Determining the increased numerical value of customer satisfaction, which has been impacted by latent and observed factors in after-sales service in the automotive industry, based on System Dynamics Method. (A Case study in car manufacturer)

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ABSTRACT

Contextualized in the field of customer satisfaction in after-sales service in the automotive industry, the authors contribute to increasing customer satisfaction in three fundamental ways. First, by offering a new conceptual framework that integrates prior studies and Delphi methodology to survey the automotive industry's experts to identify essential and influential variables on customer satisfaction. Second, by developing a system dynamics and modeling method to evaluate the effect of these variables on each other, and unlimitedly investigate these variables' impact on customer satisfaction. Third, by offering an improvement scenario, we indicated what combination of observed and latent variables leads to a numerical increase in the customer satisfaction index. The survey's analytical results suggest that the cost of services and repair time is reduced by 30%, and the time of car acceptance in the repair shop is reduced by 20%. At the same time, the satisfaction with repair order description is increased by 30%, resulting in a 5% increase in numerical satisfaction with the overall service. Heretofore did not use a dynamic system model to determine the numerical amount of increasing customer satisfaction with after-sales service in the automotive industry. Therefore, the results of this study can be used as a basis for developing new policies in customer relationship management in automotive companies to increase customer satisfaction. This fact can lead to an increase in sales and ultimately the company's profitability. The article contributes to future research by quantitatively determining the number of changes in the significant factors to increase customer satisfaction.

Keywords: Customer Satisfaction; Customer relationship management; After-Sales Services; Automotive Industry; System Dynamics.

INTRODUCTION

After-sales service has become one of the most critical parameters affecting customer satisfaction and loyalty, which increases the organization's competitive advantage over competitors and increases the organization's profitability (Gogoi, 2020; Miranda et al., 2019). Academic research in the after-sale service has revealed that providing good service creates a memorable experience for the customer and makes the company popular. In this case, customer's price sensitivity decreases, and it leads to recurring purchase from the organization and customers become an advocate of the brand and enhances brand loyalty (Zamry et al., 2020).

Past studies in the marketing domain examined after-sales service's impact on customer satisfaction, as well as the relationship between the level of service, customer satisfaction, and customer loyalty in various service industries (Shokouhyar et al., 2020; Wang et al., 2018; Murali et al., 2016; Kalmentova and Zavadsky, 2015; Hult et al., 2019; Hirata , 2019).

As such, studies indicated a positive relationship between service provided, customer satisfaction, and loyalty. The study has noted that service center facilities, staff appearance, staff behavior, accountability, access to the service network, service guarantee or warranty, significantly impact customer satisfaction. (Ma et al., 2019; Cudney et al., 2015; Lussier et al., 2017).

Moreover, the interest in the concept of after-sales service in the automotive industry has burgeoned in recent years among all the leading players in the automotive industry. These days all the car factories are using the latest technology, and the products have many similarities, and these factors cannot be used as a differentiation strategy. The customer's perception has changed regarding the factors they consider deciding on purchasing a product. Although quality and price can influence buying decision process for the customers, one of the most important variables affecting their purchase decision process is after-sales service. Therefore, in today's competitive market, car manufacturers try to increase their organization's profitability by improving customer satisfaction and turning after-sales service into a distinctive strategic resource and competitive advantage for their company (Hwang et al., 2018; Joly et al., 2019; Lee et al., 2014; Heydarieh et al., 2014).

On the other hand, many researchers have deliberated the importance of after-sales service quality in the automotive industry. As such (Bei and Chiao ,2001), in a study in the Taiwan automotive industry, examined the direct effects of product quality and fair price on customer satisfaction and loyalty. This study revealed that the quality of perceived services mainly affects customer loyalty through customer satisfaction. The perspective of this study is consistent with the results of other researchers (Roy et al., 2018; Boulding et al., 1993; Taylor et al., 1994; Parasuraman et al., 1988), who suggested that service quality through customer satisfaction had a positive effect and a direct impact on customer loyalty.

Past studies, the past have shown the quality of service in the automotive industry has been determined based on three major principles: first, what is delivered to the customer; second, the place and location where the service is provided; and third, how the service is provided (Raj et al., 2004).

Academic research in a similar domain has examined the relationship between service quality and customer loyalty and its impact on business model design in the Dutch car industry to identify the effect of service quality on customer loyalty as a dependent variable (Es, 2012). Thus, five variables have been considered to measure service quality: tangibility, empathy, reliability, and responsiveness (Parasuraman et al., 1988). The study outcomes suggested a direct and positive relationship between service quality and customer loyalty; however, customer satisfaction does not have any added value in the relationship between service quality and customer loyalty.

In the similar vein, other variables affecting the quality of services in the automotive industry are the immediate identification of product defects, experience, and the skills of employees and the providing the appropriate warranty services. (El- Adly, 2018; Lussier and Hartmann, 2017; Fowler et al., 2016; Kasiri et al., 2017; Kaladhar, 2016; Lin et al., 2018). Furthermore, (Huang et al., 2018; Chicu et al., 2018; Shepers et al., 2018) suggested that other parameters that are affecting customer satisfaction in the field of after-sales service are customer response time, repair time, service cost, availability of spare parts and general behavior of technicians, and the level of access to service.

Parallel, the impact of after-sales service on customer satisfaction in the university, hospitality, banking, and restaurant industries has been evaluated.

In the university industry, the result of the study suggested that training and satisfaction of employees have a substantial impact on the quality of the service they are providing, which can ultimately lead to student satisfaction. (Wikhamn, 2019; Shen and Tang, 2018; Shurair and porkharel, 2019)

Li and Jarinto (2012) examined the effects of service quality changes on customer satisfaction, customer loyalty, and the brand's in the hospitality industry. They determined: First, service quality positively affects customer satisfaction, customer loyalty and has a negative impact on the brand image. Second, customer satisfaction has positive effects on customer loyalty and brand image. Third, customer loyalty has a positive impact on the brand image.

Simultaneously, Kaura et al., (2015); Durugbo (2019) evaluated the effect of service quality, fair price, and convenience of service on customer loyalty and customer satisfaction variable in Indian retail banking. The results of this study exhibited that service quality, reasonable price, and convenience of service affect customer loyalty. Whereas customer satisfaction plays an arbitrating role between service quality and loyalty, at the same time, employee behavior has a positive effect on customer satisfaction and loyalty; however, tangibility did not show a significant impact on customer satisfaction and loyalty.

Chong et al. (2011) employed a structural model to examine the relationship between service orientation, service quality, customer satisfaction, and customer loyalty in a restaurant chain based in Seoul, South Korea. The study suggested that among all the coefficients embedded in the structural model, service quality has the highest impact on customer satisfaction and, ultimately, customer loyalty.

Collectively, the existing literature suggests and pays attention to the role of service factors in customer satisfaction in the field of after-sales service; however, only a limited number of previous studies have focused on accurately identifying the variables affecting satisfaction. For example, (Murali et al., 2016) evaluated 21 characteristics of the quality of the service that directly affect customer satisfaction; however, this study is simply recognizing the factors without considering the interaction of variables on each other and ultimately how they affect satisfaction. (Shokohyar et al., 2021) also identified several factors affecting customer satisfaction in after-sales service dealerships in the automotive sector. He employed a combination of Kano and SERVQUAL models to classify customer demand and concluded that due to the lack of similarity between customer groups, authorized dealerships need to segment their customers to provide more appropriate services. The results of this study also revealed that the variables affecting the quality of the services are not limited to responsiveness, competence, tangibility, goodwill, communication, credibility, security, and understanding customer perception. However, other hidden variables, including customer characteristics and demographic factors, can affect the quality of the services and customer satisfaction index that has not been addressed in these studies (Turner et al., 2016; Sulistyawati, 2020).

Until now, no effort integrated into customer satisfaction research to evaluate the effect of these observed and latent variables on customer satisfaction. The more data and information are available regarding the factors affecting customer service; the organization can provide better customer service based on their needs (Newman, 2014).

These mixed findings raise the question of whether the organization accurately determined all the factors affecting customer satisfaction or the potential for further investigation in this area exists. Although these studies provided preliminary insight into the effect of different variables on customer satisfaction, the potential for discovering these observed and latent variables remains largely untapped.

In view of the above, this research contributes to the after-sales service and customer satisfaction literature. First, this study presents a conceptual-hybrid framework by reviewing past studies and the Delphi method to identify the observed and latent variables affecting customer satisfaction with after-sales service in the automotive industry. Second, it examines the interaction of latent and observed variables affecting customer satisfaction. Also, due to the existence of complex dynamism in the effect of these variables on each other, the system dynamics model is used to achieve a dynamic customer satisfaction model. Third, providing improvement scenarios shows how much the increase or decrease in variables numerically affects the level of customer satisfaction. Finally, this model can be used to develop new policies in customer relationship management in the automotive industry.

The structure of this study is as follows. In the introduction, we examined the importance of after-sales service in its role in customer satisfaction in the automotive and other industries and past research in this area. Then, we defined the research method of this research. Finally, we present the results, discussion, and conclusions, managerial insinuations, and research limitations.

RESEARCH METHODOLOGY

The research method is based on applied purpose, and we employed an analytical survey to collect the data. We used specialized books, related articles, and related publications to gather the information and cover all the theoretical topics in this research.

Since the review of the existing literature in the field of after-sales service in the automotive industry was not sufficient to identify all the variables of the present study, we have used a combination of the documents exists from previous research, the result of surveys from 20 experts in after-sales service of the automotive industry, and the Delphi methodology.

These experts include 20 managers and experts with a background in the automotive industry. For this purpose, we have used a researcher as the facilitator to collect and validate the data regarding the variables affecting customer satisfaction in the field of after-sales service from these experts. The result of the survey suggested 66 effective variables as the final variable. A focal group was formed with 12 automotive industry experts who have already participated in the previous survey to focus on the essential variables and eliminate the less important variables. That was an essential step before starting the Delphi process. According to experts' opinion, among 66 variables,16 variables that were ranked lower and had less impact on the customer satisfaction index were eliminated. Only 50 variables were approved to enter the Delphi stages.

In the next step, the Delphi three-step methodology (the average percentage method of the majority of experts) was used to analyze the questionnaires to prevent communication problems among experts, to establish a correct interaction between the real opinions of people, and to determine the most essential latent and observed variables affecting customer satisfaction (Cottam et al., 2004).

To increase the model's accuracy and examine the convergence of experts' opinions, the variables that meet the minimum average of 60% of experts' opinions can enter the next stage of Delphi analysis. Among 50 variables that entered the Delphi triple stages, only 23 were selected as the primary variable to enter themodel .

Furthermore, due to the complexity of the issue, the system dynamics approach has been used to investigate the relationship and effects of these variables on each other and, ultimately, its impact on customer satisfaction. The main emphasis of the method is to tackle the complex situation of the real world; therefore, we need to form a structure focusing on interactive relationships between these variables resulting in dynamic behavior in the system. (Sosnowska et al., 2019; Hosseini et al., 2019).

The results obtained from the dynamic system method have good validity as we integrated the impact of these variables on one another and their effects on customer satisfaction in after-sales service (Nguyen et al., 2017; Hosseini et al., 2020).

The causal loop indicated that one element is affecting another element. A causal loop diagram (CLD) has been used to model this causality relationship. In order to show the feedback of related components, CLD requires additional positive (+) and negative (-) polarities. A positive relationship is presented with "+" and a negative one with "-" (Sterman, 2000).

A positive relationship refers to a condition in which a casual element, A, results in a positive influence on B, where an increase of A value responds to the B value with a positive increase. A negative relationship refers to a condition in which a causal element, A, results in a negative influence on B, where an increase of A value responds to the B value with a decrease. A feedback loop can cause the system's dynamic behavior, and there are two types of feedback: reinforcing (R) and balancing (B).

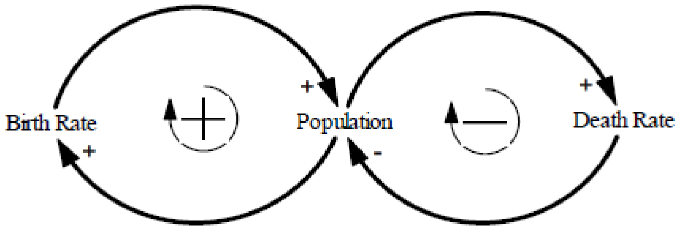

Figure 1 The diagram of casual relationship

Causal loop diagrams that have been formed into more detailed parts are flow diagrams (stock and flow diagrams or basic models). Flow charts represent the relationship between variables that have been made in a causal diagram more clearly, using various symbols for various variables involved (Forrester et al., 1994). In stock and flow diagrams, we evaluated the influence of time on the relationships between variables. The result indicated each variable is able to show accumulated results for variable levels and variables that indicate the level of system activity each time, which is a level.

Executive method of research

Figure 2 describes the process performed through this research. In the beginning, the problem was defined by reviewing the literature of the previous studies and the surveys of experts to determine the observed and latent variables. In the next step, the additional variables were removed by considering focal group opinion, and a three-step Delphi process was performed to identify the main variables. These variables were used as the primary input of the qualitative model of the research. After formulating the dynamic hypothesis, a causal diagram was drawn, the dynamic model was designed, the model was finalized and implemented, and finally, different scenarios were presented, and the optimal policy was determined.

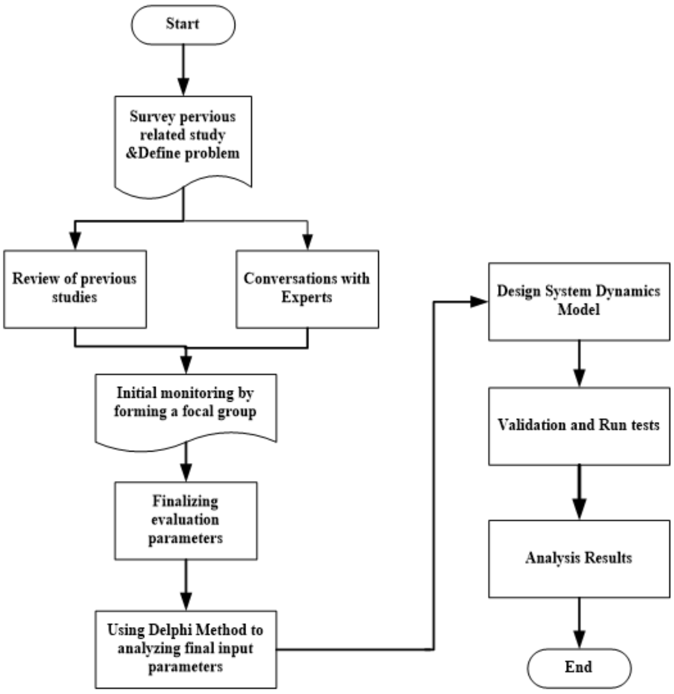

Figure 2 Executive steps of the research

Case study

The case study is a large automotive company in the Middle East. This company has started its activities since 1962. With an annual production of 750,000 vehicles and a variety of more than 30 models of passenger and commercial vehicles, it plays an essential role in the domestic market of the automotive industry. The company has an extensive sales and after-sales service network, including 750 authorized dealerships and 1100 spare parts sales shop, and serves an average of 10,000 customers daily. Providing quality services in the shortest time and at a reasonable cost to increase customer satisfaction is one of the prominent company's strategic goals.

Problem definition

In recent years, the automaker studied in this study has made extensive efforts and dedicates a large budget to increase customer satisfaction in its after-sales service. Still, the results of surveys shown in Figure 3 indicated that the satisfaction index in many indicators is either fixed or has increased slightly. According to the information gathered by the end of 2018, the customer satisfaction index ranking was 675 out of 1000. Although the case study company has a very high annual cost of training for the personnel, the quality of the repair index has not increased. (Customer satisfaction index ranking in automotive industry calculated from 1000). (JD power, 2021). Furthermore, the customer satisfaction index ranking resulting from the supply of spare parts, an essential factor in after-sales service is 678. Despite all the effort the case study company's dealership integrated into developing policies throughout the country, the customer satisfaction index ranking resulted from customer's access to the dealerships network is still 705.

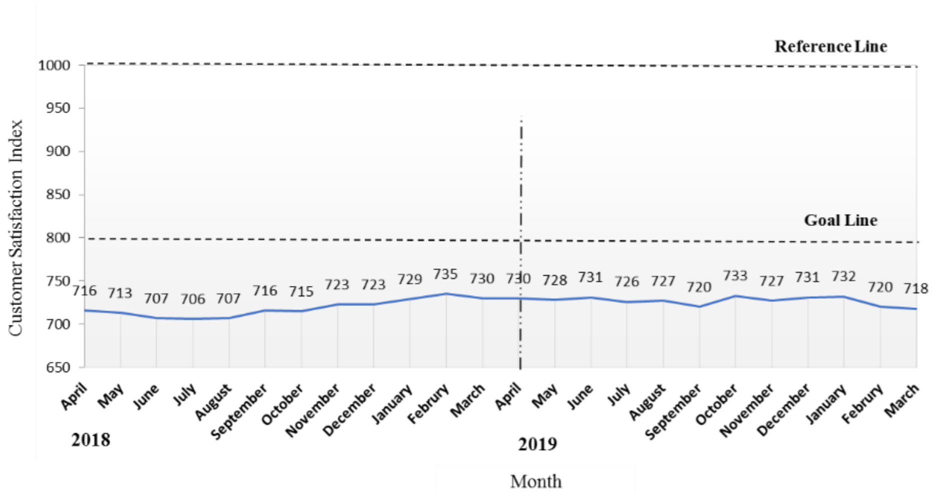

Figure 3 Customer Satisfaction yearly Result

Therefore, the case study company faces the challenge of what factors and variables play a crucial role in their customers' satisfaction with after-sales service. Which factors have the most significant impact on the satisfaction index, and what is the optimal combination of these critical factors and variables in customer satisfaction?

Due to the multiplicity of factors that affect customer satisfaction, it is necessary to analyze the relationships between different variables and provide a model to examine various aspects of the system simultaneously. For this purpose, in this study, we have reviewed the existing literature regarding customer satisfaction and the opinion of automotive industry experts to identify the influential variables by using the Delphi method. Then we employed a dynamic model to evaluate the effect of these factors on one another, and ultimately, improvement scenarios were presented.

ANALYSIS

Identification of research variables by Delphi method

As previously explained in the research method, the variables required for the research were obtained by reviewing previous research, available documents, and surveys of 20 after-sales service experts in the automotive industry in the form of a focus group (Batchelor et al., 2011; Breen, 2006).

In the next step, to determine the most essential observed and latent variables affecting customer satisfaction, the Delphi three-step method was used. The average percentage of opinions of the majority of experts was used to analyze the questionnaires in the Delphi method, which is calculated using the following formula (Cottam et al., 2004).

$$\text{APMO} = \frac{\text{Majority Agreements} + \text{Majority Disagreements}}{\sum \text{Opinions Expressed}}$$

To increase the model's accuracy and examine the convergence of experts' opinions, the variables that meet the minimum average of 60% of experts' opinions can enter the next stage of Delphi analysis. The results of the first, second, and third stages of Delphi are shown in Table 1.

Table 1 APMO Cut-off Rate for Consensus in Delphi Rounds

Delphi (APMO)	Round One	Round Two	Round Three
Majority agreements	988	796	584
Majority disagreements	156	196	134
Total Opinions expressed	1508	1282	945
APMO	76%	77%	76%
Number of statement reach consensus	8	11	8
Number of statement to be formulated into next Delphi Round	42	31	23

As shown in Table 1, in the first, second, and third steps, 11, 8, and 8 variables are removed, respectively, and finally, the remaining 23 variables are entered into the model. Table 2 presents the final variables of the problem and their additional explanations.

Causal -loops diagrams (CLDs)

As shown in Table 2, all the 23 effective variables, which were found based on this research, entered the model. Based on experts' opinion among 23 variables, the variable of vehicles' mileage was excluded from the model due to lack of importance compared to other variables. As the variable of the distance between the dealership was renamed to the density of the dealership in one region to simplify the understanding of the loops. To maintain the quality of the research, we have formed causal loops by using semi-structured interviews with experts. This model has 2 balancing loops and 6 reinforcing loops. As we observed, the system's behavior is complex because of the effects and feedback of these loops in the model. The problem is described according to the following loops.

Table 2 Final variables research

No	Index	Variables	Units	References	Description
1	V5	Customer appointment time	Day	Expert Opinion	Determining the schedule of customer visiting the repair shop in accordance with the capacity of agency based on the date and time of attendance
2	V8	car mileage	Km	Expert Opinion	The mileage usage of the client and how much they are using car
3	V10	The number of customer reception in dealer	No. Customer/month	Expert Opinion	customer who come to the dealership to receive the services
4	V13	The skill and experience of staff	Training/hour	Schepers & Nejssen (2017)	The level of expertise of the staffs which can result to get the optimized result
5	V15	The cost of service (Fee customer pays for service)	$	Fowler et al. (2016)	Partial operation cost of the organization to provide the service for customers which is being paid by the customer as compensation for the service which they have received
6	V17	The number of customer retention in dealer	Retention customer/month	Expert Opinion	Illustrate the numbers of customers which are unsatisfied regarding the quality of the products and they have technical issues with the products, and they have to get back to the company for additional services
7	V20	customer satisfaction	CSI Index	Hwang et al. (2018)	How well products and services meet or exceed the customer's
8	V23	Staff satisfaction	Leaving work/year	Shurair & pokharel (2019)	The employee's satisfaction based on how they feel about their work environment when it comes to considering their underlying interest, compensation, and other effective factors
9	V25	Employee Turnover rate	Leaving work/year	Shurair & pokharel (2019)	The organization cannot improve employee engagement which led to higher employee retention rates
10	V26	Rate of spare part usage	NO.spare part/Month	Expert Opinion	spare parts needed on repair a car that is supplied on a monthly basis
11	V27	Number of dealer	No.dealer	Expert Opinion	The official representative of Company, which is obliged to provide services
12	V30	Standard Time For Repairs	Hours	Expert Opinion	The specific time which has been announced by an organization to finalize the task
13	V32	Dealer capacity	Reception/Capacity	Expert Opinion	It is the maximum level that a service unit can maintain in product production or service delivery
14	V34	The distance between dealers	Km	Expert Opinion	The level of accessibility to the dealership considering the distance
15	V35	Spare parts inventory	NO.spare part/Month	Expert Opinion	The readiness and ability to provide the needed spare parts on time
16	V37	Number of skilled Personnel	No.Personnel/Reception	Expert Opinion	Number of skilled personnel required by the standard repair shop
17	V39	Service Quality	Retention customer/month	Wikhamn (2019)	The customer overall evaluation regarding the service which they have received from the service provider
18	V40	Staff behavior	CSI Index	Schepers & Nejssen (2017)	The dominant culture organization which defines the way employees interact with each other and their superiors
19	V42	Diagnosis Time	Hour/Car	Expert Opinion	This time included the time is needed to recognize the defect and cause of defect and solution to resolve the issue
20	V44	Repair order description	CSI Index	Expert Opinion	The explanation of the process which has been done during the stay of the vehicle in dealership including the services and cost associated with it
21	V45	The estimated report at the time reception	Incompatibility/All item	Expert Opinion	The service provider pays attention and records the details which customer is providing regarding eth problem they are facing with the car
22	V46	Time taken at reception	Minute/Car	Expert Opinion	How service providers can provide accurate service in a short amount of time and how responsive they are
23	V49	Network availability	Km/Min	Expert Opinion	Level of consumer access to the after-sales service network

The effect of increasing the number of customers and its role in the after-sales service chain is shown in loop R1. In a case when the production of automotive manufacturers increases, this fact can lead to increasing the number of customers and their visits from dealerships. Due to the increasing demand for service centers, automotive manufacturers need to increase the number of dealerships; however, the process of creation and standardization of each dealership is time-consuming and can be delayed. By increasing the density of the dealerships in the region, customers' accessibility to dealerships increased, the time customers need to spend to set up an appointment with the dealership decreased, ultimately leading to increased customer satisfaction.

With increasing the number of customers visiting dealerships, the dealerships are forced to increase their capacity by adding more workstations and recruiting more skilled technical personnel. Having experienced personnel resulted in better diagnosis, a better quality of repair, decreased the numbers of the returned car to the dealership, reduced the customer costs for the repair, and ultimately increased customer satisfaction. (Reinforcing Loop R2)

Based on the industry-standard, the working capacity of the dealership stays the same after the process of embellishment. When the number of customers visiting the dealership increased, the dealerships must increase their workstations accordingly. They also need to recruit more skilled technical personnel. Having trained personnel resulted in better diagnosis and decreased the time required to repair, which resulted in closing the loop and ultimately leading to increased customer satisfaction. (Reinforcing Loop R3)

As the capacity of the dealerships are constant when the number of customers who are visiting the dealership network increased, this fact can lead will prolong the repair time and ultimately reduce customer satisfaction. (Balancing loop B1)

Also, when the number of customers visiting the dealership network increased, the consumption of spare parts in the dealership increased, leading to a decrease in the spare parts' inventory. The shortage of spare parts prolongs the repair time and ultimately leads to a reduction in customer satisfaction. (Balancing loop B2)

Another essential part of the model is related to dealership personnel and the level of their satisfaction from their job, resulting in a higher rate of employee retention. Having skilled and more experienced personnel can lead to increased quality of repairs, reduced number of returned vehicles, reduced customers' costs, resulting in completion of the loop, and increased customer satisfaction. (Reinforcing loopR4-R5)

Also, the presence of skilled personnel ensures that the customer is treated properly and the repairs are performed correctly, leading to an increase in customer satisfaction. (Reinforcing loop R6)

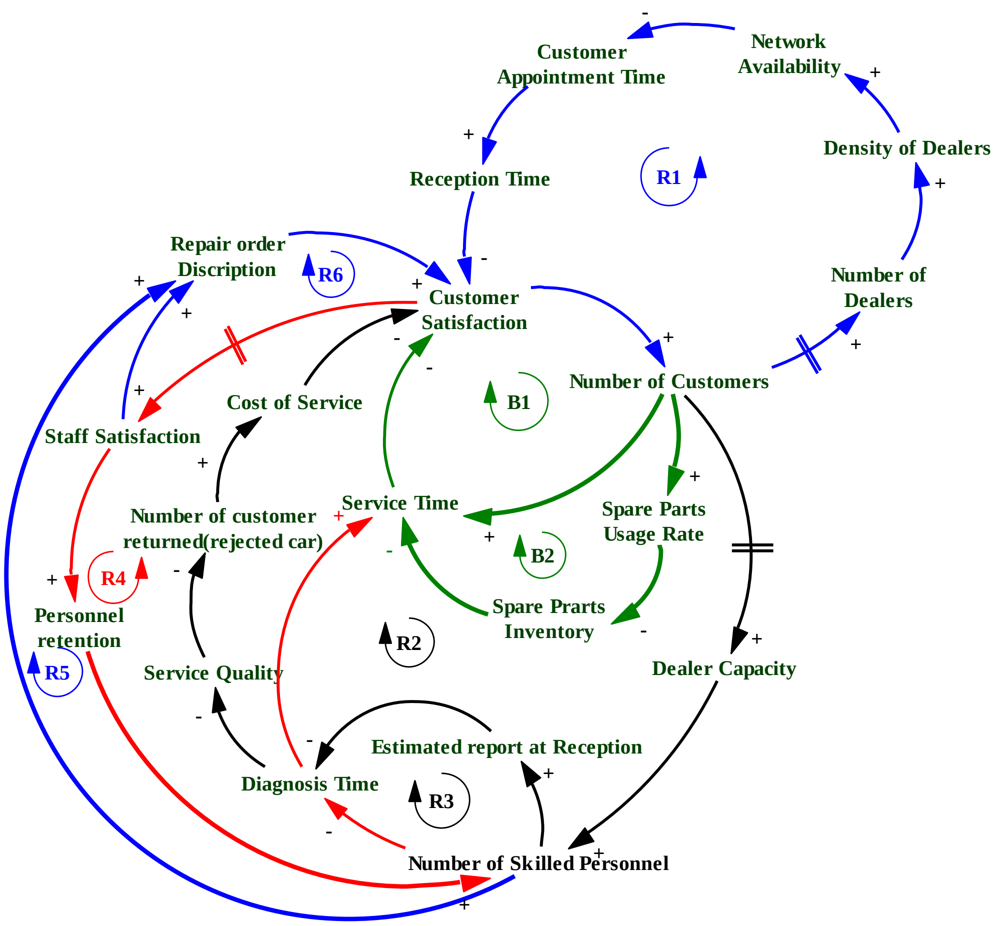

Figure 4 Causal-loop diagram for customer satisfaction

Stock and flow diagram

Figure 5 shows the state-flow model of customer satisfaction. According to the causal loops described in the previous section, this model has 6 state variables, 9 rate variables, and 25 auxiliary variables, including intermediate variables and tabular functions. Mathematical relationships between variables have been developed using the expert's opinions (experts and managers of the automotive industry) and previous studies and literature. This model finally makes it possible to calculate the increase in customer satisfaction by considering the interaction between affective variables such as the skill of personnel, quality of repairs, acceptance time, cost of repairs, description of repairs, etc.

Customer satisfaction state variable is affected by the variables of flow, customer acceptance time in the repair shop, troubleshooting time, quality of repairs, and description of repairs. Any increase in these variables leads to an increase in the customer satisfaction state variable.

The rate variables of production vehicles increase, which affects the number of customers visiting dealerships, increasing the number of dealerships, increasing the number of dealership density, increasing in acceptability of dealership for customers ultimately increases the customer satisfaction.

On the other hand, the dealership increase rate variable and the coefficient of dealership capacity increase affect the state variable of dealership capacity. This fact leads to increasing the recruitment of skilled personnel. The variables of the rate of increase in the number of dealerships and the coefficient of increase of the dealership capacity affect the variable of the dealership capacity. Increasing the number of skilled personnel affects the quality of repair work and leads to an increase in customer satisfaction.

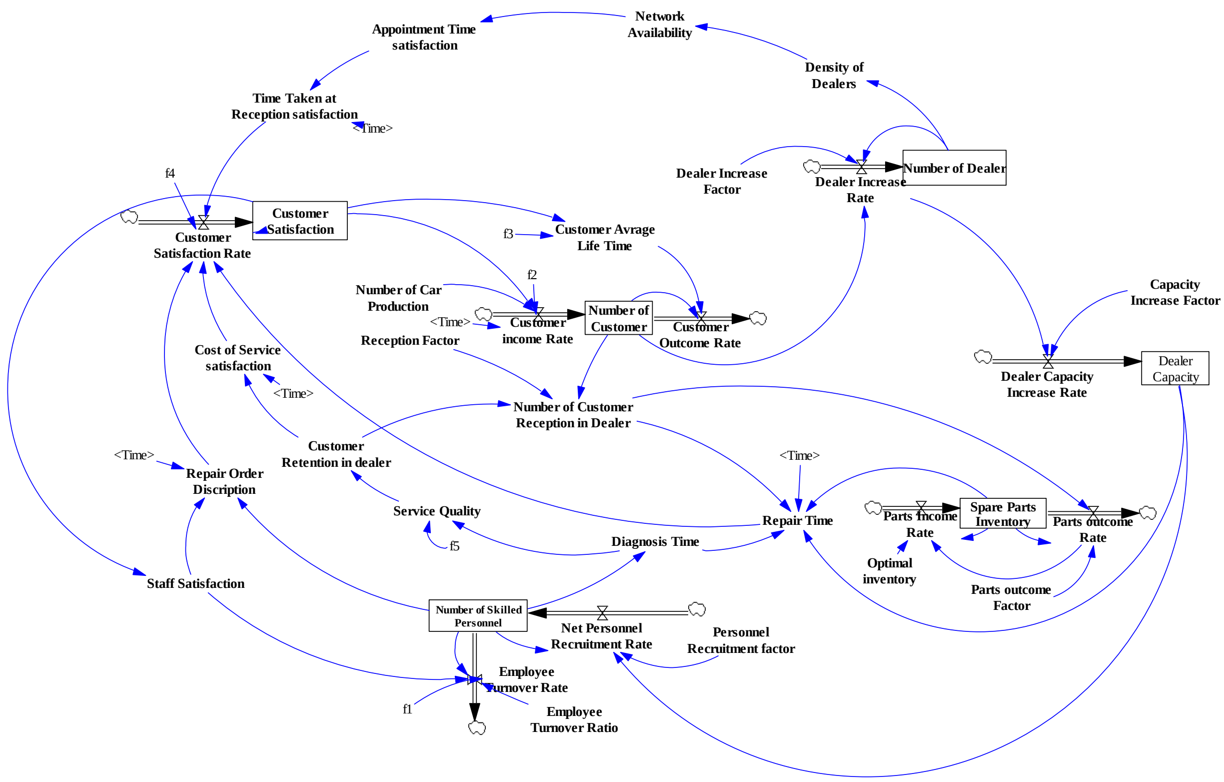

Figure 5 Stock and Flow diagram for the problem

Here, we used the following formula to calculate customer satisfaction.

$$\mathrm{CS_t} = \int_{t_0}^{t} f_4(\mathrm{RT_t})(a_0 + a_1\mathrm{CSS_t} + a_2\mathrm{RT_t} + a_3\mathrm{ROD_t} + a_4\mathrm{TTRS_t}) + \mathrm{CS_{t_0}} \qquad (1)$$

Where:

$\mathrm{CS_t} =$ Customer Satisfaction

$\mathrm{CSS}_t =$ Customer Service Satisfaction

$\mathrm{RT_t} =$ Repair Time

$\mathrm{ROD}_t =$ Repair Order Description

$\mathrm{TTRS_t} =$ Time Taken at Reception Satisfaction

In this formula, a_0-a_4 are calculated through a regression analysis on the case time-series data, and are shown in the following Table3.

Table 3 Result of regression analysis for CSI equation

Coefficient	a_0	a_1	a_2	a_3	a_4
Value	**-870.39**	**0.185**	**1.902**	**0.293**	**1.722**

Moreover, the function f4, which is the effect of the repair time on customer satisfaction rate, is defined as a Table function (the following Figure 6) formulated based on the experts' opinion.

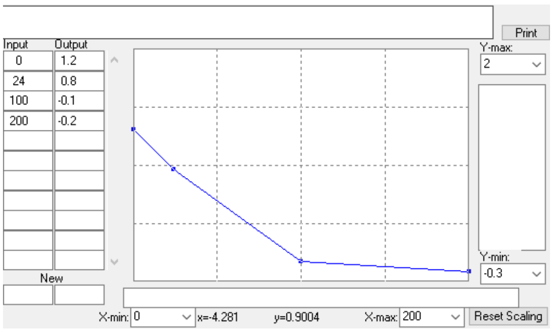

Figure 6 Effect of the repair time on the customer satisfaction rate

Therefore, we used the following formula to calculate the number of customers.

$$\mathrm{NC_t} = \int_{t_0}^{t}(f_2\,\mathrm{CS.NCP} - (\mathrm{NC/NCALT_t}) + \mathrm{NC_{t_0}} \qquad (2)$$

$\mathrm{CS} =$ Customer Satisfaction

$NCP_{\ t} =$ Number of Car Production

$\mathrm{NC_t} =$ Number of customer

$\mathrm{NCALT_t} =$ Number of Customer Average Life Time

Number of customer reception in the dealership is calculated as follows equation.

$$\mathrm{NCRD_t} = \mathrm{NC_t} * \mathrm{RF} + \mathrm{NCRD_{t0}} \quad (3)$$

$\mathrm{NC_t} =$ Number of Customer

$\mathrm{RF_t} =$ Reception Factor

$\mathrm{NCRD_t} =$ Number of Customer Retention in Dealership

The number of skilled personnel in the model is obtained from the following equation.

$$\mathrm{NSP_t} = \int_{t_0}^{t} (\mathrm{Delay}(\mathrm{PRF.DC}_{\ t} - \mathrm{NSP_t}\ , \alpha, \beta) - (\mathrm{ETR\ .\ NSP_t\ .\ f_1 . SS})) + \mathrm{NSP_{t_0}} \quad (4)$$

$\mathrm{NSP_t} =$ Number of Skilled Personnel

PRF =Personnel Recruitment Factor

$\mathrm{DC_t} =$ Dealership Capasity

$\mathrm{ETR_t} =$ Employee Turnover Rate

$\mathrm{SS_t} =$ Staff Satisfaction

α, β =Constant Number

Having access to a sufficient volume of spare parts inventory can increase the dealership's response capacity, increase the number of customer acceptances in the repair shop, reduce the supply time of spare parts, and consequently reduce repair time and ultimately will have an impact on customer satisfaction index. The inventory of the warehouse increases when the spare parts entering the warehouse and decrease with the consumption of spare parts. The import rate of spare parts is affected by the desired inventory factor. In addition, the consumption rate is a function of the consumption factor of the spare parts**.**

$$\mathrm{SPI_t} = \int_{t0}^{t} \ \mathrm{Delay}\ (\mathrm{POR_t} + \mathrm{OI} - SPI_{\ t}\ , \alpha, \beta) - \mathrm{Min}(\ \mathrm{SPI_{t0}} + POF.NCRD_t\ )) + SPI_{t0} \quad (5)$$

$\mathrm{SPI_t} =$ Spare Part Inventory

$\mathrm{POR_t} =$ Parts OutcomeRate

$\text{OI} = \text{Optimal Inventory}$

$POF = \text{Parts Outcome Factor}$

$\text{NCRD}_t = \text{Number of Customer Reception in Dealership}$

α, β=Constant Number

Model validation

Behavior reproduction test

The behavior reproduction test shows that the constructed model is able to reproduce the behavior of the real system. For example, customer satisfaction will have an ascending rate by improving the variables affecting customer satisfaction, including the cost of repairs, repair time, description of repairs, and acceptance times. Therefore, with increasing customer satisfaction, customer entry rate increases, and the number of customers over time increases Figure 7.

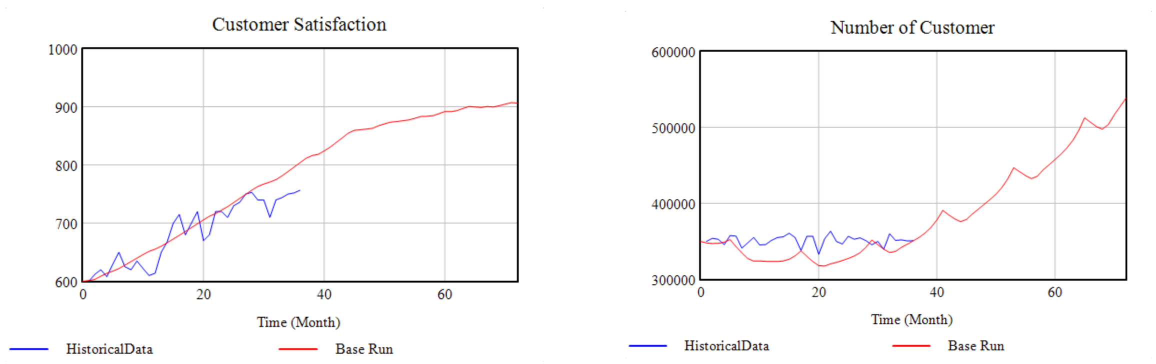

Figure 7 Result of the Model Behavior

As the number of customers increases, the rate of growth in the number of dealerships also increases. Also, with the rise in the number of dealerships, the density of dealerships increases over time, and as a result, access to dealerships becomes easier Figure 8.

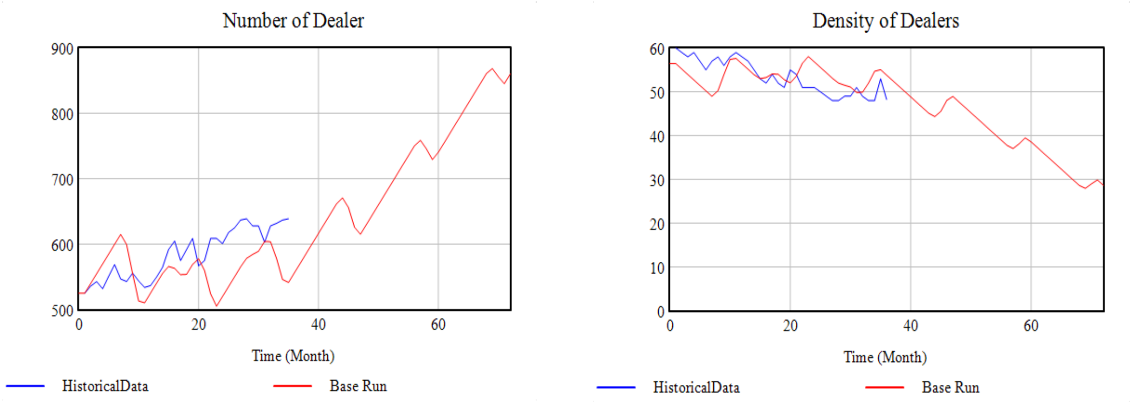

Figure 8 Result of the model behavior

According to the results, it can be seen that the built model can reproduce the real system's behavior.

Extreme condition test

Several simulations were performed with sudden and drastic changes in some model parameters, such as spare parts inventory and repair time to perform the validation. The results of this test indicated that the model also shows proportional behavior in some conditions.

DISCUSSION

Simulation result under different scenarios

After validating the model, we changed the variables in the simulated environment, examined the effects and behavior of the variables, and used different policies to test the system's response to them. If using the specific policy does not lead to the desired behavior, we evaluated other policies to identify the best desirable strategy (Forrester, 1994).

According to after-sales service experts' opinion, the basic scenario and two proposed scenarios, along with the variables affecting customer satisfaction, have been considered in this research. Baseline scenario: Figure 7, 8 shows the model behavior in the baseline scenario for the main variables.

As can be seen in the basic scenario, the customer satisfaction index has an ascent rate of 850, followed by the number of customers shows an ascent rate to 450,000 customers per month. The increasing number of customers leads to an increase in the number of dealerships and their capacity. In this case, the model follows historical behavior, which means by increasing the level of customer satisfaction, customers have more tendency to come to the network of car dealerships to receive a service.

Given that the goal scenario for the automaker is to increase customer satisfaction, we examine the model in two optimistic and pessimistic scenarios, each of which is a combination of 4 sub-scenarios Shown in Table 4.

Table 4 Research scenarios

variables	**Optimistic Scenario1**	**Pesimistic Scenario2**
Repair Time	30%(Decrease)	30%(increase)
Reception Time	20%(Decrease)	20%(increase)
Cost of Service	20%(Decrease)	20%(increase)
Repair order discription	30%(increase)	30%(Decrease)

Optimistic scenario

In this scenario, customer satisfaction is examined in four sub-scenarios. In order to meet the goal of the organization and provide the best customer satisfaction in the process of service delivery, the acceptance time shall be shortened, the repair process shall be done in the shortest possible time based on the standard, an accurate repair order description shall be made after the end of the repairs process, and the costs incurred for replacing spare parts and services provided shall follow the regulation. As a result, the optimal policy is to increase customer satisfaction by improving the skills of technical personnel through continuous and up-to-date technical training and providing the required spare parts on time, which can be possible only by having regular planning and forecasting the demand for spare parts. To implement this scenario in the model, we reduce the repair time by 30%, the acceptance time by 20%, and the repair cost by 20%, increasing satisfaction of providing an accurate repair order description by 30%. Based on the simulation of the model, the customer satisfaction index increased by 5%.

It showed that significant growth based on the ,standard customer satisfaction equivalent to 37.6 units of growth.

In order to achieve the goals, set in the scenarios, for example, to reduce the repair time, it is suggested that repair planning be developed in the repair shop and that the repair processes be performed in accordance with the repair time standard, and there should be continuous and regular technical training for employees as the company is growing. To improve the queuing process, they need to create a complete database of customers and contact customers by phone or online to set up the appointment. It is also recommended to use skilled personal in reception to improve the queuing process and decrease the wait time in queue. To reduce the cost of repairs and increase the quality of repairs, they should hire specialized and trained personnel, using original and quality of spare parts and using special tools for repair shops. It is also necessary to use the standardized procedure for the check-out process and train the employee to provide an accurate repair order description to the customer.

Pessimistic scenario

A combination of 3 positive scenarios and one negative scenario of parameters affecting customer satisfaction are examined. Suppose in the variable model we increase the repair time by 30%, the acceptance time by 20%, and the repair cost by 20% and decrease the variable of satisfaction of providing an accurate repair order description by 30%. In that case, customer satisfaction shows a decrease of 4%, which is equivalent to 31 units decline in the customer satisfaction index.

Figure 9 Result Simulation for Research scenarios for customer satisfaction

CONCLUSION

The present research aimed to have a systematic observation at the issue of after-sales service in the automotive industry to identify observed and latent factors affecting customer satisfaction and the mechanisms that enhance customer satisfaction. In the literature review, we evaluated 2 based scenarios and 4 sub scenarios. Our finding revealed the main 4 key factors affecting customer satisfaction in after-sales service are, the cost that customers pay for the service, the length of time their car is stopped for repairs at the dealership, the time it takes to receive the customer's car, and finally providing an accurate repair order description after the completion of repairs in the dealership.

The output of the designed model indicated that by implementing the optimal scenario in the model, the customer satisfaction of the studied company would increase by 37.5 units.

In the light of the above automotive manufacturers can improve their customer satisfaction index by focusing on the factors that can improve these variables.

From the practitioners' point of view, this study shows that using system dynamics in analyzing customer expectations and requests can help formulate business strategies for managers in the organization. Since after-sales service companies mainly serve so many customers, it is so complicated and costly to study and identify the elements that affect their satisfaction on a permanent and continuous basis, creating a dynamic model that can at different times. Provide a proper analysis of the organization's customer satisfaction status will be very effective in their business.

This study has some limitations. First, customers' tastes, desires, and opinions may change over time to extend the study time range. For example, by reviewing customer's demand seasonally, we can achieve more accurate results regarding the up-to-date customers' needs.

Second, we collected a wide range of variables using an expert's opinion, and the low-impact variables were eliminated. Low-impact variables can also be introduced in the model to get more complete results.

In sum, our research represents a crucial first step to understand better, main factor effect on customer satisfaction and improve that by offering a conceptual framework that integrates foundational work in CSI. We demonstrate how our model can be applied in practice and provide step-by-step guidelines for implementation to practitioners. We encourage researchers and experts in after-sales to continue work on this vital topic. This study is limited to the automotive after-sales service industry, but the same approach can be used to study other sectors.

This article refers to some future studies. Due to the limitation in determining the model boundary, some of the variables and interactions between them are omitted, so it is suggested to identify more variables that affect customer satisfaction and enter the model.

Also, because the dynamic system methodology does not consider the behavior of individual factors of social systems such as customer loyalty, Agent-based simulation can be used to overcome the limitations.

Finally, we encourage future research to further apply our conceptual framework and step-by-step guidelines to implement our model in other service contexts. In general, many methods can be used to investigate the factors affecting the performance of the model. For instance, it compares the results of several methods obtained from the dynamic system by correcting the cause-and-effect loop to increase the model's efficiency.

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