WRITING A HANDBOOK OF VEHICLE SAFETY MEASURES

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ABSTRACT
This paper describes the development of a handbook intended to increase the common Chinese knowledge of safety features in today’s cars. The handbook is the result of the joint effort of China based CATARC and Autoliv China as well as Sweden based Chalmers University and Autoliv Research. The origin and basis of the handbook is the master thesis work by the Chalmers student Jing Li.

It is known from the introduction section that road traffic safety is a big issue at global levels for it is a leading factor for fatalities. The problem in China is serious since the number of vehicles on the roads grows fast, which means it is more likely to be exposed to road accidents and the safety countermeasures and people’s safety awareness fail to catch up with the increasing traffic. This project work is done following the methods of literature review, telephone interviews with Chinese people, accident data research, and Madymo simulations for common but dangerous situations. It is to combine the techniques and the real situations, which are totally different from Sweden, to make the techniques serve more people. Through these methods, the handbook of vehicle safety measures is developed.

1 INTRODUCTION
Thousands of people are injured and killed on the roads every day. Those people who never will return home do leave shattered families and communities behind. Each year, millions of people spend long time in hospital after road accidents and many are not able to work and live as they used to. It is a global phenomenon that road accidents result in the growing problem of fatalities and injury. WHO (World health organization) predicts that road traffic injuries kill nearly 1.3 million people annually. If current trends continue, road crashes are predicted to become the fifth leading cause of death by 2030. The fact is, over 90% of the world’s fatalities on the roads occur in low-income and middle-income countries, which have only 48% of the world’s registered vehicles [1].
China has been experiencing the fast growth of urbanization and motorization along with the rapid development in economy. From the year 1980-2005, the overall GDP increased by around 10% per year and the urban population increased by three times with more rural people moving to the city. Meanwhile, the number of motor vehicles increased 18 times with the number of drivers increasing 33 times. Because of the improved motorization and road infrastructure, road transport has kept rising since 1980. The share of passenger/km on highway rose to 53.2% in 2005 compared with 32.0% in 1980. The share of freight/ton·km rose to 10.8% in 2005 compared with 6.4% in 1980 [2].

In China, the prevention of injury and death in road accidents turns out to be a big issue. It is announced that road traffic injury was the leading cause of death for people at the age up to 45 and it is also the leading cause of losing years of working life. The Chinese drivers concentrate more on driving skills and capabilities rather than practical safe-driving guidelines. A survey on driver’s views and behaviors about safety in China was done in 2005 and the results show that running-light use is nearly zero during rainy and snowy weather, headlights use after sunset is substantially delayed, and only about 40% of drivers use turn signals to indicate their intention to change lanes [3]. Roadside observational surveys on seat belt wearing in two cities including Zhoushan and Nanjing in 2005 showed that occupants to a large proportion do not wear seat belts. Table 1 demonstrates the seat belt wearing situation in China.

Table 1: Interviews and observations on seatbelt wearing [4]

<table>
<thead>
<tr>
<th></th>
<th>Driver</th>
<th>Front passenger</th>
<th>Rear passenger</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviews</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Always wear</td>
<td>920</td>
<td>70.7</td>
<td>158</td>
<td>27.4</td>
</tr>
<tr>
<td>Sometimes wear</td>
<td>275</td>
<td>20.8</td>
<td>218</td>
<td>37.8</td>
</tr>
<tr>
<td>Never wear</td>
<td>110</td>
<td>8.4</td>
<td>201</td>
<td>34.8</td>
</tr>
<tr>
<td>Total</td>
<td>1315</td>
<td>100.0</td>
<td>577</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Observational survey

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearing</td>
<td>20,229</td>
<td>56.7</td>
<td>1309</td>
<td>8.8</td>
<td>51</td>
<td>0.5</td>
</tr>
<tr>
<td>Not wearing</td>
<td>13,557</td>
<td>38.0</td>
<td>13551</td>
<td>91.1</td>
<td>10923</td>
<td>99.5</td>
</tr>
<tr>
<td>Pretend/tampering</td>
<td>1873</td>
<td>5.3</td>
<td>16</td>
<td>0.1</td>
<td>5</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>35,659</td>
<td>100.0</td>
<td>14876</td>
<td>100.0</td>
<td>10979</td>
<td>100.0</td>
</tr>
</tbody>
</table>


Modern auto safety technologies are developing rapidly in China, while it is rare with knowledge transfer from experts to end-users on how these technologies work efficiently. Lots of auto safety products in real life are genuine furnishings. The objective of the handbook is to educate ordinary people from the outside as a user, not just from the inside, as an engineer. By acquiring knowledge of vehicle safety, the public will increase their safety awareness and learn how to use safety systems for self-protection.

2 METHODOLOGY

It took nearly 2 years to finalize the whole handbook work, which experienced rising of ideas, survey before draft, draft composing, survey after draft and manuscript finalizing. The basis of the handbook being the master thesis project took half a year.
2.1 Survey before draft
Before the draft, a literature review was done to acquire knowledge about the most common and advanced safety systems at present. Twenty participants aged between 30 and 45 were chosen for the telephone interviews, since they are the target group who is more likely to possess the advanced vehicles installed with more intelligent systems due to their economic levels and social status, and who concern more about the safety features of vehicles. According to their education and similarities, a questionnaire with five questions was designed to survey on how much they know the safety systems, what they want to know and the attitude to a possible handbook.

2.2 Draft composing
The draft handbook consisted of five main parts: (1) Explanations on positions of systems’ hardware and functions of systems with pedagogic figures; (2) Statistical results of typical road accidents; (3) Safety products working mechanisms and how people behave following these mechanisms; (4) MADYMO simulation of two hazardous situations in frontal collision; (5) Introduction of advanced safety systems. In parts (1) and (2), the chosen safety technologies were grouped by passive and active safety. The input from Chinese citizens and from non-engineering experts has contributed to the outline of the content, which made it more understandable and acceptable to the public.

2.3 Survey after draft
After the draft, more than 20 drafts were sent to persons from all kinds of fields, who were asked to finish a questionnaire after reading the draft handbook. Lots of constructive feedbacks were gained. Some of the suggestions can be summarized: (1) outline was not clear; (2) it was too technological to classify the safety products into passive and active groups; (3) more safety measures should be introduced; (4) real accidents were preferred to state the importance of various safety measures.

2.4 Manuscript finalizing
According to the feedback in section 2.3, the finalized handbook is now employed a blueprint of a Shanghai ordinary family, for which auto use can be generally divided into: (1) home-office-home in work days, and (2) family touring in weekends/holidays. Auto safety technologies are introduced based on the various circumstances. 19 auto safety technologies are contained, which relate to safety measures on ordinary roads, highways, country roads as well as safety technologies for daytime, night and rough weathers.

Five real-life accidents are shared to state how seatbelt (SB), lane departure warning system (LDWS), electronic stability control (ESC), anti-distraction detection system (ADDS) and night vision system (NV) to mitigate/avoid fatalities and accidents.
3 RESULTS
As integrity, the handbook contains six parts: cover, preface, auto use in workdays, auto use in holidays, typical accident analysis and postscript. See appendix for the cover design.

3.1 Auto use in workdays
Eleven safety measures are introduced in this section. Two main lines, home-to-office and office-to-home, are employed (Fig.1).

(1) Home to office, the related safety products in sequence are seatbelts, airbag, park & cross traffic assistant system (Park&CTA system), adaptive cruise control and queen assistant (ACC&QA), blind spot detection (BSD), road sign detection (RSD).

(2) Office to home, the related safety products in sequence are lane departure warning system, forward collision warning and brake system (FCWB), anti-whiplash seat, night vision and alcohol detection system (ADS).

![Fig.1 Technologies introduced in section: auto use in workdays](image)

3.2 Auto use in holidays
Eight safety measures are shared in this section. It is assumed that the whole family travels by self-driving. Compare to workdays, travelling route could be new to the drivers, which some of auto safety products are especially important in this situation. Similarly, two lines, home-to-scenic-spot and scenic-spot-to-home, are employed to organize the words (Fig.2).

(1) Home to scenic spots: this is started by child restraint system (CRS), followed by child safety lock (CSL) and brake control system (BCS).

(2) Scenic spots to home: drowsy detection system (DDS), tire pressure detection system (TPDS), adaptive headlight system (AHLS), vehicle light source recognition system (VLSRS) and emergency rescue system (ERS) are included.
It is vital to employ a popular and interesting way to state the knowledge of safety technologies to ordinary users. In the handbook, normally each measure includes 3 aspects of knowledge: function mechanism, knowledge sharing (if available) and attentions (if available). Seatbelt is shown here as an example:

(1) Function mechanism
This section shows the readers where they can find the seatbelt and how to fasten seatbelt correctly as well as the function of height adjustor, see Figure 3.

(2) Knowledge sharing
History of seatbelt, statistical results of seatbelt efficiency and clarification of some misunderstanding are included in this section. Some adverse facts are shown to tell users the importance of seatbelts in real accidents (Fig.4).
(3) Attention
This section summarizes some examples of wrong seatbelt usage in real-life (Fig.5). It is shown that rear occupants are rarely buckled up in China. Simulation results are employed to express the injury risk of rear occupants without seatbelt (Fig.6).

3.3 Real-life accident analysis
Five real-life accidents from China In-depth Accident Study (CIDAS) database were analyzed. Accident process, accident cause, injury severity and so on are contained to show what can be learnt and what kind of measures can be applied to avoid/mitigate accident severity. The five sampled accidents are proposed to underline the importance/function of seatbelt (case1), blind spot detection system (case2), brake control system (case3), drowsiness detection system (case4) and night vision system (case5).

Case1: Unbelted 15-year-old girl was thrown out from a small MPV in a side collision;
Case2: Non-attention to following traffic when changing lane caused severe car damage and serious injuries;
Case3: Emergent avoidance maneuver at high speed resulted in father and old-brother’s death;
Case4: Fatigue driving caused three trucks rear end collision and one fatality
Case5: Fatal pedestrian accident in the dark night.

4 DISCUSSION
Before 1988, there was almost no national traffic accidents inspection system in China. Traffic administration of ministry of public security was found to inspect and collect the national wide traffic accidents since 1988. Since 1993, an annual report named “Statistics of road traffic accident in People Republic of China” has been published, which became the only way to learn about the road traffic accident data of China. However, the information provided by the annual report is not suitable for in-depth accident analysis. Since 2005, regional accident investigations are carried out in the many cities, for example in Shanghai and Changsha. In 2011, the China In-Depth Accident Study (CIDAS) project was kicked off by the support of auto suppliers, OEMs and government departments. For the 1st phase (2011~2014), 500–700 annual traffic accidents will be on-scene investigated in 5 cities from north to south China. About 1000–2500 items of information were recorded in a special database, from which the five typical accidents analyzed in this handbook were sampled.

Previous study shows that lots ordinary occupants and car users in China have no/limited knowledge on how to use the equipped technologies. Let’s take influence on seatbelt for example. Lots of wrong awareness was summarized [5]: seatbelt is only used on highways, it is unnecessary at city speed; seatbelt is useless in case of airbag existence; rear seats is safer such that they didn’t need to use the seatbelt. Observational study shows that the current usage of child restraint system is less than 1%. Lots of people regard that adult’s embrace is safe enough for baby travelling on vehicle. In China, when people come to a store to buy a car, sales consultants will boast all of the available products/technologies. But they seldom explain how the products/technologies works and why we need them.

When it comes to distribution of the handbook, cooperation with CATARC (China Automotive Technology and Research Center) has been established. CATARC is the most influential vehicle safety organization in China and will be an ideal partner to work with. They have a range of offices in cities all over China. They are well known to the Chinese public and people in China have confidence in the organization. Thus, success in getting the certification both on the handbook and the cooperation from CATARC means that the handbook will reach more readers and help more people in their daily life. Some of OEMs are also shown their interest in distribution of the handbook. Discussions are ongoing for joint distribution.

5 CONCLUSION
Many of the Chinese drivers have Buddhist or good luck symbols in their cars. They believe their ‘good luck’ rather than scientific technologies. This phenomenon is partly caused by regional culture, but most importantly lack of education. The handbook described in this paper is a good way to deliver the knowledge of technologies but also good driving behaviors.

This handbook is based on a master thesis work, with great support from car safety component supplier, university, car technology research institute, which make the content not only professional but also easily understood.
The key issue is how the handbooks can be distributed and finally benefit the end-customers. As we stated in the DISCUSSION, for the first step, cooperation with CATARC is fixed, by which the handbook is decided to distribute to new drivers in driver schools and accident vehicle drivers by CIDAS project platform. The interested OEMs provide us another option to distribute the handbook in their ‘4S’ stores, but this is still in negotiation. However irregular distribution by granting to special group, such as students, professional drivers is still in consideration.

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REFERENCES

Appendix – The cover page of the handbook to be distributed with start 2013