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The Value of Automobile Surveys in Reducing the Buyer's Risk

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ABSTRACT

Consumers use quality surveys to reduce risk in purchasing a car. The J. D. Power's initial quality survey of automobile buyers reports the number of problems found in the first 90 days of ownership. It is important that this information be clear and concise for the public to understand. In 2006, the surveys were changed to combine two measures of quality, number of defects and design problems, into a single number. In prior years, only the number of defects was used. The survey design change combined with issues related to the methodology in aggregating values leads to confusion and inconsistencies over time as the difference between cars becomes insignificant. The conclusion recommends changes to correct these problems.

INTRODUCTION

Quality survey companies follow the basic information system's process of collecting the data from the assessment documents, creating a database of the information, analyzing the data, and disseminating the probability of a defect or the number of problems per product (O'Brien & Marakas, 2009). This paper examines the information process of a survey company and identifies specific problems that may lead to incorrect conclusions. These issues result from the design of survey, computational errors, and lack of continuity in the values over time. The example used in this analysis is taken from the automobile industry. Each year, numerous automobile quality surveys are reported by several information services. Driven by the results of these studies, car manufactures have substantially improved vehicle quality. The results from the J. D. Power's Initial Quality Surveys (Tews & Perryman, 2008) provide consumers with information on the awards for best car in a segment. These awards are used extensively in advertising and influence purchasing decisions. Before purchasing a car, consumers review the available literature on the quality of a product to minimize their risk of purchasing a defective car. Collecting all this information reduces the risk of making a decision with partial or imperfect information (Heiser & Render, 2008).

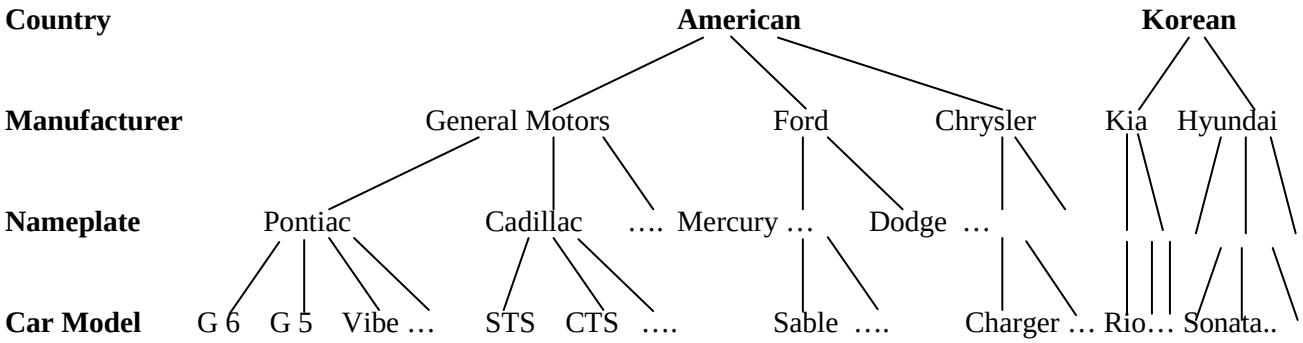
The analysis of the survey process focuses on correctly calculating values and the consistency in the final results. First, the J.D. Power's methodology that is used to aggregate the results of individual models into nameplates, manufacturers and country is examined. Next, with the number of problems becoming statistically insignificant, a qualitative measure is added to the number of defects, a quantitative measure, resulting in a confusing and inconsistent set of values for the new surveys. Throughout the paper, suggestions for improvement are made. The conclusion recommends changes in the survey, a new methodology for aggregating data, and separate surveys for qualitative and quantitative measures to improve the information content

and to make it more easily understood. All numbers are reported in problems per cars or PPC in contrast to the J. D. Power's surveys that report in problems per 100 cars.

ACCURACY OF THE AGGREGATED VALUES

The surveys collect information by individual car model, the lowest level of the aggregation pyramid in Figure 1. In this example, the models G6, G5, Vibe, and others are combined into the nameplate, Pontiac. Then, the nameplates of Pontiac, Cadillac and others are aggregated into General Motors. Finally, manufacturers are aggregated into countries or areas of the world. The American manufacturers are the combined values for GM, Ford and Chrysler. At each level, the information is reported and comparisons are made. The quality values for a model are used to award/identify the three best (lowest number of problems) by car segment (subcompact, compact, midsize, etc.). The values by nameplate are presented in the annual reports.

Figure1: Levels of Aggregation Pyramid.



The correct procedure for aggregating the values up the pyramid is to weight the survey values based on the number of units sold by model, since this is the expected quality that the buyer encounters. For example, a manufacturer has two models, A and B. Model A with sales of 10,000 units found 1.00 PPC (Problems Per Car) based on 2,000 surveys compared to 2.00 PPC from 500 surveys for model B selling 40,000 units. Figure 2 combines values for the manufacturer by weighting the Problems Per Car equally, by number of surveys, and by the number of units sold. The correct value weighted by the individual model's sales is 1.80. The manufacturer's quality would be incorrectly understated as 1.50 PPC if the problems were weighted equally, since the lesser quality model B sold four times as many cars as model A. If the number of surveys was used to weight the quality values of each model, then the aggregate quality would be understated incorrectly as 1.20 PPC.

Figure 2: Calculation of the Aggregated Weighted Values.

	Problems Per Car	**Equally Weighted**	**Weighted by Number of Surveys**	**Weighted by Sales**
Model A	1.00	50%	80% (2,000)	20% (10,000)
Model B	2.00	50%	20% (500)	80% (40,000)
Weighted Value		**1.50**	**1.20**	**1.80**

To examine the accuracy of the process used in the surveys to combine these values, there are four methodologies that could be used in making these calculations for each country. These include:

1. Weighted equally by the number of manufacturers
2. Weighted by the number of cars sold by each manufacturer in the United States
3. Weighted by the global sales of each manufacturer
4. Weighted by the number of the surveys returned

The 2004 survey (Greywitt & Tews, 2004) provides an opportunity to identify which method is used in calculating aggregate values. The easiest country to evaluate is Korea, since there are only two automobile companies, Kia and Hyundai. Further, there are no plants that could be included in with the domestic cars value, because no Korean cars were made in the United States that year. For 2004, Korean cars had an average value of 1.17 PPC. From the 2004 report (Greywitt & Tews, 2004), KIA had 1.53 PPC and Hyundai had 1.02 PPC. Since the number of surveys received by company is unknown, it is not possible to compute the value of the fourth method.

Figure 3 presents the calculation of the Korean PPC value. Since the awards are distributed and used in advertising in the United States, the sales should be based on U.S. sales. The 2003 sales were used in the calculation, because the report was issued on April 28, 2004. With none of these methods yielding the value of 1.17, the conclusion is that the values are calculated incorrectly based on the number of surveys returned to J. D. Power.

Figure 3: Calculation of the Korean Average Value.

	Values in Report	Equally Weighted	Weighted by US Sales	Weighted by Global Sales
KIA	1.53	50%	37% (237,471)	34% (858,697)
Hyundai	1.02	50%	63% (400,221)	66% (1,650,034)
Korean Value	**1.17**	**1.275**	**1.209**	**1.194**

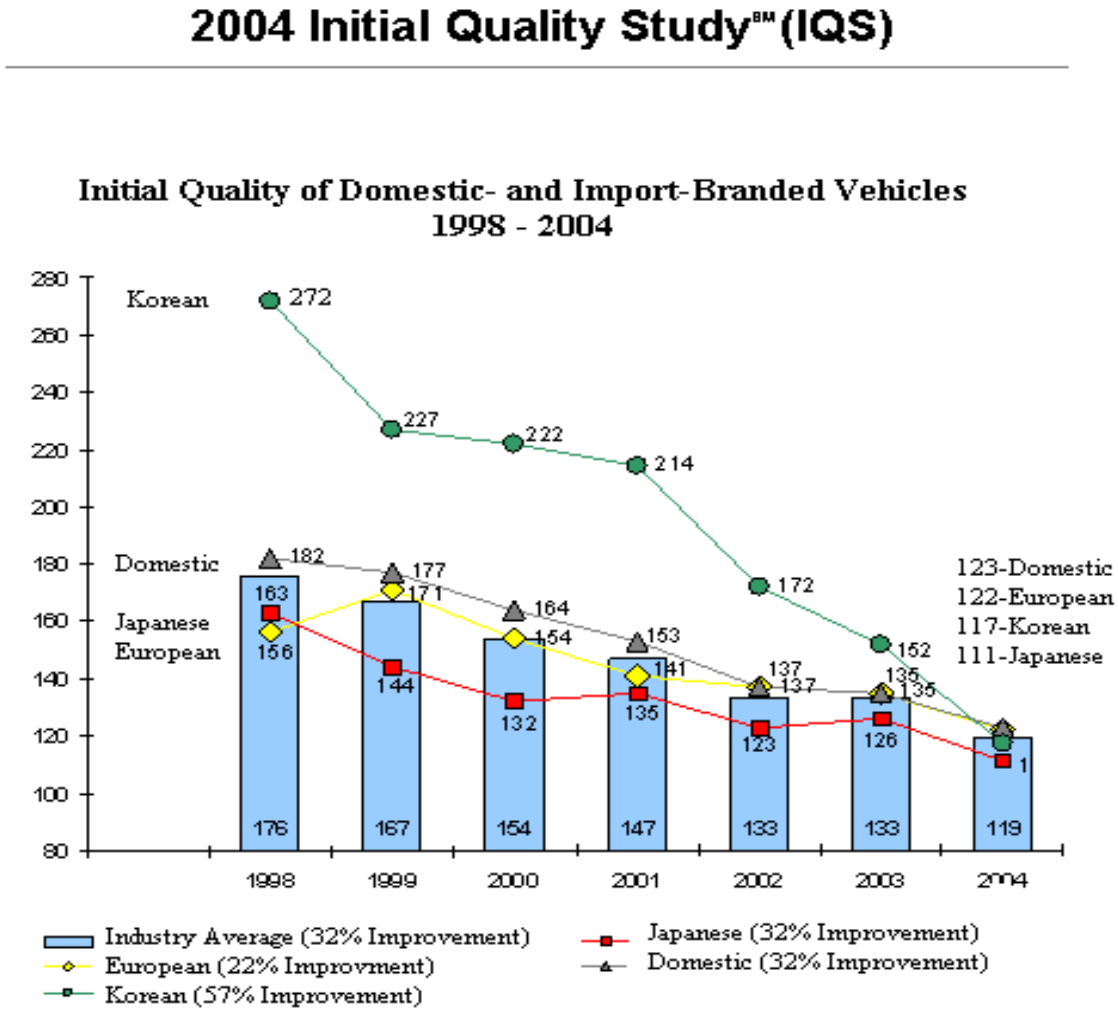
Taking the average from the number of surveys misrepresents the value for Korea, since it fails to represent the distribution of the number of cars purchased by consumers in the United States. If the same methodology was applied to computing the company value from its models, a similar error in the values is generated. These values need to be calculated correctly using the latest sales data available in Automotive News (Crain, 2009).

CHANGES IN SURVEYING PROCESS

In the 2004 J. D. Power report, the graph in Figure 4 of the average number of problems by regions of the world illustrated that the improvements in quality were converging and that within a few years there would be no significant difference among the automobiles. Recognizing that the survey would not have any value with insignificant differences between models, J. D. Power added another measure of quality to increase the value of index in 2006 (Tews & Dadlani, 2006) and increased the number of surveys in 2007 (Tews & Perryman, 2007). After the change was

made, the following footnote appeared in their press release, "NOTE: Due to changes in study methodology, 2006 IQS scores are not comparable to previous years (Tews & Dadlani, 2006)." If there is no difference in the quality, the awards for best quality are meaningless.

Figure 4: Quality Over Years (J. D. Power's IQS (Greywitt & Tews, 2004)).



The 2006 Initial Quality Survey (Tews & Dadlani, 2006) was redesigned to capture problems experienced by owners in two distinct categories—quality of design and quality of production (defects and malfunctions). Prior studies addressed only the counting of production defects/problems. The quality of design focuses on the dimension of design, the technology used in cars (Tews & Dadlani, 2006) and extended to other design flaws like floor mats (Jensen, 2006). The rating that a consumer gives to this measure is dependent upon many factors. If the respondent is young, new technology may be easier for them to deal with compared to older drivers. A bias is also created by the number of options provided by the manufacturer. Cheaper cars have substantially fewer options with less settings per option.

The impact of this change is reflected by the statistics in Figure 5. Prior to the change, the average number of problems and the range decreased each year. After the addition of design, the

mean increased to a value greater than the two prior years and the number of nameplates less than the average decreased. The mean value increases from 2006 to 2007. This is the first increase in the mean. These changes indicate that there is a shift in the distribution with the range around .80 for last two years. The exact impact is difficult to evaluate, since the two quality measures are combined. The impact of a 54% increase in the number of surveys from 63,607 in 2006 to 97,000 in 2007 further complicates the analysis. The issue of consistency is addressed in the next section.

Figure 5: Problems Per Car Summary (Greywitt & Tews, 2001, 2002, 2003,2004, 2005; Tews & Dadlani, 2006; Tews & Perryman 2007, 2008).

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	
Lowest						.76	.87	.81	.91	.91	.87
Highest						2.25	1.73	1.51	2.04	1.70	1.67
Range						1.49	.86	.70	1.13	.79	.80
Mean	1.67	1.54	1.47	1.33	1.33	1.19	1.18		1.24	1.25	1.18
Sample Size			54,000	65,000	52,000	51,000	62,000		63,607	97,000	81,500
Number of Nameplates Above Average						**15**	**16**	**15**	**14**	**13**	**16**

CONSISTENCY

By definition, consistency is the agreement with what has already been done or the conformity with previous activity (Heiser & Render, 2008). This is even more important when the information is distributed to the public. If the number of problems per vehicle varies widely from year to year without an explanation, then the sampling methodology may not be capturing the true values. Thus, consistency is one measure of the reliability of the results reported in Initial Quality Survey. First, the impact on one manufacturer and the plant level values are presented followed by the nameplate breakdowns and finally the awards by individual model.

Manufacturer Impact – BMW

The impact on BMW is used to illustrate the problem. "Without considering both quality factors, one might fail to recognize vehicles that are, in fact, excellent in certain ways. For example, BMW vehicles have among the fewest defects and malfunctions, along with Toyota. But BMW approaches controls and displays in a way that creates some problems for customers, leading to more design-related problems overall than Toyota (Tews & Dadlani, 2006)." The impact of adding the quality of design is illustrated in Figure 6 for BMW. There is a 49.5% increase in 2006 compared to decreases 8.5% and 12.0% in the prior years. The increase comes when the BMW plants (count of problems only) had a significant decline in the number of problems for 2006, 2007, and 2008. The increase is the result of more or less problems in the factory, the design of the car, or both. The consumer is not sure what caused the increase in the number of problems.

Figure 6: Impact of Technology (Greywitt & Tews, 2003,2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

		2003	2004	2005	2006	2007	2008
BMW	Ranking	8th	12th	3rd	27th	20th	21st
	PPC	1.18	1.08	.95	1.42	1.33	1.26
	Yearly % Change		**-8.5%**	**-12.0%**	**49.5%**	**-6.3%**	**-5.3%**
	Factory Counts ONLY	.93	---	.78, .85	.42, .45	.37	.39

Assembly Plant Awards

The top three plants in North and South America, Asia Pacific and Europe with the number of problems per cars for last seven years is presented in Figure 7. The 2006 change in methodology does not affect the plant statistics since "Plant awards are based solely on defect counts (Tews & Perryman, 2007)." However, there is a significant decrease in the number of defects reported from 2006 on. For example, in the North and South America group, the GM plant went from 85 to 42 or 49% decrease. Similarly, in Asia Pacific, Lexus declined 46% (59 to 32), and in Europe, a 43% decline occurred at BMW plants. These drops and the changes in manufacturers in the last three years require an explanation. The increase in the number of surveys would account for an increase in accuracy starting in 2007, but this does not explain the 2006 decline.

Figure 7: Assembly Plant Quality Awards (Greywitt & Tews, 2001, 2002, 2003,2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

	2001	2002	2003	2004	2005	2006	2007	2008
North and South America								
1st	Toyota .96	GM .93	GM .87	GM .74	GM .85	GM .43	**Ford*.35**	Toyota .42
2nd	Honda 1.01	GM .98	GM .88	GM .91	GM .89	Chrysler.47	GM .42	Toyota .43
3rd	Toyota 1.01	GM 1.00	Ford .94	Ford .92	GM .90	Toyota .47	Honda.44	GM .45
Asia Pacific								
1st	Toyota *** .74**	**Lexus*.63**	**Lexus*.63**	**Lexus*.53**	**Lexus*.59**	**Lexus* .32**	Lexus.41	Toyota .38
2nd	Lexus.77	Toyota.91	Toyota.81	Honda.75	Toyota.67	Toyota .36	Toyota.44	Nissan .43
3rd	Toyota.85	Toyota.93	Toyota.86	Toyota.78	Nissan.79	Honda .41	Honda.47	Toyota .43
Europe								
1st	BMW .86	BMW .85	BMW .93	Porsche .72	Ford .70	BMW .42	BMW .37	**Mercedes*.33**
2nd	Jaguar .90	BMW .87	Chrysler.94	Honda .82	BMW .79	BMW .45	Mercedes.41	Porsche .37
3rd	BMW .94	Chrysler .94	Volvo1.02	Ford .87	BMW .85	Porsche .46	Audi .44	BMW .39

Nameplate* Indicates Platinum Award winner (Overall lowest number of defects for ALL plants)

Nameplate Rankings

J. D. Power's 2008 Initial Quality Survey (Tews & Perryman, 2008) of customers ranked the 36 nameplates based on the number of problems per 100 vehicles. Based on a sample size of 81,500 surveys, a series of tests for significant differences between the nameplates were conducted with the results presented in Figure 8. Using the number of problems per auto from the survey, the Poisson distribution (Williams, 2008) was used in the paired comparisons to determine if the values were within the range of indifference. The test was applied to all nameplates to identify the number of cars that are not significantly different. For example from Figure 8, in 2008, the Mercedes with 1.04 problems per car is no different than the next eight nameplates (Toyota, Mercury, Honda, Ford, Jaguar, Audi, Cadillac, and Chevrolet) with higher values on the list, and two nameplates (Lexus and Infiniti) with values less than Mercedes for a total of ten.

Figure 8: Test of Significance Results by Nameplate.

Number of Nameplates That Are Not Significantly different

Nameplate	2003	2004	2005	Survey Changed	2006	2007	2008
Acura	8	12	14		12	15	17
Audi	14	17	12		17	12	14
BMW	9	17	6		12	14	11
Buick	8	12	8		16	16	17
Cadillac	5	8	12		10	12	14
Chevrolet	15	13	15		16	15	14
Chrysler	16	13	16		12	8	7
Dodge	18	14	14		16	7	6
Ford	16	12	15		17	8	14
GMC	13	11	14		13	15	11
Honda	11	11	14		8	5	14
Hummer	0	2	15		3	7	10
Hyundai	15	11	16		4	15	12
Infiniti	8	13	15		10	8	4
Jaguar	12	10	2		6	6	14
Jeep	12	8	16		5	8	3
KIA	3	8	15		13	15	17
Land Rover	0	10	9		0	4	4
Lexus	0	1	1		2	2	4
Lincoln	15	14	15		11	2	14
Mazda	12	7	9		6	7	11
Mercedes	14	12	13		14	5	11
Mercury	8	12	16		18	6	12
MINI	3	8	14		6		4
Mitsubishi	12	12	14		14	7	6
Nissan	15	8	16		11	15	11
Pontiac	16	12	15		16	14	12
Porsche	9	9	10		1	1	0
Saab	7	9	14		4	14	6
Saturn	7	10	14		17	15	6
Scion					14	11	5
Subaru	12	11	15		12	14	10
Suzuki	13	10	7		3	7	8
Toyota	12	13	12		3	6	11
Volvo	11	14	16		16	15	11
Vwagon	15	6	10		3	8	10
Maximum	**18**	**17**	**16**		**18**	**16**	**17**
Average	**10.40**	**10.57**	**12.54**		**10.03**	**9.69**	**9.86**

As expected, the addition of the design and technology factor decreased the average level of the range of indifference from 12.54 to 10.03 in 2006. The increase in the number of surveys in 2007 accounts for the reduction in the range of indifference to 9.69 in 2007 and 9.86 in 2008. At the

nameplate level, Mercedes with a 1.39 in 2006 dropped to 1.11 in 2007 and 1.04 in 2008. This could be the result of dealers improving their new car presentation to the customer with emphasis on the use of the menus. The yearly rankings changed dramatically for many nameplates (Buick, BMW, Porsche, Mercedes, and others).

Figure 9: Top 15 Nameplate Ranking Summary (Greywitt & Tews, 2003, 2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

	American	Japanese	European	Korean
2003	4 (27%)	5 (33%)	6 (40%)	0 (0%)
2004	4 (27%)	5 (33%)	5 (33%)	1 (7%)
2005	5 (33%)	5 (33%)	4 (27%)	1 (7%)
Average for 3 Years	**4.3 (29%)**	**5 (33%)**	**5 (33%)**	**.7 (5%)**
2006	7 (46%)	6 (40%)	1 (7%)	1 (7%)
2007	6 (40%)	5 (33%)	2 (14%)	2 (14%)
2008	6 (40%)	4 (27%)	4 (27%)	1 (7%)
Average for 3 Years	**6.33 (42%)**	**5.00 (33%)**	**2.33 (16%)**	**1.33 (9%)**

Using the Initial Quality Survey results from Figure 9, the information was segmented into global regions (American, European, Japanese, and Korean) by J. D. Power in 2004 (Greywitt & Tews, 2004). Figure 9 counts the number and percent of brands by region from the top fifteen best nameplates, the average number nameplates better than average quality. The average number of cars in each region is computed for the three years prior to the change and the three years after including design. The number one nameplate was Lexus for the first three years, with Porsche the leader for the last three years.

For the top fifteen, the gainer is American automobiles with two cars on average after the change. This gain was at the expense of the Europeans who lost more than two cars on average. Based on the top fifteen analyses, it appears that Europeans have developed less desirable interfaces with technology by putting excess technology features in their cars, or insufficient education of new car buyers.

Model Awards by Car Segment

Finally, the individual models are ranked based on the awards by car segment (sub-compact, compact, midsize, etc.). The three best models are identified based on the least number of defects and design flaws. Figure 10 presents the count of the top cars in each category. Figure 11 lists the award winners for the last eight years, and Figure 12 charts the winners from 2001 to 2008. Contrary to the results in the nameplate analysis, the American, European and Korean manufacturers increased the number of those selected for an award, while the Japanese declined.

Figure 10: Number of First Place Autos in Segment (Greywitt & Tews, 2001, 2002, 2003,2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

Year	# Awards	American		Japanese		European		Korean	
2001	16	5	31%	11	69%	0	0%	0	0%
2002	16	7	44%	9	56%	0	0%	0	0%
2003	16	8	50%	7	44%	1	6%	0	0%
2004	18	6	33%	10	56%	1	6%	1	6%
2005	18	7	39%	11	61%	0	0%	0	0%
5 Year Average		**6.60**	**39%**	**9.60**	**57%**	**.40**	**2%**	**.20**	**1%**
2006	20	5	25%	12	60%	1	5%	2	10%
2007	20	8	40%	6	30%	5	25%	1	5%
2008	18	8	40%	8	40%	2	12%	0	0%
3 Year Average		**7.00**	**37%**	**8.66**	**46%**	**2.66**	**14%**	**.66**	**3%**

Note: In 2006 and 2007, a single tie occurred increasing the total count by one to 20.

Figure 11. First Place Awards by Manufacturer (Greywitt & Tews, 2001, 2002, 2003, 2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

The addition of the qualitative factor has caused a shift in the individual nameplate values, the better than average nameplates and the car segment awards. The separate values for the qualitative and quantitative measures are available, but the awards and conclusions are made based on the combined values.

Figure 12: Chart of First Place Awards by Manufacturer (Greywitt & Tews, 2003, 2004, 2005; Tews & Dadlani, 2006; Tews & Perryman, 2007, 2008).

CONCLUSIONS

Quality surveys have focused the consumer's attention on quality and forced the manufacturers to improve quality. The design of the questionnaire is critical in this process. The purchaser should be clearly informed that all repairs are to be reported, not just the ones that were paid for by the consumer. The inclusion of the number of defects and the design of the car into a single document results in over 270 items to be evaluated. The next step in improving the measurement of the initial quality of an automobile is to separate the number of defects/malfunctions and the quality of design into two surveys. The new car buyers should be divided into two groups. One group receives the questions on the number of defects, and the second answers the design issues. Then the design criteria could address more items such as comfort in terms of space as well as the design of the dashboard for readability, rear window for visibility, exterior for efficient airflow dynamics, etc. The consumer needs both measures in making a purchase decision. By combining the two into one measure, the volatility of result is confusing and misleading.

Another survey of initial quality should focus on the number of recent recalls that a manufacturer has. In the past few years, the number of recalls on vehicles has increased to more than the number of new cars sold. An overall measure of quality reflecting recall counts and percent of recalls by number of models sold should be included for the last five years. The recalls could be classified into different severity categories (fatal, dangerous, and minor). This would warn buyers of potential issues after purchase.

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