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The Value of a Technical Service Bulletin Index for the Consumer

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I. Introduction

The purchase of an automobile is a complex decision involving many factors. One factor considered in this evaluation is the quality of the product. J.D. Power and Associates was founded by James David Power to provide data analytics and consumer intelligence based on surveys of customer satisfaction, product quality and buyer behavior for the automotive, banking, wealth and lending, telecommunications, insurance, health, travel and utilities industries. The J. D. Power automotive initial quality and dependability surveys (J.D. Power, 2018a) provide information for the consumer, indicating which cars are the best for people to purchase. Its rankings are based on many factors including mechanical quality, design quality, features and accessories. In a prior study (Richardson, Shin, Soluade, 2018), it was determined that these rankings were independent measures for the consumer to use in evaluating the purchase of a car based on the quality and dependability of 30 different vehicle models. Other measures of quality also utilize surveys and reports for consumers to use in their evaluations. Edmunds (Edmunds, 2018) has experts that evaluate cars based on 30-plus scores that cover performance, comfort, interior, technology, utility and value. Consumer Reports (Consumer Reports, 2018) surveys its subscribers and also develops experts' ratings based on test drives on its track. In these qualitative assessments, the surveys rely on the customers' memory to accurately report problems, while expert reviews are based on an individual's judgement.

In contrast, quantitative approaches provide additional sources of information to use in an analysis by counting actual problems. Recalls of automobiles are tracked for each model and the information is available on the National Highway Traffic Safety Administration's database (NHTSA, 2018b). This was the basis for the development of an index summarizing the number of recalls issued by the manufacturer on specific models (Richardson, Shin, and Soluade, 2018). The study focused on the period from 2011 to 2013 as a normal time prior to an unusual event created by a supplier (Takata airbag recall) as identified in Figure 1 (Jibrell, 2018). Also, since recalls may not be issued on a car until many vehicles have reported the problem, it is often years before all the defects result in a recall. With this time lag in reporting defects, a moving average over several years was evaluated in developing the index. In addition to these government surveys, it would be beneficial to the consumer to have information on the number of Technical Service Bulletins issued on a car by the manufacturer.

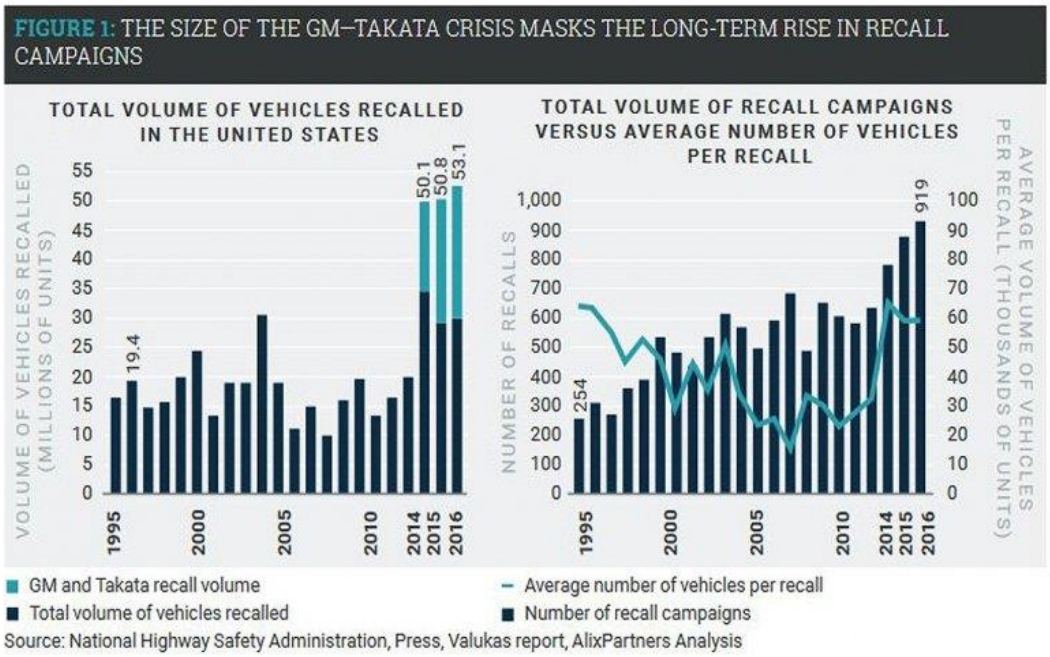

Figure 1. Recall Campaigns

The Technical Service Bulletins (TSB) are summaries of the manufacturers' Technical Service Bulletins issued to correct non-safety production defects on items that fail prematurely during the warranty period of five years for most manufacturers. Bulletins for recalls are not included (NHTSA, 2021b). Since these defects, like recalls, are reported only after a significant number of cars indicate that parts have worn out, the number of bulletins issued increases over the years of the warranty. In order to evaluate the full impact of the repair notices, it requires that all the bulletins in the warranty period be reported. For example, the final cars for the 2013 year come off the production line and are sold through the end of 2013. The five year warranty period for these cars starts in 2014 and ends in 2018. Since there is a delay in reporting these problems to the NHTSA, the final bulletins are entered into the database in 2019. This study focuses on comparisons when all the bulletins have been processed. Therefore, to determine if these bulletins provide an independent measure different from the J. D. Power surveys and the recall index, the newest data available where all the bulletins are reported for the analysis is 2011, 2012 and 2013.

II. Background on J. D. Power Rankings

J. D. Power's is one of the world's most recognized and trusted consumer ratings reports. It was created to focus on quality in the automotive industry. It first gained its prowess when, in 1973, the Wall Street Journal reported problems with the Mazda's Wankel engine based on data from J. D. Power. In 1984, these rankings became popularized as an asset to car companies when Subaru advertised its ranking in a Super Bowl commercial (J. D. Power, 2018a). "Since then, more than 200,000 television commercials and more than two billion print ad impressions refer to J. D. Power awards annually" (J.D. Power, 2018a). This has resulted in giving J. D. Power a significant influence over automobile purchases. Not only does it put pressure on the manufacturers to be highly ranked each year, but many consumers look to these reports for advice on which car to purchase. Today, J. D. Power publishes rankings from five major automotive surveys each year. The two most used by the consumer are the Initial Quality Survey and the Vehicle Dependability Survey.

The J. D. Power Initial Quality Survey serves as the industry benchmark for new vehicle quality measured at 90 days of ownership and has proven to be an excellent predictor of long-term reliability, which may significantly impact new-vehicle purchase decisions. The focus of the study is model-level performance and comparison of individual models to similar models in their respective segments, which helps manufacturers worldwide to design and produce higher quality vehicles that exceed owners' expectations (J. D. Power, 2018b). For 2011 to 2013 rankings, see Appendix A, J. D. Power Initial Quality Rankings for 2011 to 2013.

The J. D. Power Vehicle Dependability Survey focuses on problems experienced by original owners of 3-year old vehicles. Study findings are used extensively by manufacturers worldwide to help them design and build better vehicles which typically retain higher resale value, and by consumers to help them make more informed choices for both new and used vehicles (J. D. Power, 2018c). For 2011 to 2013 rankings, see Appendix B, J. D. Power Vehicle Dependability Rankings for 2011 to 2013.

These studies are based on the opinions of a sample of consumers from a variety of industries who have used or owned the product being rated (J. D. Power, 2018a). Their goal is to quantify the consumer experience. Even though this is a difficult task, J. D. Power uses a proprietary index model and finds the driving forces of the consumer experience to accurately measure and link their impact to business results and uncover insights to drive results for their clients (J. D. Power, 2018a). The J. D. Power studies are used as an aid to the consumer who is looking for a quality car. They are also used as a benchmark for manufacturers to both improve quality and understand what the consumer desires.

III. Comparison of J. D. Power Initial Quality Studies to J. D. Power Dependability Studies 2008-2013

The J. D. Power Initial Quality Rankings were compared to the J. D. Power Dependability Rankings (Richardson, Shin, Soluade, 2018**)** using Spearman's Rank-Order Correlation (McDonald, 2014). This analysis was performed to validate that the rankings are independent between the 90-day quality survey and the third-year dependability survey. The Initial Quality Study measures whether all the parts of the car were assembled correctly as the car roles off the assembly line, while the Dependability Study measures how well the car holds up after three years. If they are highly correlated, this means that the dependability study provides no new information. If they are not correlated, it means that the J. D. Initial Quality Study and the J. D. Dependability Study are not related and provide different information to the consumer. The results of the correlation analysis are presented in Table 1, Correlation between the Initial Quality Survey and the Vehicle Dependability Survey.

Year	Correlation
2008	.3793
2009	.5553
2010	.4934
2011	.6334
2012	.2301
2013	.7624

Table 1. Correlation Ranking Between J.D. Initial Quality Study and J.D. Dependability Study

The J. D. Power Initial Quality and J. D. Dependability Rankings are not significantly correlated to each other. This indicates that these surveys provide two independent measures for the consumer to use in evaluating a car or that the Initial Quality Rating alone is not enough information for the consumer to choose a car that will perform over the long term. Both Initial Quality and Dependability studies are necessary to get a better picture to determine which cars are the best. While both of these studies provide good information, they do not incorporate a quantitative measure of a vehicles quality. The next step is to create an index based on TSB and evaluate if the TSB index correlates with the existing J. D. Power rankings.

IV. Technical Service Bulletin Data

Two new indices were created based on the TSBs of 30 different models for the years 2011 to 2013 from the NHTSA (National Highway Traffic Safety

Administration) Technical Service Bulletin database (NHTSA, 2018b). First, a weighted index is calculated for each model by summing the number of automobiles effected by each bulletin divided by the number of automobiles sold for that model in the given year (Automotive News Data Center, 2018). This index is solely based on a quantitative measure of quality, which is an important aspect of any vehicle, compared to the J. D. Power rankings that are based on consumer opinions of manufacturing quality. The index was computed for each model for the years 2011 to 2013 and a 3-year average index to smooth over any major discrepancies. Then, the 30 models were ranked for each year using the model with the smallest Technical Service Bulletins Index ranked first, meaning it had the lowest number of cars listed in the TSB to sales ratio. The three-year average is ranked in Table 2, Weighted Technical Service Bulletins Index for the 3 Year Average. For the 2011 to 2013 rankings, see Appendix C. Weighted Technical Service Bulletins Index Rankings for 2011 to 2013.

Rank	Name Plate	3 Year Average
1	Infiniti	2.0
2	Volvo	10.3
3	Porsche	15.0
4	Chrysler	16.3
5	Mitsubishi	18.3
6	Nissan	18.7
7	Jeep	22.0
8	Hyundai	24.3
9	MINI	28.3
10	Scion	28.3
11	Lincoln	30.0
12	BMW	31.0
13	Dodge	38.7
14	Mercedes	50.3
15	Acura	56.3
16	Mazda	56.7
17	Honda	61.0
18	Lexus	63.0
19	Volkswagen	72.0
20	Kia	83.7
21	Ford	101.0
22	Subaru	118.7
23	Jaguar	144.0
24	Toyota	144.0
25	GMC	168.7
26	Cadillac	173.0
27	Buick	187.0
28	Land Rover	199.3
29	Audi	284.0
30	Chevrolet	493.0

Table 2. Weighted Technical Service Bulletin Index for the 3 Year Average

A second ranking was created using the absolute number of bulletins issued (See Appendix D. Number of Technical Service Bulletin Issued Rankings for 2011 to 2013). An analysis compares the Weighted TSB Index to the Number of TSBs issued. These are highly correlated as indicated in Table 3, Comparison of TSB Measures.

Correlations with the TSB INDEX

and the

the NUMBER of TSB Issued

2011	2012	2013
0.831	0.794	0.849

Table 3. Comparison of TSB Measures

V. Comparison of TSB Indices to J. D. Power Initial Quality Ranking

The Technical Service Bulletin Index Rankings were compared to the J. D. Power Initial Quality Rankings. After performing Spearman's Rank-Order Correlation, no year of the Technical Service Bulletin Index correlated significantly to the J. D. Power Initial Quality rating (with a significant correlation greater than .80). The rank order correlations for the three years are seen in Table 4, Correlation between IQS and the Technical Service Bulletin Indices.

	2011	2012	2013
J. D. Power Initial Quality Survey and			
Weighted Technical Services Bulletin Index	**-0.10**	**-0.07**	**-0.21**
Number of Technical Service Bulletin Index	**-0.21**	**0.00**	**-0.22**

Table 4. Correlation between IQS and the Technical Service Bulletin Indices

This indicates that the Technical Service Bulletin Indices provides new information for the consumer.

VI. Comparison of TSB Indices to J. D. Power Dependability Ranking

Even though the Technical Service Bulletin Index did not correlate with the initial quality, another comparison was performed against the J. D. Power Vehicle

Dependability Rankings from 2011 to 2013, which measures the quality of the vehicle after 3 years of ownership. The results were the same, with no significant correlation between the Technical Service Bulletin Index and the J.D. Dependability Ranking. The rank order correlations for the three years are presented in Table 5, Correlation between Dependability and Technical Service Bulletins.

	2011	2012	2013
J. D. Power Dependability Survey and			
Weighted Technical Services Bulletin Index	**-0.004**	**0.098**	**-0.035**
Number of Technical Service Bulletin Index	**-0.097**	**0.273**	**0.005**

Table 5. Correlation between Dependability Survey and Technical Service Bulletins

This indicates that the Dependability Study is not the same measure of quality as the Technical Service Bulletin Issued and that the number of Technical Service Bulletins Issued provides new information for the consumer.

VII. Conclusion

Government TSBs provide the consumer with information about the quality of vehicles. Currently, there are no reports summarizing the Technical Service Bulletins for a consumer to understand the implication of this information. How can one compare the quality of different cars from the TSB database with hundreds of thousands of records on each manufacturer's different models? The TSB Index is a method for taking all of this information and presenting it in a way that provides new, useful information about vehicle quality to the consumer looking to purchase a new car.

After comparing the Technical Service Bulletin Index to both the J. D. Power Initial Quality Studies and the J. D. Power Vehicle Dependability Studies, there is no evidence of correlation. This indicates that the J. D. Power Rankings are different indicators of quality and that the newly created Technical Service Bulletin Issued Index offers additional information that the consumer did not know before. Since the J. D. Power rankings rely on consumer opinions, it means that consumers are not likely to be able to accurately determine quality with a single measure. The consumer should consider the J. D. Power rankings as a report on consumer satisfaction and one measure of the quality of the vehicle. When the consumer is going to buy a car, it would be in their best interest to look at the J. D. Initial Quality Study to see if the car was properly assembled. Then, the consumer should look at the J. D. Power Vehicle Dependability Study to gauge how well the car has held up mechanically for the next three years. Finally, the consumer should look at the

Technical Service Bulletin Index and the Recall Index to evaluate the overall quality of the vehicle.

VIII. Future Research

There is a delay in the National Highway Traffic Safety Administration's data collection process for identifying problems. To compensate for this lag in reporting, additional research is required to develop the index into a meaningful representation of a car's quality profile for the current purchase. Initially, an average of the last three or five years will be considered. Also, an analysis of the TSB Indices (weighted by the number of cars and the number of TSB Issued) to determine the best measure of the TSB to use is required, since only one should be implemented. Finally, the recall index, the TSB index and other J.D. Power surveys could be combined into a single quality measure.

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Appendix A. J.D. Power Initial Quality Rankings for 2011 to 2013

	JD Power Rankings by Year for the Initial Quality Survey		
Model	**2011**	**2012**	**2013**
Acura	3	6	6
Audi	18	15	13
BMW	13	10	18
Buick	20	16	15
Cadillac	9	4	14
Chevrolet	14	14	5
Chrysler	16	23	16
Dodge	30	27	25
Ford	22	25	26
GMC	10	12	2
Honda	2	5	8
Hyundai	11	17	10
Infiniti	8	7	4
Jaguar	21	2	9
Jeep	24	22	21
Kia	19	18	11
Land Rover	25	26	20
Lexus	1	1	3
Lincoln	17	19	17
Mazda	5	11	23
Mercedes	4	9	12
MINI	27	30	27
Mitsubishi	29	28	29
Nissan	23	13	28
Porsche	6	3	1
Scion	26	24	30
Subaru	12	21	24
Toyota	7	8	7
Volkswagen	28	29	22
Volvo	15	20	19

Appendix B. J. D. Power Vehicle Dependability Rankings for 2011 to 2013

	JD Power Rankings by Year for the Dependability Survey		
Model	**2011**	**2012**	**2013**
Acura	6	11	8
Audi	18	15	21
BMW	19	19	14
Buick	7	9	6
Cadillac	9	3	12
Chevrolet	14	13	10
Chrysler	26	29	24
Dodge	27	28	29
Ford	12	8	11
GMC	23	20	15
Honda	11	12	7
Hyundai	10	10	20
Infiniti	13	25	18
Jaguar	3	26	25
Jeep	29	27	27
Kia	17	23	19
Land Rover	28	30	30
Lexus	2	1	1
Lincoln	1	7	3
Mazda	21	22	9
Mercedes	8	6	5
MINI	30	21	23
Mitsubishi	24	18	28
Nissan	22	17	17
Porsche	4	2	2
Scion	20	5	16
Subaru	16	16	13
Toyota	5	4	4
Volkswagen	25	24	26
Volvo	15	14	22

Appendix C. Technical Service Bulletin Index Rankings for 2011 to 2013

Technical Service Bulletins Index-Rankings by Year			
Model	**2011**	**2012**	**2013**
Acura	18	14	13
Audi	26	27	26
BMW	16	7	6
Buick	28	28	27
Cadillac	27	22	30
Chevrolet	25	26	25
Chrysler	5	13	11
Dodge	7	15	9
Ford	9	8	16
GMC	24	24	21
Honda	11	12	14
Hyundai	10	4	7
Infiniti	1	1	1
Jaguar	29	29	28
Jeep	6	17	8
Kia	19	21	20
Land Rover	30	30	29
Lexus	20	9	18
Lincoln	8	6	15
Mazda	15	18	23
Mercedes	13	16	5
MINI	23	20	22
Mitsubishi	4	11	10
Nissan	3	3	2
Porsche	12	5	3
Scion	17	10	12
Subaru	22	25	24
Toyota	14	19	17
Volkswagen	21	23	19
Volvo	2	2	4

Appendix D. Number of Technical Service Bulletin Issued Rankings for 2011 to 2013

Technical Service Bulletins Issued Rankings by Year			
Name Plate	**2011**	**2012**	**2013**
Acura	18	16	16
Audi	29	29	29
BMW	15	11	3
Buick	26	28	26
Cadillac	27	21	27
Chevrolet	30	30	30
Chrysler	2	6	9
Dodge	9	13	14
Ford	22	19	22
GMC	28	26	21
Honda	16	14	19
Hyundai	7	10	10
Infiniti	1	1	1
Jaguar	24	24	25
Jeep	3	12	6
Kia	17	20	20
Land Rover	25	27	28
Lexus	19	15	17
Lincoln	10	5	15
Mazda	13	17	18
Mercedes-Benz	14	18	12
MINI	12	7	11
Mitsubishi	4	8	8
Nissan	11	4	5
Porsche	5	3	7
Scion	8	9	13
Subaru	20	22	23
Toyota	23	25	24
Volkswagen	21	23	4
Volvo	6	2	2