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Measuring aftersales productivity by multi attribute decision making methods: An application in the automotive sector

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ABSTRACT

The aim of the research is to propose a Data Envelopment Analysis (DEA) methodology for the performance evaluation of 76 dealers of Hyundai in Turkey in terms of after sales services such as repair and maintenance. Through this work, appropriate inputs and outputs are determined and the DEA methodology is applied for 76 dealers. DEA is a multi-criteria decision making model that can be used to determine rank orders of units when there are given inputs and outputs. Three inputs and four outputs are determined by the authors and expert opinion. After data collection and DEA analysis, we reported the ranks of 76 dealers after sales services and classify the ranks by regions in order to spotlight certain regional considerations (such as popular touristic destinations) in terms of after sales performance. Research is limited to a specific brand and can be extended to include other brands in the future. Also, other after sales services such as appliance repair can be included. After sales service personnel can easily use the method by Excel and can see their performance with respect to other dealers. As dealers can see performance based incentives becoming a major part of their total profits being able to see the relative positions among the many dealers would have practical implications.

1. Introduction

Global automotive firms' after sales activities contribute to their competitiveness as much as their production and R&D activities. On the other hand after sales activities are very difficult to measure and it becomes increasingly difficult to design proper reward systems. Hyundai has a production capacity of 200,000 in Turkey and is producing the models i20 and i10 (recently introduced in 2013). The official dealers number more than 70 and are combinations of sales and after sales services. Not properly rewarding dealers, or rewarding based on a single criteria can cause conflict within the distribution network. Multi-criteria methods therefore can be very useful in this application area.

In this study we use Data Envelopment Analysis (DEA) which has a long history as a MCDA tool. DEA has no assumption about a particular production type. Also it does not depend on expert opinions and is therefore immune from expert bias. DEA does not have any upper limits in terms of the number of business units to be analyzed. Solution by widely available spreadsheet program is another advantage of this method. This would also result in the benefit of easy application by service employees who may have little training in OR. DEA measures the efficiency of DMUs (Decision Making Unit) by comparing those to other similar DMUs. Our study compares the efficiency of the service stations to each other.

2. DEA literature

The aim of firms is to employ inputs for producing outputs with an incentive which is regarded as maximizing profits. Technically inefficient firms could not increase the level of outputs by a smaller increase in the level of inputs.

DEA Literature is very broad, for historical and mathematical background, Førsund and Sarafoglou (2002) is the reference paper. For the seminal DEA Theory, milestone papers are the studies of Charnes et al. (1978) for the CCR Model and Banker et al. (1984) for the BCC Model.

Multi-Attribute Decision Making (MADM) literature contains extensive discussions on the use of imprecise data, including data known only in the

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form of upper and lower bounds. White et al. (1984) and Kim et al. (1999) stated various forms of imprecise data that can occur in practice. In our study we not have imprecise data but some automotive firms or dealers might face such a situation. To deal with all aspects of such imprecise data that can appear in DEA, Cooper et al. (1999) proposed a body of concepts and methods that go by the name of IDEA (Imprecise Data Envelopment Analysis).

Moreover, DEA was originally used to investigate the relative efficiency of non-profit organizations, following which it was quickly adopted by profit-making organizations. Application of DEA can be found in such diverse settings as financial institutions, hospitals, the US Air Force, airports, schools and courts (Lewin et al., 1982; Charnes et al. 1985; Thanassoulis et al., 1987; Sherman and Ladino, 1995; Sarrico et al., 1997; Gillen and Lall, 1997). A Fortune magazine article provides an easy-to-read introduction to DEA for managers (Melao, 2005).

Complexities of productivity measurement in services mean there is a need to go beyond accounting and ratio measures or regression analysis. Ultimately, the choice of outputs must reflect the objectives and service mix of the organization and the inputs must be traceable to these outputs (Avkiran, 2006). Productivity analysis becomes useful when the output/input levels change in response to decisions taken by management. This is where we can introduce data envelopment analysis as a method that can measure productivity in complicated situations and calculate potential improvements.

DEA is actually a relatively old methodology but it has constantly been applied and new developments are also made on the methodology. A certain Handbook of DEA by Cooper et al. (2011) has been cited by more than 1200 publications according to Google Scholar and 127 are since the year 2016. This shows that the method still enjoys widespread practical and methodology oriented applications in the literature. In one recent example Abbasi and Kaviani (2016) used three uncertain data envelopment analysis (DEA) models, namely fuzzy DEA (FDEA), imprecise DEA (IDEA) and Grey DEA in order to assess the performance of organizations in terms of the operations. The applicability of the proposed framework is demonstrated through a case study of cement manufacturers. Another recent application has been demonstrated in the field of selection of corporate spare parts inventory for Brazilian refineries (de Alvarenga et al., 2016). Again Ross et al. applied DEA in the growing field of sustainability to a set of 89 countries using secondary data (Ross et al., 2012). The authors of this study used data sources for supply chain research at the country-level, obtained from the World Bank and International Monetary Fund databases. DEA was used to compute country-level efficiencies and ANOVA was used to carry out regional comparisons. Again in a transportation related study, Wu et al. (2016) applied DEA to measure the energy and environment performance of transportation systems in China with the goal of sustainable development. We do not intend to do a comprehensive literature review in this paper, but one last application to show the diversity of industries that DEA has been applied in, Wu and Lin (2008) conducted revealed comparative advantage (RCA) analysis to investigate India's logistics competitiveness and subsequently used DEA to analyze the efficiency of India's container port operations, using data from the transportation and freight service industry during 2000-2005.

As most industries within the service sector come to terms with maturing markets, profitability will increasingly be sourced from higher productivity. The developed economies in particular are dominated by service industries that are often less productive than the manufacturing industries. This relationship implies an overall falling economic productivity unless the service industries continue to make a special effort to raise the efficiency of their operations. DEA provides an invaluable opportunity to identify the inefficiencies in the service units and devise improvements.

3. Automobile aftersales productivity in Turkey

We examine here the productivity in automobile aftersales in Turkey by a brief introduction of automobile aftersales services procedures and the industry realities in Turkey.

Considering from the sectorial point of view, it can be said that automotive industry is one of the most important sectors that the impact of globalization is seen. Therefore automotive industry is considered as a prototype of all globalized products. Called the representative of the automotive industry and described as a global product, automobiles' place in human life is consistently changed. At first it had become curiosity, with time it became a passion/love and today it has become almost an essential consumption good.

Also, World Trade Organization describes automotive industry as an example sector which represents the future of globalization. Automotive industry has various functions such as to contribute to technological development, employment and creating added value and being a source to gain currency in foreign trade. From this perspective, Turkish automotive industry which has only about 60-years history, has gained its status as the leading sector of the economy.

The Far East Asian companies also have started several initiatives to establish a production plant in Turkey. In 1994, Toyota, Hyundai and Honda, have received permission to car production and performed their investment decisions. From these newcomers, Toyota began production in 1994, while Hyundai and Honda began production in 1997. In addition to production of these new brands the Customs Union was enacted in 1996, and Turkish

automotive industry has begun to experience more intense levels of competition. Since the year 2000 with the impact of globalization, companies operating in the automobile sector, such as Toyota, Renault and Fiat, which had production facilities in Turkey have incorporated the global axis of development projects through their Turkish partners. In particular, these global firms through their modernization processes in their production facilities in Turkey have started to produce in Turkey and export their products to the world market.

Aftersales procedures are very detailed when compared with the sales business of the cars. Basically, sales explains the varieties of the car, convinces the customer and takes the money, the process is very short, sometimes less than one day in Turkey. There are also situations that these negotiations take months. Nevertheless, aftersales business starts with buying a car until the customer sells that car. Today, the main purpose of the automotive manufacturers is to create lifetime customers by successful service operations which make the customer to select the same brand in his/her next car. It is not easy to create a life-time customer.

The customer is expected to come and visit the authorized aftersales station of the producer company to have the advantages of manufacturers' warranties. So, unless an accident or breakdown happens, all customers are expected to visit the service stations for the purpose of maintenance. In Turkey, varying by mileage limits, every car sold has to visit the authorized service station minimum once a year.

It is economically a burden for the service stations to have each and every spare part in their inventory so they also make the spare parts ready before the appointment. Generally, they carry the inventory of maintenance parts and order the spare parts for repairing in case of need. The maintenance and/or repairing process is ready to start. The staff in the service station is educated by the expertise, procedures and control of the distributor firm, so a customer expects a reliable service quality in authorized service stations.

4. DEA implementation

Selection of inputs and outputs and number of DMUs is one of the difficulties in developing a productivity model and preparing data. In this brief summary, we will use the Avkiran (2006) study which focused more on the computational and data aspects of the variable selection process.

Some of the data are taken from Hyundai Company records. But, the data of some service stations needed to be refreshed, and at times this required an actual visit to those service stations. In our visits to the service stations, we also needed to take their permission to be analyzed in our study. Here, nearly 5% of the service stations abstained from being in our study. After the long update and permission process, we had reached the useful data for our study which included 76 service stations.

It is obvious that, the selection and the quantity of inputs and outputs, and the sample size of DMUs determine the goodness of discrimination that exists between efficient and inefficient units. In the literature, usually we see two considerations; the first one is to include as many DMUs as possible to increase the probability of high performance with a larger sample size which will be a result of better efficient frontier. Whereas the second one which is conflicting with the first is stating that the homogeneity of the data set may decrease, which shows that some exogenous factors of no interest to the researcher may affect the research results (Golany and Roll, 1989). Another supporter of the conflicting idea is the need of high technological programs to analyze larger data sets.

Desired analysis depends partly on the definition of the DMU to be studied (Avkiran, 2006). In our study, by the detailed literature review and meetings with the business authorities, four outputs are selected from many alternatives. Gross sales of mechanics, Gross sales of body and paint, complaint rate (1-*c*), and the results of Customer Satisfaction Index scores are determined as outputs by the authors. In literature, gross sales is included in nearly all sectors and by additions of sector specific critical success factors which are low complaints and high satisfaction in terms of automobile aftersales sector.

The physical properties and number of employees are mainly used in most of the DEA analysis in several sectors together with the inputs that reflect the potential of the DMUs. Specifically, in automobile service sector, stations' monthly or yearly total number of car visits signals the potential for each car service (DMU). These inputs are decided by the combined analysis of expert opinions and literature review.

To summarize; our inputs are closed area of the service station, number of employees working in the service station and yearly number of car visits to that service station which are controllable and recorded both by the information systems of distributor and the dealer. Our outputs, as mentioned above are the Gross sales of mechanics, Gross sales of body and paint, complaint rate (1-*c*), and the results of Customer Satisfaction Index scores which are also controllable and recorded by both distributors and service stations. All dealers in this study are using the same standards including the physical resources and software systems which ensure the consistency of the input/output data collection.

5. Service rankings

In our study, we reached the data of 76 service stations of one of the market leader brands in Turkey. These stations are located in different parts of the country and classified to seven different regions by the brand distributor firm. The map for the region distribution is provided in Fig. 1. As

mentioned above, by the detailed literature review and meetings with the business authorities, the inputs are; the closed area of the service station, number of employees working in the service station and yearly number of car visits to that service station.

Fig. 1: Regional Map of Turkey

On the other hand four outputs are Gross sales of mechanics, Gross sales of body and paint, complaint rate (1-*c*), and the results of Customer Satisfaction Index scores. We run the DEA calculations by the help of Microsoft Excel DEA solver, and the results are also given in Table 1.

Table 1: General DEA results

DEA Results Table – General							
No	Code	Result	Region	No	Code	Result	Region
1	DEAL1	1	REG3	39	DEAL39	0.966	REG1
2	DEAL2	0.935	REG4	40	DEAL40	1	REG2
3	DEAL3	0.901	REG7	41	DEAL41	0.739	REG7
4	DEAL4	0.776	REG4	42	DEAL42	0.998	REG6
5	DEAL5	0.973	REG7	43	DEAL43	1	REG6
6	DEAL6	0.709	REG5	44	DEAL44	0.98	REG2
7	DEAL7	0.857	REG5	45	DEAL45	0.878	REG6
8	DEAL8	0.853	REG1	46	DEAL46	0.947	REG4
9	DEAL9	1	REG4	47	DEAL47	0.759	REG2
10	DEAL10	0.865	REG1	48	DEAL48	0.911	REG5
11	DEAL11	0.938	REG5	49	DEAL49	1	REG6
12	DEAL12	0.889	REG5	50	DEAL50	0.977	REG6
13	DEAL13	0.909	REG3	51	DEAL51	0.849	REG7
14	DEAL14	0.93	REG7	52	DEAL52	0.971	REG6
15	DEAL15	0.945	REG7	53	DEAL53	0.899	REG2
16	DEAL16	1	REG3	54	DEAL54	0.738	REG1
17	DEAL17	1	REG3	55	DEAL55	1	REG1
18	DEAL18	0.816	REG3	56	DEAL56	0.797	REG3
19	DEAL19	0.816	REG6	57	DEAL57	0.866	REG6
20	DEAL20	1	REG6	58	DEAL58	1	REG1
21	DEAL21	0.777	REG2	59	DEAL59	0.789	REG5
22	DEAL22	0.895	REG5	60	DEAL60	0.945	REG1
23	DEAL23	0.889	REG3	61	DEAL61	0.977	REG2
24	DEAL24	0.843	REG6	62	DEAL62	1	REG2
25	DEAL25	0.774	REG7	63	DEAL63	0.791	REG4
26	DEAL26	0.981	REG3	64	DEAL64	0.782	REG5
27	DEAL27	0.953	REG5	65	DEAL65	1	REG4
28	DEAL28	0.941	REG5	66	DEAL66	0.886	REG3
29	DEAL29	0.872	REG5	67	DEAL67	0.992	REG4
30	DEAL30	1	REG2	68	DEAL68	0.88	REG1
31	DEAL31	1	REG1	69	DEAL69	0.961	REG4
32	DEAL32	0.796	REG3	70	DEAL70	0.982	REG7
33	DEAL33	1	REG1	71	DEAL71	0.953	REG3
34	DEAL34	0.765	REG4	72	DEAL72	0.944	REG2
35	DEAL35	1	REG1	73	DEAL73	0.98	REG3
36	DEAL36	0.838	REG5	74	DEAL74	0.91	REG7
37	DEAL37	0.962	REG2	75	DEAL75	0.94	REG4
38	DEAL38	0.997	REG2	76	DEAL76	0.956	REG3

From the 76 DMUs, there are 16 service stations that have the score of one which means that they are working efficiently. Results of other stations vary from 0.998 to 0.709. When we examine the DMUs that have the efficiency score of 1, we see that they are generally located in big cities. Thus, to work efficiently an automobile service station should appeal to a high potential of customers.

There are also exceptions that have efficient results because of their success in working by less personnel or smaller service areas. The important point here is that, all automotive brands have minimum requirements for both the closed area and number of employees of a service station. The success comes from the well organization of the staff, or working area.

We will also show the rankings accordingly with the region classification. We have a minimum result of 0.709, which may show the success of this brand in terms of dealers' location determination. To open a service station where there is no potential may cause the bankruptcy of the entrepreneur firm which also harms the brand image of the distributor firm. In other words, this minimum result signals the minimum survival efficiency limit for automobile aftersales service stations.

Turkey has seven geographic regions, which is used as a base by management of different companies. Automotive companies in Turkey are slightly differentiating their regions from geographic boundaries because of the potential differences in regions. Generally, their zoned areas include more cities in North and East side of Turkey, and fewer cities are combined in West and South sides of the country. This is a reflection of the population density which directly affects the potential of car sales and aftersales service stations. The regions of our examined brand are also given. Now, we will show the results by regional details in Tables 2-8.

Table 2: DEA results of region 1

No.	Result	Region	Code
1	1	REG1	DEAL31
2	1	REG1	DEAL33
3	1	REG1	DEAL35
4	1	REG1	DEAL55
5	1	REG1	DEAL58
6	0.966	REG1	DEAL39
7	0.945	REG1	DEAL60
8	0.88	REG1	DEAL68
9	0.865	REG1	DEAL10
10	0.853	REG1	DEAL8
11	0.738	REG1	DEAL54

Region 1 includes the European side of Istanbul and all areas to the west. Here, we have five aftersales service stations that have the score of 1, which show that they are efficient DMUs. The average efficiency score for region 1 is 0.931 and this region has a minimum score of 0.738. When we look at the efficient DMUs, common point is that they are all from Istanbul, which again shows the advantage of high potential for an aftersales service station. This may be shown as a result of economies of scope which is an advantage for the DMUs that are located in big cities.

Table 3: DEA results of region 2

No.	Result	Region	Code
1	1	REG2	DEAL30
2	1	REG2	DEAL40
3	1	REG2	DEAL62
4	0.997	REG2	DEAL38
5	0.98	REG2	DEAL44
6	0.977	REG2	DEAL61
7	0.962	REG2	DEAL37
8	0.944	REG2	DEAL72
9	0.899	REG2	DEAL53
10	0.777	REG2	DEAL21
11	0.759	REG2	DEAL47

Region 2 includes the service stations that are located in the Asian side of Istanbul and Marmara region, where there is a great increase in terms of population in recent years. Here, there are three DMUs that have the efficiency score of 1, and there are also many DMUs that have very high scores. From the three service stations, two are located in Istanbul and one is located at Kocaeli. The average efficiency score for region 2 is 0.935 and this region has a minimum score of 0.759. Also, the high population density of the region is reflected by the efficiency scores.

Table 4: DEA results of region 3

No.	Result	Region	Code
1	1	REG3	DEAL1
2	1	REG3	DEAL16
3	1	REG3	DEAL17
4	0.981	REG3	DEAL26
5	0.98	REG3	DEAL73
6	0.956	REG3	DEAL76
7	0.953	REG3	DEAL71
8	0.909	REG3	DEAL13
9	0.889	REG3	DEAL23
10	0.886	REG3	DEAL66
11	0.816	REG3	DEAL18
12	0.797	REG3	DEAL56
13	0.796	REG3	DEAL32

Region 3 includes two geographic zones of Turkey; Aegean and Mediterranean cities are included in this region. We had a high return rate from this region. Here, there are three service stations that have the maximum efficiency score of 1. When we examine in detail, we see that one of them has the highest efficiency score because of the high potential of the city it is located. Whereas the other two service stations are working efficiently in such cities which does not have a high population. Their success comes from well organization of the staff and working areas. The average of the efficiency scores in Region 3 is 0.920 with a minimum of 0.796.

Region 4 includes the cities which are located in Central Turkey. Here, we could reach the data of ten service stations and they have an average efficiency of 0.910 with a minimum of 0.765. There are two service stations that have the maximum efficiency score in this region. One of them is located in the capital city of Turkey, and dominates the potential in

Ankara, whereas the other one shows a success of efficiency in a city that has a moderate population.

Table 5: DEA results of region 4

No.	Result	Region	Code
1	1	REG4	DEAL9
2	1	REG4	DEAL65
3	0.992	REG4	DEAL67
4	0.961	REG4	DEAL69
5	0.947	REG4	DEAL46
6	0.94	REG4	DEAL75
7	0.935	REG4	DEAL2
8	0.791	REG4	DEAL63
9	0.776	REG4	DEAL4
10	0.765	REG4	DEAL34

Table 6: DEA results of region 5

No.	Result	Region	Code
1	0.953	REG5	DEAL27
2	0.941	REG5	DEAL28
3	0.938	REG5	DEAL11
4	0.911	REG5	DEAL48
5	0.895	REG5	DEAL22
6	0.889	REG5	DEAL12
7	0.872	REG5	DEAL29
8	0.857	REG5	DEAL7
9	0.838	REG5	DEAL36
10	0.789	REG5	DEAL59
11	0.782	REG5	DEAL64
12	0.709	REG5	DEAL6

Region 5 includes the service stations that are located in Southern Turkey. We could reach the data of 12 DMUs from this region and they have an average efficiency score of 0.864, with a minimum of 0.709. The minimum of this region is also the minimum of Turkey. There is not any service station in this region that has a score of 1, which may be a result of the population characteristics of this region. Southern Turkey is a tourism region and the variation of the potential is changing through the year, in other words seasonality is the main problem of the companies in this region. The DMUs in Region 5 has to have high closed working areas to work in their high season which harm their efficiency score. Here, we see the seasonality disadvantage of the automobile aftersales service stations.

Table 7: DEA results of region 6

No.	Result	Region	Code
1	1	REG6	DEAL20
2	1	REG6	DEAL49
3	0.998	REG6	DEAL42
4	0.977	REG6	DEAL50
5	0.971	REG6	DEAL52
6	0.878	REG6	DEAL45
7	0.866	REG6	DEAL57
8	0.843	REG6	DEAL24
9	0.816	REG6	DEAL19

Region 6 includes the service stations that are located in North Turkey of Turkey. This region is also called the Black Sea Region. We have the data of nine service stations from this region which show an average of 0.927 and a minimum of 0.816. There are two service stations in this region that have the highest efficiency score. DEAL49 is located in one of the biggest cities of Turkey that is in North Turkey and uses the advantage of high potential. On the other hand, the DEAL20 uses the advantage of being the only service station in a very big area including four or five small cities.

Table 8: DEA results of region 7

No.	Result	Region	Code
1	1	REG7	DEAL43
2	0.982	REG7	DEAL70
3	0.973	REG7	DEAL5
4	0.945	REG7	DEAL15
5	0.93	REG7	DEAL14
6	0.91	REG7	DEAL74
7	0.901	REG7	DEAL3
8	0.849	REG7	DEAL51
9	0.774	REG7	DEAL25
10	0.739	REG7	DEAL41

Region 7 is our last region which includes the cities that are located in East Turkey. We could reach the data of ten service stations in this region and the efficiency average of this region is 0.900 with a minimum of 0.739. There is only one service station in this region that has the efficiency score of one which is located in one of the biggest cities of Turkey and they use the advantage of high aftersales potential. We also provide the average and minimum efficiency scores of regions in Table 9.

Table 9: Regional statistics

Region	# of SS	# of '1'	Avg.	Min.
REG1	11	5	0.9315	0.738
REG2	11	3	0.9359	0.759
REG3	13	3	0.9202	0.796
REG4	10	2	0.9107	0.765
REG5	12	0	0.8645	0.709
REG6	9	2	0.9276	0.816
REG7	10	1	0.9003	0.739
Total	76	16		
Average	10.86	2.29	0.9130	0.7603

When examined regionally, there are 16 efficient DMUs in our study, which are mainly located in big cities of Turkey. Region 1 has five DMUs that are working efficiently whereas Region 5 has none. The average number of Service Stations that we analyzed in each region is more than ten which is a high number that shows the characteristics of each region.

The average efficiency score of Turkey is higher than 90% which is a result of strict rules and regulations of the distributor firm when selecting a location for opening a service station. On average, there are 2.29 service stations that are working efficiently in each region.

6. Conclusion

This study evaluated the data of 76 automobile aftersales service stations of a popular automotive brand in Turkey by DEA and classified them according to their efficiency results. There are seven regions of the studied automobile firm, which is taken as the base to detailed classification of results which are reported by DEA. Further studies should enlarge the data collected in this study by other automobile brands and make a cross-brand DEA for evaluating the efficiency of different brands in Turkey. Another study to follow our research may be

to compare the same brand's dealers in another country it serves and to make a comparison between different countries. Furthermore, to analyze the same data by any other MADM method is also a brief idea to follow this study.

Hyundai with 76 service and sales stations across the country has comprehensive evaluation systems for the business units. These evaluation systems range from biannual inspection by independent audit authorities to customer satisfaction measurement by the research firm Ipsos (a market research company). Independent audits serve to make sure that stations live up to global standards while the satisfaction results are directly used to calculate end of year benefits services receive. Up to our study the HGSI (Hyundai Global Satisfaction Index) was the only ranking available. Our study incorporated three other output factors and three input factors to scientifically rank the services. The input and output factors have high variability in different geographic regions of Turkey. Some stations may have high sales (due to sales to neighboring cities) but low service volume. Others may have very high service volume but would lack the corresponding high sales. The benefits distribution at the end of year may cause conflict among the dealers and between the dealers and parent company. Our simple model, which can be directly applied by means of a popular spreadsheet program, can help the dealers see their positions independently of the corporate assessment.

Hyundai now plans to have Excel macros written and Internet links with data sources enabled so that all services could voluntarily sign up and see the results of the DEA analysis and improve their efficiency. A secondary DEA analysis which could recommend the exact changes (such as personnel and service area) a service needs to implement to improve efficiency is also under consideration.

Our study is unique in the sense that it is the only DEA application made in the category of after sales automotive services. Services and after sales services are a growing field and MADM approaches are likely to become more important in the future. To carry out the analysis in a realistic fashion real data were obtained from a major automotive producer in Turkey with the help of the expertise and contacts of the primary author who has more than 10 years of experience working in a major automotive dealer in Turkey. As part of the same research project encompassing the DEA analysis, a service quality scale called AutoSERVQUAL has been developed and published by the authors (Gencer and Akkucuk, 2017). In the future we hope to apply novel approaches in the field of after sales in general in terms of measuring the efficiency of the units and in terms of measuring levels of customer satisfaction with the newly developed quality scale.

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