July 20, 2001

Mr. L. Robert Shelton III
Executive Director
National Highway Traffic Safety Administration
U.S. Department of Transportation
400 Seventh Street, SW
Washington, DC 20590

Ref: **Interim Report of the Committee for the Study of a Motor Vehicle Rollover Rating System**

Dear Mr. Shelton:

This letter constitutes the interim report of the Transportation Research Board Committee for the Study of a Motor Vehicle Rollover Rating System. This committee was convened in response to a request from the Congress asking the U.S. Department of Transportation to fund a study by the National Academy of Sciences on motor vehicle rollover. The main objectives of this report are (1) to present the committee's preliminary findings and (2) to identify outstanding issues that the committee intends to address before issuing its final report at the end of the year.

The National Highway Traffic Safety Administration (NHTSA) has studied motor vehicle rollover for more than 30 years, with the aim of finding ways to reduce the numbers of fatalities and injuries sustained in rollover crashes. A number of related rulemaking proposals have been issued by the agency, starting with a 1973 initiative to develop a standard for rollover resistance. Subsequent proposals have addressed the provision of consumer information, as well as options for a rollover standard. Aside from a requirement for a rollover warning label in some utility vehicles (CFR 1984),[1] however, those proposals did not result in a final rule until quite recently. A brief chronology of NHTSA's rulemaking activities related to rollover is given in Appendix A.

In June 2000, NHTSA proposed a rollover consumer information program based on the static stability factor (SSF) (*Federal Register* 2000).[2] In 1987 NHTSA had reported that "basing an effort to address the rollover problem on the stability factor alone is too narrow and inappropriate an approach" (*Federal Register* 1987); however, the agency's subsequent work led to a final rule, issued in January 2001, to provide consumers with rollover resistance ratings based on SSF (*Federal Register* 2001). NHTSA has now issued rollover resistance "star" ratings for a number of vehicles, and these ratings are incorporated in the New Car Assessment Program (NCAP).

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[1] A reference list is provided at the end of this letter.

[2] The SSF of a vehicle is defined as the track width, T, divided by twice the center of gravity height, H; i.e., SSF = T/2H.

Following NHTSA's June 2000 request for comments on its proposed rollover consumer information program, the Congress issued a mandate for a study on motor vehicle rollover. Public Law 106–346 (Department of Transportation and Related Agencies Appropriations Act, 2001) requires the U.S. Department of Transportation to fund a study by the National Academy of Sciences

> on whether the static stability factor is a scientifically valid measurement that presents practical, useful information to the public, including a comparison of the static stability factor test versus a test with rollover metrics based on dynamic driving conditions that may induce rollover events.

In response to a request from NHTSA, and following the receipt of project funding in December 2000, the Transportation Research Board (TRB) of the National Research Council (NRC) convened the Committee for the Study of a Motor Vehicle Rollover Rating System to undertake this study. Appendix B provides a listing of the committee members.

The objectives of this interim report from the committee are as follows:

- Provide background information on the committee's task.
- Outline the approach taken to this task.
- Describe activities performed to date.
- Present preliminary findings.
- Identify outstanding issues the committee intends to address during the remainder of the study.
- Outline plans for completing the study.

THE COMMITTEE'S TASK

Light vehicle[3] rollovers result in approximately 10,000 deaths and 27,000 serious injuries each year (Garrott and Boyd 2001).[4] During the period 1995–1999, only 7 percent of light vehicle tow-away crashes involved rollover, but these crashes accounted for 31 percent of light vehicle occupant fatalities.[5] The risk of death or injury is particularly high for single-vehicle rollovers, which comprise approximately 80 percent of light vehicle rollover crashes (Garrott and Boyd 2001).[6] The Insurance Institute for Highway Safety (2000a) has noted that "single-vehicle crashes involving rollover accounted for 43 occupant deaths per million registered passenger vehicles in 1999, compared with 10 deaths per million in multiple-vehicle crashes." In 1999,

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[3] Light vehicles are defined by NHTSA as the combination of (1) passenger cars and (2) multipurpose passenger vehicles under 10,000 pounds gross vehicle weight rating.

[4] Fatality data were taken from the Fatality Analysis Reporting System (FARS) for 1999. Injury data were obtained by averaging data from the National Automotive Sampling System (NASS) for the period 1995–1999.

[5] As reported by Steve Kratzke in a presentation to the committee on April 11, 2001.

[6] Averaging of the NASS data for the period 1995–1999 reveals that of the 253,000 light vehicle rollovers that occur each year, 205,000 involve single-vehicle crashes.

8,345 people were killed in single-vehicle rollovers, representing 26 percent of all light vehicle occupant fatalities for that year, and during the period 1995–1999, 19,000 people each year suffered severe injuries in such crashes (Garrott and Boyd 2001). These data indicate that a reduction in single-vehicle rollovers would likely lead to a decrease in the total numbers of occupant deaths and injuries resulting from single-vehicle crashes.

Rollovers, like all automobile crashes, are complex events that result from interactions among the driver, the driving environment (e.g., weather and road conditions, time of day), and the vehicle (see Figure 1). Approaches to reducing the numbers of deaths and injuries resulting from rollover crashes address one or more of the contributory factors involved. For example, a change in driver behavior leading to increased seat belt use could result in a reduction in rollover-related deaths and injuries. In 1999, 80 percent of the 10,142 people killed in light vehicle rollovers were not wearing a seat belt, and 64 percent were ejected from the vehicle (*Federal Register* 2000). NHTSA (2001) estimates that belted occupants are about 75 percent less likely to be killed in a rollover crash than unbelted occupants. Similarly, there is evidence that vehicles involved in single-vehicle crashes in rural areas are much more likely to roll over than those involved in such crashes in urban areas, primarily due to the higher speeds of rural crashes and the more hazardous roadside encountered upon leaving the roadway (Insurance Institute for Highway Safety 2000b). Analysis of FARS data has shown that roadside slopes are the predominant tripping mechanism[7] in rollovers involving a vehicle that runs off the road (Viner, 1995). Other roadside hazards that can result in rollover crashes include ditches, embankments, trees, sign posts, and barriers. Thus, design improvements in both the roadside and roadside structures have the potential to reduce the likelihood of rollover when a vehicle leaves the roadway, particularly in rural environments.

The committee's task focuses on the potential role of vehicle characteristics in achieving a reduction in rollover-related deaths and injuries. One of the major challenges is to isolate the effects of vehicle characteristics, and of SSF in particular, from the effects of driver actions and driving environment on rollover events. A further complication is that the relative importance of vehicle characteristics, driver actions, and driving environment differs depending on whether one is considering the likelihood of a crash or the crash outcome. Within the category of vehicle characteristics, different vehicle attributes—for example, steering response, brake and suspension characteristics, center of gravity height, track width, tire characteristics, car body strength, and car interior and airbag characteristics—affect crash avoidance and crashworthiness differently (see, e.g., TRB 1996).[8]

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[7] Most rollovers are tripped, occurring when a vehicle encounters something that causes it to roll over, such as a curb or soft dirt.

[8] Crashworthiness refers to vehicle design characteristics and features that provide protection from harm during a crash, whereas crash avoidance refers to vehicle attributes related to the probability of being in a crash.

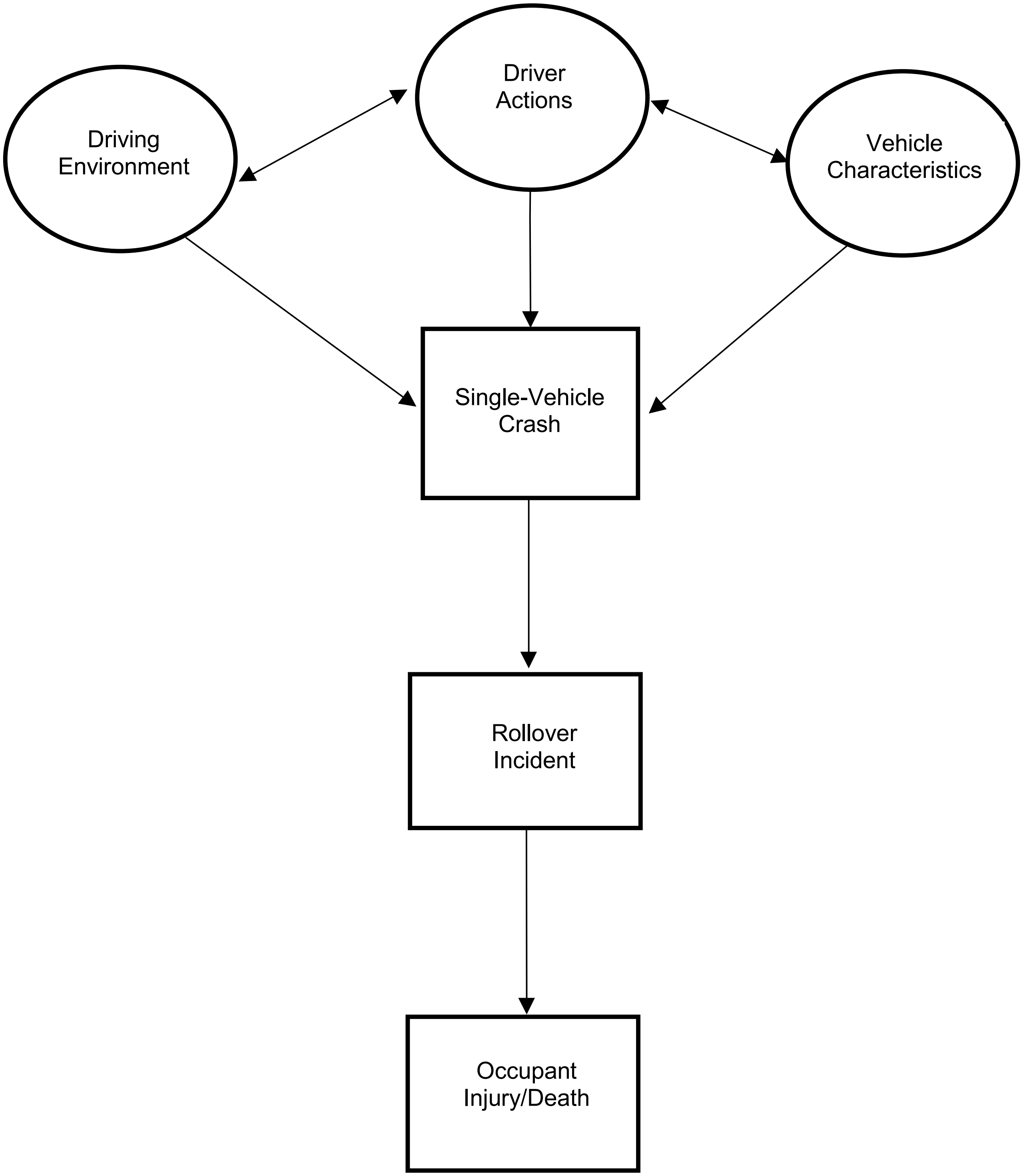

FIGURE 1. Interactions that result in single-vehicle rollover crashes.

APPROACH

The committee has identified three subject areas of major importance for this study—vehicle dynamics, statistics and data analysis, and consumer information. The activities being undertaken within each of these areas are described below.

Vehicle Dynamics

The committee is assessing approaches to the characterization of rollover events based on the following:

- Static vehicle metrics, notably SSF
- Tests related to dynamic driving conditions

Statistics and Data Analysis

The committee has undertaken a critical review of the complex statistical analyses of crash data conducted by NHTSA and the Alliance of Automobile Manufacturers. These analyses relate rollover events to various driver, road, and vehicle factors, including SSF. Specifically, the committee's review is addressing the following:

- The statistical methodologies used
- The crash data used in the analyses, including approaches to combining data from different databases
- The interpretation of statistical results

Consumer Information

The committee is undertaking the following activities in this area:

- Compilation of information on the behavior of consumers when shopping for cars, with emphasis on the possible influence of safety or risk information on shopping behavior
- Investigation of the ways in which consumers seek and use vehicle information before deciding to buy, with emphasis on their use of the rollover information on NHTSA's website
- Assessment of the design, content, presentation, and distribution of NHTSA's rollover resistance rating system
- Investigation of the broader information context that affects consumers when they make informed choices about which vehicle to buy (The information available includes assessments of vehicle performance, such as crashworthiness ratings for different crash types; listings of such vehicle attributes as price, size, and quality; and vehicle-to-vehicle comparisons.)

COMMITTEE ACTIVITIES TO DATE

To date the committee has held two meetings in Washington, D.C.: the first on April 11–12, 2001, and the second on May 29–30, 2001. At each meeting, the open sessions commenced with a series of presentations from invited speakers. The purpose of these presentations was to provide the committee with information on topics related to motor vehicle rollover and NHTSA's star rating for rollover resistance. In addition, interested groups and individuals addressed the committee during open discussions. (A list of speakers at the open sessions of both meetings is provided in Appendix C.) To supplement these information-gathering activities during committee meetings, the members have also reviewed material on motor vehicle rollover from the technical literature, the web, NHTSA dockets, and the popular press. In addition, interested organizations and individuals have provided written submissions for the committee's consideration.[9]

At each committee meeting, the open sessions were followed by closed sessions. During these closed sessions, the committee met to discuss the information acquired, specify its next set of tasks, and develop this report.

PRELIMINARY FINDINGS

The committee's deliberations to date have led to preliminary findings in each of the three study areas. These findings are presented below.

Vehicle Dynamics

Background

As described in the literature, a number of simple static measures have been developed to characterize a vehicle's rollover propensity (see, e.g., Lund and Bernard 1995). The following are the most commonly cited measures:

- Static stability factor (SSF)
- Critical sliding velocity (CSV)[10]
- Tilt table ratio (TTR)[11]
- Side pull ratio (SPR)[12]

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[9] A list of all materials considered by the committee is available from the Public Records Office of the National Academies (e-mail: publicac@nas.edu).

[10] CSV is defined as the lateral velocity necessary to cause a rigid block, representing the vehicle, to trip on an obstacle and tip over.

[11] TTR is obtained by putting a vehicle on a table that tilts about a longitudinal axis and raises one side of the vehicle higher than the other. TTR is defined as the tangent of the tilt angle of the table when the front and rear wheels on the uphill side of the vehicle first lift up from the table.

[12] SPR is defined as the lateral force acting at the vehicle's center of gravity that is necessary to cause two-wheel lift, divided by the vehicle's weight.

SSF and CSV are calculated from measured vehicle parameters, whereas TTR and SPR are derived from the results of static vehicle tests.

SSF is defined as the track width, T, divided by twice the center of gravity height, H. T is the side-to-side distance between the wheels. The front track width may differ slightly from the rear track width, but any difference is averaged out in calculating SSF. H is the height of the mass center above the ground as the vehicle sits at the curb.

A number of organizations and studies have advocated the use of dynamic vehicle testing to assess vehicle performance. This suggestion reflects the belief that dynamic testing should provide more comprehensive information related to rollover than is derived from static metrics, particularly those metrics derived without recourse to vehicle testing.[13] Congress has now required that, by November 1, 2002, NHTSA develop a dynamic test for consumer information on rollover, conduct the tests, and determine how best to disseminate the test results to the public. These requirements are specified in the Transportation Recall Enhancement, Accountability, and Documentation (TREAD) Act (P.L. 106–414).

Findings

The following are the committee's preliminary findings in the area of vehicle dynamics:

- The at-the-curb value of a vehicle's center of gravity height, H, is typically just over 20 inches for a passenger car and several inches higher for a sport utility vehicle (SUV). The corresponding values of SSF are approximately 1.35–1.45 for passenger cars and 1.05–1.20 for SUVs (Heydinger et al. 1999). Typically, loading the vehicle changes the center of gravity height. For many SUVs, the center of gravity height increases—and the SSF decreases—when the vehicle is loaded because the loads are placed above the center of gravity of the empty vehicle. For a number of passenger cars, loading results in a minimal change in center of gravity height and SSF (Heydinger at al. 1999).
- SSF is mathematically equivalent to the constant value of the lateral acceleration required to tip a vehicle (considered as a rigid body) with a center of gravity height H and (track) width T.[14] A value of SSF equal to 1 corresponds to a constant lateral acceleration of 1 g, where g is the acceleration due to gravity. Thus, SSF has a direct mathematical relationship to an element of the vehicle characteristics related to rollover. To the extent that a constant lateral acceleration model of a rigid body is

[13] See, for example, a Consumers Union press release dated January 9, 2001: "There is no real way to know how a vehicle will act in an emergency situation by simply measuring its shape at rest. We must see how it performs when it is driven, when the whole vehicle is acting as a complete dynamic system."

[14] For a rigid body of mass m with a center of gravity height H and track width T, simple physics shows that the constant value of the lateral acceleration, a, required to tip the body is given by

$$a/g = T/2H$$

where g is the acceleration due to gravity. Thus, the acceleration expressed in g's (a/g) is equal to SSF.

a valuable analogy to vehicle rollover situations, SSF is a scientifically valid measure of rollover resistance.

- The SSF metric is not directly comparable with—or a substitute for—vehicle dynamic performance characteristics determined by dynamic tests. The results of such tests depend on many vehicle characteristics in addition to SSF. Furthermore, dynamic testing is by its nature complex, with measured results dependent on the specifics of the test maneuver, as well as the environmental conditions at the test track.
- Before formally proposing its rollover consumer information program based on SSF, NHTSA undertook a program of vehicle dynamic testing. The results of this investigation, conducted during the period 1997–1998, led NHTSA to conclude at the time that "dynamic test methods are not currently superior to simpler, less costly methods, particularly static metrics." In addition, NHTSA noted that "dynamic tests did not provide greater capability to indicate the rollover resistance...of light vehicles" (*Federal Register* 2000).
- Two types of dynamic testing—closed-loop and open-loop—have been discussed in the literature and in presentations to the committee. Closed-loop testing typically involves a skilled professional test driver who is charged with performing a prescribed driving maneuver. The results of closed-loop dynamic testing have been criticized as lacking repeatability and as being of limited utility because they depend on driver skill. Open-loop dynamic testing typically involves precisely prescribed values of steering and braking parameters, which are often input by a machine because a driver cannot provide the desired input repeatability with enough precision. The results of open-loop testing have been criticized on the grounds that the associated vehicle trajectories do not correlate well with driving experiences during maneuvers.
- On the basis of the information gathered to date, it is clear to the committee that the interested parties have not yet reached agreement on the specifics of dynamic tests that would best provide rollover information.

Statistics and Data Analysis

Background

Statistical analysis of crash data is a potentially useful method of identifying trends in motor vehicle crashes. A strong statistical correlation between two events, or parameters, does not necessarily imply the existence of a corresponding causal relationship. However, if an understanding of physics and vehicle dynamics indicates that a vehicle characteristic, such as SSF, is an important factor in rollover events, investigation of the statistical relationship between SSF and the rollover rate derived from crash data may be illuminating.

One of the challenges in analyzing rollover crashes is to isolate the effect of a particular parameter—such as SSF—from the influence of other variables. Differences in rollover risk due to how, when, where, and by whom a vehicle is operated complicate comparisons of the rollover risk of different vehicles. The statistical analysis performed by NHTSA to support its proposed rollover consumer information program used stepwise linear regression analysis to investigate the influence of SSF on rollover, while taking account of possible cross-correlations of SSF with such variables as driver age, driver drinking, and speeding.

An alternative statistical analysis of crash data, conducted by Exponent Failure Analysis Associates, Inc. on behalf of the Alliance of Automobile Manufacturers, used logistic regression and crash scenario analysis to assess the magnitude of factors influencing rollover risk (Donelson et al. 2000). The logistic regression technique was developed to provide a statistically rigorous methodology for analysis of data that are naturally binary, for example, "rollover" or "not rollover." Crash scenario analysis uses combinations of factors reported for individual crashes as a starting point for multivariate analysis. A crash scenario is defined as a unique combination of selected precrash and at-crash factors likely to affect the outcome of a motor vehicle crash (Donelson et al. 1996). In the case of single-vehicle crashes involving rollover, scenarios might be defined using the following criteria: (1) Was the driver male? (2) Was the driver under 25 years of age? (3) Was drinking or illegal drug use noted for the driver? (4) Was the speed limit 50 mph or greater? (5) Did the crash occur in a rural area? and (6) Did the crash occur on a curve? Further details are provided in a recent review and explanation of crash scenario analysis (*Federal Register* 2001).

NHTSA has compared the results it obtained using logistic regression of individual variables and risk scenarios with its earlier results derived using the linear regression method. Both the logistic and linear approaches were found to produce models that "fit the data well," and both yielded an estimated coefficient for the SSF term that was "very important" (*Federal Register* 2001). For their analyses, both NHTSA and the Alliance used state data files for which crash type and vehicle identification numbers (VINs) are available.

Findings

The following are the committee's preliminary findings in the area of statistics and data analysis:

- The order-of-magnitude difference between the results of statistical analyses of rollover crashes performed by NHTSA and by the Alliance of Automobile Manufacturers (the Alliance) is of concern to the committee. According to NHTSA, SSF appears to explain about 72 percent of the variability in rollover rate among different crash experiences (*Federal Register* 2000). In contrast, Exponent Failure Analysis Associates (on behalf of the Alliance) finds that SSF "explains" 3–8 percent of the variability in rollovers resulting from single-vehicle crashes.[15]
- On the basis of information provided by NHTSA and the Alliance, it is the committee's understanding that the two groups obtain comparable results when using a logistic model approach and similar data. In particular, both groups find SSF to be a statistically significant factor in estimating rollover risk in single-vehicle crashes. Furthermore, both acknowledge that the effect of SSF on rollover risk depends on the crash scenario, as characterized by a unique combination of driver and road-use variables. As expected, the differences between results obtained using the logistic and linear regression techniques are small, and are not, therefore, the main source of the different results obtained by NHTSA and the Alliance.
- Using the results of their statistical analyses, NHTSA and the Alliance reach different conclusions regarding the *relative* importance of SSF for rollover risk in single-vehicle crashes. The committee is seeking to determine if these differences derive primarily from the choice of different baseline scenarios, or if there are other factors that account for the differences.

[15] As reported by Alan Donelson in a presentation to the committee on April 11, 2001.

Consumer Information

Background

Although the literature contains a wealth of information on consumers' use of information, decision making, and purchasing behavior when shopping for a variety of consumer goods, little research has been reported in the open literature on the behavior of car buyers. The committee has not yet determined to what extent the automobile manufacturers have conducted proprietary studies on methods of communicating vehicle information to consumers and on the decision-making and purchasing behaviors of consumers when shopping for a car.

A number of researchers have identified good practices in developing consumer information, including product rating systems. For example, Wogalter et al. (1999) suggest the following design approach:[16]

- In the initial phase of a project, a number of candidate information systems should be investigated and a few selected for further study. This process should involve formative research on candidate systems, possibly using focus groups or individual interviews, together with an iterative design process.
- Following the preliminary testing, more extensive formal testing of information products is suggested. This second phase should test whether consumers are able to apply the information in a practical case and whether they understand the limits of that information. In addition, this phase could be used to assess consumer preferences for candidate systems.

Findings

The following are the committee's preliminary findings in the area of consumer information:

- Some consumers are interested in vehicle safety information (see, e.g., TRB 1996); hence it is likely that rollover ratings will influence some car-buying decisions
- Much remains to be learned about how consumers understand rollover events and the associated risks, particularly in light of the complexity of rollover crashes and their dependence on driver actions, the driving environment, and vehicle characteristics. When speaking with the committee, several presenters commented that, in their opinion, some consumers have serious misconceptions about rollover. For example, many consumers believe heavier vehicles are less likely than lighter ones to roll over, and that adding weight to a vehicle (passengers or luggage) reduces the likelihood of rolling over. In fact, for many SUVs adding weight increases the center of gravity height and reduces the SSF. In a broader context, the committee recognizes that, with a few exceptions (see, e.g., Ferguson and Williams 1996), little research specific to consumer automotive safety information has been conducted.
- The committee's understanding is that NHTSA has not proceeded very far along the recommended trajectory of good practices in developing its five-star rating system for rollover resistance. Preliminary usability testing was conducted with focus groups,

[16] In a presentation to the committee on May 29, 2001, Mike Wogalter discussed means of presenting risk-based information to consumers.

and the findings from a second group of focus group sessions (Equals Three Communications 2000) were used to refine consumer information related to the rollover resistance rating. The committee is continuing its investigation to determine whether NHTSA's activities in this area are sufficient to demonstrate that the star rating system is practical and useful for the public.

OUTSTANDING ISSUES

The committee is continuing its investigations in two major areas: dynamic testing and NHTSA's rollover resistance ratings.

Dynamic Testing

The committee plans additional interactions with consumer groups, vehicle manufacturers, and NHTSA to gain a better understanding of the various viewpoints on dynamic testing. This investigation will encompass the relative merits of open-loop and closed-loop testing as bases for a consumer information program.

NHTSA's Rollover Resistance Ratings

A number of issues require further investigation before the committee can determine whether NHTSA's star ratings based on SSF present "practical, useful information to the public."

As part of its critical review of the statistical analyses used by NHTSA to support the rollover resistance rating system, the committee plans to:

- Seek a better understanding of the relation of SSF to rollover risk, as revealed by the correlation between SSF and rollover crash data.
- Determine the sources of the different statistical results obtained by NHTSA and the Alliance, including the possible effects of choosing different baseline crash scenarios.
- Investigate the development and statistical validity of NHTSA's five-star rating system, with particular emphasis on the choice of five rating categories and of the break points between these categories.

The committee has asked NHTSA to undertake some additional statistical analyses to inform the committee's further discussions of the above items.

To assess the practicality and usefulness of NHTSA's rollover resistance ratings and their usefulness to the public, the committee will consider:

- NHTSA's strategy for providing consumers with safety information, as well as strategies used by manufacturers and consumer groups to reach and inform consumers.
- Consumers' past and current use of various types of vehicle safety information, including rollover resistance ratings and related information on the NHTSA website.
- Ways in which safety information—and rollover information in particular—may influence car-buying decisions.

The committee also plans to examine the broad implications of NHTSA's rollover resistance ratings for both manufacturers and consumers. As noted earlier, automobile crashes result from complex interactions among the driver, the driving environment, and the vehicle. It is important to ensure that simple measures of risk—such as rollover propensity based on SSF—do not isolate problems to the extent that consumer misunderstandings result, or solutions developed by manufacturers in response to NHTSA's rulemaking compromise other safety factors.

PLANS FOR COMPLETION OF STUDY

The committee has accepted invitations from automobile manufacturers and Consumers Union to visit their vehicle test facilities and meet with their experts in two subject areas—vehicle testing and consumer information. A small group of committee members visited the Consumers Union vehicle test facility in East Haddam, Connecticut, on June 21, 2001. In addition, a number of committee members will visit the DaimlerChrysler, Ford, and General Motors proving grounds in the Detroit area immediately prior to the July committee meeting. The primary purpose of these visits is to obtain further information about efforts by various groups to develop a dynamic test for assessing vehicle rollover propensity. The insights thus gained will inform the committee's comparison of "the static stability factor test versus a test with rollover metrics based on dynamic driving conditions that may induce rollover events." In addition, the meetings with experts in consumer information and marketing from Consumers Union and automobile manufacturers will assist the committee in (1) learning more about how consumers gather information for making vehicle purchasing decisions, and (2) assessing the practicality and usefulness of NHTSA's rollover resistance ratings.

After completing its information-gathering activities, the committee will hold two further meetings: in Dearborn, Michigan, on July 25–26, 2001, and in Irvine, California, on September 13–14, 2001. Both of these meetings will be devoted to committee deliberations and the development of a draft final report.

In the context of the committee's visits to vehicle test facilities, it should be noted that the committee was not asked to comment on NHTSA's activities mandated under the TREAD Act. In particular, the scope of the present study, as defined in P.L.106–346, does not require the committee to recommend one or more dynamic vehicle tests as a basis for the development of consumer information on rollover. Consequently, the committee's final report will address the merits and applicability of static measures and dynamic vehicle tests in general, but will not speak to the more detailed question of which dynamic test or tests might usefully be pursued in an effort to quantify or rank the rollover propensities of passenger cars and light multipurpose passenger vehicles and trucks.

The committee expects to prepare a draft of its final report for review in late October 2001. The report review will be conducted according to established procedures of the NRC. Following final approval by the NRC, the report will be delivered to NHTSA and members of the Senate Appropriations Subcommittee on Transportation in December 2001. It will also be made available to the public on the National Academies website (www.nationalacademies.org).

The committee welcomes the opportunity to contribute to efforts aimed at reducing the number of injuries and fatalities resulting from rollover crashes, and looks forward to delivering its full response to the congressional question posed in P.L. 106–346 at the end of the year.

Sincerely,

David N. Wormley
Chair, Committee for the Study of a Motor Vehicle Rollover Rating System

REFERENCES

Abbreviations

CFR	Code of Federal Regulations
NHTSA	National Highway Traffic Safety Administration
TRB	Transportation Research Board

1. CFR. 1984. Title 49, Part 575, "Consumer Information Regulations," §575.105 "Vehicle Rollover."

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13. Insurance Institute for Highway Safety. 2000b. *Comments to NHTSA on Docket No. NHTSA 2000-6859*, July 31.

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cc:
The Honorable Patty Murray
Chair, Senate Appropriations Subcommittee on Transportation

The Honorable Richard C. Shelby
Ranking Member, Senate Appropriations Subcommittee on Transportation

The Honorable Harold Rogers
Chair, House Appropriations Subcommittee on Transportation

The Honorable Martin Olav Sabo
Ranking Member, House Appropriations Subcommittee on Transportation

APPENDIX A

CHRONOLOGY OF NHTSA'S RULEMAKING ACTIVITIES RELATING TO ROLLOVER[1]

April 1973

NHTSA issues an Advance Notice of Proposed Rulemaking for a safety standard that would specify minimum performance requirements for rollover resistance. Research is undertaken by the agency to investigate the handling and stability of different types of vehicles in severe steering maneuvers associated with untripped rollovers.[2]

1978

NHTSA terminates action on a rollover resistance standard because "untripped rollover, even on high skid-resistance surfaces, is difficult to predict and accomplish." The agency's research indicates that computer simulation of dynamic testing may be a more repeatable alternative to full-scale track testing.

September 1986

Congressman Wirth petitions NHTSA to establish a safety standard for rollover resistance by setting a minimum allowable static stability factor (SSF) of 1.2.

December 1987

NHTSA denies Congressman Wirth's petition on the grounds that, "while a vehicle's stability factor has some relation to its overall involvement in rollover accidents, basing an effort to address the rollover problem on the stability factor alone is too narrow and inappropriate an approach."

June 1988

Consumers Union petitions NHTSA to establish a safety standard to protect vehicle occupants against "unreasonable risk of rollover." The petition is granted, and NHTSA undertakes a 5-year vehicle and data analysis program, studying more than 100,000 single-vehicle rollover crashes. Two static vehicle metrics—tilt table angle and critical sliding velocity—are eventually identified as "promising" with respect to tripped rollovers.

December 1991

The Intermodal Surface Transportation Efficiency Act (ISTEA) requires NHTSA to initiate a rulemaking effort addressing the need for protection against unreasonable risk of rollover.

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[1] The following sources were used in compiling this chronology:

- *Federal Register*, 52[249], 49,033–49,038, December 27, 1987.
- *Federal Register*, 59[123], 33,254–33,272, June 28, 1994.
- *Federal Register*, 65[106], 34,998–35,024, June 1, 2000.
- *Rollover Chronology: Major Events*. Advocates for Highway and Auto Safety (http://www.saferoads.org/press/2000/rollover010901.html).
- "Light Vehicle Rollover: Background on NHTSA's Activities in this Area." Presentation to the committee by Steve Kratzke, NHTSA, April 11, 2001.

[2] Untripped rollovers are those for which there is no apparent cause—or tripping mechanism—other than normal surface friction.

January 1992

NHTSA issues an Advance Notice of Proposed Rulemaking for a minimum performance standard for rollover resistance. The agency's goal is to use a vehicle metric other than SSF to establish a minimum performance standard.

June 1994

NHTSA terminates the rulemaking effort on a minimum performance standard on the grounds that increasing several vehicle rollover metrics to levels higher than those characterizing most compact SUVs "would not appreciably decrease crash fatalities and injuries in rollovers." In the same notice, the agency proposes a new consumer information regulation that would require manufacturers to label vehicles with information on rollover stability based on either tilt table angle or critical sliding velocity. This proposal represents a significant shift in NHTSA's policy. After 20 years spent considering various options for a rollover standard, the focus has shifted to the provision of consumer information on rollover.

September 1994

Congress requests a study by the National Academy of Sciences (NAS) on communicating vehicle safety information to consumers. NHTSA is required to review the NAS study before issuing a final rule on vehicle rollover labeling.

May 1996

The Transportation Research Board (TRB) of the National Research Council issues the report *Shopping for Safety—Providing Consumer Automotive Safety Information*, which contains the recommendation that NHTSA expand the scope of consumer information it provides to the public.

May 1996

NHTSA issues a status report on rollover prevention and injury mitigation, and describes a planned project to develop a dynamic test for rollover and control stability in light vehicles.

June 1996

NHTSA reopens the comment period on its proposed rule for vehicle rollover labeling.

June 1996

NHTSA denies a 1994 petition from Advocates for Highway and Auto Safety and the Insurance Institute for Highway Safety that the agency reconsider the termination of rulemaking on a rollover standard. In denying the petition, NHTSA cites the results of its cost/benefit analysis, which show that a standard based on static vehicle measurements would (1) eliminate compact SUVs and (2) not result in an appreciable decrease in deaths and injuries due to rollover crashes.

August 1996

Consumers Union files a petition with NHTSA asking the agency to (1) develop a test of vehicle emergency handling and (2) provide test results on new vehicles to the public as consumer information.

May 1997

In granting the petition from Consumers Union, NHTSA agrees to explore options for an appropriate dynamic emergency handling test that could be used to assess a vehicle's propensity for an "on-road, untripped rollover crash."

April 1998

NHTSA proposes a revised SUV rollover warning label.

March 1999

NHTSA issues its final rule on a revised SUV rollover warning label.[3]

July 1999

NHTSA publishes the results of its research on dynamic emergency handling maneuvers that may induce on-road, untripped rollover (Garrott et al. 1999). The agency concludes that "several maneuvers appear to be able to discriminate between vehicles [that have] low static and dynamic rollover propensity measures and those that do not."

June 2000

NHTSA proposes a rollover consumer information program using SSF as an indicator of overall rollover risk in single-vehicle crashes.

October 2000

Congress requests a study by NAS to assess NHTSA's proposed rollover rating system based on SSF.

November 2000

As part of the TREAD Act, Congress requires NHTSA to develop a dynamic test for consumer information on rollover, conduct appropriate tests, and determine how best to disseminate the resulting information to the public. These actions are to be completed by November 1, 2002.

January 2001

NHTSA issues its final rule on the rollover consumer information program based on SSF, together with its first rollover resistance "star" ratings.

[3] 49 CFR Part 575, §575.105, "Vehicle Rollover."

APPENDIX B

COMMITTEE FOR THE STUDY OF A MOTOR VEHICLE ROLLOVER RATING SYSTEM*

DAVID N. WORMLEY, *Chairman*, The Pennsylvania State University
KARIN M. BAUER, Midwest Research Institute, Kansas City, Missouri
JAMES E. BERNARD, Iowa State University, Ames
ANN BOSTROM,** Georgia Institute of Technology, Atlanta
SUSAN A. FERGUSON, Insurance Institute for Highway Safety, Arlington, Virginia
B. JOHN GARRICK (National Academy of Engineering), Independent Consultant, Laguna Beach, California
PAUL A. GREEN, University of Michigan Transportation Research Institute, Ann Arbor
DAVID L. HARKEY, University of North Carolina Highway Safety Research Center, Chapel Hill
J. KARL HEDRICK, University of California at Berkeley
DAVID C. HOLLOWAY, University of Maryland, College Park
L. DANIEL METZ, Metz Engineering and Racing, Champaign, Illinois
N. EUGENE SAVIN, University of Iowa, Iowa City
KIMBERLY M. THOMPSON, Harvard School of Public Health, Boston, Massachusetts

*The committee was composed and reviewed according to National Research Council procedures, and was judged to be free of potential conflicts of interest.

**Dr. Bostrom is serving as Program Director for the Decision, Risk and Management Science program at the National Science Foundation for the period 1999–2001.

APPENDIX C

SPEAKERS AT INFORMATION-GATHERING MEETINGS OF THE COMMITTEE FOR THE STUDY OF A MOTOR VEHICLE ROLLOVER RATING SYSTEM

FIRST MEETING, APRIL 11-12, 2001, WASHINGTON, D.C.

Invited Speakers

Pat Boyd, NHTSA
David Champion, Consumers Union
Alan Donelson, Exponent Failure Analysis Associates, Inc., on behalf of the Alliance of Automobile Manufacturers
Riley Garrott, NHTSA
Steve Kratzke, NHTSA
Roger Kurrus, NHTSA
Granger Morgan, Carnegie Mellon University
Sue Partyka, NHTSA
David Pittle, Consumers Union
Scott Schmidt, Alliance of Automobile Manufacturers
Rob Strassburger, Alliance of Automobile Manufacturers
Mary Versailles, NHTSA

Speakers During Open Discussion

Michael Cammisa, Association of International Automobile Manufacturers, Inc.
Barry Felrice, DaimlerChrylser Corporation
Doug Greenhaus, National Automobile Dealers Association
Ian Jones, Consultant

SECOND MEETING, MAY 29, 2001, WASHINGTON, D.C.

Invited Speakers

John Brophy, NHTSA
Carl Larsen, MTS Systems Corporation
Greg Schultz, Aberdeen Test Center, Department of Defense
Mike Wogalter, North Carolina State University
Robert Woodill, Veridian Engineering

Speakers During Open Discussion

Wade Allen, Systems Technology, Inc.
George Ball, Graeme Fowler, and **Jerry Hashimura,** American Suzuki Motor Corporation
Joan Claybrook, Public Citizen
Clarence Ditlow, Center for Auto Safety
Phil Headley, Continental Teves
Ian Jones, Consultant
Jeya Padmanaban, JP Research
David Pittle, Consumers Union
Tab Turner, Turner & Associates