Impact of Mobile Phone Use Related Driver Distractions on Road Accidents - A Study in Oman

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Abstract – **Road mishaps has been causing great distress for the public and for the governments as well. Driver distraction is one of the major problems causing road accidents and the use of mobile phones during drive is believed to have a direct influence on driver inattention leading to fatal mishaps. The main aim of this study is to put light on the underlying factors that contribute towards driver attention diversion and analyse the impact of cell phone use related driver distraction on roads in Oman. For this study, unique data about driving behaviors were taken from 245 sample divers of different age groups in the Al Dahira Governorate, through a questionnaire survey. Interpretation of the data is done by exploratory factor analysis technique and Cronbach's alpha values were calculated to check the reliability and consistency of the factors. A structural model for distracted driving factors is developed for substantiating the relationship between driving attributes and crash likelihood due to use of mobile phones during drive. The goodness of fit parameters indicate that the developed model has a fair fit and explains reasonably well, the relation of driver distraction attributes with accident probability. The study concludes with a suggestion of an engineering solution to curb driver negligence due to cell phone use and make automobiles smarter and interactive.**

Index Terms - **Texting-and-driving, driving behavior, crash likelihood, distraction factors.**

INTRODUCTION

Distracted driving is a significant threat to all road users, whether eating, talking to fellow passengers or using cell phones while driving. As per the statistics of USA, National Highway Transportation and Safety Administration (NHTSA) [1], 3,142 people were killed in in 2019; 2,628 in 2018 and 3,003 in 2017 due to fatal distracted driving accidents, which makes, on average, 9% of all crash fatalities each year. Whereas, each year, approximately 280,000 are injured due to distractions while driving. Statistics show that 25% of distracted drivers between the ages of 20 and 29 end up in fatal crashes even though the District of Columbia and other 48 states have legal bans on use of cell phones to combat distracted driving.

This shows how distressing the consequences can be when drivers are preoccupied while driving especially using mobile phones.

In Oman, more than 10,000 traffic offences were registered in 2017 alone which involved the use of mobile phones while driving. Since then, the road accident mortality rate due to distracted driving is increasing annually on an average of 9.7%, according to the Royal Oman Police (ROP), index calculated at the National Center for Statistics and Information (NCSI) (https://www.ncsi.gov.om/). Referring to registered cases, the ROP reports that use of mobile phone while driving – whether involving watching multimedia or reading messages or texting or voice calls – reduces the alertness of the driver, thus jeopardizing the safety of road users. Among the chief causes behind the road accidents such as, unskilled drivers, sloppiness, over loading, speeding etc., the usage of cell phones during driving is seen to be the most critical one. Data collected by the NCSI and several other independent surveys shows the huge number of drivers who call or text while driving.

Road safety is one of the main priorities of Oman's government and has introduced new traffic rules and increased law enforcement. Although enlarged penalties and increased jail terms have been imposed for traffic offences including the use of mobile phones during driving, it has not been a solution for curbing the risks. It is found that distracted drivers speaking over phone, while driving, are four times as likely to be involved in accidents and those who are texting are more than twenty times likely to get into crashes than non-distracted drivers. This grave situation requires immediate and stringent steps, and authorities are seriously considering, as the current measures seem not to have much effect on errant drivers [2]. In response to these concerns, an engineering solution to control driver distraction thus preventing a larger proportion of road mishaps, is also proposed in the paper.

Research on road traffic crashes has only recently started in Oman. The major causes of this problem and its most optimal response have not yet been well-explored.

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This study intends to throw light into the basic factor that contribute towards road mishaps, namely driver inattention and analyze the impact of cell phone use related driver distraction on roads in the Sultanate of Oman. Also, to ensure road safety, it is essential to assess the contributing factors leading to accidents, so that suitable counter measures can be devised and employed. The paper is outlined as follows: Section 2 reviews the literature on current factors influencing road accidents in Oman, Section 3 discusses the methodology of data collection of the driving behaviors of Omani drivers, Section 4 details the data analysis methods adopted, Section 5 discusses results of the study and main findings followed by conclusion in Section 6.

LITERATURE REVIEW

A research conducted by the NHTSA and the Virginia Tech Transportation Institute in April 2006 revealed that the driver inattention was the cause of almost 80% of crashes and 65% of near-crash outcomes within three seconds of the accident. In addition, drowsiness was identified as the most common distraction, followed by mobile phone use. Data from 2010 to 2018 show that the number of mortalities from distracted driving have decreased in 2018 as compared to in 2015, but is again seen increasing in the subsequent years, as shown in Figure 1 (Source: NHTSA Studies: 2018 and 2013). Figure 2 shows the total number of distracted driving accidents. Therefore, unfocussed driving has remained a steadily contributing factor, accounting for between 14% and 17% of all road crashes.

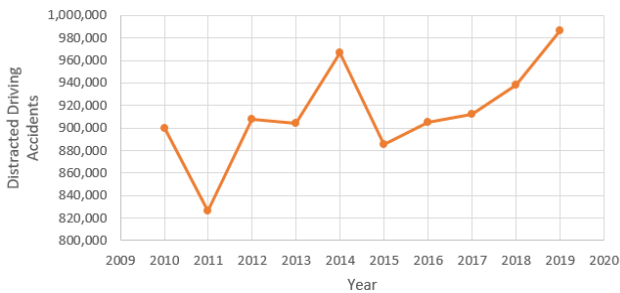**FIGURE 1 NUMBER OF FATALITIES FROM DISTRACTED DRIVING**

FIGURE 2 NUMBER OF DISTRACTED DRIVING ACCIDENTS

This section presents the main factors that influence road accidents in Oman. The National Centre for Statistics and Information (NCSI) sources show that, the number of cell phone subscribers in Oman at the end of December 2018 were 6.44 million which increased to 6.598 million by the end of September 2019 [Times of Oman, 22/October/2019]. The nation's population as on October 22, 2019 was 4,675,898; which depicts that there are more mobile phone subscribers than the inhabitants in the country, or there are about an average of 1.5 mobile phone subscriptions per person.

The rapid increase in motorization and infrastructure development and the shortage of public transportation system has led to tremendous increase in use of private vehicles in the Sultanate of Oman [3]. For every 1000 person, there are almost 230 vehicles in Oman and motorization rate is about 26% since 2000 [4]. This is a very high rate among middle-income countries which leads to more traffic issues and in turn high accidents rates. The World Health Organization (WHO) reports that, around 10,000 people have lost their lives in road mishaps in Oman and over 110,000 people have been injured, since 2000 [5]. Same statistics shows 25.4 deaths per 100,000 people which has made Oman the second highest country in rate of road accident fatalities in the GCC (Gulf Cooperation Council). According to the Royal Oman Police (ROP) statistics, the number of road mishaps in Oman showed varied trends. In the mid of 80's, the accident rate reached its peak with more than 16,000 calamities in 1985. In the 90s, the number started to decrease, reaching to 11,000 accidents on average [6]. The number gradually decreased reaching to its lowest in 2017 with around 6000 accidents. The number of mortalities and casualties in 2015 reduced by 30% compared to that in 2013 [6]. Islam and Al-Hadhrami [4] have reported that, nearly 70% of the crashes in Oman are caused by drivers from 17 to 36 years of age. Over speeding is another major cause of road accidents (nearly 50%), followed by careless or negligent driving (around 29%). In almost 98% of accidents, human fault is responsible. According to Al-Reesi et al. [7], accidents mostly occur on single highway and are primarily caused due to speeding by young drivers. The authors also reported that the strongest reasons of mortality are run-over type mishaps, early morning crashes and collisions with bicycles and motor cycles.

Distracted driving and driver's behavioral issues are found to be leading causes of increased accident rates [8]. Distracted or inattentive driving is when a driver gets distracted from the primary task of driving due to his involvement in any other activity that increases their risk of crashing. The distractions are classified into three main groups: visual, manual and cognitive. Visual distraction refers to the driver taking his eyes away from the road while manual distraction implicates taking his hands away from the steering wheel.

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When the driver takes his mind off the road, it is referred to as cognitive distraction. Regan et al. [9] introduces the internal and external driver distraction factors which is another comprehensive classification of distraction factors. Internal distraction factors include in-vehicle activities such as mobile phone use, GPS navigation, controlling of audio/video systems, eating or drinking, interacting with fellow passengers, smoking etc. External distraction factors include looking at advertisement signs, traffic sign boards, scenery, other automobiles, pedestrians, incidents, address search etc. come under the external distraction factors. Yannis et al. [10] reports that using mobile phones at high speed and under unfavorable weather conditions increases the chances of accidents and cases of unforeseen events. The most critical in-vehicle distraction factor is the use of mobile phones. The external sources of distraction are not mainly associated with risk of accidents but mostly with increased driver distraction [11][12]. Foss and Goodwin [13] accounts that use of electronic devices such as mobile phones, grooming and adjusting vehicle controls are the most significant contributing factors of distraction, and these behaviors are less common in the presence of other passengers. However, when the driver is with multiple peer passengers, loud talk and horsing around were very common. Simson-Morton et al. [14] infer that engaging in secondary activities and taking eyes off the roadway ahead increased the probability of crashes. Regardless of the secondary task, the longer the duration of glancing away from the road, the higher is the risk of accidents. Likewise, compulsions to answer work related calls and overconfidence of the drivers to text and drive are critical areas that have large public health implications and therefore needs to be seriously dealt with [15].

The driver's behavioral issues such as drifting lanes without notice or deviating across lanes, pausing at green light and not stopping at red ones, overlooking and driving out of their lanes, and missing pedestrians and/or other vehicles contribute to high accident rates in Oman. Most of the stated events happen because of unfocussed activities such as talking or texting on phone, attending to unrestrained children, eating and drinking or a combination of several above mentioned actions while driving. Out of all the reported distracted driving factors, texting and driving is the riskiest activity which is six times more probable to lead to an accident than drunk driving. This behavior is reported to be involved in over 1.6 million crashes each year. In this case, the driver is being cognitively, visually, and manually distracted from maintaining focus on the road, putting himself and others at risk. The rate of possible accident happening when the driver takes his eyes off the road increase by a staggering 400%. It is also observed that children are often allowed to occupy the front seat next to the driver and the drivers are busy dealing with them while driving. This behavior also endangers other road users as the drivers are not fully focused on the primary task of driving.

A few earlier studies have examined various driver's behavior such as demographic traits and personality attributes relating to abnormal driving conduct and accident involvement [7] [16].

In the above-mentioned studies, use of cell phones is found to be a common and significant in-vehicle driver distraction factor that leads to road mishaps. However, the driving culture and driver's behavior vary between regions as infrastructure development conditions and traffic enforcements differ. Local drivers behave in accordance with, what they observe from the society, available infrastructure and legal constrains. Considering the social and cultural conditions of Oman, investigating the causal relationship between distracted driving factors and driver's tendency to be involved in an accident, is very much needed at the moment. In this regard, the main objective of this study is to design a questionnaire survey to collect required data; identify significant factors causing driver's distraction that lead to mishaps (in the local context of Oman); develop a measurement model using factor analysis and come up with a structural model based on the results obtained.

METHODOLOGY

A comprehensive questionnaire survey was designed for this study, consisting of three sections. Personal details of the driver like age, gender, marital status, profession, educational qualification, driving experience, the driving frequency (in terms of number of hours per day), type of vehicle driving etc. are included in the first section. Different statements on potential internal and external distraction factors were designed to assess the driving attributes of the driver in the second section. The questions were designed based on the existing literature on distracted driving behaviour [9][11][12][17] and considering the behavioural and attitudinal aspects of Omani drivers and local driving conditions. The main statements included activities that drivers generally indulge in while driving, e.g. GPS navigation, mobile phone use, eating/drinking, interaction with fellow passengers, controlling of entertainment devices and looking at sign boards and advertisement displays. The questionnaire statements in the first section were designed to seek the test driver's behaviour while driving and their chances of resulting in accidents on the roads. The evaluation of questions was against a 5-point Likert scale (1: never, 2: seldom, 3: occasionally, 4: frequently and 5: always). The 5-point scale in the survey was chosen in search of the reliability of the data from drivers of different social and economic backgrounds. Questions related to the impact of policies the authorities are adopting and contemplating to reduce traffic accidents in Oman are included in section 3 of the questionnaire. Finally, the driver's opinion on the most contributing factors that cause road accidents, their personal driving behaviour and history of involvement in crashes are also taken.

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A. Survey and Samples

In September 2021, the drivers of private cars, taxies, buses and trucks at various locations in Al Dahira region, mostly in the city of Ibri, were asked to fill out this questionnaire survey, to observe the driving behaviours and attitude of Omani drivers. The survey form was tested for its suitability and correctness of the designed sections, with 20 in-campus drivers before conducting the actual survey. This confirmed whether the questionnaire is clear and comprehensible to the drivers who at different literacy levels. A revised questionnaire was devised after the initial testing. The drivers who were selected randomly were familiarized with the purpose and contents of the questionnaire before the survey forms were filled. The literate drivers filled the questionnaire form by themselves and other forms were filled by interviewing each driver. The survey was completed with the help of university undergraduate students. Target sample size was decided in view of the location of survey, ease of conducting the study and the analysis methods used. The response rate was low at few locations in the Al Dahira Governorate as many drivers disagreed to respond to the questions, citing various reasons. 257 samples were taken in total, out of which 12 samples were discarded due to partially complete and/or errors in the filled questionnaire. Thus, the data used for supplementary analysis is from the 245 total collected samples.

B. Respondent's Socio-Economic Attributes

Commercial vehicles like buses, taxis and trucks are not mostly driven by women in Oman. As women drive only personal cars for their own travel and for family trips, almost 60% of the respondents were male. Most of the drivers selected as respondents have an education level of a diploma or above. Almost 73% of drivers belong to young age group, having age between 20-35 years. 90% of the target drivers are either students or employees of different public and private sector organizations and the rest are freelancers. Commercial vehicle drivers only account for 10% of the sample. 19% of respondents have 1-2 years of driving experience, 26% have 3-4 years, 17% have 4-5 years and 38% have more than 6 years. The driving frequency of 51% drivers is between 1-2 hours, 18% drive for 3-4 hours per day and 21% drive for more than 4 hours per day. Remaining 10% of respondents drive occasionally.

DATA ANALYSIS BY EFA

In order to develop a measurement model that includes various indicators and latent variables, an exploratory factor analysis (EFA) [3] technique is used. A structural model is then derived by combining the measurement models. Factor analysis technique is a statistical means performed to examine the covariance among a set of indicators (observed variables) so as to group them according to their latent (unobserved) variables. Latent variables are then used to estimate their impact on behavioral variables.

Among the two types of factor analysis techniques, viz. exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), EFA is used in this study which is suitable for the questionnaire items designed. Here, a preliminary exploratory factor analysis was performed using the method of maximum likelihood and Varimax rotation on driver's responses on distraction factors, to construct a structural model of the same. Varimax factor rotation technique is used as it is the most commonly used method for the factors that are independent. The analysis resulted in three factors, viz, the Mobile phone related distraction factors (MDF), Activity oriented distraction factors (ADF) and Disturbance oriented distraction factors (DDF). MDF mainly includes observed variables of driver's tendency and frequency of using mobile phones for texting, calling and browsing social media. The ADF consists of variables related to different driver's in-vehicle activities such as interacting with other passengers, music systems, GPS navigation and eating and drinking. Third factor DDF includes elements that tend to disturb the driver's attention while driving.

TABLE I
ROTATED FACTOR LOADINGS FOR IDENTIFIED FACTORS

Observed Variables	Factor loadings			Factor Mean
	MDF	ADF	DDF	
MDF-1 (Frequency of texting and driving)	0.851	-	-	2.33
MDF-2 (Frequency of talking over hand-held mobile phone during driving)	0.804	-	-	
MDF-3 (Browsing social media websites during driving)	0.776	-	-	
ADF-1 (Interaction with other passengers or entertainment devices during driving)	-	0.618	-	2.78
ADF-2 (Frequency of using GPS navigation during driving)	-	0.703	-	
ADF-3 (Frequency of eating and drinking while driving)	-	0.566	-	
DDF-1 (Disturbed by the advertisement boards, bright lights and other outside distractions on the roads)	-	-	0.513	2.66
DDF-2 (Disturbed by children or fellow passengers in the vehicle)	-	-	0.609	
DDF-3 (Affected by whether conditions such as rains etc.)	-	-	0.546	
Cronbach's Alpha	**0.812**	**0.651**	**0.563**	

Table 1 shows the rotated factor loadings for the identified factors. The observed variables with higher factor loadings indicate that they have more influence on the corresponding identified factors. The values of Cronbach's alpha were calculated to check the reliability and internal consistency of the factors.

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When the value of Cronbach's alpha is high, it means that there is high consistency among respondents in evaluating the indicators of that factor [18]. From the values computed in the above table, it can be seen that the identified factors, mainly the mobile phone related driver distraction factors (MDF) are very much acceptable in predicting the driver's behaviour in general.

A structural model was developed by combining the measurement models based on the results of EFA as shown in Figure 3. For indicating increased tendency of road mishaps due to the use of cell phones, an internal observed variable on a 5-point ordinal scale was defined namely 'crash likelihood with cell phone use during drive'. Few other observed variables related to driver's attributes such as, drivers age group, driving experience and driver's educational background were also included in the model to understand their correlations with the 'crash likelihood with cell phone use during drive'. Few significant variables reported are defined as dummy variable i.e. 1 if driver's age group is between 20 - 35 years, else 0; 1 if the driving experience is 4-5 years, else 0; 1 if driver's education level is higher diploma and above, else 0; 1 if reason of accident is calling during drive, else 0; and 1 if the reason for accident is texting and driving, else 0.

The positive structural relationship between MDF and 'crash likelihood with cell phone use during drive' indicate that mobile phone distractions increases the tendency of crashes. The structural relationship between ADF and DDF with 'crash likelihood with cell phone use during drive' is also positive with moderate level of significance comparatively. This implies that in-vehicle and external interaction also increases driver's chances of involving in accidents. Also the structural relationships between the attributes for the reason of distraction, whether calling or texting during drive and the internal variable are positive and structural weights indicate higher tendency of crashes for the attribute texting and driving. The structural weights between internal variable and defined driver's attributes such as driver's age group, educational background and driving experience are positive too which shows that drivers between age group of 20-35 years having higher diploma and above qualification with minimum 4 to 5 years of driving experience consider that the driving and using cell phones in chorus, increases the likelihood of experiencing a crash. The goodness-of-fit parameters for the structural model are found within the permissible values which indicate that the developed model has a fair fit and explains reasonably well, the relation of driver distraction attributes with crash likelihood.
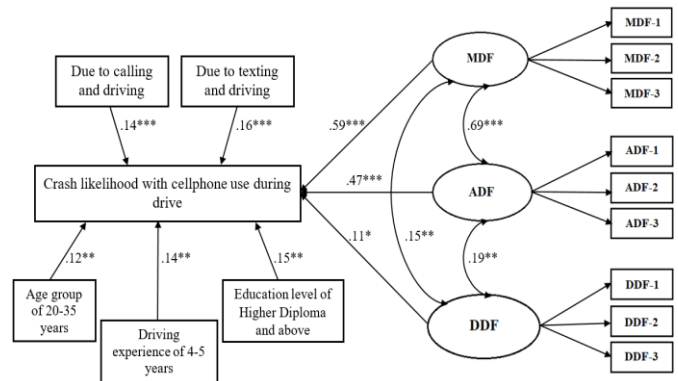

FIGURE 3 DISTRACTION FACTOR STRUCTURAL MODEL (***SIGNIFICANT AT 1%, **SIGNIFICANT AT 5% AND *SIGNIFICANT AT 10%)

RESULTS AND DISCUSSIONS

Most of the respondents admitted to possess the habit of indulging in supplementary activities while driving, at different rates. The driver's response against internal distraction factors are as follows. Around 67% of the respondents use their phone occasionally, frequently or always to make hand calls or sending and listening WhatsApp voice messages or texting while driving. This alarming rate shows the extent to which cell phones are used during driving. The use of Bluetooth / headphones or hands-free is less trendy in Oman compared to handheld ones. 56.7% of the total respondents admitted that they eat or drink while driving. 8.9% of respondents from 25 to 34 years of age acknowledged that they felt extreme pressure to reply to text messages instantly, and 7.3% of that same age group (25 to 34 years) also felt a high degree of pressure to answer work-related emails/messages while driving.
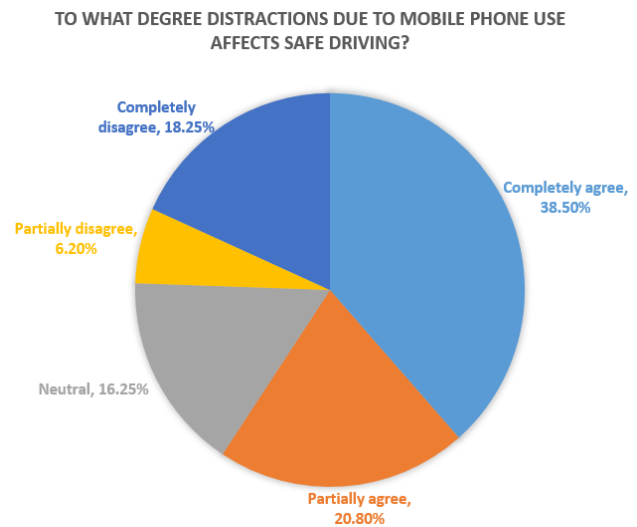

FIGURE 4 RESPONSE OF OMANI DRIVERS FOR THE STATED QUESTION

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Among the external factors of distraction, only 5% of the drivers responded that they don't concentrate on roadside advertisements whereas 95% do observe outside distractions while driving, at different degrees of focus. 40% of the drivers admitted to browsing through social media during driving. All the respondents agreed to have observed other drivers using cell phones in passing vehicles. These results show the alarming rate at which drivers perform various in-vehicle activities and get influenced by external distractions while driving. The most common distraction factors are use of mobile phones (hand calls or texting), eating or drinking and using GPS navigation while driving. These activities are very much likely to result in driver's focus diversion from the main task of driving and consequently leading directly or indirectly to fatal accidents. Figure 4 shows that 38.5% of respondents accept that distractions on the mobile devices ruin the ability to drive safely, while 20.8% partially agree to the statement. On the other hand, it is also surprising to note that 18.25% think that distraction due to mobile phones does not affect safe driving and 16.25% have stayed neutral to the comment.

Figure 5 depicts that 28.6% of the total respondents acknowledged to texting and driving, to be their primary distracted driving behavior, over others such as engaging in social media, video-chatting, responding to work emails, taking videos or photos etc. Other personal distracted driving behaviors identified by the respondents are watching videos (3%), GPS navigation (16%), eating or drinking during driving (18.5%), either occasionally or frequently.
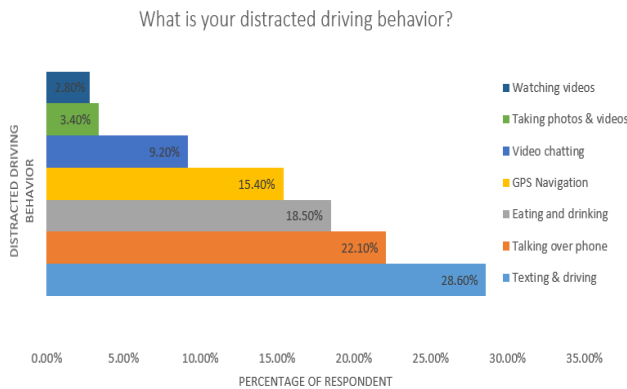

FIGURE 5 DISTRACTED DRIVING BEHAVIORS OF TARGET GROUPS IN OMAN

For the question on crash history, 32% of the participants responded that they have involved at least in one crash in the past and 12% believed that the crashes occurred because of distractions caused by using mobile phones while driving.

54% of the participants acknowledged that they have heard incidents of other drivers who met with accidents while phoning and driving. Figure 6 shows that 41% of the respondents accept that over speeding is the primary cause of crashes in Oman; while 39% participants admit the use of mobile phones; 12% choose incorrect overtaking; 5% opt stress and fatigue and 3% choose poor road conditions.

Majority of the participants agreed that over speeding mostly is an outcome of other distractions, especially phoning whist driving that increases the chances of having an accident. This data is encouraging in the sense that road users have started to realize that the use of cell phones during driving can lead to fatal mishaps.
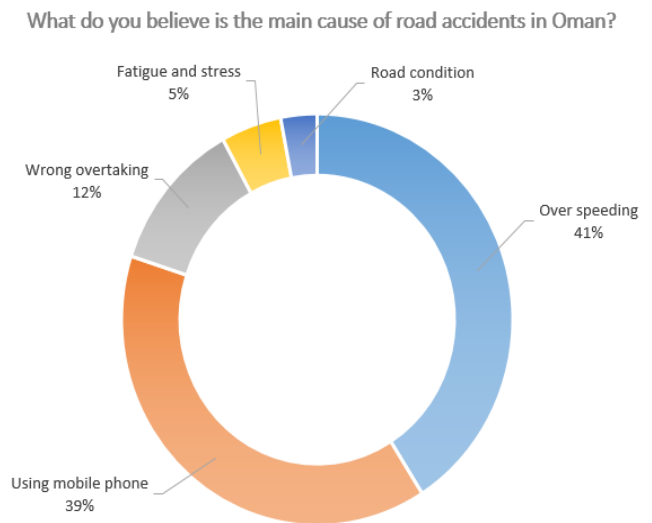

FIGURE 6 RESPONDENT'S VIEW ON CAUSES OF ROAD ACCIDENTS IN OMAN

The respondent's driving patterns based on their smart phone's OS (Operating System) were also analysed. According to the statistics of the mobile operating system market share in Oman (from April 2021 to April 2022), 25.04% of smart phone consumers are Apple iOS users while 74.69% are Android users [19]. 40.6% Apple iOS users responded that they endured compulsion to respond to a SMS, when only 28.7% of Android users perceived the same. 20.4% of iPhone users admitted to browsing social media during driving while 13.6% of Google Android users chose alike. 15.4% of iPhone using respondents did face-timing whilst driving, while merely 10.7% Android users did so. Figure 7 depicts the driving behaviours of iPhone and android operating system users. The results show that percentage of distractive behaviour by Apple iOS users are comparatively more in Oman than Android users.

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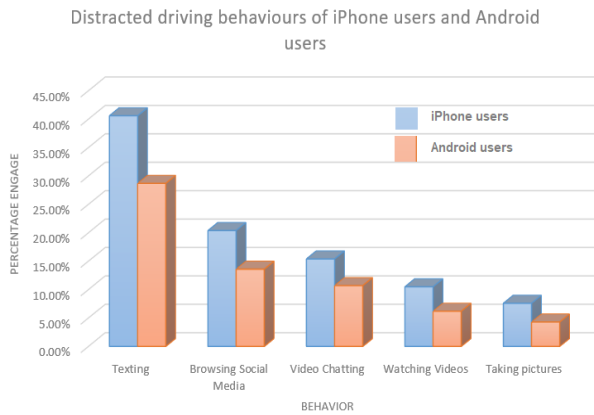**International Journal of Applied Engineering & Technology**

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FIGURE 7 Distracted Driving Behaviors of IPhone and Android OS Users

Conclusion

The significant factors contributing to driver's distraction and corresponding road mishaps in Oman are studied in this paper. Drivers having the habit of performing other in-vehicle and out-of-vehicle activities while driving are more than 80%. About 67% of them engage in mobile /smart phones for varying reasons at different degrees. The most common distracted driving behaviour is found to be texting and driving. The inference of the study is that such activities, specifically, phoning while driving causes both physical and mental distraction to the drivers and increases the probability of occurrence of fatal road mishaps.

This study paves way, in future, to address the issue of phoning related driver distractions and think towards developing and installing a smart system for vehicles, that can detect the offence event in the drive mode and alert the driver from inappropriate driving conditions and/or remotely disengage the multimedia applications and mobile data in the driver's cell phone whilst driving. This could help to avoid possible unfortunate accident situations to a greater extend.

Acknowledgement

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