations and Number of Road Accidents

	Road Accidents	Observance Traffic Regulation	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.63				
Std Dev	.73	.93				
			-.15	P=.00	-.15	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

As shown in Table 6.42, the Pearson 'r' correlation coefficient was -.15 while the probability was .00. The Spearman Brown correlation coefficient was -.15 while the probability was .00. Hence, the null hypothesis was rejected ($p<0.05$). This indicates that there was a significant relationship between the observance of traffic regulations and the number of road accidents.

6.4.13. Cassettes and radio

HO: There is no significant relationship between use of cassettes and radio while driving and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was utilised. The Spearman Brown formula was employed to test for the significant relationship between the two variables. The findings of the analysis are shown in Table 6.43.

Table 6.43

Correlation Analysis in respect of Use of Cassettes and Radio while driving and Number of Road Accidents

	Road Accidents	Use of Cassettes and Radio	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	2.18				
Std Dev	.73	1.34				
			-.14	P=.00	-.17	P=.00

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.43 shows that the Pearson 'r' correlation coefficient was -.14 while the probability was .00. The Spearman Brown correlation coefficient was -.17 while the probability was .00. Consequently, the null hypothesis was rejected ($p<0.05$) indicating that there was a significant relationship between use of cassettes and radio while driving and the number of road accidents.

6.4.14. Mobile telephone

HO: There is no significant relationship between the use of mobile telephone while driving and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was used. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.44.

Table 6.44

Correlation Analysis in respect of. Use of Mobile Telephone and Number of Road Accidents

	Road Accidents	Use of Mobile telephone	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	3.96				
Std Dev	.73	1.37				
			-.16	P=.00	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.44 shows that the Pearson 'r' correlation coefficient was -.16 while the probability was .00. The Spearman Brown correlation coefficient was -.13 while the probability was .01. Hence, the null hypothesis was rejected (p<0.05). This indicates that there was a significant relationship between the use of mobile telephones while driving and the number of road accidents.

6.4.15. Child Seats

HO: There is no significant relationship between the use of special seat for children and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The significance in the relationship between the two variables were tested with the use of the Spearman Brown formula. The findings are shown in Table 6.45.

Table 6.45

Correlation Analysis in respect of the Use of Special Seats for Children and Number of Road Accidents

	Road Accidents	Special Seat for Children	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	4.09				
Std Dev	.73	1.36				
			-.02	P=.63	-.05	P=.33

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.45, the Pearson 'r' correlation coefficient was -.02 while the probability was .63. The Spearman Brown correlation coefficient was -.05 while the probability was .33. Hence, the null hypothesis was accepted ($p>0.05$). This shows that there was no significant relationship between the use of a special seat for children and the number of road accidents.

6.4.16. Use of mirrors

HO: There is no significant relationship between the use of front and side mirrors and the number of motor accidents.

In testing this hypothesis, the Pearson correlation coefficient was employed. The Spearman Brown formula was used to test for the significant relationship between the two variables. The findings of the analysis are contained in Table 6.46.

Table 6.46

Correlation Analysis in respect of Use of Front and Side Mirrors and Number of Road Accidents

	Road Accidents	Use of Front and Side Mirrors	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.38				
Std Dev	.73	.81				
			-.12	P=.01	-.13	P=.01

Correlation Coefficients 2-tailed Significance at 0.5 level

Table 6.46 shows that the Pearson 'r' correlation coefficient was -.12 while the probability was .01. The Spearman Brown correlation coefficient was -.13 while the probability was .01. As such, the null hypothesis was rejected ($p<0.05$) indicating that there was a significant relationship between the use of front and side mirrors and the number of road accidents.

6.4.17. Concentration

HO: There is no significant relationship between concentration on part of the driver and the number of motor accidents.

This hypothesis was tested with the use of the Pearson correlation coefficient. The Spearman Brown formula was utilised to test for the significant relationship between the two variables. The findings of the analysis are indicated in Table 6.47.

Table 6.47

Correlation Analysis in respect of Concentration on the Part of the Driver and Number of Road Accidents

	Road Accidents	Concentration on Part of the Driver	Pearson's 'R'	Probability	Spearman Coefficients	Signif
Mean	1.68	1.44				
Std Dev	.73	.79				
			-.08	P=.09	-.10	P=.05

Correlation Coefficients 2-tailed Significance at 0.5 level

As indicated in Table 6.47, the Pearson 'r' correlation coefficient was -.08 while the probability was .09. The Spearman Brown correlation coefficient was -.10 while the probability was .05. This shows that the null hypothesis was rejected (p<0.05) and it indicates that there was a significant relationship between concentration on part of the driver and the number of road accidents.

6.5. Recognition of Road Signs

As indicated in Chapter Five, respondents were given a multiple choice test to determine whether they could recognise 30 road signs used in Saudi Arabia. The outcome is shown in Table 6.48.

Table 6.48

Recognition of Road Signs By Drivers

Road Signs		Yes	No	Total	%Yes	%No
One way road		460	24	484	95.4	4.6
Road closed		255	222	477	53.4	46.6
Hospital		420	61	481	87.32	12.68
Stop		390	92	482	80.9	19.9
No entry		430	50	480	89.7	10.3
No U turn		387	94	481	80.4	19.6
Road narrows		423	54	477	88.7	11.3
Uneven road		252	216	468	53.8	46.2
Road intersection		338	134	472	71.6	28.4
Car park		388	92	480	80.8	19.2
First aid centre		426	54	480	88.7	11.3
Telephone		435	49	484	89.9	10.1
No left turn		449	32	481	93.4	6.6
No overtaking		187	296	483	30.3	69.7
No stopping or waiting		370	113	483	76.6	23.4
No entry		228	252	480	47.5	52.5
No right turn		425	57	482	88.1	11.9
Slippery road		417	65	482	86.5	13.5
Pedestrian crossing		374	107	481	77.7	22.3
Working zone		434	46	480	90.4	9.6
Minor crossroad		368	106	474	77.6	22.4
Diverted road		286	180	468	61.37	38.63
One side overtaking		350	128	478	73.3	26.7
No overtaking mark		294	180	474	62	38
Give Way		437	43	480	91	9
Two way road		446	34	480	92.9	7.1
No car entry		264	217	481	54.8	45.2
Speed limit		427	57	484	88.8	11.2
School zone		447	36	483	92.5	7.5
Animals area		436	47	483	90.3	9.7

It can be seen from the table that levels of recognition varied widely from one sign to another. Only seven signs were recognised by at least 90% of the drivers (for greater clarity, these are shown separately in Table 6.49).

Table 6.49

Signs Mostly Known (90%+)

Road Signs		Yes	No	Total	%Yes	%No
One way road		460	24	484	95.4	4.6
No left turn		449	32	481	93.4	6.6
Working zone		434	46	480	90.4	9.6
Give Way		437	43	480	91	9
Two way road		446	34	480	92.9	7.1
School Zone		447	36	483	92.5	7.5
Animals area		436	47	483	90.3	9.7

It can be seen that the most widely recognised sign was the 'One-way' sign, recognised by 95.4% of respondents. Similarly high levels of correct responses were obtained for the signs for the No Left Turn, that for a Two-way road, the Give Way sign and signs warning of the need for special care due to the presence of workmen, school children or animals.

On the other hand, it was disturbing to find that four signs could be correctly identified by only around half the respondents, or even fewer (see Table 6.50).

Table 6.50

Signs Unknown (40%+)

Road Signs		Yes	No	Total	%Yes	%No
Road closed		255	222	477	53.4	46.6
Uneven road		252	216	468	53.8	46.2
No overtaking		187	296	483	30.3	69.7
No entry		228	252	480	47.5	52.5

It is possible that respondents might not often come across the 'Road Closed' and 'Uneven Road' signs, but it is surprising and cause for concern that so few gave correct answers in respect of the 'No entry' sign and that fewer than a third of respondents recognised the 'No Overtaking' sign. Failure to recognise and comply with these signs in a driving situation might be expected to lead to unsafe driving and, consequently, road accidents.

6.6. Summary

This chapter began with cross tabulation and chi square analysis of the relationship between drivers' personal characteristics and the criterion variable – the number of road accidents they had had.

Variables that were significantly associated with the criterion variable are educational level, age, profession of the driver, violation record and vehicle ownership.

The second part of the analysis showed the outcome of testing the various hypotheses postulated for this study, regarding behavioural and environmental variables. Variables which showed a significant relationship with the dependent variable, the number of road accidents reported by respondents, were uncomfortable seats, traffic congestion, non-marking of roads, inappropriate road engineering, presence of strayed animals, sun haze, excessive heat or cold, sand storm, eye sight, joy riding, frustration, non observance of speed limits, not keeping a safe distance, overtaking, emerging from and exiting roads, non-familiarity with the road, regular car servicing, regular car checking, long hours driving, driving when tired, driving when sick, driving after taking medication, driving under psychological stress, use of seat belts, use of signals when changing lane, smoking when driving, eating and drinking when driving, observance of traffic regulations, use of cassette and radio while driving, use of mobile telephone while driving, use of front and side mirrors, and loss of concentration on the part of the driver.

The Table of Responses to Questionnaire 2 in Appendix E shows 40 environmental and behavioural factors potentially contributing to the driver's loss of control. The highest risk factor was found to be lack of concentration, followed by failure to use front and side mirrors effectively. Not observing current traffic regulations followed next.

Drivers changing lanes without giving the proper signal was fourth in degree of importance.

The less important factors, which came lowest on the list, included having an uncomfortable seat, having poor eyesight, and lastly, having an ear disorder (this latter was non-significant, Table 7.27). Tables 2 and 3 in the Appendix group these results into two broad categories, namely, environmental and behavioural factors and habitual driving behaviours, respectively.

The 40 factors can be classified into 9 categories as shown in the pie chart, item 4 in the Appendix. As the chart shows, the categories of factors involved in driving accidents, in order of importance, are as follows:

1. Unsafe driving is the most important category, accounting for 25% of the total. This can be broken down into 5 sub-factors as shown in Appendix E, Table 5.

2. Driver's physical/psychological condition (the 9 elements of which are shown in Appendix C, Table 6) accounts for 22% of the total.

3. Driver behaviour represents 17% of the total. See Appendix E, Table 7, which lists 5 sub-factors.

4. Road conditions make up 10% of the total. Appendix E, Table 8 shows the 6 sub-factors involved in this category.

5. Safety precautions (i.e. failure to take them) account for 8% of the total. Appendix E, Table 9 lists 4 sub-factors.

6. Driving situations make up 7% of the total. See Appendix E, Table 10 showing 3 sub-factors.

7. Others' behaviour, which comprises of 3 sub-factors (see Appendix E, Table 11)

accounts for 6% of the total.

8. Weather conditions, accounting for 3% of the total, is made up of 4 sub-factors, as seen in Table 12.

9. Vehicle condition, accounting for 2% of total, includes 2 sub-factors, as shown in Table 13.

Variables that the research indicated were not significant were:

- Mechanical fault (Table 6.9).
- High light beam (Table 6.18).
- Non-lighting of roads (Table 6.11).
- Non alertness to others' errors (Table 6.27).
- Passengers' behaviour (Table 6.19).
- Reversing (Table 6.28).
- Ear disorder (Table 6.20).
- Driving with no licence (Table 6.5).
- Child seat (Table 6.45).
- Marital status (Table 6.3).

In the third part of the analysis, the recognition of road signs among the drivers was examined through the use of percentages. Many of the drivers claimed that they could recognise some road signs such as "one way road, no left turn, working zone, yield sign, two way road, school zone and animals area" while a large number of them reported that they could not recognise such road signs as "road closed, uneven road, no overtaking, and no entry."

The foregoing description of data has enabled the researcher to consider the study objectives and produce recommendations. These are presented in Chapter Seven, which follows.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

In the previous chapter, the final part of the statistical analysis was presented, together with interpretation and discussion of the data. The present chapter summarises the main findings of the study and presents conclusions, recommendations and suggestions for further research.

7.2. Summary

The aim of this study was to identify the direct and indirect causes of motor accidents in Saudi Arabia, as a basis for proposing measures to reduce such accidents in the country. The following are the main findings related to the objectives encompassed within this aim.

7.2.1. Objective I : To describe conditions for drivers in Saudi Arabia

Saudi Arabia covers a vast area. There are a small number of densely concentrated centres of population and industry, and a large number of widely scattered small towns, villages and hamlets. The Kingdom is characterised by varied terrain, including extensive tracts of desert, and by an arid climate with extremes of temperature (see Section 2.2). All of these conditions create difficulty in the construction and maintenance of an adequate road network.

Despite these difficulties there have been rapid quantitative and qualitative developments in the road network in recent years. A major role in this respect has been played by oil exploitation, which has increased the need for paved roads and has provided the revenue to finance development of the country's infrastructure (Section 2.3). Roads are classified and numbered similarly to roads in the U.K. Road classification, directional and other information is provided on colour-coded signs at the road-side (Section 2.4).

There is a high level of car ownership, due to the lack of other land transport and high earnings which make it easy to afford vehicles (see Chapter 1). Saudi males tend to learn to drive at a young age, but few attend driving schools; indeed, there are not many driving schools in the towns and cities of the country, and maybe only one in the larger cities (see Chapter 3).

Since women are not allowed to drive, many families employ chauffeurs. The incidence of motor accidents is high; official statistics cite speeding as the main cause (see Section 2.7).

7.2.2. Objective II : To review relevant research on driver behaviour

Research on road traffic accidents in the West has shown that human factors (as opposed to vehicle or road factors) are responsible for the majority of accidents (see Chapter 4). Errors of perception, lack of skill and errors in executing manoeuvres have been identified as the main human factors contributing to road accidents (Jacobs and Sayer, 1983). Associated with and underlying these, however, may be other, indirect factors. Driving skill and acuity of perception may, for example, be related to the driver's age (young drivers may have less skill and experience; older drivers are more likely to have impaired hearing or eye-sight and slow reactions – OECD, 1986, see Section 4.4.1.). Another significant factor (Section 4.4.3.) may be the attitude of the road user, e.g. whether he or she is cautious or impulsive; whether or not he or she finds speed exhilarating (Mostyn and Sheppard). The driver's behaviour may also be influenced by external factors, such as weather conditions (see Section 4.3.2.), and by the driver's physical or psychological condition (see Section 4.4.3.). Thus, the behaviours that result in driving accidents appear to result from a number of interacting external and internal factors.

In contrast to the plethora of studies and reports on driving conditions and behaviour in the West, there have been few such studies in Saudi Arabia. The few that have been conducted, reviewed in Section 2.7, present quantities of statistics on accident rates and cite the more obvious causes, such as speeding and running red lights, but have not really considered drivers' attitudes, habitual behaviours, or the various physical and psychological factors which may have contributed to their loss of control of the vehicle or violation of traffic regulations.

7.2.3. Objective III : To identify major causes of accidents

On the basis of the review of literature and of the researcher's experience of investigating traffic accidents in Saudi Arabia in the course of his work, a number of likely causes of road accidents in Saudi Arabia were proposed for further investigation. Some of these pertained to the vehicle (e.g. whether regular maintenance was carried out) or to the road (e.g. weather conditions and aspects of road engineering such as lighting or marking). Most, however, pertained to the driver. These included violation of traffic regulations, such as speeding; behaviours likely to lead to loss of concentration and control, such as smoking, eating, or using mobile telephones while driving; and aspects of the driver's physical or psychological condition, such as poor eye-sight, tiredness and frustration, which might impair his driving ability.

7.2.4. Objective IV : To conduct a quantitative analysis of causes of road accidents in Saudi Arabia between May and September 1996

The population of interest in this study embraced all the 4,100 drivers involved in road accidents in the Eastern province of Saudi Arabia. This population cut across all drivers, both commercial and private. For the purposes of empirical survey, a sample was selected of 600 drivers who had been involved in road accidents. This sample constituted 15% of the total population of the study and was representative of the population. Returns were received from 484 drivers constituting 81% of the drivers sampled and this was deemed to be a good response rate (see Section 5.7.1.).

The instrument utilised to elicit information for the study was a questionnaire tagged the "motor drivers' questionnaire" (MDQ). This questionnaire was in three major sections. The first section (see Section 5.5.1.)was concerned with the collection of personal data. The second section (see Section 5.5.2.) was to find out the factors which, in drivers' experience, had contributed to their road accidents and to find out about aspects of their habitual behaviour in relation to driving (e.g. checking the vehicle, using seat-belts). The third part (Section 5.5.3.) tested the ability of the drivers to recognise road signs commonly found in the country.

Three statistical techniques were utilised in the study. These were the chi-square statistic, the correlation coefficient and the Spearman formula (see Chapter 6). The chi-square statistic was utilised to test for the significant relationship between drivers' personal characteristics and the criterion variable, road accidents. The correlation coefficient was used to test the null-hypotheses related to driver behaviour and environment, while the Spearman formula was utilised to adjust the correlation coefficient. These techniques were appropriate for this research because the study sought to test for relationships between environmental or behavioural factors and motor accidents in Saudi Arabia.

The survey revealed that for many of the drivers, the accident which occurred during the survey period and led to their being contacted by the researcher was not their first road traffic accident. 154 of the drivers had been involved in two accidents, while 127 reported having had three or more accidents. Thus, the 484 drivers responding to the survey had, between them, been involved in at least 892 accidents (see Chapter 6). The three main direct causes of accidents were lack of concentration, failure to observe regulations, and not signalling when changing lane (see Chapter 6).

7.2.5. Objective V : To consider causes of accidents related to loss of control

Consistent with previous research in other countries (e.g. Wright and Baker, 1976), it was found that the majority of the factors significantly associated with the incidence of road accidents among the surveyed Saudi drivers were human factors, leading to loss of control of the vehicle. Those human factors can be classified into three types: dangerous or careless behaviour on the part of the driver; physical impairment of the driver; and physical and psychological factors indirectly influencing driving behaviour, by contributing to loss of concentration or recklessness when driving.

1) Dangerous or careless driving behaviour

a) The findings of this study show that the non-observance of traffic regulations was significantly related with road accidents. This finding is consistent with that of the Manchester University Driver Behaviour Research Group, that 'violations' are the type of aberrant driver behaviour most associated with accidents (see Section 4.4.5.).

b) This study has found that excessive speeding was significantly associated with road accidents (Chapter Six, Table 6.24). Many drivers did not always observe speed limits when driving, thereby leading them to have many road accidents. Again this is consistent with experience elsewhere. As indicated in Section 4.4.5., speed has been named as being one of the major causes of accidents in Europe (European Transport Safety Council, ETSC 1994). Studies have shown that speed reduction measures led to fewer accidents (e.g. Armah, 1997), see Section 4.5.2. This suggests that speed reduction measures could be a useful solution to traffic problems in Saudi Arabia.

c) Another example of unsafe driving found in this study was the non-use of front and side mirrors by many drivers when driving (Chapter Six, Table 6.46). Since the use of front and side mirrors showed a significant relationship with road accidents in this study, the fact that many drivers were not in the habit of using front and side mirrors has made them susceptible to road accidents. No evidence on this specific issue was found in the literature, but it is widely reported (e.g. Faith, 1997) that driver error is a cause of accidents (Table 6.39).

d) Many drivers have not acquired the habit of using signals when changing lanes, leading to erratic, unsafe driving, and hence, road accidents.

e) Vehicles emerging from and exiting onto side roads were found to be significantly associated with road accidents in the country (Chapter Six, Table 6.29). This is related to lack of signalling before such manoeuvres.

f) Failure to maintain a safe distance when driving was significantly related with road accidents (Chapter Six, Table 6.25). This behaviour, which might be caused by impatience, puts the driver, his passengers and other road users at risk. In its extreme form of "tailgating", it is one of the behaviours attributed to the Type A personality (Olsen, 1993).

g) The study has identified the use of radio cassettes when driving as being significantly associated with road accidents (Chapter Six, Table 6.43). Any distraction may impair the driver's concentration, as indicated in section 4.4.3. Inattention due to use of car radios, mobile phones etc. has been cited as a significant cause of accidents in studies in Toronto, Canada (Redelmeir and Tibshirane, 1997), though no specific evidence was found in the literature, concerning radio cassettes.

h) Eating and drinking while driving was also found in this study to be significantly related with road accidents (Chapter Six, Table 6.41), as was smoking (Chapter Six, Table 6.44). These behaviours could distract the attention of the drivers and lead them to having road accidents.

i) Joy riding was found in this study to have a significant relationship with road accidents in Saudi Arabia (Chapter Six, Table 6.22). Drivers who just pick up vehicles without any meaningful purpose are by definition acting irresponsibly, and this mentality is likely to be reflected in their driving behaviour.

Although this study identified some specific behaviours which were not highlighted in the previous literature review as causes of accidents, e.g. eating, its findings are in line with the general trend of evidence presented in section 4.4.5. concerning the role played by driver errors and, more particularly, violations. Particularly relevant in this respect are the work of the Manchester University Driver Behaviour Research Group reported by Faith (1997), the European Transport Safety Council (1994), Nilsson (1981) and

Baruya and Finch (1994) which agree with these findings, especially with regard to speed.

2. Physical impairment of driver

The findings identify poor eye sight as significantly related with road accidents in the country (Chapter Six, Table 6.21). This is consistent with concerns expressed by OECD (1986) and research showing that visual activity is significantly related to accident histories (Quimby and Watts, 1981; Burg, 1967), and with the comments of Phillips et al. (1990) regarding the importance of visual information (see Sections 4.4.1. and 4.3.2., respectively).

3. Physical and psychological factors

a) The lack of concentration on the part of many drivers when driving was found to be significantly related with road accidents (Chapter Six, Table 6.27); this relates to the evidence in 4.4.3.3. (Redelmeir and Tibshirani, 1997 and Cartwright et al., 1996) on mobile telephones and occupational stress, respectively, which can be causes of concentration loss.

b) Tiredness was also found to be significantly related with road accidents in the study (Chapter Six, Table 6.34). This is likely to cause loss of concentration and delayed reflexes. The study finding in this respect is consistent with reports by the Transport Research Laboratory (1998) and New South Wales Road Traffic Authority (1998) – see section 4.4.4.

c) Driving for long hours, was also found to be significantly related with road accidents in this study (Chapter Six, Table 6.33). This is likely to lead to tiredness and lack of concentration on the part of many drivers, and hence, loss of control of the vehicle, as indicated by the New South Wales Traffic Authority (1998) – see section 4.4.4.

d) Sickness was found to be significantly associated with road accidents according to the findings of this study (Chapter Six, Table 6.33). Driving when unwell may be a cause of tiredness and loss of concentration. Drivers would be well advised, if they have been ill or have a chronic medical condition, to check with their doctor before driving.

e) Medication was another variable identified in this study as being significantly associated with road accidents in Saudi Arabia (Chapter Six, Table 6.36). As indicated in Section 4.4.4. it is a recognised fact that some drugs cause drowsiness, for example, which would impair the driver's concentration and reactions (Lemoine and Chaifon, 1996). The present finding is also consistent with that of Hanson et al. (1996).

f) Psychological stress was found to have been significantly associated with road accidents in the study (Chapter Six, Table 6.37). Those who drive when under stress are less likely to be in control of their behaviour and may drive erratically. Again, this finding is consistent with trends observed in the literature, e.g. Cartwright et al.'s (1996) findings in relation to the significant role of occupational stress – see Section 4.4.3.3.

g) The findings also identified frustration as a significant variable related with road accidents in Saudi Arabia (Chapter Six, Table 6.23). This may be related to the evidence on stress. Drivers who are frustrated due to home problems or problems at work are, again, likely to drive erratically or aggressively, leading to road accidents. Compare, again, Cartwright et al. (1996) and also Faith (1997) – see section 4.4.3.3.

h) The presence of uncomfortable seats in many vehicles was identified in this study as being significantly associated with road accidents in Saudi Arabia (Chapter Six, Table 6.8), perhaps because it impairs the driver's concentration. This is a variable not mentioned explicitly in any prior studies reviewed.

The evidence from this study, therefore suggests that, in Saudi Arabia, the problems of driving with impairment and of psychological disturbances such as stress and inattention, are contributory factors in road accidents. In general, the findings of the present research are consistent with those of Western studies, such as Redelmeir and Tibshirane, 1997; Cartwright et al., 1996; and Hansen, 1996. The main difference from findings in other countries (e.g. Deery and Love, 1996; Hanson, 1996) is that, in Saudi Arabia, impairment is related particularly to medication, rather than to alcohol, which is prohibited in the Kingdom.

7.2.6. Objective VI : To consider factors external to the driver

A small number of environmental factors were found to be significantly associated with driving accidents, as follows:

1) Regarding the conditions of the roads, the findings of this study revealed that congestion, non-marking of the roads, non-familiarity with the roads and improper road engineering were significantly associated with road accidents (Chapter Six, tables 6.10, 6.12, 6.13, 6.30). Thus, poor infrastructure and traffic management might result in road accidents in the country.

In this respect, comparison with previous research is difficult, as most previous studies have been carried out in countries with highly advanced road networks, and do not seem to have identified road engineering as a major factor in accidents, though evidence has been presented of the importance of skid resistance (e.g. Sattewaite, 1976), and that holidays and peak periods when congestion is likely to be greater, are characterised by an upsurge in the incidence of accidents (N.H.T.S.A., 1986) - (see Section 4.3.2.).

2) The presence of strayed animals was found in this study to be significantly related with road accidents in Saudi Arabia (Chapter Six, table 6.14). This is a relatively common problem, especially in rural areas, which can cause drivers to lose control of their vehicles. It may be a factor relatively unique to Saudi Arabia; it does not seem to have been highlighted in previous research, but is noted in an article in the Times newspaper of 17/12/98.

3) Weather conditions were also found in this study to be significantly related with road accidents (Chapter Six, tables 6.17, 6.15). These weather conditions include sand storms and sun haze. It was concluded from the findings that these natural phenomenon could have led drivers in Saudi Arabia to having many road accidents.

The findings of the study in this respect are consistent with those of previous research. The weather conditions themselves may be different (in the countries where most previous research was done, the main hazards were rain, ice etc. – e.g. Sattewaite, 1976, N.H.T.S.A., 1986, Section 4.3.2.) but the hazards they pose, in terms of reduced visibility and loss of traction, are the same. The problem of reduced visibility due to sun haze, for example, was highlighted in section 4.3.2. with reference to Saudi Aramco's (1996) safety magazine.

7.3. Additional Findings

Non-servicing and non-checking of vehicles were found to be significantly related with road accidents in Saudi Arabia (Chapter Six, tables 6.31, 6.32). Not only may failure to check and service vehicles directly cause accidents due to undetected mechanical fault, but they may also by indirectly related to road accidents, as tending to denote less careful and responsible drivers. It is noteworthy that systems of vehicle inspection such as that introduced in Sweden (Svenson, 1988) have been instrumental in improving traffic safety – Section 4.5.1.

The study has also identified the age of the driver, the educational level of the driver, the profession of the driver, past violation record and vehicle ownership as being significantly associated with road accidents in the country (Chapter Six, tables 6.1, 6.2, 6.3, 6.4, 6.6 and 6.7).

Education and profession have not been identified in previous research as contributory factors in accidents. The finding in this study of a relationship between education level and accident involvement, with more accidents among the less educated, could be explained in terms of education-related differences in both ability to read and absorb driving and safety information, and also to reason about the consequences of one's driving behaviour.

Non-alertness to others' errors, reversing in the centre of the road for long distances, use of high beam lights while driving, non-lighting of the roads, passengers' behaviour while driving, ear disorder and mechanical faults were not found to be significantly associated with driving accidents (Chapter Six, tables 6.11, 6.18, 6.19, 6.20, 6.26, 6.27, 6.28), suggesting that these are not major causes of road accidents in Saudi Arabia.

According to the findings of this study, the factors associated with road accidents can be summarised into nine main groups. These groups, and the sub-factors comprising each, are summarised in Figures 4-13 in Appendix C.

The information obtained from the test of drivers' ability to recognise road signs revealed that most signs were correctly identified by the majority of drivers; there were seven signs that were correctly identified by almost all (90% or more) drivers. However, the fact that four signs including, for example, no overtaking and no entry, were not known by up to two thirds of drivers, is cause for concern, as failure to recognise and respond appropriately to information, warnings and prohibitions when driving could obviously contribute to road accidents.

7.4. Significance of the Study

This study is important in the sense that it will be the first of its kind in Saudi Arabia on the variables related to road accidents in the country. The study will be useful to policy makers who will find the recommendations helpful in reducing road accidents in the country. The study may also be useful in correcting mistaken assumptions as to the factors that cause road accidents and lead to a more detailed consideration of factors that underlie or accompany the more obvious ones such as speed.

The study will also be useful to guidance counsellors and drivers' unions in Saudi Arabia who may require the findings and the recommendations in counselling drivers about how to modify their driving habits in order to reduce to a minimum the level of road accidents in the country.

7.5. Limitations of the Study

There are several variables that could be related with road accidents. These variables are numerous. The limitation of time, however, has forced the researcher to restrict the variables in the study to only a selected number that might be related to road accidents in Saudi Arabia. An examination of more than the selected list of variables might distract attention from the theme of the research. These variables were chosen in the belief that they were important in terms of road accidents in Saudi Arabia.

In the process of the study, it was noticed that there was a shortage of materials to review. This is because not much work has been done in this area of research. Very few books have been written on road accidents. Likewise, not many articles have been written on factors that can cause road accidents in Saudi Arabia. This obviously limited the information available to the researcher. Most previous work on road accidents across the world has taken the form of statistics showing number of road accidents in various countries. Only in a few cases did such statistics show the cause of the accidents. However, these were not articles, neither were they research papers. Moreover, this study will be the first of its kind in Saudi Arabia. Hence, the little material available for comparison was mostly related to road accidents in other countries.

7.6. Conclusion

A breakdown of the findings has shown the contribution of each of the selected variables towards the rate of road accidents in Saudi Arabia. The findings have shown the variables that had significant relationships with road accidents in the country and those that were not significant. The significant variables are those to which drivers, driving instructors, police and legislators need to pay particular attention.

Certain direct variables are significantly associated with road accidents in Saudi Arabia. These direct variables include over-speeding, poor eyesight, joy riding, frustration, failure to give safe distance to other vehicles, spending long hours driving, tiredness, sickness, driving under medication, stress, changing lanes without signalling, smoking, and failure to observe traffic regulations.

Other factors are significant indirect contributors to road accidents in the country. These indirect variables include uncomfortable seats in the vehicles, traffic congestion, non-lighting of roads, non-marking of roads, inappropriate road engineering, presence of strayed animals, sun haze, sand storm and familiarity with the roads.

Grouping the findings together, the researcher concludes that the variables found in this study to be significantly related with road accidents in Saudi Arabia could be identified in terms of drivers' behaviour in terms of the way they drive, weather conditions, road conditions, lack of safety precautions, driving situations, other passengers' behaviour and the vehicle conditions. The findings regarding the primacy of human factors are consistent with previous research in, for example, the U.K., U.S.A., Australia and Sweden, as Section 8.1. has demonstrated. Similarly, the findings of the important, though lesser role of weather conditions and vehicle condition support previous findings. The study has, however, broken down these categories in detail, to highlight a number of sub-factors not explicitly mentioned in previous research.

The findings suggest a need for intensive efforts to be undertaken in Saudi Arabia to raise public awareness of road safety issues and to educate drivers in safe driving practices. Consideration must also be given to the introduction of incentives for safe driving and effective enforcement of sanctions against those who commit violations of traffic regulations or engage in careless behaviour likely to increase the risk of accident.

In view of the findings of the study, the limitations of the study and the conclusions drawn, the following recommendations are made in a bid to reduce road accidents in Saudi Arabia.

7.7. Recommendations

* **Policy makers should organise training programmes, induction courses and seminars for drivers where they would be taught the art of safe driving.** This is necessary in view of the findings of this study which identified drivers' behaviour as responsible for many of the road accidents in the country. This is also evident in the significant relationship found in this study in respect of variables such as the lack of keeping safe distance when driving, tiredness, long hours driving, lack of observance of speed limits, lack of concentration on the part of many drivers, poor eye sight, joy riding, overtaking by many drivers, lack of car checking and irregular car servicing (Chapter Six, tables 6.21, 6.22, 6.24, 6.25, 6.26, 6.31, 6.32, 6.33, 6.34, 6.42, 6.47).

* **Designated driver education programmes could be introduced as a means of dealing with offenders, for example those caught exceeding the speed limit.** Attendance on such programmes could be made an alternative to the normal penalties applicable in such cases (the experience of the Devon and Cornwall Police Authority, described in section 4.5.2. may provide a model for such a scheme).

* **Policy makers should promulgate a law that would restrict driving in Saudi Arabia to a certain age and education level.** This is because these two variables were found in this study to be significantly related with road accidents in Saudi Arabia (Chapter Six, tables 6.1, 6.2). In view of the numerous road accidents encountered by drivers in the country (Chapter Two, section 2.7.1.), the researcher recommends that a person should not be allowed to drive until he attains the age of 18 years. At the same time, a minimum educational level of

school certificate is recommended for prospective drivers in the country.

* **Animals should be kept in separate locations far away from roads and highways.** This is because the findings of this study have identified the presence of strayed animals as being significantly related with road accidents in Saudi Arabia (Chapter Six, Table 6.14). They should be supervised by their owners, failing which disciplinary action should be taken against such owners by the local authority.

* **Given the high rate of road accidents in Saudi Arabia as shown by statistics (Chapter Two, section 2.7.1.), the introduction of motor insurance is recommended.** Drivers might be inclined to drive more carefully, if they stood to lose financially as a result of having an accident, particularly if it was due to their carelessness or mis-behaviour. To ensure acceptance of an insurance scheme, however, it must be devised in strict accordance with Islamic principles.

* **The curriculum of driving schools should include courses on the rules and regulations about driving, observance of traffic regulations and other related matters about driving.** This is because these variables were found in this study to have significant relationship with road accidents (Chapter Six, table 6.42). Such courses would inculcate the spirit of carefulness in driving into prospective drivers.

* **A mobile driver education programme should be introduced, to take road safety messages to companies, schools and community centres in all regions, especially those with no driving school.** The programme could include poster displays, leafleting and videotapes, highlighting such issues as defensive

driving, night driving, long distance driving, and so on.

* **The law enforcement agents should be reinforced and made more functional. They should also be more vigilant on parking offenders who should be penalised for wrong parking and misuse of the roads.** This recommendation is necessary in view of the finding of this study which found congestion of vehicles to be significantly related with road accidents in the country (Chapter Six, Table 6.10). The congestion created by vehicles parked arbitrarily on both sides of the roads in many cities in Saudi Arabia might possibly have resulted in many of the accidents recorded in the country.

* **There is a need to develop public transport services in Saudi Arabia.** The high level of vehicle ownership in Saudi Arabia creates a severe strain on the traffic management system. Part of the problem is that there is little public transport. Bus services are infrequent and unreliable, and many places are not served by public transport at all. Consequently most people rely on private cars to travel to study, work, etc. Development of a reliable public transport service would do much to reduce the number of vehicles on the road, and hence reduce the incidence of accidents.

* **Schools, government organisations and private companies could consider providing transportation for students or employees.** As in the case of the previous recommendation, the rationale here is to reduce the need to rely on private cars, and so lower the number of vehicles on the road.

* **Measures should be taken to reduce driving speed.** This would involve a review and possible reduction of existing speed limits, and setting limits on rural

roads where non apply at present. Measures to enforce the speed limits, such as the introduction of speed cameras, should also be considered.

Based on the findings made in this study, issues are also raised for further research. These areas are indicated in the following discussion.

7.8. Suggestions for Further Research

1) This study has examined drivers' behaviour in relation with road accidents in Saudi Arabia. The study was limited to only the Eastern Province of the country and has not taken account of the driving situation in other Provinces. Further research might be necessary to examine drivers' behaviour in other Provinces of the country and identify which variables have significant relationship with road accidents in these Provinces. This study will be useful in revealing drivers' behaviour in the entire country and it would enable future researchers to give useful recommendations to policy makers in the country.

2) Some variables were not found to be significantly associated with road accidents in this study. Among these variables are the use of high beam light while driving, non-lighting of roads, non-alertness to others' errors, reversing, mechanical fault, ear disorder and driving without a licence. Further research might be useful to examine these variables and determine their relationship or otherwise with road accidents in the country.

3) Interviews were not conducted in this study with motor drivers and other road users such as passengers. This was due the limitation of time. Hence, it was not possible to elicit their opinion on other variables which they might consider important in relation with road accidents in the country. It might therefore be necessary to include interviews with drivers and other road users like passengers

in any further research on drivers' behaviour and their relationship with road accidents in the country.

Concluding Comments

This study has shed light on the complex array of interrelated factors which contribute to the high incidence of road accidents in Saudi Arabia. There are conditions unique to the Saudi environment, particularly the extreme weather conditions such as severe sun haze and sand storms, over which drivers have no control, though they could, perhaps, be better prepared to deal with them. Other factors relate to the road network itself and raise issues for planners and others responsible for road engineering and traffic management. By far the greatest number of factors, however, are human factors which could be addressed by means of publicity, legislation and education. It is hoped that by identifying and highlighting these factors, this study will go some way towards reducing the incidence of traffic accidents in Saudi Arabia, with all the economic losses and human misery that go with them.

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APPENDICES

APPENDIX A

Violations, by Category

SCHEDULE OF THE FIRST CATEGORY VIOLATIONS AND THE ADDITIONAL MEASURES THAT CAN BE TAKEN IN REGARD THERETO

1. Driving an automotive vehicle without possessing a driver's licence.
2. Operating a vehicle without licence plates: Seizure of the vehicle until the violation is corrected.
3. Forged licence plates: Seizure of the vehicle until the violation is corrected.
4. Obtaining a driver's licence unlawfully: withdrawal of the licence.
5. Driving a motor vehicle against the direction of traffic.
6. Driving a vehicle in a state of intoxication: Withdrawal of the licence.
7. Driving at night or in the fog without using any lights.
8. Operating a vehicle without brakes: Seizure of the vehicle until it is repaired.
9. Failure to stop by a driver involved in an accident that resulted in bodily injuries, or his failure to assist the injured person or to report the accident to the police.
10. Driving at a speed exceeding the maximum limit permitted in inhabited areas.
11. Excessive speed despite notices warning of the existence of traffic difficulties or obstructions.
12. Non-compliance with electric traffic signs or with the signals of the traffic policeman on duty.
13. Manoeuvring or turning in areas where there are signs prohibiting such movement.
14. Failure to yield the right-of-way to emergency vehicles and official motorcades, which forewarn of their approach by giving their special signals.
15. Passing when a line of motor vehicles has stopped because traffic is obstructed or due to a stop sign.
16. Passing a motor vehicle while it is passing another one if the paved road is not

divided into more than two one-way lanes.

17. Passing on curves and hill tops.

18. Violating the rules for the use of approach lights.

19. Using annoying or multi-sound horns, sirens, or whistles: Seizure of the vehicle until the violation is corrected and the relative device removed.

20. Operating vehicles and public works or agricultural equipment on roads before necessary measures are taken to protect the roads against their damaging effects: Seizure of the vehicle.

21. Making licence plates different from the specified specimens: Licence shall be withdrawn from the manufacturer after the third violation.

22. Using the motor vehicle for immoral acts: Licence shall be withdrawn for one year, then permanently in case of repetition.

23. Racing on roads without prior authorisation.

SCHEDULE OF THE SECOND CATEGORY VIOLATIONS AND THE ADDITIONAL MEASURES THAT CAN BE TAKEN IN REGARD THERETO

1. Failure to observe the speed limit.
2. Failure to comply with the rules for passing or approaching.
3. Changing the speed or direction suddenly without making sure that such change can be made safely, or without cautioning others.
4. Existing from a side street or from a road-side building or property without making sure that the action is safe.
5. Stopping the vehicle engine for the purpose of coasting on a downgrade.
6. Failure to observe the right-of-way rules at crossroads, bridges, tunnels and railroad [crossings].
7. Leaving the engine of the motor vehicle running while the owner is not in it.
8. Leaving the motor vehicle unlocked on a sloping road.
9. Drivers of motorcycles and bicycles taking hitching rides with the assistance of other vehicles.
10. Defective brakes: Seizure of the vehicle until the violation is corrected.
11. Red rear light, parking light, or triangular light reflector missing.
12. Failure to use clearance or side-marker lights in vehicles supposed to be equipped with such lights.
13. Failure to stop at Traffic, Police, Passports and Customs stations where stopping is required for inspection and control.
14. Operating equipment and tractors equipped with metal tracks on public roads: Seizure.
15. Failure to stop upon the occurrence of an accident resulting in damage to property.

16. Failure to assist the injured persons and remove them from motor vehicles involved in accidents on the road.

17. Failure to equip a tank truck designed for carrying inflammable materials with a fire extinguisher.

18. Licence plate missing from the front or rear of the vehicle: Seizure until the violation is corrected.

19. Licence plate missing from the rear of trailer or semi-trailer.

20. Failure to submit the vehicle for mechanical inspection or registration.

21. Failure to submit the vehicle for mechanical inspection after material alteration of such vehicle.

22. Failure to submit the vehicle for periodic mechanical inspection.

23. Failure to report modifications made on the vehicle (engine, chassis, colour, body).

24. Using the motor vehicle for purposes other than those for which it is licensed: Seizure.

25. Driving the motor vehicle with an expired or unrenewed licence.

26. Non-compliance with transportation tariff rates.

27. Failure to deliver to the nearest police station any articles and belongings left by passengers in the motor vehicle.

28. Abandoning vehicles on the public road.

29. Crossing the lines of military units and processions on the move.

SCHEDULE OF THE THIRD CATEGORY VIOLATIONS

1. Failure to equip an animal-drawn vehicle with speed-reducing and stopping devices.
2. Failure to equip a bicycle with two effective brakes.
3. Slowing down in such a manner as to obstruct traffic.
4. Failure to stop or slow down to enable the blind or disabled persons to cross.
5. Sudden application of brakes unnecessarily.
6. Ascending, descending, and hanging on while the vehicle is moving.
7. Slowing down to solicit passengers.
8. Washing vehicles on public roads.
9. Repairing motor vehicles on public roads except in the case of necessity.
10. Non-compliance with the rules for using the horn..
11. Violating the rules for stopping and parking.
12. Stopping on railroad sections crossing the road.
13. Equipping vehicles with prohibited lighting or signalling devices.
14. Driving on roadways reserved for other categories of road users, except in case of necessity.
15. Damaging signposts or traffic signs; sticking advertisements or notices on them; or changing their appearance, location or direction.
16. Mechanical windshield wiper missing or defective in rainy reason.
17. Rear-view mirror missing.
18. Speedometer missing or defective.
19. Manufacturer's identification plate missing.
20. Plate [numbers] invisible or illegible.
21. Carrying load in excess of the weight specified in the motor vehicle's registration

booklet, when the excess weight is more than one tenth of the permitted load. The fine shall be multiplied by the number of tenths in excess of the first tenth.

22. Carrying passengers in excess of the number specified in the registration booklet.
23. Failure to report a vehicle that was wrecked or permanently withdrawn from operation.
24. Failure to place the signs specified for motor vehicles for hire (taxicabs).
25. Failure to renew the driver's licence on time.
26. Operating a motor vehicle without doors, hood, or fenders.
27. Operating trucks with their tailgates hanging, or carrying any cargo protruding beyond the body of the truck.
28. Placing curtains on rear or side windows of a small motor vehicle which obstruct vision.
29. Leaving the ignition key in the motor vehicle.
30. Failure to slow down upon seeing animals.
31. Failure to carry the registration booklet or driver's licence while driving, or failure to present them when requested.
32. Using sidewalks or pedestrian crossings and failure to yield the right-of-way to pedestrians at such crossings.
33. Driving cycles side by side, except in case of passing.
34. Failure of cycles to keep to the extreme right side of the paved road.
35. Carrying cargo weighing more than 25 kgs. On a bicycle equipped with a basket.
36. Failure to equip a bicycle with the lights required under the Regulations.
37. Meters missing on taxicabs.
38. Dome lights missing on taxicabs.

39. Violation of the prescribed measurements and weights.

40. Committing any act prohibited under the Traffic Regulations which is not mentioned in any of the three schedules of Violations.

APPENDIX B

Survey Instruments and Covering Letters

LETTER TO THE PANEL

REGARDING THE THREE QUESTIONNAIRES

Dear

The enclosed questionnaires are part of a Ph.D. research study seeking to identify the causes of driving accidents in Saudi Arabia, so that recommendations can be made to improve driving safety.

The questionnaires are intended to be administered at traffic stations to drivers who have been involved in an accident.

I would greatly appreciate your opinion on the suitability and clarity of the questionnaires. Please read each item and then mark with a ( ) in the appropriate box to indicate whether you think it is: a) not relevant; b) minimally relevant; c) fairly relevant; d) very relevant. Would you please also indicate, on the basis of its relevance and understandability, whether you think the item should be:

a) Retained in its present form

b) Rephrased (say how)

c) Deleted

If you have any other comments on the questionnaire (for example, its length, format, presentation etc.), please write them in the space provided at the end of the questionnaire.

Thank you for your assistance.

QUESTIONNAIRE FOR BASIC PERSONAL INFORMATION NO.1

To answer, please tick (✓) the relevant box for each of the questions below.
Where there is a supplementary question (items 2,6,7 & 8), write your answer in the box provided.

Name (optional):						Please do not write in this column
1 Educational level ☐NR ☐FR ☐MR ☐VR	1 Non-Educated ☐	2 Primary ☐	3 Intermediate ☐	4 Secondary ☐	5 University/ College ☐	☐
2. Citizenship ☐NR ☐FR ☐MR ☐VR	1 Saudi ☐	2 Non-Saudi ☐	3 What Nationality? ☐			☐
3 Age ☐NR ☐FR ☐MR ☐VR	1 18-25 ☐	2 26-40 ☐	3 40 & above ☐			☐
4 Civil Status ☐NR ☐FR ☐MR ☐VR	1 Married ☐	2 Single ☐	3 Divorced ☐			☐
5 Profession ☐NR ☐FR ☐MR ☐VR	1 Employee ☐	2 Student ☐	3 Professional driver ☐			☐
6 Do you have a driving licence? ☐NR ☐FR ☐MR ☐VR	1 Yes ☐	2 No ☐	3 Length of time holding driving licence? ☐			☐
7. Have you been involved in an accident before? ☐NR ☐FR ☐MR ☐VR	1 Yes ☐	2 No ☐	3 No. of accidents? ☐			☐
8. Have you committed driving violations punished by the court/police, before? ☐NR ☐FR ☐MR ☐VR	1 Yes ☐	2 No ☐	3 No. of violations? ☐			☐
9 Do you own the vehicle which was involved in the accident? ☐NR ☐FR ☐MR ☐VR	1 Owner ☐	2 Hired car ☐	3 Driver only ☐			☐
10 What were the consequences of the accident? ☐NR ☐FR ☐MR ☐VR	1 Damage to vehicle ☐	2 Injury ☐	3 Death ☐			☐

Key. NR = not relevant, MR = minimally relevant, FR = fairly relevant, VR = very relevant

QUESTIONNAIRE II

Respondents are requested to put a tick ( ) in the chosen column

Behaviour of Drivers	Yes	No
1. Has joy-riding ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
2. Has feeling uncomfortable in your seat ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
3. Has passengers' behaviour ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
4. Has use of high beam lights ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
5. Has the presence of stray animals on the road ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
6. Has non-observance of speed limits ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
7. Has poor eye sight ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
8. Has sun haze ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
9. Has excessive heat or cold ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
10. Has not keeping a safe distance between you and the car in front ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
11. Has traffic congestion ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
12. Has over-taking another car ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
13. Have you ever been involved in an accident when reversing your car? ☐NR ☐MR ☐FR ☐VR		
14. Has non-lighting of roads ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
15. Has non-marking of roads ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
16. Has non-alertness to others' errors ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
17. Has an ear disorder ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
18. Has emerging from or exiting a road ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
19. Has a sand storm ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
20. Has being frustrated while driving ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
21. Has a mechanical fault in your car ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		
22. Do you service your car every six months? ☐NR ☐MR ☐FR ☐VR		
23. Has non-familiarity with the road ever caused you to have an accident? ☐NR ☐MR ☐FR ☐VR		

Key NR = not relevant MR = minimally relevant. FR = fairly relevant. VR = very relevant

QUESTIONNAIRE II (contd...)

Respondents are requested to put a tick (   ) in the chosen column

Behaviour of Drivers	Often	Some-times	Rarely	Never	
24. Do you continue driving for long hours? ☐NR ☐MR ☐FR ☐VR					
25. Do you drive when you are tired? ☐NR ☐MR ☐FR ☐VR					
26. Do you drive when you are sick? ☐NR ☐MR ☐FR ☐VR					
27. Do you drive when under psychological stress? ☐NR ☐MR ☐FR ☐VR					
	Always	Often	Some-times	Rarely	Never
28. Prior to driving, do you fasten your seat belt? ☐NR ☐MR ☐FR ☐VR					
29. Do you observe traffic regulations? ☐NR ☐MR ☐FR ☐VR					
30. Do you use a special seat for children? ☐NR ☐MR ☐FR ☐VR					
31. Do you eat, drink or smoke while driving? ☐NR ☐MR ☐FR ☐VR					
32. Do you make use of front and side mirrors? ☐NR ☐MR ☐FR ☐VR					
33. Do you concentrate while you are driving? ☐NR ☐MR ☐FR ☐VR					
34. Do you use cassette/radio or telephone while driving? ☐NR ☐MR ☐FR ☐VR					
35. Do you use signals when changing lanes? ☐NR ☐MR ☐FR ☐VR					

Key: NR = not relevant, MR = minimally relevant, FR = fairly relevant, VR = very relevant

SUMMARY RESULTS OF QUESTIONNAIRE (PILOT)

	QUESTIONS	NR	MR	FR	VR
1	Educational level	-	13%	33%	53%
2	Citizenship	6%	13%	6%	66%
3	Age			20%	80%
4	Civil status		13%	53%	33%
5	Profession		6%	26%	66%
6	Do you have a driving licence?			33%	66%
7	Have you been involved in an accident before?	6%	6%	13%	73%
8	Have you committed driving violations punished by the court/police before?	6%	6%	33%	53%
9	Do you own the vehicle which was involved in the accident?		33%	13%	53%
10	What were the consequences of the accident?		33%	33%	33%
	BEHAVIOUR OF DRIVERS				
1	Has joy-riding ever caused you to have an accident?		28%	6%	66%
2	Has feeling uncomfortable in your seat ever caused you to have an accident?		33%	20%	46%
3	Has passengers' behaviour ever caused you to have an accident?		6%	40%	53%
4	Has use of high beam lights ever caused you to have an accident?	6%	6%	33%	53%
5	Has the presence of stray animals on the road ever caused you to have an accident?		2%	33%	65%
6	Has non-observance of speed limits ever caused you to have an accident?			26%	73%
7	Has poor eyesight ever caused you to have an accident?		6%	26%	66%
8	Has sun haze ever caused you to have an accident?			46%	52%
9	Has excessive heat or cold ever caused you to have an accident?			40%	59%
10	Has not keeping a safe distance between you and the car in front every caused you to have an accident?		6%	26%	66%
11	Has traffic congestion ever caused you to have an accident?			46%	53%
12	Has over-taking another car caused you to have an accident?			20%	79%
13	Have you ever been involved in an accident when reversing your car?			46%	53%
14	Has non-lighting of roads ever caused you to have an accident?			53%	47%
15	Has non-marking of roads ever caused you to have an accident?			20%	79%
16	Has non-alertness to others' errors ever caused you to have an accident?		6%	3%	60%
17	Has an ear disorder ever caused you to have an accident?			33%	65%
18	Has emerging from or existing a road ever caused you to have an accident?			33%	66%
19	Has a sand storm ever caused you to have an accident?			40%	59%
20	Has being frustrated while driving ever caused you to have an accident?		2%	40%	58%
21	Has a mechanical fault in your car ever caused you to have an accident?		13%	33%	53%
22	Do you service your car every six months?		2%	46%	52%
23	Has non-familiarity with the road ever caused you to have an accident?		6%	26%	66%
24	Do you continue driving for long hours?		20%	6%	73%
25	Do you drive when you are tired?			40%	60%
26	Do you drive when you are sick?			53%	46%
27	Do you drive when you are under psychological stress?		20%	26%	53%
28	Prior to driving, do you fasten your seat belt?			46%	52%
29	Do you observe traffic regulations?		13%	26%	60%
30	Do you use a special seat for children?			60%	39%
31	Do you eat, drink or smoke while driving?		13%	33%	53%
32	Do you make use of front and sign mirrors?		13%	33%	53%
33	Do you concentrate while you are driving?		26%	6%	66%
34	Do you use cassette radio or telephone while driving?		13%	26%	60%
35	Do you signals when changing lanes?			20%	80%

APPENDIX C

SUMMARY OF DRIVERS' QUESTIONNAIRES (PILOT STUDY)

Table 1

1. Educational level	Non-Educated	Primary	Intermediate	Secondary	University/ College
Percentage	17%	22%	37%	20%	4%

Table 2

2. Citizenship	Percentage
Saudi	65%
Non-Saudi	34%

Table 3

3. Age	18-25 years	26-39 years	40 years and above
Percentage	37%	34%	29%

Table 4

4. Civil Status	Married	Single	Divorced	Widowed
Percentage	46%	54%		

Table 5

5. Profession	Employee	Student	Professional driver	Self-Employed
Percentage	42%	23%	33%	2%

Table 6

6. Do you have a driving licence?	Percentage
Yes	97%
No	3%
Length of time holding driving licence:	
a) 1-2 years	15%
b) 3-5 years	25%
c) 6-10 years	31%
d) 11-20 years	19%
e) 21 years and above	10%

Table 7

7. Have you been involved in an accident before?	Percentage
Yes	100%
No	-
Number of accidents:	
a) One accident	28%
b) Two accidents	28%
c) Three accidents or more	42%

Table 8

8. Have you committed driving violations punished by the court/police before	Percentage
Yes	91%
No	8%
Number of violations:	
a) 1-2 violations	86%
b) 3-4 violations	14%
c) 5 or more violations	-

Table 9

9. Do you own the vehicle which was involved in the accident?	Owner	Hired car	Driver only
Percentage	40%	11%	34%

Table 10

9. What were the consequences of the accident?	Damage to vehicle	Injury	Death
Percentage	91%	8%	-

Table 11

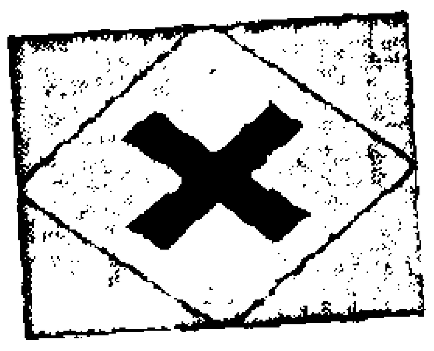
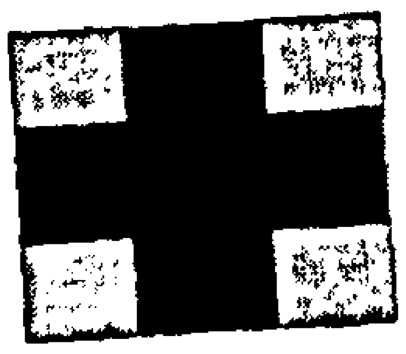
Q. No.	Behaviour of drivers	No	Yes
1	Has joy-riding ever caused you to have an accident?	8%	91%
2	Has feeling uncomfortable in your seat ever caused you to have an accident?	-	100%
3	Has passengers' behaviour ever caused you to have an accident?	25%	74%
4	Has use of high beam lights ever caused you to have an accident?	11%	88%
5	Has the presence of stray animals on the road ever caused you to have an accident?	5%	94%
6	Has non-observance of speed limits ever caused you to have an accident?	28%	71%
7	Has poor eyesight ever caused you to have an accident?	11%	88%
8	Has sun haze ever caused you to have an accident?	17%	83%
9	Has excessive heat or cold ever caused you to have an accident?	5%	94%
10	Has not keeping a safe distance between you and the car in front ever caused you to have an accident?	37%	62%
11	Has traffic congestion ever caused you to have an accident?	11%	88%
12	Has traffic congestion ever caused you to have an accident?	20%	80%
13	Has over-taking another car caused you to have an accident?	31%	68%
14	Has non-lighting of roads ever caused you to have an accident?	11%	88%
15	Has non-marking of roads ever caused you to have an accident?	11%	88%
16	Has non-alertness to others' errors ever caused you to have an accident?	48%	51%
17	Has an ear disorder ever caused you to have an accident?	5%	94%
18	Has emerging from or exiting a road ever caused you to have an accident?	31%	68%
19	Has a sand storm ever caused you to have an accident?	2%	97%
20	Has being frustrated while driving ever caused you to have an accident?	5%	94%
21	Has a mechanical fault in your car ever caused you to have an accident	14%	86%
22	Do you service your car every six months?	22%	77%
23	Has non-familiarity with the road ever caused you to have an accident?	100%	-

Table 12

Q. No.	Behaviour of Drivers	Never	Sometimes	Rarely	Often
24	Do you continue driving for long hours?	11%	40%	34%	14%
25	Do you drive when you are tired?	5%	31%	45%	17%
26	Do you drive when you are sick?	5%	11%	28%	54%
27	Do you drive when you are under psychological stress?	5%	17%	28%	48%

Table 13

Q. No.	Behaviour of Drivers	Never	Often	Sometimes	Rarely	Always
28	Prior to driving, do you fasten your seat belt?	91%	2%	2%	3%	2%
29	Do you observe traffic regulations?	74%	25%			
30	Do you use a special seat for children?	20%	11%	5%	8%	54%
31	Do you eat, drink or smoke while driving?	82%	4%	2%	5%	7%
32	Do you make use of front and side mirrors?	94%	5%			
33	Do you concentrate while you are driving?	68%	20%	11%		
34	Do you use cassette/radio or telephone while driving?	35%	4%	40%	14%	5%
35	Do you use signals when changing lanes	86%	14%			

9.		62%	37%
10.		100%	
11.		88%	11%
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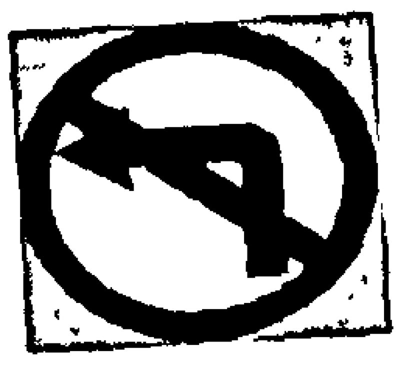
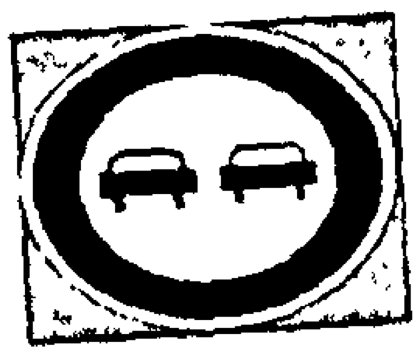
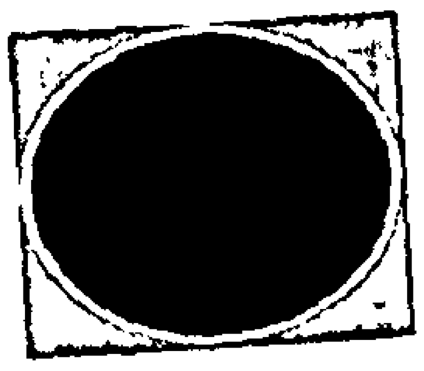
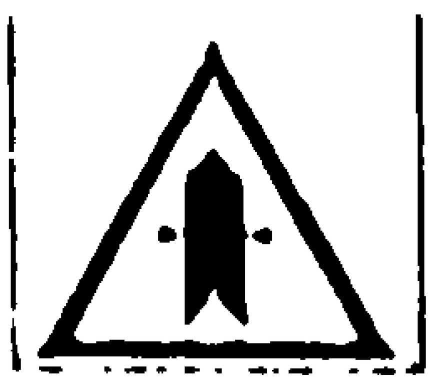
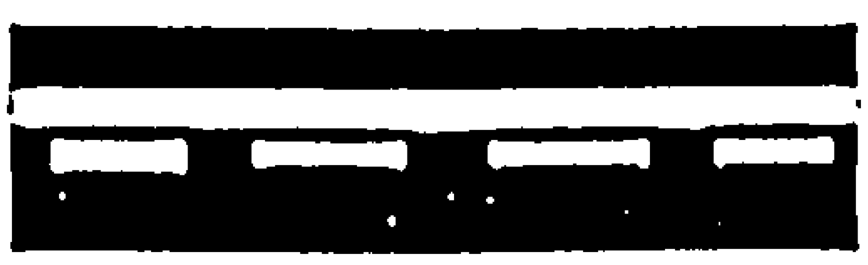
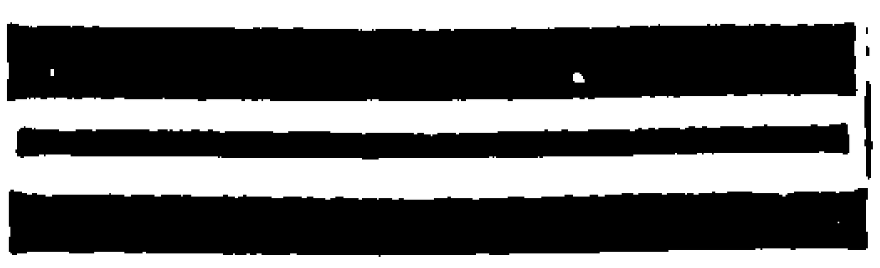
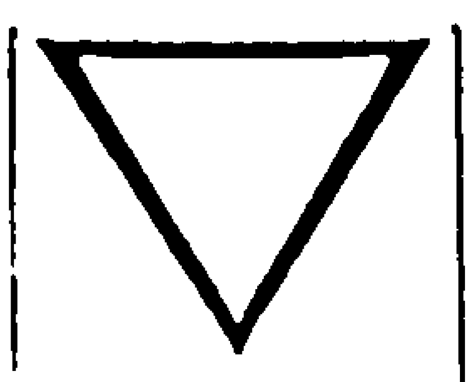
13.		100%	
14.		51%	48%
15.		51%	48%
16.		51%	48%

17.		97%	3%
18.		97%	3%
19.		94%	6%
20.		100%	
21.		37%	62%
22.		37%	62%
23.		86%	14%
24		94%	6%
25.		100%	

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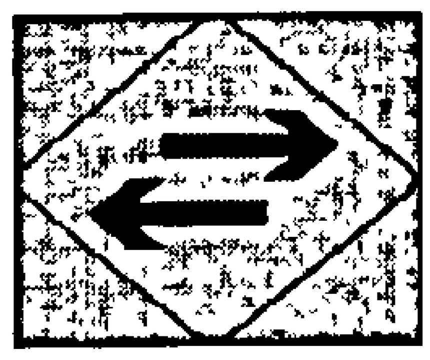
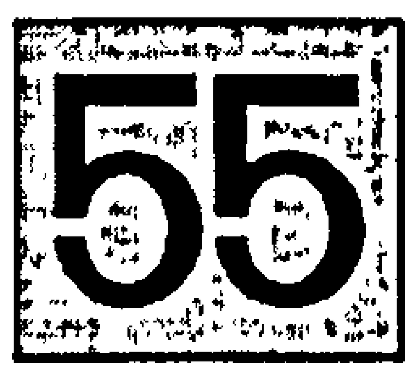
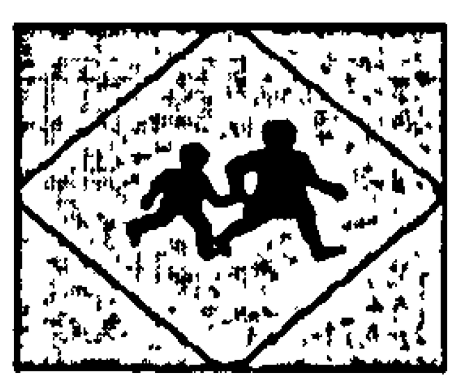
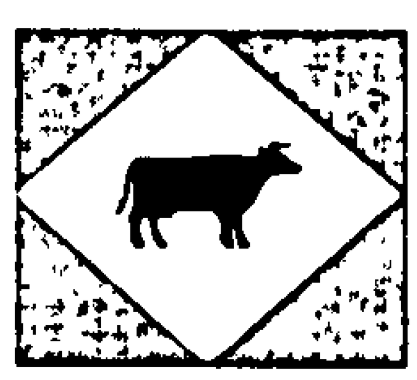
26.		100%	
27.		57%	43%
28.		100%	
29.		94%	6%
30.		100%	

No. of respondants = 35

APPENDIX D

Driver Questionnaires (Main Study)

1. Cover letter

QUESTIONNAIRE FOR A DRIVER
INVOLVED IN A DRIVING ACCIDENT

Dear Driver

This questionnaire is part of a special survey on traffic accidents, which is being carried out in order to find ways of making driving in Saudi Arabia safer for everyone. Your co-operation in this regard would be very valuable.

Please answer the questions by putting the sign (✓) to indicate the appropriate response.

Note that your responses will be used for scientific purposes only. You will not be identified, your answer will not be shown to anyone else, and no action will be taken against you in respect of anything you say in answer to this questionnaire.

Thank you.

The Researcher

QUESTIONNAIRE FOR BASIC PERSONAL INFORMATION NO. 1

To answer, please tick (✓) the relevant box for each of the questions below.
Where there is a supplementary question (items 2, 6, 7 & 8), write your answer in the box provided.

Name (optional):					
1. Educational level	Non-Educated ☐	Primary ☐	Intermediate ☐	Secondary ☐	University/ College ☐
2. Citizenship	Saudi ☐	Non -Saudi ☐			
3. Age	18-24 ☐	25-30 ☐	31-39 ☐	40 & above ☐	
4. Civil Status	Married ☐	Single ☐	Divorced ☐	Widowed ☐	
5. Profession	Employee ☐	Student ☐	Professional driver ☐	Self-employed ☐	
6. Do you have a driving licence?	Yes ☐	No ☐	Length of time holding driving licence ☐ 1-3 yrs	☐ 4-10 - yrs	☐ 10+
7. How many driving accidents have you been involved in?	One ☐	Two ☐	Three or more ☐		
8. Have you committed driving violations punished by the court/police, before?	Yes ☐	No ☐	Number of violations? ☐ 1 to 2	☐ 3 to 4	☐ 5+
9. Do you own the vehicle which was involved in the accident?	Owner ☐	Hired Car ☐	Driver Only ☐		
10. What were the consequences of the accident?	Damage to vehicle ☐	Injury ☐	Death ☐		

QUESTIONNAIRE II

Respondents are requested to put a tick (✓) in the chosen column

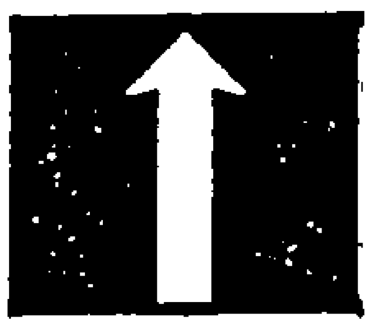
The Items	Yes	No
1. Has feeling uncomfortable in your seat ever caused you to have an accident?		
2. Has a mechanical or other fault in your car ever caused you to have an accident?		
3. Has traffic congestion ever caused you to have an accident?		
4. Has non-lighting of roads ever caused you to have an accident?		
5. Has non-marking of roads ever caused you to have an accident?		
6. Has inappropriate road engineering ever caused you to have an accident?		
7. Has the presence of stray animals on the road ever caused you to have an accident?		
8. Has sun haze ever caused you to have an accident?		
9. Has excessive heat or cold ever caused you to have an accident?		
10. Has a sand storm ever caused you to have an accident?		
11. Has use of high beam lights ever caused you to have an accident?		
12. Has passengers' behaviour ever caused you to have an accident?		
13. Has an ear disorder ever caused you to have an accident?		
14. Has poor eyesight ever caused you to have an accident?		
15. Has joy-riding ever caused you to have an accident?		
16. Has being frustrated while driving ever caused you to have an accident?		
17. Has non-observance of speed limits ever caused you to have an accident?		
18. Has not keeping a safe distance between you and the car in front ever caused you to have an accident?		
19. Has over-taking another car ever caused you to have an accident?		
20. Has non-alertness to others' errors ever caused you to have an accident?		
21. Have you ever been involved in an accident when reversing your car?		
22. Has emerging from or exiting a road ever caused you to have an accident?		
23. Has non-familiarity with the road ever caused you to have an accident?		
24. Do you service your car every six months?		
25. Prior to driving, do you check your car?		

Behaviour of Drivers	Often	Some-times	Rarely	Never	
26. Do you continue driving for long hours?					
27. Do you drive when you are tired?					
28. Do you drive when you are sick?					
29. Do you drive after taking medication causing drowsiness?					
30. Do you drive when under psychological stress?					
	Always	**Often**	**Some-times**	**Rarely**	**Never**
31. Prior to driving, do you fasten your seat belt?					
32. Do you use signals when changing lanes?					
33. Do you smoke while driving?					
34. Do you eat or drink while driving?					
35. Do you observe traffic regulations?					
36. Do you use a cassette or radio while driving?					
37. Do you use a mobile telephone while driving?					
38. Do you use a special seat for children?					
39. Do you make use of front and side mirrors?					
40. Do you concentrate while you are driving?					

Questionnaire regarding traffic information, No. III

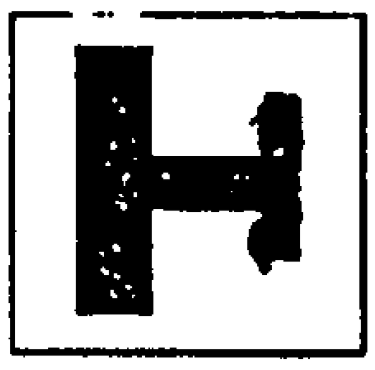
Please tick (✓) the correct answer for each sign.

1



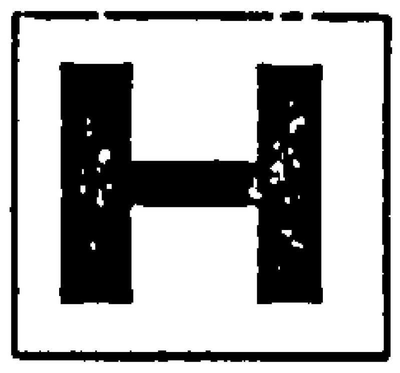
1. One way road ☐
2. Road closed ☐
3. Road narrows ☐

2



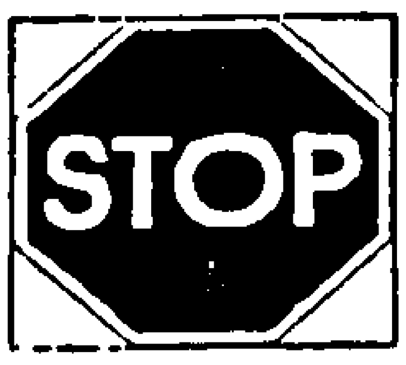
1. One way road ☐
2. Road intersection ☐
3. Road closed ☐

3



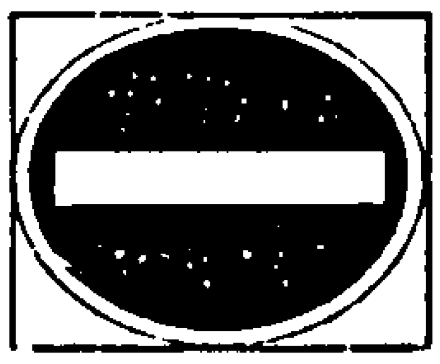
1. First aid centre ☐
2. Hospital ☐
3. Road intersection ☐

4



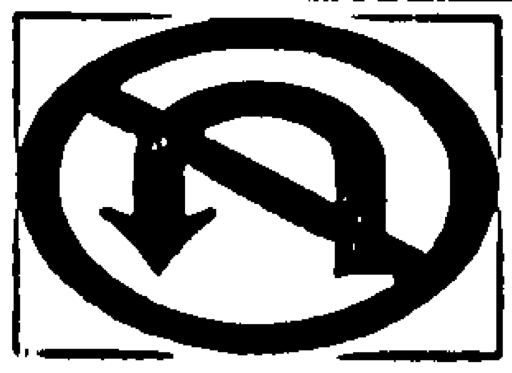
1. Optional stop ☐
2. Stop ☐
3. Stop if you can see a car ☐

5



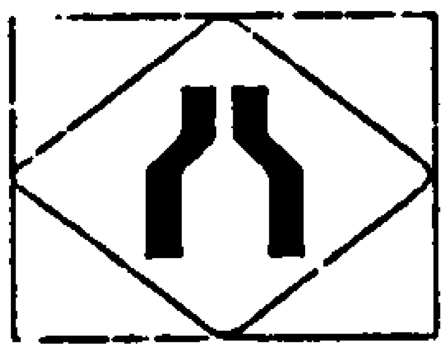
1. No entrance for all vehicles ☐
2. No entry at night ☐
3. No entry for trucks ☐

6



1. U-turn ☐
2. No left turn ☐
3. U-turn prohibited ☐

7

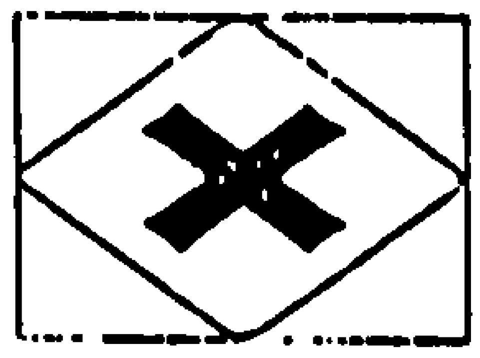


1. Road narrows ☐
2. Road closed ☐
3. One way road ☐

8

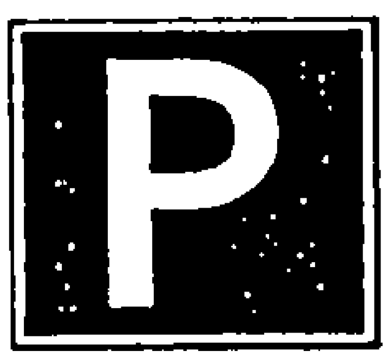
1. Dangerous hill ☐
2. Uneven road ☐
3. Mountain road ☐

9



1. Road intersection ☐
2. Rail road ☐
3. Working area ☐

10

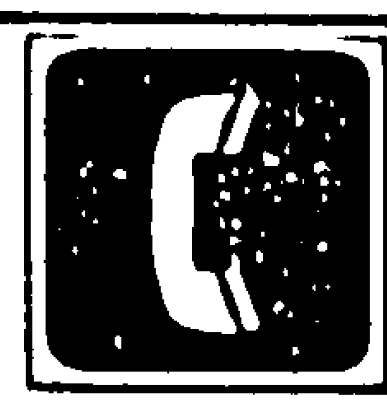


1. Hospital ☐
2. No waiting ☐
3. Car park ☐

11

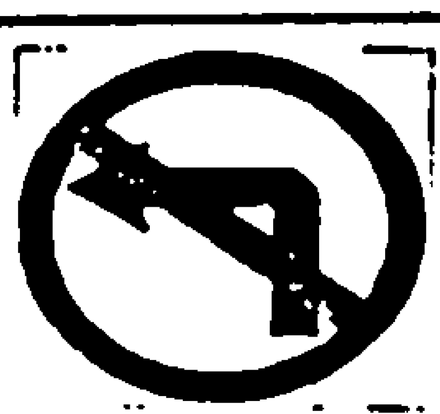
1. First aid centre ☐
2. Hospital ☐
3. Parking ☐

12



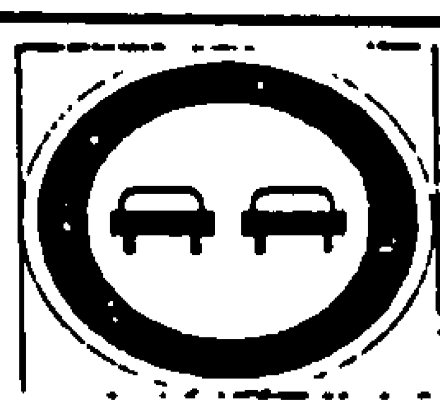
1. Car park ☐
2. Restaurant ☐
3. Telephone ☐

13



1. No left turn ☐
2. Left turn permitted ☐
3. Road veers to the left ☐

14



1. Two way road ☐
2. Overtaking allowed ☐
3. Overtaking prohibited ☐

15

1. No stopping ☐
2. No stopping or waiting ☐
3. Road intersection ☐

بسم الله الرحمن الرحيم

<u>استبيان خاص بالسائق الذي تعرض لحادث سياقه</u>

أخي سائق السيارة ...

هذا الاستبيان هو جزء من مسح خاص بحوادث السياقة , وهو يأمل لإيجاد حلول تجعل السياقة في المملكة العربية السعودية أكثر أمانا للجميع ... نثمن عاليا تعاونكم بهذا الخصوص ....

الرجاء من الأخ السائق الإجابة على الأسئلة بوضع إشارة (✓) أمام الإجابة المناسبة ....

نلفت انتباه السائقين إلى أن إجاباتهم ستستخدم لأغراض علمية فقط .. ولن يكشف عن هوية السائق ولن تطلع أية جهة على إجاباته.. كما ولن يتخذ أي إجراء إزاء ما يقدمه الأخ السائق من معلومات في الاستبيان .

وجزاكم الله خيرا,,,

الباحث

١

المعلومات الشخصية الأساسية

للإجابة الرجاء وضع علامة (✓) في المربع المناسب لكل سؤال:

الاسم (اختياري) :	....
(١) المستوى التعليمي	غير متعلم □ أولي □ متوسط □ ثانوي □ جامعي □
(٢) الجنسية	سعودي □ عربي □ آسيوي □ أوروبي □ أمريكي □
(٣) العمر	١٨-٢٤ □ ٢٥-٣٠ □ ٣١-٣٩ □ ٤٠ فما فوق □
(٤) الحالة الاجتماعية	متزوج □ عازب □ مطلق □ أرمل □
(٥) المهنة	موظف □ طالب □ سائق دولي □ عمل خاص □ :
(٦) هل لديك إجازة سياقة؟	نعم □ لا □
مدة حمل إجازة السياقة	١-٣ سنوات □ ٤-١٠ سنوات □ ١١ سنة وأكثر □
(٧) ما هو عدد حوادث السياقة التي كنت سببا فيها؟	واحد □ اثنان □ ثلاثة أو أكثر □
(٨) هل سبق أن ارتكبت مخالفة سياقة عاقبتك عليها المحكمة أو الشرطة؟	نعم □ لا □
عدد المخالفات	١-٢ □ ٣-٤ □ ٥ أو أكثر □
(٩) هل كانت السيارة التي أدت الحادث..	ملك □ مستأجرة □ سائق فقط □
(١٠) ماذا كانت نتائج الحادث..؟	تلفيات □ إصابات □ وفيات □

٢

استبيان رقم (٢)

الرجاء من الاخوة السائقين وضع إشارة (✓) أمام الإجابة المناسبة:

سلوكيات السائق	نعم	لا
(١) هل تعرضت لحادث بسبب عدم ارتياحك في مقعد السياقة ...؟		
(٢) هل تعرضت لحادث بسبب عطل فني في السيارة...؟		
(٣) هل تعرضت لحادث بسبب الاختناق المروري...؟		
(٤) هل تعرضت لحادث بسبب عدم إنارة الطريق...؟		
(٥) هل تعرضت لحادث بسبب عدم وجود الخطوط الأرضية...؟		
(٦) هل تعرضت لحادث بسبب خطأ في التصميم الهندسي للطريق...؟		
(٧) هل تعرضت لحادث بسبب الحيوانات السائبة...؟		
(٨) هل تعرضت لحادث بسبب وهج أشعة الشمس...؟		
(٩) هل تعرضت لحادث بسبب زيادة الحرارة أو البرودة...؟		
(١٠) هل تعرضت لحادث بسبب العواصف الرملية...؟		
(١١) هل تعرضت لحادث بسبب النور العلي المبهر للسيارة المقابلة...؟		

لا	نعم	سلوكيات السائق
		(١٢) هل تعرضت لحادث بسبب سلوك الركاب الذين معك..؟
		(١٣) هل تعرضت لحادث بسبب مرض في الأذن أو ضعف السمع...؟
		(١٤) هل تعرضت لحادث بسبب ضعف النظر...؟
		(١٥) هل تعرضت لحادث بسبب " التفحيط"...؟
		(١٦) هل تعرضت لحادث بسبب الإحباط...؟
		(١٧) هل تعرضت لحادث بسبب عدم ترك مسافة كافية بين سيارتك والسيارة التي أمامك...؟
		(١٨) هل تعرضت لحادث بسبب تجاوزك سيارة أخرى...؟
		(١٩) هل تعرضت لحادث بسبب عدم الحيطة لأخطاء الآخرين...؟
		(٢٠) هل تعرضت لحادث بسبب عدم التقيد بحدود السرعة...؟
		(٢١) هل تعرضت لحادث بسبب أثناء الرجوع للخلف...؟
		(٢٢) هل تعرضت لحادث بسبب عند الدخول أو الخروج من الطريق...؟
		(٢٣) هل تعرضت لحادث بسبب عدم معرفتك بالطريق...؟
		(٢٤) هل تجري صيانة لسيارتك كل ستة أشهر...؟
		(٢٥) هل تتفقد سيارتك قبل القيادة...؟

الرجاء من الاخوة السائقين وضع إشارة (✓) أمام الإجابة المناسبة:

سلوكيات السائق	غالبا	أحيانا	نادرا	أبدا
(٢٦) هل تواصل السباقة لساعات طويلة...؟				
(٢٧) هل تواصل السباقة عندما تكون متعب...؟				
(٢٨) هل تسوق السيارة وأنت مريض...؟				
(٢٩) هل تسوق السيارة بعد تناولك دواء يسبب النعاس...؟				
(٣٠) هل تسوق السيارة وأنت تحت ضغط نفسي...؟				

سلوكيات السائق	دائما	غالبا	أحيانا	نادرا	أبدا
(٣١) هل تربط حزام الأمان قبل السباقة...؟					
(٣٢) هل تستخدم الإشارة عند تغيير المسار...؟					
(٣٣) هل تدخن أثناء السباقة...؟					
(٣٤) هل تأكل أو تشرب أثناء السباقة...؟					
(٣٥) هل تتقيد بتعليمات المرور...؟					

سلوكيات السائق	دائما	غالبا	أحيانا	نادرا	ابدا
(٣٦) هل تستمع إلى المسجل أو "الراديو" أثناء السياقة...؟					
(٣٧) هل تستخدم الهاتف الجوال أثناء السياقة...؟					
(٣٨) هل تضع مقعد خاص للأطفال في سيارتك...؟					
(٣٩) هل تستخدم المرآة الأمامية و الجانبية...؟					
(٤٠) هل تركز أثناء القيادة...؟					

استبيان المعلومات المرورية

الرجاء وضع إشارة عند الاجابة الصحيحة

١


١- طريق ذو اتجاه واحد
٢- طريق مغلق
٣- الطريق يضيق

٢

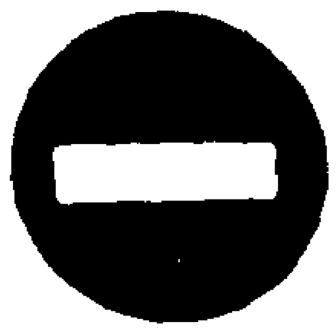

١- طريق ذو اتجاه واحد
٢- تقاطع طرق
٣- طريق غير نافذ

٣


١- موقف إسعاف
٢- مستشفى
٣- تقاطع طرق

٤


١- وقوف اختياري
٢- قف إجباريًا
٣- الوقوف عند رؤية سيارة أخرى

٥


١- ممنوع الدخول نهائيًا
٢- ممنوع الدخول ليلًا
٣- ممنوع دخول الشاحنات

٦


١- مسموح الرجوع للخلف
٢- ممنوع الاتجاه لليسار
٣- ممنوع الدوران للخلف

٧


١- الطريق يضيق
٢- الطريق مغلق
٣- طريق ذو اتجاه واحد

٨

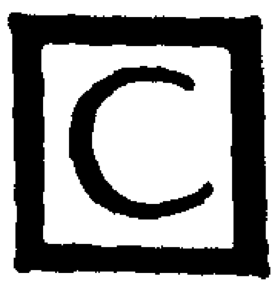

١- أمامك منحدر
٢- طريق غير مستوي
٣- طريق جبلي

٩


١- تقاطع طرق
٢- طريق سكة حديد
٣- منطقة عمل

١٠


١- مستشفى
٢- ممنوع الانتظار
٣- موقف سيارات

١١


١- مركز إسعاف
٢- مستشفى
٣- موقف

١٢


١- موقف
٢- مطعم
٣- هاتف

١٣


١- ممنوع الدوران الى اليسار
٢- مسموح الدوران الى اليسار
٣- الطريق يتجه لليسار

١٤


١- طريق مزدوج
٢- مسموح التجاوز
٣- ممنوع التجاوز

١٥


١- ممنوع الوقوف
٢- ممنوع الوقوف أو الانتظار
٣- تقاطع طرق

استبيان المعلومات المرورية

الرجاء وضع إشارة عند الاجابة الصحيحة

١٦

١- ممنوع الدخول

٢- اتجاه طريق

٣- ممنوع الوقوف

١٧

١- ممنوع الدوران الى اليمين

٢- مسموح الدوران الى اليمين

٣- الطريق يتجه الى اليمين

١٨

١- طريق زلق

٢- منطقة عمل

٣-طريق غير مستوى

١٩

١- مدارس

٢- منطقة عمل

٣- عبور مشاه

٢٠

١- عمال يشتغلون

٢- منطقة مشاه

٣- ممنوع مرور المشاه

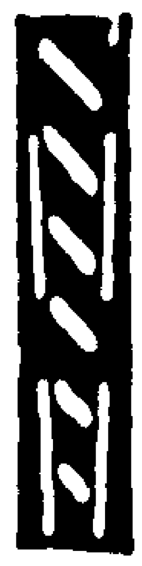
٢١

١- نهاية الطريق

٢- تقاطع طريق رئيسي مع فرعي

٣- تقاطع طرق

٢٢



١- منطقة فاصلة بين اتجاهين

٢- منطقة سكة حديد

٣- مطبات اصطناعية

٢٣

١- طريق ضيق

٢- ممنوع التجاوز

٣- يسمح التجاوز في اتجاه واحد

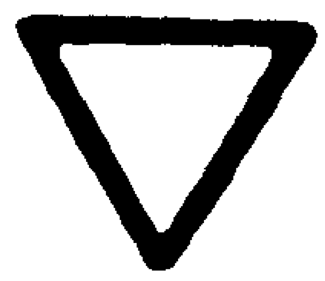
٢٤

١- ممنوع التجاوز

٢- مسموح التجاوز

٣- يسمح التجاوز باتجاه واحد

٢٥



١- طريق الأفضلية

٢- منطقة عمل

٣- ممنوع الوقوف

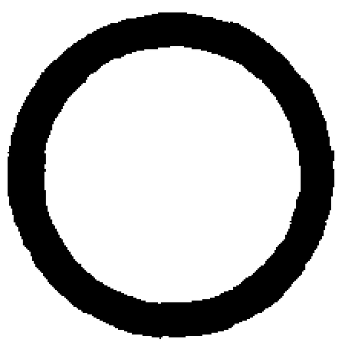
٢٦

١- طريق اتجاهين

٢- اتجاه واحد

٣- ممنوع التجاوز

٢٧



١-ممنوع الدخول لجميع السيارات

٢- ممنوع الوقوف

٣- مسموح الدخول

٢٨

١- تحديد السرعة

٢- يسمح بالسرعة

٣- سرعة التجاوز

٢٩

١- مدارس

٢- عمال يشتغلون

٣- مشاه

٣٠

١- منطقة صيد

٢- انتبه – حيوانات

٣- ممنوع صيد الحيوانات

APPENDIX E

Summary of Research Findings

1. RESPONSES TO QUESTIONNAIRE 2 AND FREQUENCIES AND PERCENTAGES, IN RANK ORDER

		Yes %
1	Concentration	7.16
2	Use F.S. mirrors	7.09
3	Observe regulation	6.87
4	Changing lane – no signal	6.85
5	Listening to radio/cassette	6.13
6	Long house	5.34
7	Eat/drink	4.15
8	Speed limit	3.16
9	Smoking	3.01
10	Tiredness	2.85
11	Stress	2.85
12	Emerge/exit	2.46
13	Overtaking	2.09
14	Safe distance	2.44
15	Congestion	2.32
16	Sickness	1.82
17	Stray animals	1.60
18	Sand storm	1.06
19	Frustration	1.02
20	Check car	0.92
21	Sun haze	0.89
22	Medication	0.89
23	Seat belt	3.97
24	Joy riding	0.86
25	Car service	0.75
26	Poor eyesight	0.47
27	Excessive heat or cold	0.72
28	Non-marking – road	1.46
29	Mobile phone	2.47
30	Road engineering	1.65
31	Uncomfortable seat	0.52
32	Non-familiarity with road	1.02
33	Others' errors	3.71
34	Reversing	2.04
35	Passenger behaviour	0.72
36	Mechanical fault	1.07
37	Non-light – road	1.56
38	Light beam	1.69
39	Child seat	2.08
40	Ear disorder	0.32
	TOTAL	**100%**

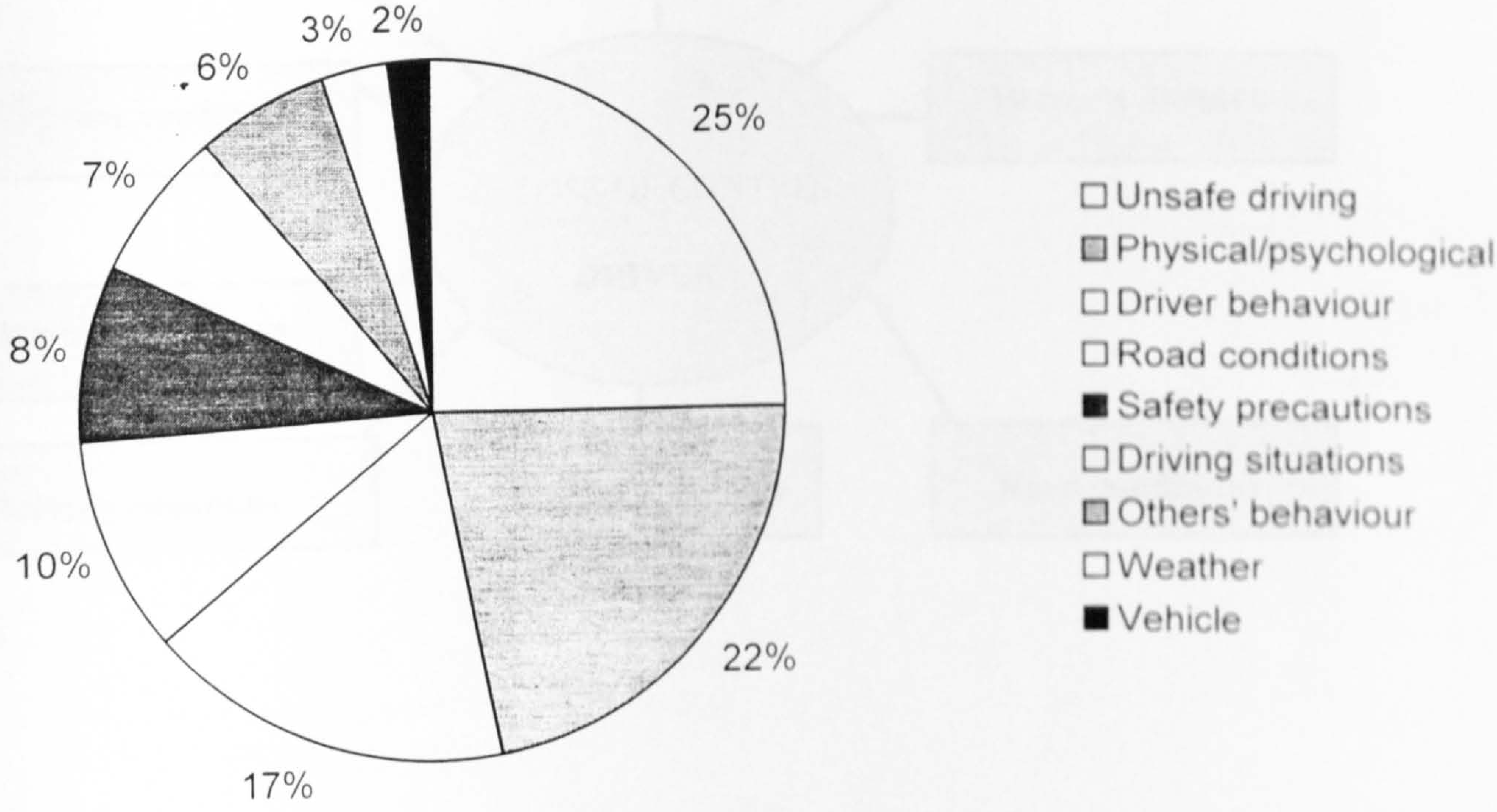
2. MENTAL AND BEHAVIOURAL FACTORS

		Yes %
1	Speed limit	10.15
2	Emerge/exit	8.64
3	Overtaking	6.68
4	Safe distance	5.72
5	Congestion	6.68
6	Stray animals	6.35
7	Sand storm	5.59
8	Frustration	4.63
9	Check car	4.51
10	Sun haze	4.38
11	Joy riding	4.26
12	Car service	4.01
13	Poor eyesight	2.92
14	Excessive heat and cold	2.88
15	Non marking - road	2.80
16	Road engineering	2.80
17	Uncomfortable seat	2.51
18	Non familiarity with road	2.42
19	Other errors	2.34
20	Reversing	2.05
21	Passenger behaviour	1.96
22	Mechanical fault	1.96
23	Non light – road	1.59
24	Light beam	1.29
25	Ear disorder	0.88
	TOTAL	**100.00**

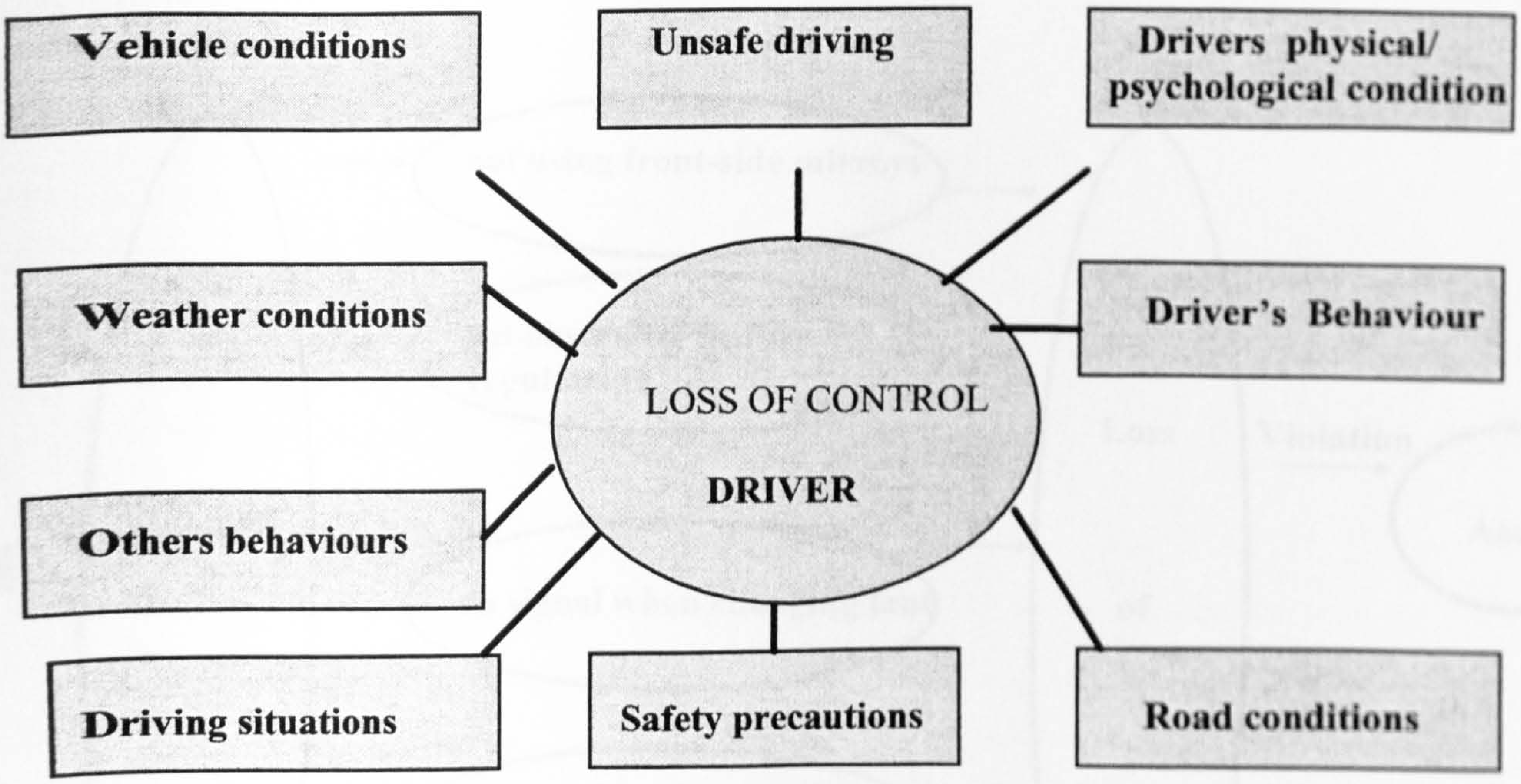
3. HABITUAL DRIVING BEHAVIOUR

		Yes %
1	Concentrate	11.79
2	Use F.S. mirrors	11.74
3	Observe regulations	6.31
4	Changing lane – no signal	11.34
5	Listening to radio cassette	10.15
6	Long hours driving	8.84
7	Eating/drinking	6.87
8	Smoking	6.56
9	Tiredness	4.97
10	Stress	4.72
11	Sickness	4.72
12	Medication	4.09
13	Seat belt	3.43
14	Mobile phone	3.00
15	Child seat	1.46
	TOTAL	**100.00**

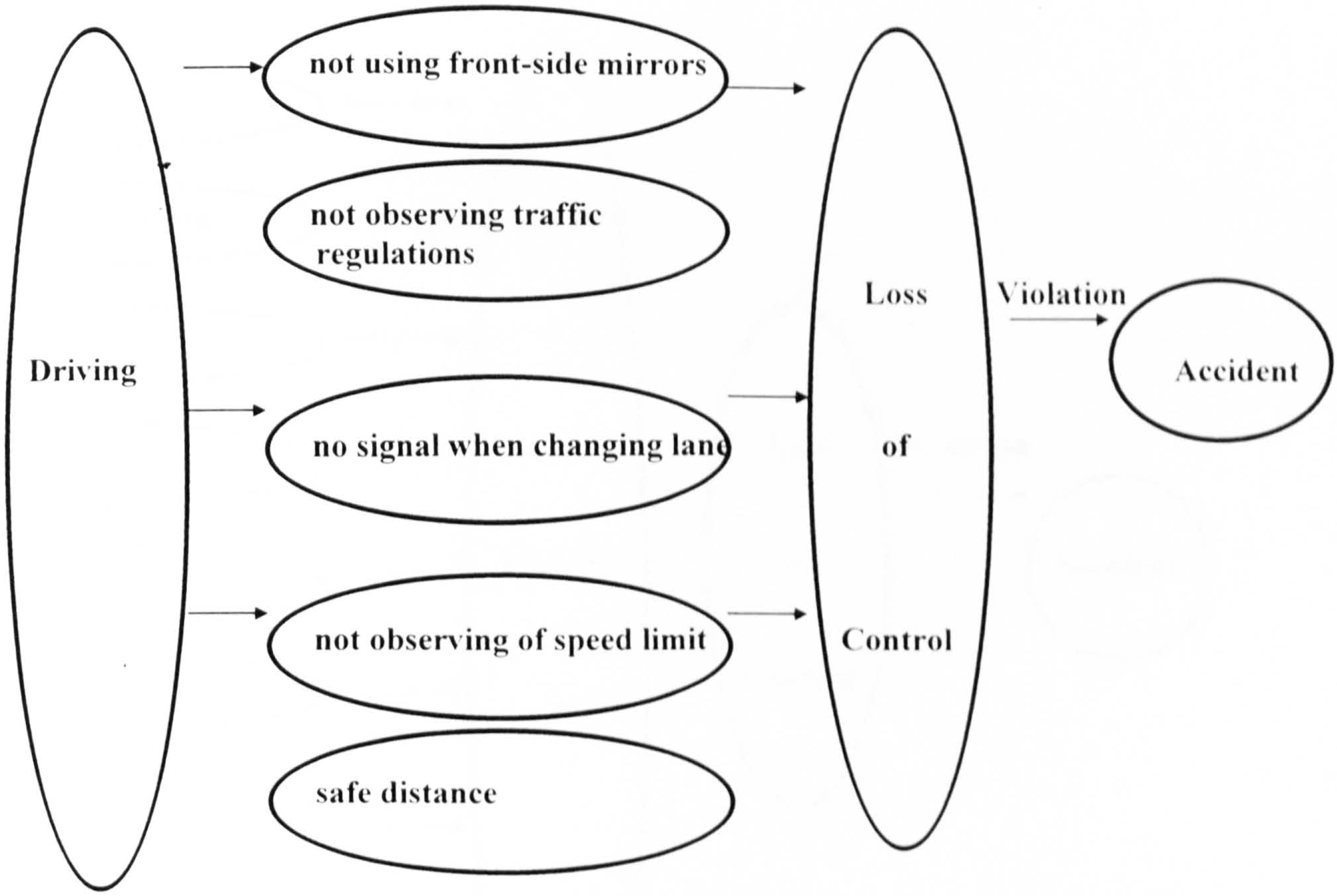
4. CATEGORIES OF FACTORS INVOLVED IN DRIVING ACCIDENTS



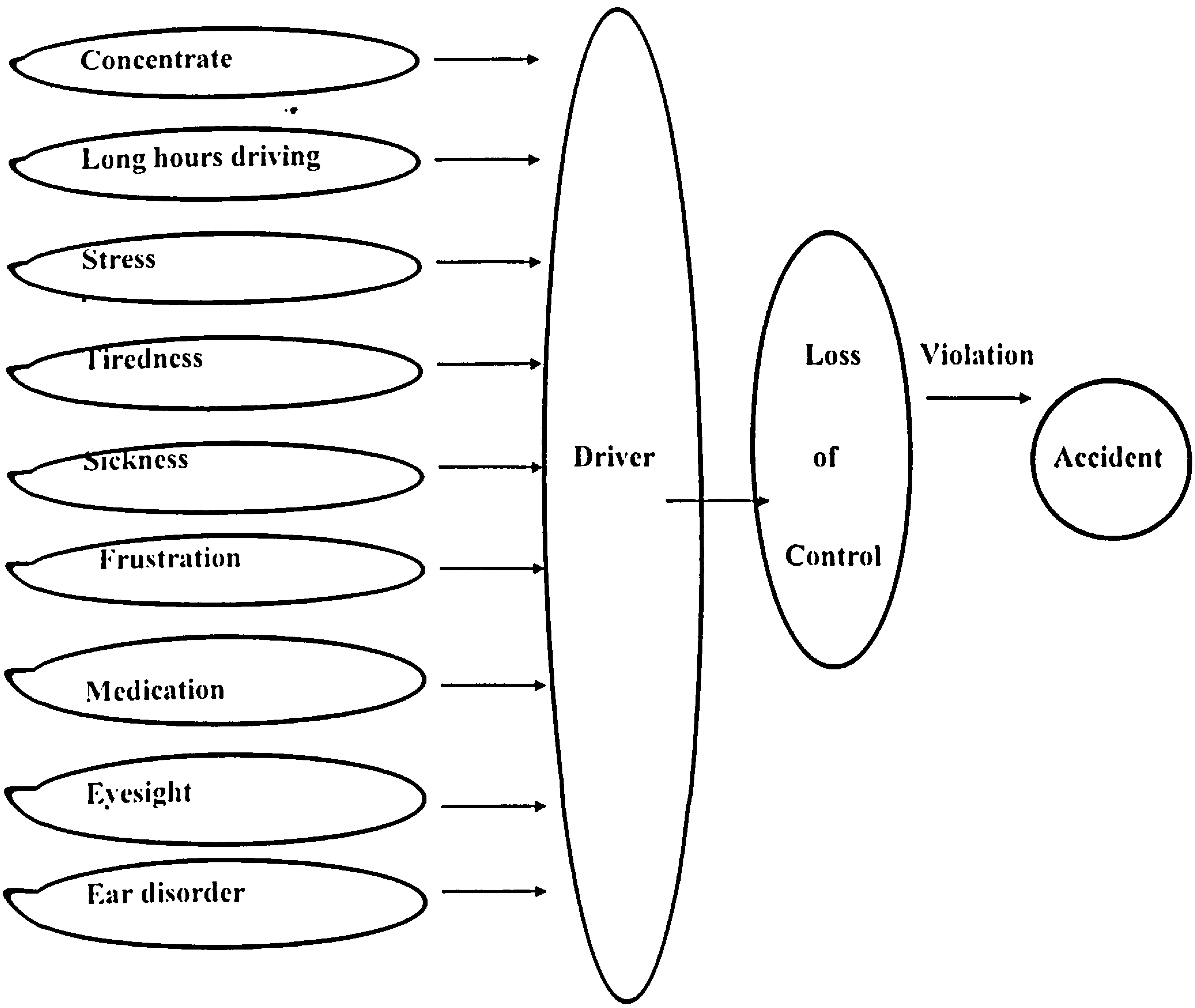
5. DRIVER'S LOSS OF CONTRAOL AND CONTRIBUTING FACTORS



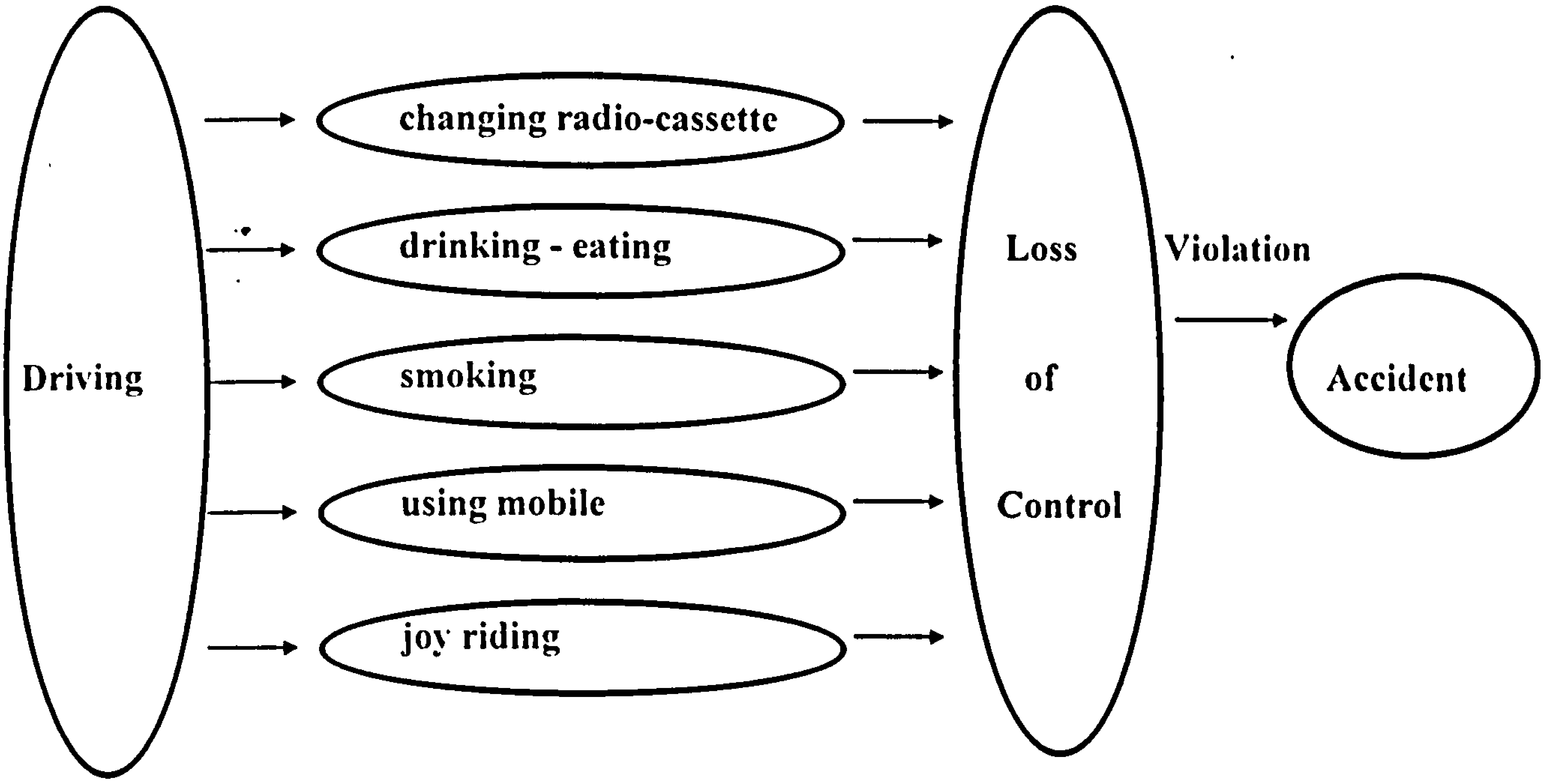
5. UNSAFE DRIVING – SUB-FACTORS



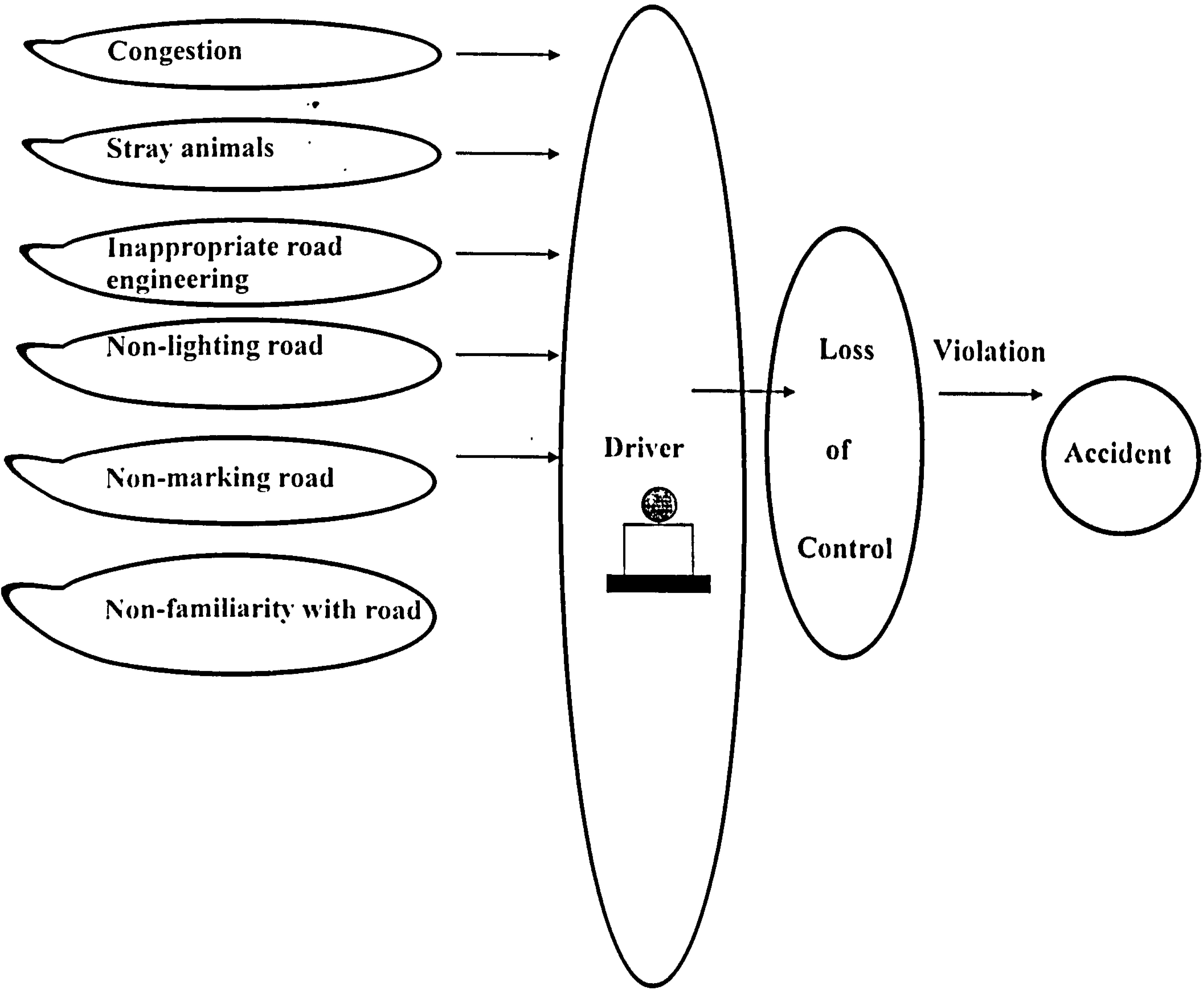
6. DRIVER'S PHYSICAL/PSYCHOLOGICAL CONDITIONS – SUB-FACTORS



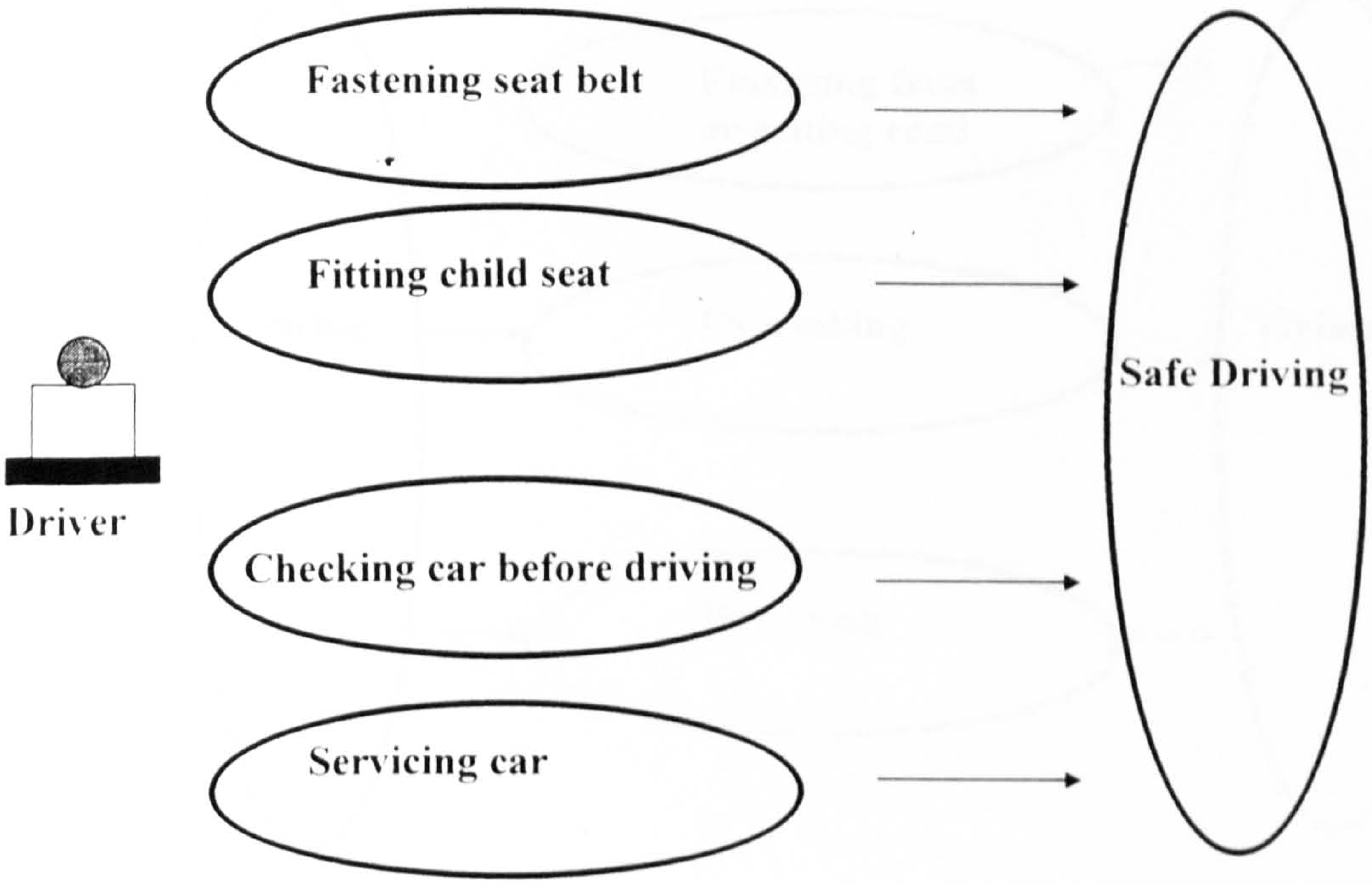
7. DRIVER'S BEHAVIOUR – SUB-FACTORS



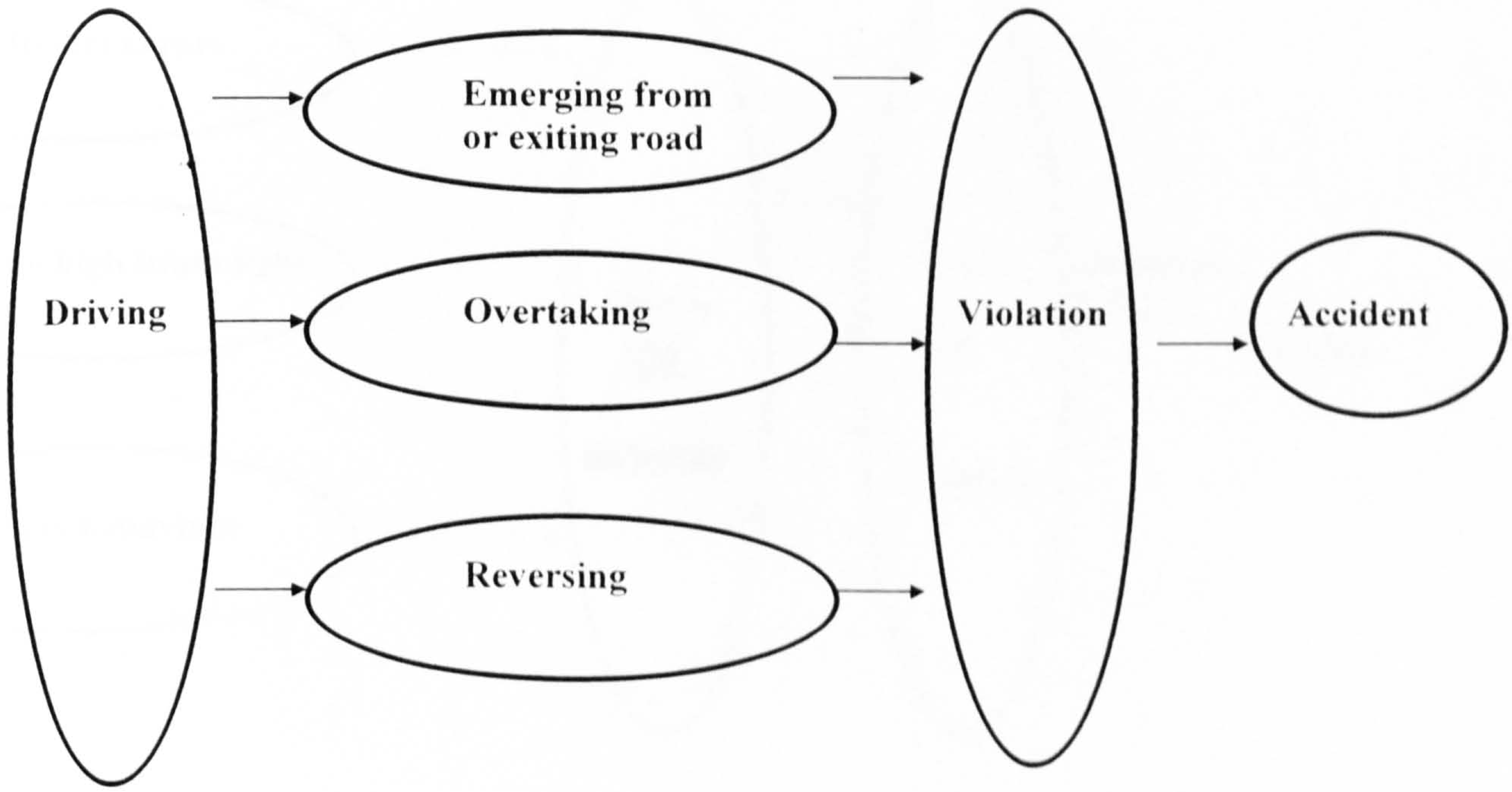
8. ROAD CONDITIONS – SUB-FACTORS



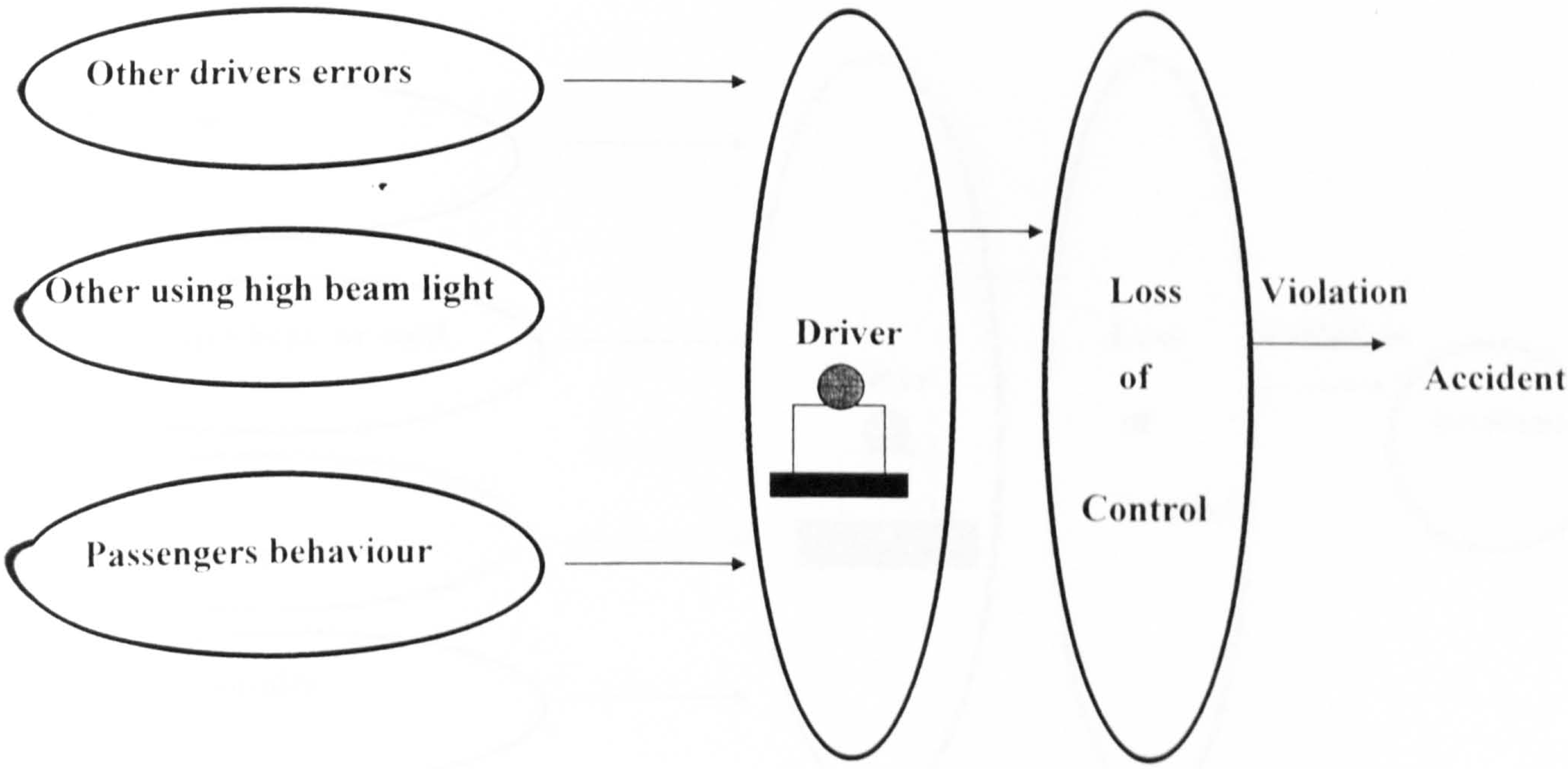
9. SAFETY PRECAUTIONS – SUB-FACTORS



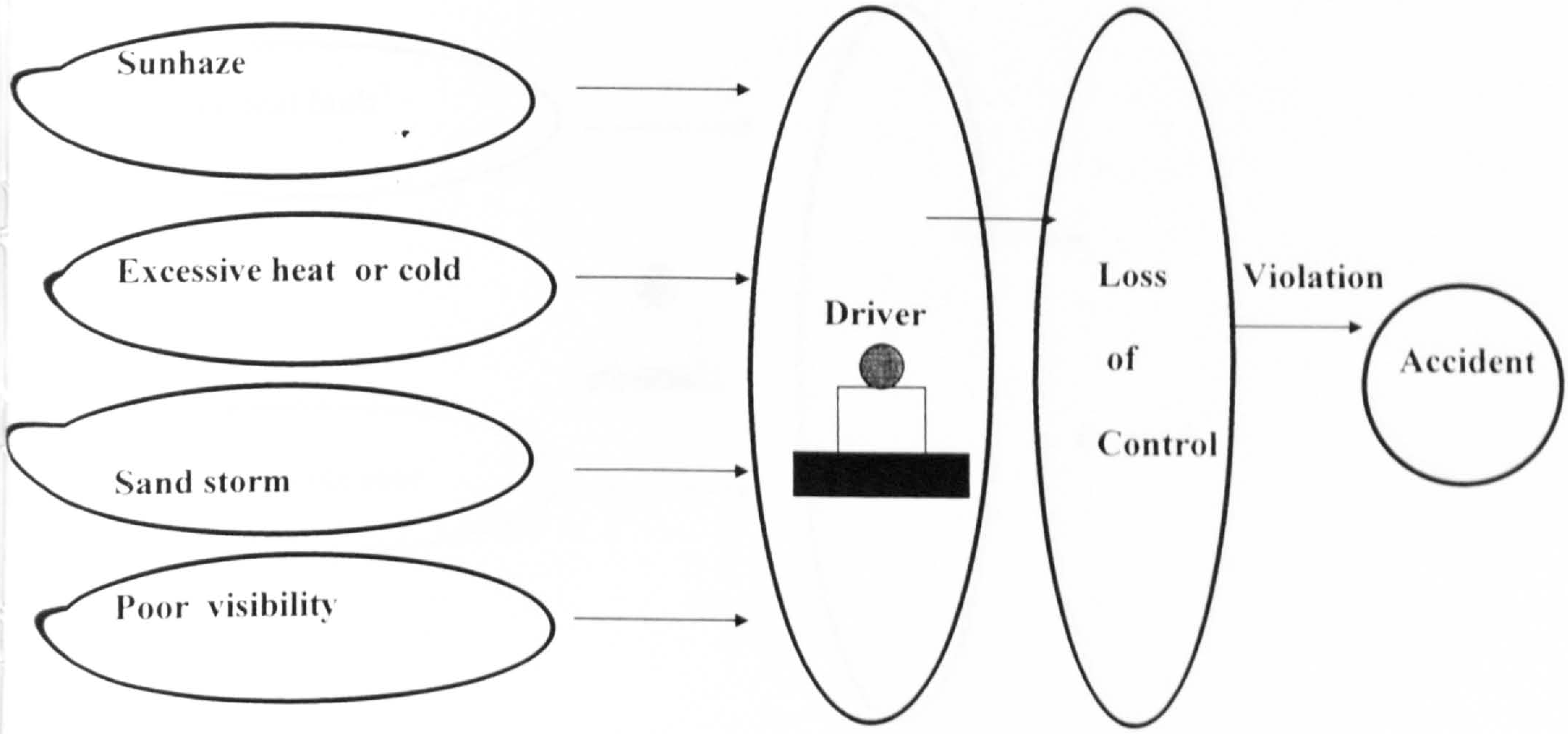
10. <u>DRIVING SITUATIONS – SUB-FACTORS</u>



11. OTHERS' BEHAVIOUR – SUB-FACTORS



12. WEATHER CONDITIONS – SUB-FACTORS



13. VEHICLE CONDITIONS – SUB-FACTORS