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THE CAUSES OF ROAD ACCIDENTS IN IRAN

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The aim of this project is to detect human factors and safety issues in road accidents in Iran and eradicate casualties, injuries and damages by improving safety culture and using new technology. Nowadays, nearly 1.24 million people are killed in road accidents every year in the world. Vehicle accidents can be divided into three fundamental categories: 1-accidents caused by human errors, 2-accidents caused by equipment failure and 3- bad road conditions. Safety design and paying adequate attention to human factors can eliminate the root of all these deadly crashes, injuries and musculoskeletal diseases; moreover, it can reduce economic loss due to disabilities caused by accidents. Iran is among the countries which has a high casualty rate due to cultural attitudes towards road rules and poor vehicle safety and facilities. In this project, one Iranian car company named Iran Khodro is chosen and all its aspects of safety design, human factors and production are studied and examined. In addition, some methods and solutions are given with new tested technologies in Europe to deal with human error and lack of safety facilities, e.g., using fatigue device technology to make the driver safe while driving, choosing safe cars for the roads by testing them in Euro NCAP program, etc. to reduce the possibility of accidents and to lower the number of fatalities and injuries and improve overall road safety.

Keywords: road accidents, human errors, equipment failures

1. INTRODUCTION

1.1. Accident rates around the world

Accidents today are among the leading causes of death in some cases, and also the number one cause in many parts of the world, especially in the more highly industrialized nations (Aarts, Van Schagen, 2006). Road crashes are an enormous cause of injuries and deaths all over the world. Furthermore, nearly 1.24 million

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people die every year on the world's roads, and another 20 to 50 million suffer from serious injuries as a consequence of road traffic accidents. Wage earners are involved in almost half of the casualties, mostly in an underprivileged occasion (EURONCAP, 2013). These injuries and fatalities have an instant and immense impact on the families influenced, whose lives are frequently changed, certainly in the society in which they worked and lived (Payvand news, 2012). Road traffic injuries are calculated to be the eighth cause of death worldwide. They are the most common cause of fatalities and injuries for young people aged 15 to 29 years, and as a result, have a heavy cost and toll on young people when they enter their most productive years. Road traffic injuries have systematically been one of the top three causes of fatalities for people (Leplat, 2015). Road crash injuries are considered to cost low and middle income countries around 1 and 2 percent of their gross national products, which has been calculated to be over one hundred billion dollars a year (Kulcsar et al, 2013). A nationwide debate about the death penalty is once again raging in the United States. Studies have found a system so fraught with vulnerabilities and error that some states are halting proceedings altogether, while others are scrambling to invest more in countermeasures against the executions of the innocent (Rasmussen, 2011). The debate is a window into people's beliefs about the sources of error. Says one protagonist: "The system of protecting the rights of accused is good. It's the people who are administering it who need improvement: The judges that make mistakes and don't permit evidence to be introduced. We also need improvement of the defense attorneys (Rensink, 2012)". The system is basically safe, but it contains bad apples. Countermeasures against miscarriages of justice begin with them. Get rid of them, retrain them, and discipline them. But what is the practice of employing the least experienced, least skilled, least paid public defenders in many death penalty cases other than systemic? What are the rules for judges' permission of evidence other than systemic? What is the ambiguous nature of evidence other than inherent to a system that often relies on eyewitness accounts to make or break a case (Parker et al, 2014)?

2. METHODS AND SUGGESTIONS

2.1. Accident statistics in Iran

Road accidents in Iran are divided into three categories, caused by the driver, the vehicle and the road. Around 90% of car crashes in the world are caused by human errors (Salmon et al, 2015) and it is the same factor for Iran. Travelling above the speed limit, acting carelessly and dangerously while driving, tailgating, overtaking out of passing zone, violation of road safety rules, drowsiness, speaking on the phone while driving are the most common driver faults or human errors that

bring casualties and cost the country billions of dollars every year. Meanwhile, there is no strong and strict preventive action against road traffic offences and violations. The overproduction of vehicles with inadequate attention to vehicle safety, safety design, quality control management and ergonomics influence the country negatively in this matter because foreign-built cars are not affordable by the majority of Iranians and domestic products are much cheaper. The following items are some examples of equipment failures:

- braking systems that fail to correctly stop a vehicle,
- lack of air bags in most domestic cars or air bags that fail to deploy in an accident,
- seat belts and other vehicle safety equipment that fail to stay in place and adequately hold a person when an accident happens, or seat belts themselves cause an injury at the time of accidents,
- unusual noise from the vehicle's body,
- tires which are very sensitive to blowouts and other problems,
- not intelligent steering systems that do not supply enough control over a vehicle,
- unsuitable interior and exterior appearance.

Also, road signs and warning signals are insufficient and low-quality bumps and slopes in the roads create a tendency for vehicles to overturn and be involved in an accident (Van Elslande, 2015).

Table 1. Driving rules in Iran (Wang et al, 2012)

Country	Speed limit (motorway) (km/h)	Speed limit (urban area) (km/h)	Permitted alcohol level (%)	Seatbelt required	Minimum driver's age
Iran	120	50	0.00	all	18

- a) Driving is on the right side of the road
- b) Third party insurance is compulsory and also personal insurance is needed (Wang et al, 2012).

Table 2. Fatalities and injuries caused by not wearing safety helmet and safety belt among drivers and motor cyclists in Iran-Tehran in 2015 according to the DMV of Tehran province, 2015

Sum	Non-Injured	Injured	Death	Wearing safety helmet and safety belt
70774	57370	13321	83	belted vs unbelted
8881	3976	4864	41	belted
3730	609	3087	34	unbelted
83385	61955	21272	158	sum

As it is shown, out of 8881 accidents, 41 people were killed, 4864 injured and 3976 non-injured, this indicates that using and wearing a seat belt and safety helmet could save lives for those ones that were belted. On the other hand, out of 3730 accidents, 34 people were killed, 3087 injured and 609 non-injured while they were unbelted. This data shows that being belted before driving is the most effective way to avoid an injury. In Iran not wearing a safety belt is the second most common offence after unauthorized speed. Table 4, shown on the next page, illustrates the number of human errors and equipment failures by drivers in Tehran, the capital city of Iran. As it is clear, the most common reason of accidents which caused death is related to human errors. Furthermore, equipment failure is taking second place, which means that it has an important effect on accidents and car crashes.

Table 3. Accidents caused by human errors and equipment failures in Iran-Tehran in 2015 according to the DMV of Tehran province

Total	Non-Injured	Injured	Death	Accident caused by
16036	10285	5699	52	disregarding forward
8680	6007	2668	5	failure to yield
5135	3502	1625	8	changing direction suddenly
4135	3565	561	9	driving against traffic
3622	3276	345	1	tailgating
3268	2215	1020	33	inability to control the vehicle
1088	964	124		failure to comply with level crossing
1065	699	366		turning in to the wrong way
1036	393	640	3	reversing dangerously
991	446	543	2	prohibited entry
957	388	568	1	opening the left door while vehicle is moving
946	588	356	2	other causes
697	383	313	1	sudden swerve
651	397	254		jumping red lights
612	443	168	1	overtaking in a wrong way
454	306	144	4	exceeding the safe speed
430	220	210		bypassing a driving ban
247	197	50		mechanical failure
71	60	10	1	violating overload regulations
67	32	35		unknown
60	45	15		overtaking from the right
44	24	19	1	travelling above the speed limit
39	24	15		lacking driving skills
30	21	9		equipment failure
11	3	8		towing in the wrong way
9	5	4		violating road safety rules
4		4		pedestrian's fault
50385	34488	15773	124	total

Table 4. Number of accidents caused by various vehicles in Tehran in 2015

Peugeot			Samand			Perayd			
Injured	Killed	Damaged	Injured	Killed	Damaged	Injured	Killed	Damaged	
35	1	117	5	0	19	22	1	40	Travelling above the speed limit
47	0	95	9	0	13	30	0	87	Passing zone violation
5	0	32	1	0	10	2	0	18	Mechanical failures
1	0	3	1	0	1	2	0	3	Equipment failures
76	0	1027	7	0	266	75	0	464	Tailgating

Iran's automobile industry is the second largest industry of the country after petrochemicals and the 11th largest automaker in the Middle East. According to the World Bank, it accounts for 10% of the country's GDP and 4% of the workforce. Two major car manufacturers named Iran Khodro and Saipa are accounted to produce nearly 91.6% of total Iranian domestic production in 2015. In this study, the Samand car which is an Iranian national car is chosen from Iran Khodro Company. Samand is the first car which was released with a symbol of the Iranian Car Company and Iran Khodro Samand, meaning fast horse, was created in the company. Although the standard Samand had some safety issues, such as poor driver visibility because of the small rear window area and tiny and high placed rearview mirrors, it benefits from advantages such as high safety due to the strong body, suitability for use inside and outside of the city and considerable space inside the trunk, and especially after optimization of the Samand SE, has made this car one of the most popular cars in the country with a suitable price. Statistics show that among cases of accidents that occurred in Tehran province during the first 9 months of Iranian year 1394, which is 2015, by 3 different types of the most common Iranian cars, Samand didn't have an accident that led to death. Moreover, the rate of accident-caused injuries and damages during a car crash was lower in Samand.

2.2. Technology

2.2.1. Anti-fatigue alarm

According to reports around 20% of deadly road accidents involve driver fatigue (Van Elslande, 2013). In Iran this factor has a very high negative impact on drivers and road accidents because the driver wants to reach his destination as fast as possible, so that most of the time it leads to other human errors and dangerous factors on roads, such as using high speed and travelling above the speed limit due

to tiredness. So anti-fatigue alarm technology is needed to inform drivers before they fall asleep at the wheel or before they lose their consciousness in their vehicles and on the roads. This device has warning signals in two dangerous situations: when drowsing off or when there's a reduction of reaction. The anti-fatigue alarm takes 3–5 minutes to measure a driver's present brain activity and then their tiredness is approximated from this level. Drivers can put it on before they drive and it doesn't need to drive a particular number of miles. The anti-fatigue alarm controls the level of driver's reaction and it is even helpful for short distances. The anti-fatigue alarm has been studied and examined as to whether it decreases the risk of accidents by the National Scientific Research Centre (CNRS) in France. The results of this study have proved the success of the device in warning at two levels in commencing signs of drowsiness and reduction of reaction (Van Elslande et al, 2013).

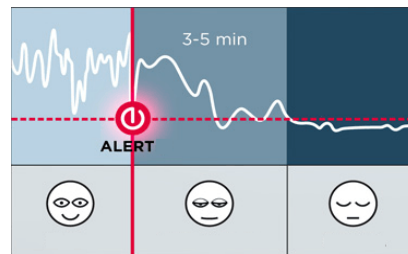


Fig. 1. The function of the device (Van Elslande et al, 2013)

2.2.2. Euro NCAP Program

The EURO NCAP program is a new car assessment program whose target is expressing and calculating newly produced automotive technology and design against several menaces. This is a standard test for any car to measure its minimum safety and technology, and it is now run by the European commission.

As it is mentioned, in Iran most of the vehicles lack minimum safety facilities, thus car makers should make at least minimum safety and ergonomic facilities to test their products and should participate in this program in order to have their new products checked and measured for their safety and technology.

The minimum safety components and technology for any newly produced car are the following:

- visual aspect,
- air Bags and air bag warnings,
- comfort, usability of seat belts and automotive seat design for sitting comfort,
- collision avoidance system,
- traction control system,
- brake assist system,
- vehicle interior, controls and pedals-physical aspect of car design (Van Elslande, Fouquet, 2015).

2.2.3. AEB Test

There are several tests done by Euro NCAP program. AEB test is one of them and it is a good way for Iranian car manufacturers to get their new-born products in there to measure brake systems for their safety and design functions. Research shows that 90% of road crashes are caused by drivers who are distracted or unaware. AEB systems decrease car crashes by up to 38% and lead to a considerable reduction in injuries. The aim of this test is to reduce accidents and deadly fatalities, and it is divided into two categories to reduce accidents. The first one is the 'AEB City' category, it works at low driving speeds and aims at decreasing rear-end shunts mostly connected with whiplash neck injuries. The second category, 'Inter-Urban AEB,' works at higher speeds and focuses on deadly and serious injury crashes that might be caused by driver heedlessness or distraction. An AEB system might be projected to work just at low or high speeds, or might work in both conditions. Euro NCAP uses a braking robot that responds to the signal and alarm in the same and exact way as a driver, to ensure a good repeatability of the tests. Those cars which have a tendency to travel at closer distance in slow traffic which cuts down the driver's ability and capability to prevent a crash at the last minute. Consequently, the Euro NCAP concentrates on the automatic braking performance in its AEB City tests up to 50 km/h. There is mostly an adequate time for the driver to take action to prevent the crash at higher driving speeds. Moreover, the second category mostly provides a Forward Collision signal function with an increased braking function, which can be supplemented with an automatic brake function, in case the driver does not react to the signal. Euro NCAP evaluates the system function, in both where the driver brakes and where there is no response to the alarm and signal for their ability to prevent and reduce crashes and accidents up to 80 km/h (Vinay, 2008).

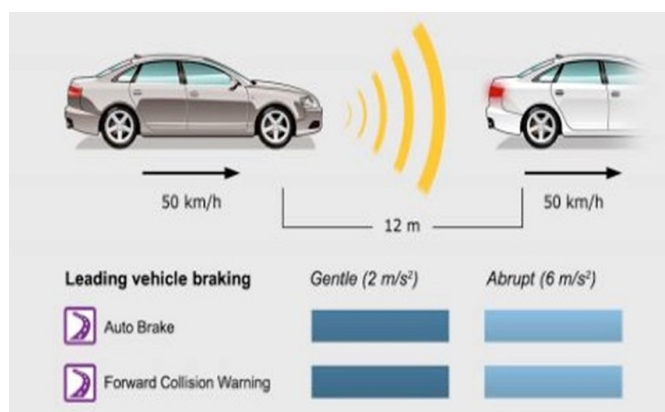


Fig. 2. Mercedes Benz E Class tested by Euro NCAP for its pre- safe brake in 2013 (Vinay, 2008)

2.2.4. Performing cultural and road traffic safety program

As it has been mentioned not only are Iranian cars different than foreign-built cars, but also the driving culture in Iran is different. So dealing with road casualties, an adequate cultural and road traffic program is needed to be implemented to reduce or maybe eliminate the roots of road accident fatalities. First of all, manufacturers must improve their product's qualities such as safety design and the government must let foreign-built cars enter the country. This situation will create a competition between domestic products and foreign products and domestic manufacturers will have to improve the quality of their products and stop overproduction with inadequate attention to safety and ergonomics in order to stay in the market. Meanwhile, any vehicles with a lack of safety standards must be removed and must be given a number as a low quality car. After this process, car manufacturers must promote the quality of their products according to the world's standardizations in safety. Although this issue will cost people more expenses to buy a new car, manufacturers can offer and sell their cars in installments.

Secondly, tight traffic regulations and controls must be implemented due to traffic offences and violations, because in Iran those who violate safety and traffic regulations are imposed to pay a fine which has no effect on their life and behavior. Therefore, this issue leads them in the way that they put not only their lives but also other road user's lives who obey the rules in danger. So, police with implementing tight traffic regulations and controls can reduce traffic offences with imposing heavy fines for the ones who travel above the speed limit for the first time and if they repeat it for the second time then their driving license will be taken away and their cars will be stopped for 3 months and driver will be detained. Also other preventive actions must be taken by traffic officials such as imposing heavy fines on road traffic offences such as passing zone violations. Also, setting up proper speed limits, creating programs to make drivers aware about speeding-related safety issues, using traffic control devices for enforcing proper speed and having appropriate and safe roadway design can help deal with the problem.

After all, these methods will need to be implemented by authorities for a period of 10 years. In fact, using these methods, improving road safety culture and safety implementation programs are priorities. By creating and using these programs, a huge number of road traffic fatalities will be reduced and this matter won't take place without great cooperation among authorities, manufacturers and people.

3. DISCUSSION AND CONCLUSION

Accidents today are among the leading causes of death in some cases, and the number one cause in many parts of the world, particularly in the more highly industrialized nations" (Reason, 2016). In 2011, over 30,000 people died on the roads

of the European Union (Saad, 2014). And the World Health Organization (WHO) reported in 2012 that Iran had the highest number of deaths caused by road accidents in the world. Road accident (ROSPA, 2011) which Every year, nearly 28,000 people are killed in Iran by road traffic accidents, and 300,000 more are injured or disabled (Rensink, 2012). As was mentioned, traffic accidents are divided into categories and the majority of road accidents are due to human error. Research has proven that driver error accounts for over 80% of all deadly and injury-associated crashes on Irish roads (Olarte, 2011) that human errors are caused by various factors which some of them represented in this thesis as musculoskeletal disorders due to long term driving and fatigue which A 2006 study discovered that over 14 million British drivers, nearly half of British drivers were sustaining (Repetitive Driving Injury) (Jamroz, Smolarek, 2013) and Around 20% of deadly road accidents involve driver fatigue (Autodriver club, 2016). Another one of the represented factors was driving speed and according to NHT SA speed was a helping factor in 30 percent of all deadly crashes, and 10,219 lives were lost in speeding-related crashes (Leplat, 2015). In Iran around 25% of fatalities are caused by not wearing safety belts in vehicles and not using safety helmets in motorcycles (CNRS, 2015) and 14,748 mobile offences around 13% were recorded by the police in 2014 (Leplat, 2015). The mentioned factors were caused by human errors, which are the main reason for any car crashes. Moreover, some solutions were introduced to deal with human error such as technologies, programs and guidelines, for example, the Stop-Sleep device, to tackle fatigue, Stop-Sleep has been studied and examined towards its ability to decrease the risk of accidents by the National Scientific Research Centre (CNRS) in France (Parker et al, 2014); designing intelligent steering wheels and following guidelines to prevent fatigue while driving; performing highway safety programs to decrease deadly and severe injury traffic accidents caused by speeding or inappropriate speed; and using safety belt reminders to avoid injury. The second problem in car crashes, in the second category, is caused by equipment failure or poor vehicle safety in which poor ergonomics may not directly cause the accident, but operators or drivers might take the wrong action to correct the inceptive cause (Payvand news, 2012). Equipment failure accounted for less than 5% of all motor vehicle accidents (Rasmussen, 2011) and mechanical failures are a factor in 12% to 13% of all car accidents caused by unsuitable vehicle maintenance (Parker et al, 2014). The number of people who were killed in road accidents was over 140000 between 1998 and 2005 according to the DMV of Iran. Dealing with such a problem, car manufacturers have to make their products ergonomically designed and they have to pay more attention to vehicle safety such as designing ergonomic brakes with a good distance, smart steering wheels, equipping cars with airbags, ergonomic seats and so on to decrease the risk of accidents and injuries. In this matter Euro NCAP is made to check out any vehicles for their safety and technology and vehicles are given marks and scores by Euro NCAP to ensure customers that the cars they use or they want to buy are safe to be used on roads. There are many safety tests conducted by Euro NCAP such as ABE tests,

whiplash tests and so on. This study showed that the overproduction of cars is one of the main reasons of car accident fatalities in Iran these days and it caused the situation that quantity got more important than quality due to not paying enough attention to vehicle safety and ergonomics by Iranian manufacturers. Therefore, this problem can have a direct effect on increasing the rates of death and injuries during accidents. In fact, poor vehicle safety can have a fundamental role in car accidents. The higher quality of car production leads to less people being hurt in a car accident. In this study, the Samand car was chosen and statistics demonstrate that it didn't have an accident that led to death. Moreover, the rate of accident-caused injuries and damage during a car crash were lower than for other types of common cars in Iran. It illustrated that Iran Khodro is trying to decrease vehicle safety issues, especially on Samand by considering ergonomic standard methods and making its products ergonomically designed.

The lack of safety culture is another main reason of road traffic fatalities in Iran. In fact, driver faults by ignoring road traffic safety regulations, doing dangerous actions while driving and not paying adequate attention to other road users have made the situation in road traffic fatalities much worse. Also, road users must pay more attention to the general understanding on roads, follow implemented road traffic safety regulations and avoid dangerous actions to decrease fatalities and severe injuries. It is going to be hopeful for Iran's future in this matter if all Iranian manufacturers stop their over-production of cars and try to focus on safety and ergonomics with increasing safety culture among Iranian people and also increasing the cooperation of authorities and people on Iran's roads. As a consequence, the number of fatalities will be decreased, impressively.

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PRZYCZYNY WYPADKÓW DROGOWYCH W IRANIE

Streszczenie

Celem tego artykułu jest omówienie czynników ludzkich i zagadnień bezpieczeństwa w wypadkach drogowych w Iranie oraz zmniejszenie strat, obrażeń i szkód przez poprawę kultury bezpieczeństwa i stosowanie nowych technologii. Obecnie co roku na świecie blisko 1,24 miliona osób umiera w wypadkach samochodowych. Wypadki samochodowe można podzielić na trzy podstawowe kategorie: 1 – wypadki spowodowane błędami ludzkimi, 2 – wypadki spowodowane awarią sprzętu i 3 – spowodowane złymi warunkami drogowymi. Projektowanie bezpieczeństwa i poświęcenie odpowiedniej uwagi czynnikowi ludzkiemu mogą wyeliminować przyczyny śmiertelnych wypadków, urazów i chorób układu mięśniowo-szkieletowego. To może zmniejszyć straty ekonomiczne spowodowane niepełnosprawnością spowodowaną wypadkami. Iran jest jednym z krajów o wysokim wskaźniku wypadków spowodowanym kulturowymi postawami wobec przepisów drogowych, złym stanem bezpieczeństwa i obiektów. W tym artykule omówiono irańskie przedsięwzięcie motoryzacyjne Iran Khodro, w którym przeanalizowano aspekty dotyczące bezpieczeństwa, czynników ludzkich i produkcji. Ponadto niektóre metody i rozwiązania stosuje się w Europie, aby zająć się błędami ludzkimi i brakiem bezpieczeństwa, np. z użyciem technologii urządzeń zmęczeniowych. Dzięki temu kierowcy mogą bezpiecznie jeździć samochodem, wybierając bezpieczne samochody, przeprowadzając testy w programie Euro NCAP w celu zmniejszenia możliwości wystąpienia awarii, zmniejszenia liczby ofiar śmiertelnych i urazów oraz poprawy ogólnego bezpieczeństwa na drogach.

Słowa kluczowe: wypadki drogowe, błędy ludzkie, awarie urządzeń