

Driver Fatigue Detection and Warning System in Road Freight Operation

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Abstract: Driver fatigue is a common phenomenon among road freight drivers. This could have potentially serious consequences for them if they are not aware of it. Some possible fatigue detection and warning technologies provide a possible solution for road freight operators. Taking this into consideration that the road haulage industry in the UK consists of small, medium and large sized operators, this paper aims to identify these groups their awareness regarding this technology, the appropriation of this technology will be for road freight area and the attitudes of them see a long term need to invest in such a technology. Moreover it investigated their attitudes to such technology varies by size of operator.

Keywords: road freight; fatigue; detection and warning system

1. Introduction

Almost over the past three decades, great changes have taken to UK road haulage field. It resulted in an increasing the number and size of road haulage firms, which implies an increased use of logistics governing operations. However, as ITF reported in their information sheet (2003) such changes hit the driver hard. Standard tariffs for haulage have been abolished in favour of competition, which has led to reduced wages and conditions for drivers, and increased hours.^[1]As a result, working time becomes one of the basic economic inputs to transport. Therefore, driver fatigue is a frequent issue in road freight operation.

2. The Road Freight Driver Fatigue Problem

Fatigue is a widespread problem, which can affect any driver but people who drive as part of their job especially road freight drivers are deemed to be at the highest risk. As working long hours, working at night, working irregular hours, and early starting times are often common work practices, thus fatigue is a common issue among road freight drivers. In order to predict or avoid an accident caused by driver fatigue, there are a number of fatigue countermeasures presently available including legislation, management of employer, education, road design, fatigue monitors, stimulants and auditory input.

3. Review of Technologies

Over the last decade, transport industry has gradually become an essential user of telematics applications, which unites modern information and telecommunications technologies to realise the huge potential of the information society. These tend as well as the appearance of driver fatigue issues enable to develop the technology on detecting driver's fatigue. As such this technology at first has taken place in US and then it developed in

Europe and Australia.

Recently, possible technologies for detecting drowsiness in drivers can be generally divided into: sensing of physiological characteristics, sensing of driver operation, sensing of vehicle response and monitoring the response of driver. According to Dinges and Mallis's research, they summarized such technologies into 4 classes:

- (1) Readiness-to-perform and fitness-for-duty technologies;
- (2) Mathematical modal of alertness dynamics joined with ambulatory technologies;
- (3) Vehicle-based performance technologies, and

In-vehicle, on-line, operator status monitoring technologies^[2]

4. Methodology

A number of driver fatigue detection and warning technologies are currently designed for reduce the risk of road accidents caused by sleepiness. As one of the major sectors for the reduction in the transport, road freight may be disproportionably affected by fatigue problems due to the demands on professional drivers. In this case, it was decided to determine whether such technologies are appropriate for road freight transport and the resulted answers of the questionnaires would indicate whether operators see a long term need to invest in such technologies.

The survey concentrated on operators of UK's road-freight, and a mail questionnaire was adopted. The population of the sample is been estimate by the website: www.roadhaulage.com which listing the road haulage companies in the UK. Therefore, the population size N is 2953. The population number is not large enough, therefore, in this case, the equation for estimate the sample size n is chosen: $n = \frac{z_{\alpha/2}^2 S^2}{e^2} + \frac{z_{\alpha}^2 S^2}{N}$, where $S^2 = N/(N-1)p(p-1)$. The author plan to take a simple random

sampling of the $N = 2953$, and the author want to use a 95% confidence interval with margin of error 0.03. Therefore, the sample size $n=784$.

For a survey of this nature a sample size of between 200 and 300 has been found to give statistically significant results. The author's expect response rate was 15%; therefore, a sample size of 250 was used for the survey.

5. Statistical Analysis of the Survey

By posting 250 surveys with 4 parts and a total of 23 completed questions to a selected larger group a response rate of 28% was achieved as 67 operators sent back. Most respondents are road general haulage companies, which were assumed that this type of transport companies would be in need of some type of driver fatigue detection and warning system. Most of the companies have their business mainly in UK and Europe. This indicates that drivers usually have a long distance drive task when they are working. The 67 respondents are divided into three types by fleet size. There are 26 small fleet size respondents, which have less than 10 vehicles, 29 medium fleet size respondents, which have 10 to 50 vehicles, and 12 large fleet size respondents owning vehicle more than 50. It assumed that the attitude of operators to adopt the driver fatigue detection and warning system is related to the fleet size of the company. The status of choosing the sample is shown as the table1 below:

Table 1. Status of choosing the sample

Study area	Sample size
The North	50
The Midlands	50
East Anglia	10
The South	50
Southeast	25
Southwest	25
London	40

These above sample contained different types of road haulage companies including general haulage. International haulage, light haulage, heavy haulage, express, storage and warehousing etc and different fleet size.

5.1. Analysis of Small Fleet Size Respondents

The data indicates that this group consider the driver safety as their most important characteristics of their operating. Therefore, there are 19 operators think driver fatigue problem is serious. Because they obey the EU law which regular the driver's working and driving time. Therefore, the working time and driving time in this group a reasonable. Comparing to the medium fleet size respondents and large fleet size respondents, the average working and driving time is the shortest.

However, the knowledge of the operator on telematics

technology is low. Mobile communication is the most common technology for this group fleet vehicle. This result indicate that due to the small scope of economic of this group, they more concern the telematics technology like mobile communication which contribute to more profit for them. Driver fatigue is not a very emergency problem. So, 16 operators (61.5%) previous do not know the driver fatigue detection and warning system. Only 10 out of 26 operators have the trust that such technology may benefit to the road freight industry.

To expect the prospect of the driver fatigue detection and warning system in road freight area, willing to pay is consider one of the essential issues. Only 6 operators (23.1%) operators would pay for this technology to be installed in their fleet vehicle. If not consider the current cost of the technology, still only a few operators (8 operators) are interested in paying for it. However, for a long time consideration, if the technology evolves into a low cost, "mass market" technology for fleet vehicle, more than half of operators likely adopt it. It shows the potential that driver fatigue detection and warning system may be acceptable due to lower the price to this group in the future. At this point, small operators may interest in such technology in the future.

5.2. Analysis of Medium Fleet Size Respondents

The data shows that this group also consider the driver safety as their most important characteristics of their operating. Therefore, there are 16 operators think driver fatigue problem is serious. The drivers working and driving time also reasonable. But compare to the other two types of companies, drivers have the longest working and driving time. The result indicates that drivers may more often suffer from fatigue in this group.

Result shows that operators in this group show more interest in the application of telematics to improve their service for they adopt most of the telematics technologies to their fleet vehicles. 2 medium sized companies have already adopted a drowsy driver detection system.

The results shows that still only 6 operators (20.7%) operators would pay for this technology to be installed in their fleet vehicle. However, if not consider the current cost of the technology, 15 operators are interested in paying for it and for a long time consideration if the technology evolves into a low cost, "mass market" technology for fleet vehicle, almost 20 operators likely or very likely adopt it. They result indicates that the technology has a great potential in medium fleet size companies in the future. However, the price is the main constraints for them to adopt this technology.

5.3. Analysis of Large Fleet Size Respondents

Large fleet size companies also consider the driver safety as their most important characteristics of their operating. But only 3 operators think this is a very serious problem. It indicates that driver fatigue is not really an emergent

problem at the moment for the large sized company that they should pay a lot of attention to. In addition, only 1 accident happened by fatigue in this respondents group in the last operational year. Therefore, most of the operators think driver fatigue issue is not serious for road freight operation.

Result shows that mobile communication is the most common technology to them. No companies adopted drowsy driver detection. Therefore, 41.7% (5 operators) didn't know this technology before. And still one third think this will benefit to their operation.

For the willing to pay, results shows that only 3 operators (25%) would pay for this technology to be installed in their fleet vehicle. However, if not consider the current cost of the technology, 6 operators are interested in paying for it and for a long time consideration if the technology evolves into a low cost, "mass market" technology for fleet vehicle, almost 7 operators likely or very likely adopt it. They result indicates that the technology has also a great potential in large fleet size companies in the future. However, the price is the main constrain for them to adopt this technology.

5.4. Interpretation of Results

The previous phases present the findings of the each group in this research. However, the most important comments were grouped and stressed. Therefore, the following phases are trying to interpret the major findings of operators investing on the driver fatigue detection and warning system by gathering the findings of each group.

If only considered the function and advantage of this technology, the three groups all seems less interesting in adopting such technology, there are around 20% of each group who seem willing to pay for such technology to be installed in their fleet vehicle. One of the reasons this figure may be is low, is that there are lack of current products of this technology available in UK market. Operators have no conception of the price on this technology. They do not want to invest money on such technology.

Moreover, the Drowsy driver problem is not perceived as a serious enough threat to their operations. Each of these three groups has reported few accidents related by driver fatigue in the last year, and of the accidents reported no fatalities have resulted. According to the comments given by companies, one of the company believe that unless the fitting and use of such equipment were subject to legislation, then the take-up would be very low. And another one of the companies said that fatigue problem is not a big problem now. However, if it was a serious problem, i.e. 2-3 accidents a year attributed to driver fatigue, they would look at ways to reduce it.

Further more, these road freight companies are already subject to restrictive drivers' hours and working time directive by EU, which limits the driver hours, worked to

48 hours.

Therefore, only consider the function and advantages for such technology; it has very small potential in road freight industry.

However, cost is a very important component to be considerate. Most of the customers choose a road haulage company first by considering the cost and then the quality of service. The current cost for such technology is really high, like mobile phone when they appeared at first. By asking them if irrespective of current cost of the technology, the attitude of operators shows different in different fleet size.

As small fleet size company, still 16 operators (61.5%) are not interested in such technology. One of the reasons is that smaller companies have very small budget for operating and investment even if do not considered the price. The function of drowsy driver detection is not as important as, for example mobile communications. Moreover, to adopt such technology may not increase profit of their operation. Therefore, the small group is still not interested in adopting such technology.

In medium and large fleet size companies, more than half of the respondents indicated willingness to pay for such technology. Quality of service is one of the important characteristics for such scope of companies. In addition, they have more budgets for operating than small fleet size companies and they have more demanding customers which more complicated needs. Therefore, on time delivery gives driver more pressures. If not considering the price, in order to improve their service, they would like to adopt such technology.

For future consideration, if the technology evolves into a low cost, "mass market" technology for fleet vehicle. These three groups all seem more interested in providing it. There are 13 out of 26 operators of small fleet size companies would likely to adopt it, and 1 operators is very likely to adopt it. 20 out of 29 operators of medium fleet size company would possibly provide this technology which includes 12 operators being very likely to adopt it. Moreover for large fleet size companies, 7 out of 12 operators are likely to arrange it into their fleet vehicles. The results still shows that operators in small companies still pay less interesting in adopting such technology.

As far as the development of this technology in the future is concerned, the results indicate that operators think that driver fatigue detection and warning system will have its market in medium and large scope of road freight industry if the price is down and "mass market" technology for fleet vehicles.

6. Conclusion

According to the research, the key findings are highlighted as following:

(1) Road freight companies considered driver safety very important characteristics of them. However, drowsy

driver problem is not a serious problem in road freight companies' operation.

(2) Operators show little interest in this technology if only considering its function and advantages.

(3) If current costs are not considered, medium and large fleet size companies may be more interested to provide it.

(4) For a long-term consideration, if the technology evolves into a low cost, "mass market" technology for fleet vehicle, more than 50% of the respondents would like to adopt this technology.

Therefore, the research created the opportunity for further investigation of the road freight operators' attitude and perception towards driver fatigue detection and warning system and its use. Finally, it would be very interesting to categorize the road freight transport into professional transport companies and logistics companies in the further study. Furthermore, China would be a very

interesting study area for the future research.

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