Buick collision avoidance features: initial results

Several collision avoidance systems are options on the Buick Lucerne. Lane Departure Warning and Side Blind Zone Alert are offered together. Ultrasonic Rear Parking Assist is available separately. This analysis of insurance claims shows that the parking assist feature is working to reduce losses. The frequency of both collision and property damage liability claims is lower for vehicles that have it than for those that don't. No insurance loss benefit was found for Buick's side assist systems of Lane Departure Warning and Side Blind Zone Alert.

▸ Introduction

Collision avoidance technologies are becoming popular in U.S. motor vehicles, and more and more automakers are touting the potential safety benefits. However, the actual benefits in terms of crash reductions still are being measured. This Highway Loss Data Institute bulletin examines the early insurance claims experience for Buick vehicles fitted with three features:

Lane Departure Warning utilizes a forward-facing camera mounted near the interior rearview mirror to identify traffic lane markings. Audio and visual warnings will indicate if the vehicle path deviates from the intended lane. The system is functional at speeds over 35 mph but does not warn if the turn signal is on or the movement is determined to be sufficiently sudden as to be evasive. The system may be deactivated by the driver, and at the next ignition cycle it will be in the previous on/off setting. All vehicles equipped with this feature are also equipped with Side Blind Zone Alert.

Side Blind Zone Alert is Buick's term for a side view assist system that alerts drivers to vehicles that are adjacent to them. Side Blind Zone Alert utilizes radar sensors mounted behind each rear quarter panel to scan a range behind and to the side of the vehicle, areas commonly known as driver blind spots. If a vehicle is detected in a blind spot, a warning light on the appropriate side mirror is illuminated. If the driver activates a turn signal in the direction a vehicle has been detected, the warning light will flash. The feature may be deactivated by the driver and will be in the previous on/off setting at the next ignition cycle.

Ultrasonic Rear Parking Assist uses ultrasonic sensors to detect objects within 8 feet of the rear bumper and at least 10 inches off the ground. A single warning tone sounds when an object is first detected and sounds continually when the object is within 1 foot of the vehicle. While backing, a display mounted on the rear shelf changes color from amber to red indicating the vehicle's closing distance. The visual display communicates four distance zones utilizing two amber and one red indicator lights. As the vehicle gets closer to an object additional lights are illuminated and all the lights flash within a 1 foot distance. The system is functional at speeds less than 5 mph while the transmission is in reverse. The system may be deactivated by the driver but will reactivate on the next ignition cycle.

In addition to the features listed above the vehicles in this study could also be equipped with electronic stability control (ESC). There were three distinct feature groupings: vehicles with no collision avoidance features, vehicles with ultrasonic rear park assist and electronic stability control and vehicles with Lane Departure Warning, Side Blind Zone Alert, Ultrasonic Rear Park Assist and electronic stability control. ESC is always bundled with another collision avoidance feature and therefore it is not possible to know with absolute certainty whether or not any changes in insurance losses are related ESC or the other collision avoidance features.

Method

Vehicles

Ultrasonic Rear Parking Assist and the combination of Lane Departure Warning and Side Blind Zone Alert are offered as optional equipment on Buick Lucernes. The presence or absence of these features is not discernible from the information encoded in the vehicle identification numbers (VINs), but rather, this must be determined from build information maintained by the manufacturer. Buick supplied HLDI with the VINs for any Lucerne that was equipped with at least one of the collision avoidance features listed above. Vehicles of the same model year not identified by Buick were assumed not to have these features and thus served as the control vehicles in the analysis. **Table 1** lists the vehicle series and model years included in the analysis. In addition, exposure for each vehicle, measured in insured vehicle years is listed. The exposure of each feature in a given series is shown as a percentage of total exposure.

Table 1 : Feature exposure by vehicle series					
Make	Series	Model year range	Lane Departure Warning and SZBA	Ultrasonic Rear Parking Assist	Total exposure
Buick	Lucerne 4dr	2008-09	17%	62%	171,777

Insurance data

Automobile insurance covers damages to vehicles and property as well as injuries to people involved in crashes. Different insurance coverages pay for vehicle damage versus injuries, and different coverages may apply depending on who is at fault. The current study is based on property damage liability, collision, bodily injury liability, personal injury protection and medical payment coverages. Exposure is measured in insured vehicle years. An insured vehicle year is one vehicle insured for one year, two for six months, etc.

Because different crash avoidance features may affect different types of insurance coverage, it is important to understand how coverages vary among the states and how this affects inclusion in the analyses. Collision coverage insures against vehicle damage to an at-fault driver's vehicle sustained in a crash with an object or other vehicle; this coverage is common to all 50 states. Property damage liability (PDL) coverage insures against vehicle damage that at-fault drivers cause to other people's vehicle and property in crashes; this coverage exists in all states except Michigan, where vehicle damage is covered on a no-fault basis (each insured vehicle pays for its own damage in a crash, regardless of who's at fault). Coverage of injuries is more complex. Bodily injury (BI) liability coverage insures against medical, hospital, and other expenses for injuries that at-fault drivers inflict on occupants of other vehicles or others on the road; although motorists in most states may have BI coverage, this information is analyzed only in states where the at-fault driver has first obligation to pay for injuries (33 states with traditional tort insurance systems). Medical payment coverage (MedPay), also sold in the 33 states with traditional tort insurance systems, covers injuries to insured drivers and the passengers in their vehicles, but not injuries to people in other vehicles involved in the crash. Seventeen other states employ no-fault injury systems (personal injury protection coverage, or PIP) that pay up to a specified amount for injuries to occupants of involved-insured vehicles, regardless of who's at fault in a collision. The District of Columbia has a hybrid insurance system for injuries and is excluded from the injury analysis.

Statistical methods

Regression analysis was used to quantify the effect of each vehicle feature while controlling for other covariates. The covariates included calendar year, model year, garaging state, vehicle density (number of registered vehicles per square mile), rated driver age group, rated driver gender, rated driver marital status, deductible range (collision coverage only), and risk. For each safety feature supplied by the manufacturer a binary variable was included. Based on the model year and series a single variable called SERIESMY was created for inclusion in the regression model. Statistically, including such a variable in the regression model is equivalent to including the interaction of series and model year. Effectively, this variable restricted the estimation of the effect of each feature within vehicle series and model year, preventing the confounding of the collision avoidance feature effects with other vehicle design changes that could occur from model year to model year.

Claim frequency was modeled using a Poisson distribution, whereas claim severity (average loss payment per claim) was modeled using a Gamma distribution. Both models used a logarithmic link function. Estimates for overall losses were derived from the claim frequency and claim severity models. Estimates for frequency, severity, and overall losses are presented for collision and property damage liability. For PIP, BI, and MedPay, three frequency estimates are presented. The first frequency is the frequency for all claims, including those that already have been paid and those for which money has been set aside for possible payment in the future, known as claims with reserves. The other two frequencies include only paid claims separated into low and high severity ranges. Note that the percentage of all injury claims that were paid by the date of analysis varies by coverage: 79.4 percent for PIP, 72.4 percent for BI, and 72.8 percent for MedPay. The low severity range was <$1,000 for PIP and MedPay, <$5,000 for BI; high severity covered all loss payments greater than that.

A separate regression was performed for each insurance loss measure for a total of 15 regressions (5 coverages x 3 loss measures each). For space reasons, only the estimates for the individual crash avoidance features are shown on the following pages. To further illustrate the analyses, however, the Appendix contains full model results for collision claim frequencies. To simplify the presentation here, the exponent of the parameter estimate was calculated, 1 was subtracted, and the resultant multiplied by 100. The resulting number corresponds to the effect of the feature on that loss measure. For example, the estimate of the effect of Ultrasonic Rear Parking Assist on PDL claim frequency was -0.18199; thus, vehicles with that feature had 16.6 percent fewer PDL claims than expected ((exp(-0.18199)-1)*100=-16.6).

► Results

Results for Buick's Lane Departure Warning System and Side Blind Zone Alert, are summarized in **Table 2**. The lower and upper bounds represent the 95 percent confidence limits for the estimates. For vehicle damage losses, frequency of claims and overall losses are generally up. The increases are not statistically significant.

For injury losses, overall frequency of claims is lower for BI but not for MedPay or PIP, and none of the differences is statistically significant. Among paid claims, there appears to be an increase in low severity injury claims under all coverages, though still not statistically significant. No pattern is observed for high severity claims.

Table 2 : Change in insurance losses for Lane Departure Warning and Side Blind Zone Alert									
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper Bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-1.1%	4.2%	9.7%	-$212	-$34	$154	-$10	$6	$24
Property damage liability	-1.3%	7.2%	16.4%	-$138	$46	$247	-$2	$6	$15

Injury coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	LOW SEVERITY FREQUENCY	Upper Bound	Lower bound	HIGH SEVERITY FREQUENCY	Upper bound
Bodily injury liability	-24.2%	-1.5%	27.9%	-33.7%	1.3%	54.9%	-38.3%	-3.4%	51.1%
Medical payments	-15%	12.5%	48.9%	-25.1%	39.4%	159.4%	-32.9%	0.1%	49.2%
Personal injury protection	-11.6%	11.6%	40.8%	-20%	25.8%	97.7%	-34.8%	-9%	26.9%

Results for Buick's Ultrasonic Rear Parking Assist are summarized in **Table 3**. Again, the lower and upper bounds represent the 95 percent confidence limits for the estimates. Significant reductions (indicated in blue) in loss claims are estimated for both first- and third-party vehicle damage coverages, resulting in somewhat lower losses per insured vehicle year (overall losses). The change in overall losses for PDL is statistically significant.

Under injury coverages, the frequency of paid plus reserved claims is higher for PIP, lower for MedPay and remains essentially unchanged for BI. None of the differences are statistically significant. Among paid only claims, there is no pattern for both low and high severity claims. Only the frequency reduction for MedPay at high severity is statistically significant (30 percent).

Table 3 : Change in insurance losses for Ultrasonic Rear Parking Assist								
Vehicle damage coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	SEVERITY	Upper Bound	Lower bound	OVERALL LOSSES	Upper bound
Collision	-8.7%	**-5%**	-1.1%	-$93	$49	$198	-$20	-$7	$6
Property damage liability	-21.6%	**-16.6%**	-11.4%	-$96	$43	$190	-$16	**-$11**	-$6

Injury coverage type	Lower bound	FREQUENCY	Upper bound	Lower bound	LOW SEVERITY FREQUENCY	Upper Bound	Lower bound	HIGH SEVERITY FREQUENCY	Upper bound
Bodily injury liability	-17.9%	-0.8%	19.9%	-30.4%	-5.4%	28.5%	-27.5%	0.3%	38.8%
Medical payments	-28.9%	-12.3%	8.1%	-31%	19.7%	107.4%	-46.9%	**-30%**	-7.8%
Personal injury protection	-13.8%	4.7%	27%	-3%	50.1%	132.4%	-26.8%	-6.1%	20.5%

▸ **Discussion**

This analysis confirms that Buick's Ultrasonic Rear Parking Assist system is reducing insurance costs. The frequency of both collision and PDL coverage claims dropped for vehicles with the system, with a corresponding reduction in overall losses even though the average cost of the remaining crashes rose slightly. This increased severity may reflect the elimination of lower severity crashes, typical of parking situations, meaning that the average cost of the remaining crashes is higher. The greater benefit for PDL claims than collision may indicate the sensors are more effective at eliminating two-vehicle crashes than single-vehicle crashes with trees or poles. It also might reflect the fact that people are less likely to file a collision claim for damage that is less than the deductible. Given that the feature is always bundled with ESC we cannot be entirely certain that the reduction in losses is coming from the parking system. However, previous HLDI studies have not shown ESC to reduce PDL losses in cars. The size of the PDL frequency reduction for the parking system suggests the benefits are coming from the parking system.

Rear parking assist also was associated with fewer MedPay claims, especially those of higher severity. HLDI is currently unaware of any mechanism by which rear park assist would cause such a reduction. Until this effect is replicated with other manufacturers, it seems prudent to treat this effect as tentative, despite its statistical significance.

This analysis did not find an insurance loss benefit for Buick's side assist systems of Lane Departure Warning and Side Blind Zone Alert. Losses under both vehicle damage coverages were somewhat elevated with these systems, as were losses for both first-party medical coverages, MedPay and PIP, although none of the changes was statistically significant. BI liability was essentially unchanged. As both of these systems could reasonably be expected to prevent some crashes, it is not clear how their combination would have the opposite effect. It seems prudent to treat this effect as tentative until more data is available.

▶ Limitations

There are limitations to the data used in this analysis. At the time of a crash, the status of a feature is not known. The features in this study can be deactivated by the driver and there is no way to know how many, if any of the drivers in these vehicles had manually turned off the system prior to the crash. If a significant number of drivers do turn these features off, any reported reductions may actually be underestimates of the true effectiveness of these systems.

Additionally, the data supplied to HLDI does not include detailed crash information. Information including point of impact is not available. The technologies in this report target certain crash types. For example, rear parking assist is designed to prevent collisions when a vehicle is backing up. Transmission status is not known – therefore, all collisions, regardless of the ability of a feature to mitigate or prevent the crash, are included in the analysis.

All of these features are optional and are associated with increased costs. The type of person who selects these options may be different from people who decline. While the analysis controls for several driver characteristics, there may be other uncontrolled attributes associated with people who select these features.

Appendix : Illustrative regression results — collision frequency								
Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
Intercept		1	-9.2426		0.5032	-10.2289	-8.2563	337.33	<0.0001
Calendar year	2007	1	-0.2473	-21.9%	0.1036	-0.4503	-0.0443	5.70	0.0170
	2008	1	-0.0011	-0.1%	0.0300	-0.0599	0.0576	0.00	0.9697
	2009	1	0.0223	2.3%	0.0228	-0.0225	0.0671	0.95	0.3293
	2011	1	-0.0807	-7.8%	0.0260	-0.1318	-0.0297	9.62	0.0019
	2010	0	0	0	0	0	0		
Vehicle model year and series	2008 Lucerne 4dr	1	-0.0478	-4.7%	0.0223	-0.0915	-0.0041	4.60	0.0319
	2009 Lucerne 4dr	0	0	0	0	0	0		
Rated driver age group	14-20	1	0.0861	9.0%	0.2023	-0.3103	0.4826	0.18	0.6702
	21-24	1	0.3780	45.9%	0.1553	0.0736	0.6823	5.93	0.0149
	25-39	1	0.3312	39.3%	0.0751	0.1840	0.4783	19.46	<0.0001
	65+	1	0.1491	16.1%	0.0232	0.1037	0.1946	41.36	<0.0001
	Unknown	1	0.0773	8.0%	0.0473	-0.0154	0.1700	2.67	0.1024
	40-64	0	0	0	0	0	0		
Rated driver gender	Male	1	0.0379	3.9%	0.0247	-0.0106	0.0864	2.34	0.1261
	Unknown	1	0.0438	4.5%	0.0574	-0.0686	0.1562	0.58	0.4453
	Female	0	0	0	0	0	0		
Rated driver marital status	Single	1	0.2633	30.1%	0.0283	0.2079	0.3188	86.70	<0.0001
	Unknown	1	0.1369	14.7%	0.0575	0.0243	0.2496	5.67	0.0172
	Married	0	0	0	0	0	0		
Risk	Nonstandard	1	0.1864	20.5%	0.0577	0.0732	0.2996	10.42	0.0012
	Standard	0	0	0	0	0	0		
State	Alabama	1	0.1090	11.5%	0.5047	-0.8802	1.0983	0.05	0.8290
	Arizona	1	0.1031	10.9%	0.5058	-0.8883	1.0945	0.04	0.8384
	Arkansas	1	0.1510	16.3%	0.5089	-0.8464	1.1484	0.09	0.7667
	California	1	0.0817	8.5%	0.5040	-0.9062	1.0697	0.03	0.8712
	Colorado	1	0.1078	11.4%	0.5076	-0.8872	1.1027	0.05	0.8318
	Connecticut	1	-0.0860	-8.2%	0.5099	-1.0854	0.9134	0.03	0.8661
	Delaware	1	0.2081	23.1%	0.5130	-0.7975	1.2136	0.16	0.6851
	District of Columbia	1	0.2309	26.0%	0.5780	-0.9019	1.3637	0.16	0.6896
	Florida	1	-0.1058	-10.0%	0.5019	-1.0896	0.8779	0.04	0.8330
	Georgia	1	-0.1348	-12.6%	0.5056	-1.1258	0.8561	0.07	0.7897
	Hawaii	1	-0.1689	-15.5%	0.7075	-1.5556	1.2177	0.06	0.8113
	Idaho	1	-0.1468	-13.7%	0.5271	-1.1799	0.8864	0.08	0.7807
	Illinois	1	0.0654	6.8%	0.5014	-0.9173	1.0482	0.02	0.8961
	Indiana	1	0.0751	7.8%	0.5029	-0.9105	1.0607	0.02	0.8813
	Iowa	1	0.0070	0.7%	0.5048	-0.9823	0.9963	0.00	0.9889
	Kansas	1	0.0757	7.9%	0.5051	-0.9143	1.0657	0.02	0.8809
	Kentucky	1	0.0229	2.3%	0.5063	-0.9695	1.0154	0.00	0.9639
	Louisiana	1	0.2525	28.7%	0.5057	-0.7385	1.2436	0.25	0.6175
	Maine	1	0.1557	16.8%	0.5265	-0.8763	1.1876	0.09	0.7675
	Maryland	1	0.1386	14.9%	0.5042	-0.8497	1.1269	0.08	0.7835
	Massachusetts	1	0.1578	17.1%	0.5072	-0.8363	1.1520	0.10	0.7557
	Michigan	1	0.4229	52.6%	0.5016	-0.5603	1.4061	0.71	0.3992
	Minnesota	1	0.0635	6.6%	0.5024	-0.9213	1.0483	0.02	0.8995

Parameter		Degrees of freedom	Estimate	Effect	Standard error	Wald 95% confidence limits		Chi-square	P-value
	Mississippi	1	0.2782	32.1%	0.5069	-0.7153	1.2716	0.30	0.5831
	Missouri	1	0.0175	1.8%	0.5031	-0.9686	1.0035	0.00	0.9723
	Montana	1	0.0870	9.1%	0.5202	-0.9325	1.1065	0.03	0.8672
	Nebraska	1	0.0339	3.4%	0.5071	-0.9601	1.0279	0.00	0.9467
	Nevada	1	0.1872	20.6%	0.5235	-0.8387	1.2132	0.13	0.7206
	New Hampshire	1	0.4565	57.9%	0.5198	-0.5624	1.4753	0.77	0.3799
	New Jersey	1	0.0042	0.4%	0.5049	-0.9853	0.9937	0.00	0.9933
	New Mexico	1	-0.0224	-2.2%	0.5209	-1.0434	0.9986	0.00	0.9657
	New York	1	0.1234	13.1%	0.5016	-0.8597	1.1066	0.06	0.8056
	North Carolina	1	-0.1875	-17.1%	0.5037	-1.1748	0.7998	0.14	0.7098
	North Dakota	1	0.2022	22.4%	0.5168	-0.8108	1.2152	0.15	0.6956
	Ohio	1	-0.0994	-9.5%	0.5020	-1.0834	0.8846	0.04	0.8431
	Oklahoma	1	-0.0134	-1.3%	0.5065	-1.0062	0.9794	0.00	0.9788
	Oregon	1	-0.1825	-16.7%	0.5186	-1.1990	0.8341	0.12	0.7250
	Pennsylvania	1	0.1383	14.8%	0.5015	-0.8446	1.1212	0.08	0.7827
	Rhode Island	1	0.0591	6.1%	0.5406	-1.0004	1.1186	0.01	0.9130
	South Carolina	1	-0.1056	-10.0%	0.5063	-1.0979	0.8867	0.04	0.8348
	South Dakota	1	0.1122	11.9%	0.5120	-0.8913	1.1157	0.05	0.8266
	Tennessee	1	0.1632	17.7%	0.5036	-0.8238	1.1503	0.11	0.7458
	Texas	1	0.0456	4.7%	0.5016	-0.9375	1.0287	0.01	0.9276
	Utah	1	0.0765	8.0%	0.5109	-0.9249	1.0779	0.02	0.8810
	Vermont	1	0.0965	10.1%	0.5479	-0.9773	1.1703	0.03	0.8602
	Virginia	1	0.1115	11.8%	0.5037	-0.8756	1.0987	0.05	0.8247
	Washington	1	-0.0310	-3.1%	0.5108	-1.0322	0.9702	0.00	0.9516
	West Virginia	1	-0.0923	-8.8%	0.5110	-1.0939	0.9093	0.03	0.8566
	Wisconsin	1	0.0836	8.7%	0.5027	-0.9017	1.0690	0.03	0.8679
	Wyoming	1	-0.1527	-14.2%	0.5272	-1.1860	0.8807	0.08	0.7721
	Alaska	0	0		0	0	0		
Deductible range	0-250	1	0.7745	117.0%	0.0443	0.6877	0.8614	305.39	<0.0001
	251-500	1	0.3913	47.9%	0.0446	0.3039	0.4788	76.95	<0.0001
	1001+	1	-1.0688	-65.7%	0.4483	-1.9475	-0.1900	5.68	0.0171
	501-1000	0	0		0	0	0		
Registered vehicle density	0-99	1	-0.2554	-22.5%	0.0265	-0.3073	-0.2036	93.18	<0.0001
	100-499	1	-0.1422	-13.3%	0.0233	-0.1879	-0.0965	37.21	<0.0001
	500+	0	0		0	0	0		
Lane Departure Warning and Side Blind Zone Alert		1	0.0410	4.2%	0.0265	-0.0109	0.0929	2.40	0.1216
Ultrasonic Rear Parking Assist		1	-0.0511	-5.0%	0.0203	-0.0909	-0.0112	6.31	0.0120

Table title: Appendix : Illustrative regression results — collision frequency