IMPROVING EMPLOYEE TRANSPORTATION SYSTEM USING SIX SIGMA METHODOLOGY

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Abstract: Passenger comfort is an important index that can be used to qualify and measure the quality of transport services of an organization. Poor transportation service will lead to employee dissatisfaction and decrease in overall efficiency of work. Therefore it is necessary to ensure continuous improvement of quality throughout the process of services. The application of a new technology i.e. Six Sigma concept is likely to be effective for improving the efficiency of employee transportation system. This methodology is proposed for improvement in one of the offices of NRSC ISRO, Hyderabad-Telangana. A promising analytical study aimed at identifying and rectifying such drawbacks to improve the transportation service amongst the NRSC-ISRO employees is aim and objective of this project. It presents the improvement of employee transportation service by applying Six Sigma DMAIC Method and also focuses on methods for enhancing the quality of service which is determined by the passenger's experience at the time of travel and feedback received from user The result is reduction in the number of passenger complaints, effective transportation management system and improved customer satisfaction which enhances the overall efficiency at work *place.*

Keywords - Six Sigma, Employee transport system, DMAIC, Passenger comfort.

1. INTRODUCTION

   This project looks at a successful application of the Six Sigma improvement methodology within employee transportation department of NRSC, a unit of ISRO, Hyderabad. NRSC provide home pick up and drop facility to their employees through the company transport services within the company defined transport zones and also outstation commutes for official work. It offers it services to nearly 800 employees every month. Passenger comfort is an important index that can be used to measure the quality of transport services of an organization. At any level, offering commuter benefits enables a company to positively influence their employees' travel choices, promote a more productive work environment, and improve employee retention. Therefore it is necessary to ensure continuous improvement of quality throughout the process of services. The application of Six Sigma concept is likely to be effective for improving the efficiency of employee transportation system..A promising analytical study aimed at identifying and rectifying such drawbacks to improve the transportation service amongst the NRSC employees is aim and objective of this project. The wider organization had not embraced Six Sigma prior to the conduct of this project, although this organization was keen to use Six Sigma to tackle its key operational challenges. The aims were to improve the efficiency of employee transportation system and enhance the quality of service which is determined by the passenger's experience at the time of travel.

2. CASE STUDY

   ➢ Provides services for nearly 800 employees every month.
   ➢ Operates 30 vehicles for regular Hiring and 20 vehicles for casual Hiring daily.
   ➢ 10-20 transport requests need to be attended daily.
   ➢ Daily pick up and drop of employees From their home to various campuses of NRSC in Hyderabad**.**

3. APPLICATION OF SIX SIGMA METHODOLOGY

3.1 DEFINE PHASE:

   The objective of this phase is to clearly understand and articulate the current reality and the desired situation. A clear definition of the problem is the first step of a six sigma approach.

3.1.1 DEFINING THE PROBLEM:

Before we defined our process defects, units and opportunities, we have understood the needs of our customers. Voice of the Customer i.e. through interviewing and surveying customers we have gathered customer complaints, suggestions and requirements. After summarizing the result from feedbacks we have translated them into measurable requirements, as a result quality characteristics -customer CTQ (Critical To Quality) of the process are identified as they are inherent characteristic of a, process or system related to a requirement. The summarized result from employee feedback is shown in the figure 1.

Fig 1: Employee Feedback

3.1.2 HOUSE OF QUALITY MATRIX

As needs of employees, and quality characteristics i.e. CTQ (critical to quality) characteristics are identified as shown in table 1 .we have find out their relative importance (priority) with certainty. For this reason, we had to prioritize, so that we can channel energies and resources in the most prudent way. The House of quality Matrix is a simple tool that provides a way of sorting a diverse set of items into an order of importance. House of quality is a diagram, resembling a house, used for defining the relationship between the customer desires and the organization capabilities.

Table 1: Customer Wants vs. Quality Characteristics

Customer wants	Quality characteristics
1. On time arrival of cab (punctual). 2. Comfortable ride with reduced time and distance. 3. Fewer breakdowns. 4. Regular cleaning and necessary safety measures. 5. Feedback system.	1. Route optimization. 2. Driver scheduling. 3. Process automation. 4. Regular inspection. 5. Employee and driver training. 6. Proper vehicle maintenance.

The weight of quality characteristics and their relative weight are calculated using the equation 1and equation 2 .Information availability got the highest relative weight as 8.4 followed by vehicle maintenance with relative 7.8 Therefore we decided to tackle with the information availability issue and then followed by other characteristics as per the relative weight from HOQ matrix .

$$\text{Weight of quality characteristic} = \sum_0^n \text{relative weight of demand x realtionship value .} \quad \text{Eq. 1}$$

$$\text{Relative weight of quality characteristic} = \frac{\text{weight of quality characterstic m1}}{\text{total weight of all characterstics}} \quad \text{.Eq.2}$$

3.1.3 PROJECT CHARTER

The Project Charter is a living document that outlines a process improvement project for both the team as well as leadership. It acts as a guideline for future projects as well as an important material in the organization's knowledge management system. All the elements of project charter i.e. problem statement, business case, goal of the project ,time line of project duration, scope, and stake holders have been identified and project charter is prepared as shown in table 2.

Table 2: Project charter

PROJECT CHARTER	
Problem statement The employee satisfaction rate is very low and process performance is 83%, due to use of outdated systems and procedures according to the survey conducted in the month of November 2018	**Business case & benefits** Employees of NRSC are facing lot of issues with their transport facility i.e. poor maintenance of vehicle, rude driver behavior and feeling uncomfortable during their rides .As Poor transportation service will lead to employee dissatisfaction and decrease in efficiency of work. Therefore it is necessary to ensure continuous improvement of quality throughout the process of services.
Goal statement Increase process performance rate from 83% to at least 95% by Mar 2018 and improve efficiency of system resulting in higher customer satisfaction.	**Timeline** | Phase	Planned date	Actual date
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Define:	25-Nov	24-Nov
Measure:	10-Dec	01-Dec
Analyze:	25-Dec	30-Dec
Improve:	15-Jan	12-Jan
Control:	29-Jan	10-Feb	
Scope - first/last and in/out **In Scope**: Transport facility for employees across NRSC balanagar,jeedimetla and shadhnagar campuses. **Out Scope**: Transport facility for non-employees of NRSC and cost incurred	**Team members** | Position	Person	Title
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Head P&G	Shri Hariharan	Project Sponsor
MTO	Shri Chandra Shekhar	Process Owner
GH SR&QAG	Dr SaindranathJonna	Project Manager
Scientist S/F	Dr.R.Srinivas	Champion
Asst.Proff.	Dr.K. Om Prakash	Black belt
Student	GRB.Nikhil Theja	Team Leader	

3.1.4 DEFINING THE PROCESS

This was done to understand the process in detail. This included the macro as well as micro level of process mapping. The macro level mapping was done using value stream map tool as shown in below figure 2.

3.2. MEASURE PHASE

The Objective of this phase is to identify and understand the components of variation arising out of the process and to be able to use the appropriate tool for analysis depending on the data type. In this phase we started collecting data by focusing on both the process as well as measuring what customers care about. This means initially there are two focuses: reducing lead time and improving quality .Refined the measurement definitions and determined the current performance or the baseline of the process. Lead time determined as baseline for the process and it becomes the standard against which we measure the improvement. We tried to Define and refine the process measurement that leads to collection of sound information which ensures future corrective action is based on facts and data rather than assumptions and opinions. Based on the data from the feedback forms collected we have tried to calculate the current process performance level, sigma level and developed a high level process map.

SIGMA LEVEL CALCULATION:

From data collected through feedback, we have obtained the following values
- o Total no of employees travelled in the month of November: 361.
- o Total no of complaints: 10.
- o No of employees involved in the complaint: 63.

We use seven-step method that helps make meaningful analyses of the complaints data, which can provide critical information to practitioners. Necessary complaints data, such as number of complaints received. Then the sigma level of the number of actual complainers to the number of possible complainers in each year is determined using the seven-step procedure is determined and tabulated in table 3.

Table 3: Sigma level calculation

S.no	Procedure	Notation	Value
1	Total no of complaints	N1	10
2	No of employees involved in the complaint	A1	63
3	Average no of employees per complaint	A2= A1/N1	6.3
4	Total no of employees travelled in November	A3	361
5	Total no of possible complaints	N2=A3/A2	57.30
6	Possible no of complaints per million customers	N3=N1/N2 x 1000000	1,74,520
7	Corresponding sigma level	K	2.44

3.2.2 VALUE STREAM MAP

   To identify waste, reduce process cycle times, and implement process improvement we used fundamental tool value stream map. It is a lean tool that employs a flow diagram documenting in high detail every step of a process. Value stream map has enabled us to see at a glance where the delays are in the process, restraints and excessive inventory. The entire process and their time are represented using the value steam map as shown in the figure 2.
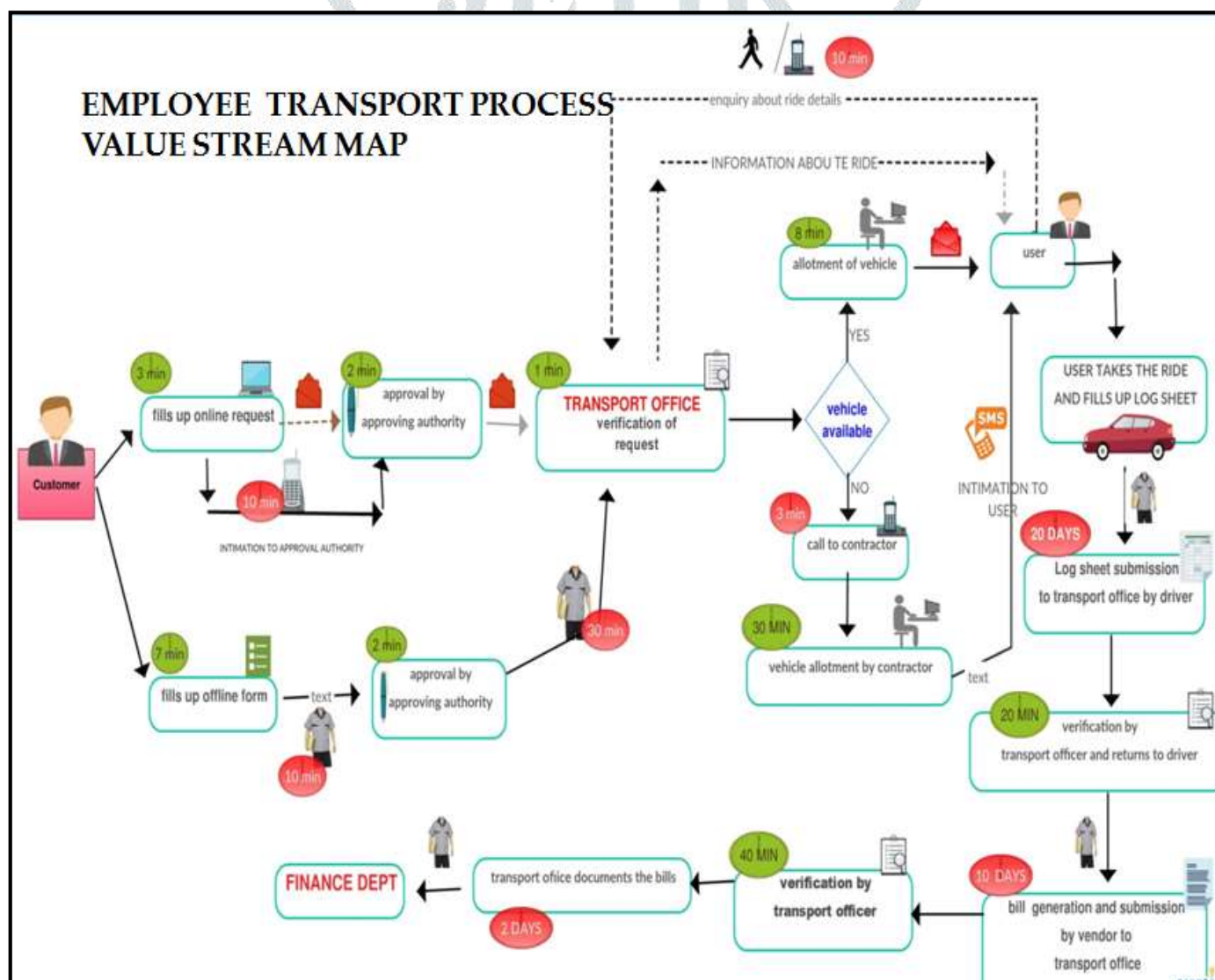

Fig 2: Value stream map

3.3. ANALYZE PHASE

The third phase of Six Sigma DMAIC is the Analyze Phase. This is where the statistical study of a problem starts. In this phase statistical reviews are done to the groups of deviation or variation in order for project owners to identify which are the considerable contributors to the output. The focal point of this phase is to identify and Analyze the root cause/s of imperfection. In this phase we have identified root causes for the problems with the possible solutions for improvement with thoroughly analyzing the causes and validated it. We have classified all issues into 7 problem areas In each problem area we listed the concerned problems, their causes and possible solutions and are tabulated in table 4.

Table 4: Analysis of problems

Problem area	Problem	Cause	Possible solutions for improvement
Requisition	Request (space) form/template not sufficient. Incomplete confirmation messages. More no of requests through offline forms.	Lot of bugs in software. Routing error. Employees unaware of online requests.	Request form modification. Online mode of request should be made mandate.
Approving authority	No alert for approving authority regarding request. Manual intimation by user. Delayed approval due to absence of approving authority.	**1**.Routing error **2**.Software bug **3**.Authorization not given to the immediate officer	Approval routing process (program) should be modified. (Mobile alert) App to be developed. Immediate officer should be given authorization rights
Transport office	Processing of offline and incomplete requests are difficult. Non utilization of available web portal. No booking id generation. Manual intimation of request confirmation. Old version of data base	Late submission and writings can't be read properly. Staff doesn't know how to use. Software bug. .Routing error .No up gradation done.	Online mode of request should be made mandatory. Upgrading of Available software. Android app development for driver.
Vehicle maintenance and safety inspection	**1**.No inspection is performed	No inspection schedule No inspection staff No inspection manual	Development of vehicle inspection checklist. Training staff for inspection Preparation of inspection manual.
Vehicle usage	Employee failure in filling log sheet. No proper tracking of trip. No pre vehicle check-up. Irregular submission of log sheets.	Employee negligence No tracking device installed No inspection procedure No specified submission time	App can be developed for log entry with feature of GPS tracking. Log book submission on date should be mandate.
Billing	Late submission of log sheets and bills. Use of very old software	No specified time for log sheet/log book submission.	Upgrading of software

3.4 IMPROVE PHASE

The goal of the DMAIC Improve phase is to identify a solution to the problem that the project aims to address. This involved brainstorming potential solutions, selection of solutions to test and evaluating the results of the implemented solutions. Often a pilot implementation is conducted prior to full-scale rollout of improvements. A variety of techniques were used to brainstorm potential solutions to counter the root cause identified in Analyze phase. After identifying the waste in the process in the analyze phase, we have decided to develop transport management system by automization of all the process with the help of a new web portal. Under this transport management system we have covered the entire problem areas mentioned in the last and developed detailed algorithm's as shown in 3 .
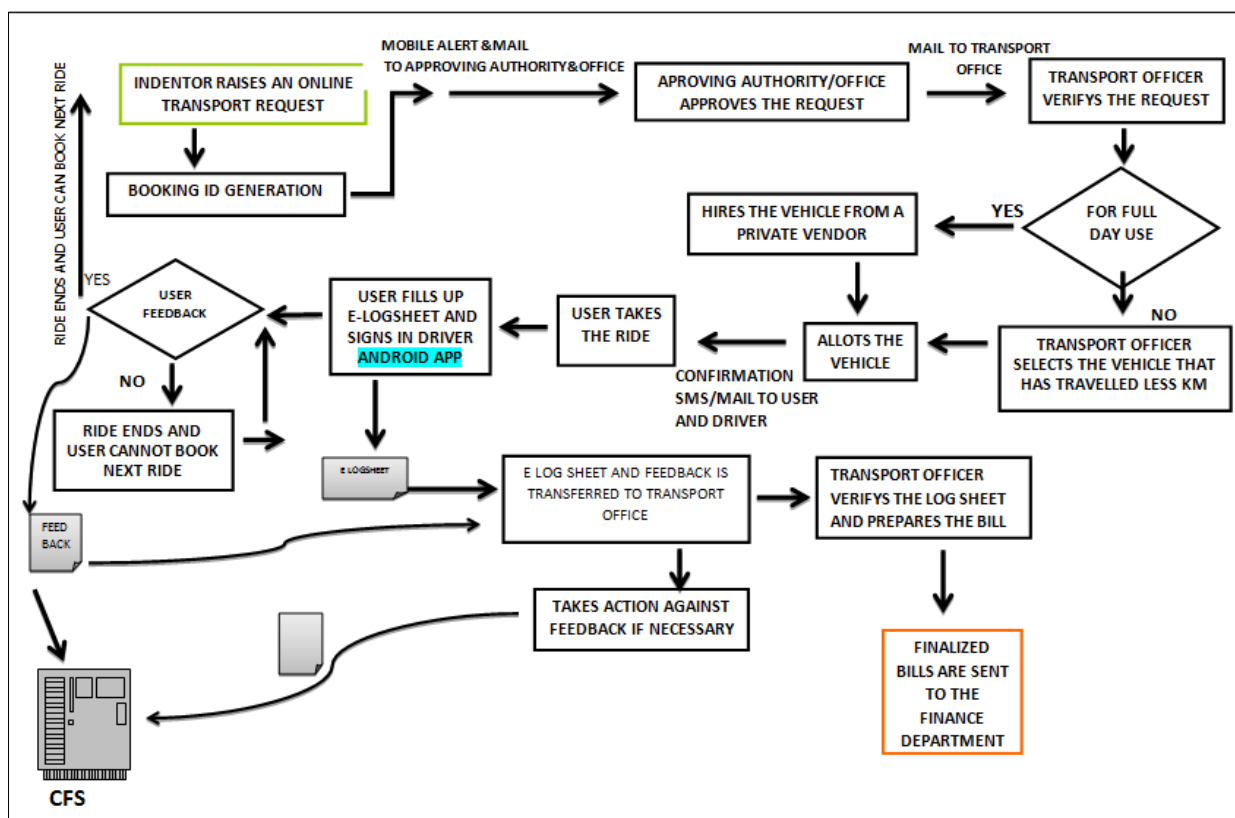
Fig 3: Detailed Algorithm

3.4.1 IMPLEMENTATION

We have tried to test our recommendations to validate the solutions and their effects on the transport system .in order to accomplish this we have tested on sample basis and again taken feedback from all the employees .new request forms were made available online and offline .confirmation messages are received by the employees regarding their commute. one week vehicle inspection is being carried out using the prepared pre-vehicle inspection check list and reports are verified by the transport officer. One day training was given to all the drivers and staff briefing them the entire problems and recommended solutions. Instructions were also passed to all the drivers to be punctual and follow the code of uniform. Every route schedules with information of vehicle details and driver details is made available to all the people of NRSC.

Table5: Sigma Level Calculation after Implementing Recommended Results

S.No	Procedure	Notation	Value
1	Total no of complaints	N1	6
2	No of employees involved in the complaint	A1	38
3	Average no of employees per complaint	A2= A1/N1	6.33
4	Total no of employees travelled in November	A3	361
5	Total no of possible complaints	N2=A3/A2	57.03
6	Possible no of complaints per million customers	N3=N1/N2 x 1000000	1,05,207
7	Corresponding sigma level	K	2.8

New vehicles with excellent condition have been deployed to improve the comfort of employees .daily i.e. for one week in-time and out-time of vehicles are monitored by the transport office staff .surprise inspection was held to check the condition of vehicle and taken immediate actions .immediate officer has been given the rights to approve the transport request which avoided the delay in processing the request. One week results were taken and analyzed and found increase in employee satisfaction as well as the Performance rate. The summarized results are shown in figure 4.

We have calculated sigma level by analyzing the feedback from employees after implementing recommended measures and we have found very good improvement in process performance level and sigma level increased by 0.4 i.e. 2.4 to 2.8 which means process success rate (yield %) increased from **83%** to **90.32% ≈ 90%.**
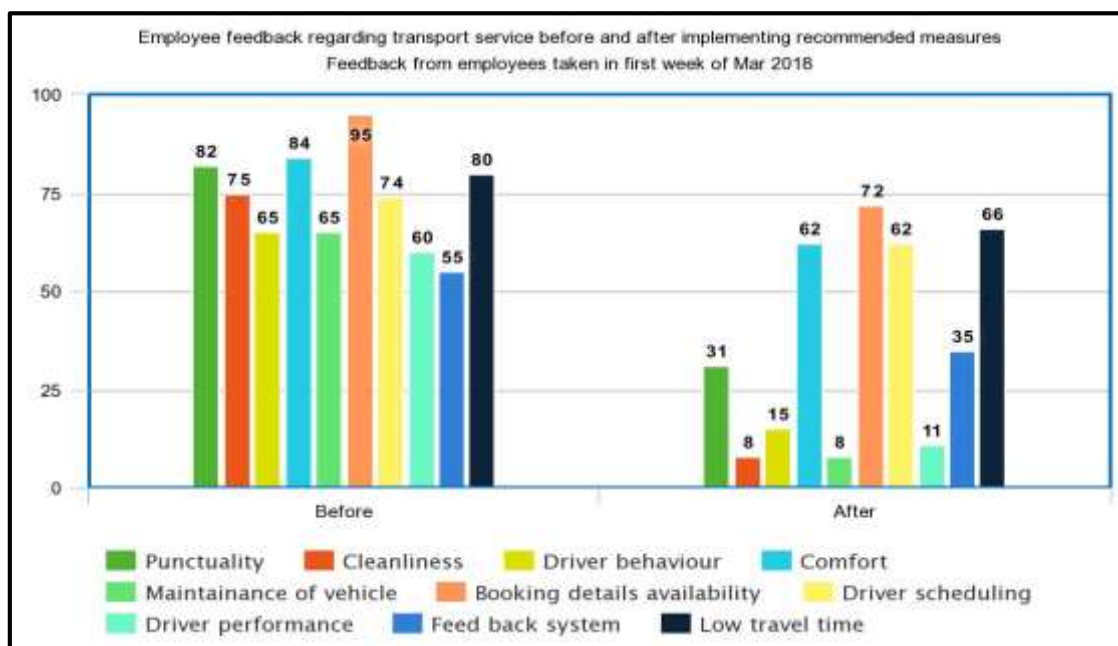

Fig 4: Employee feedback before and after implementing recommended measure

3.5 CONTROL PHASE

3.5.1. Control plan

As the process problem is fixed and improvements are in place, we need to ensure that the process maintains the gains. In the Control Phase we have focused on creating a Monitoring Plan to continue measuring the success of the updated process and developing a Response Plan in case there is a dip in performance. Once in place, we hands these plans off to the Process Owner for ongoing maintenance. This is about holding the gains which have been achieved by the project team. Implementing all improvement measures during the improve phase, periodic reviews of various solutions and strict adherence on the process yield is carried out and a control plan is prepared as shown in table 5.

Table 5: Control plan

Process step	Control item (input or output)	Control methods	Responsibility	Specification/requirements	Response plan
Allotting a vehicle	Input –less distance travelled vehicle availability.	Updating of reporting details of vehicles.	Transport staff	Less distance travelled vehicle should be allotted.	Continuous monitoring of vehicle movement.
Vehicle maintenance	Good mechanical condition of vehicle	Inspection	Transport staff	Regular cleaning and maintenance of vehicle	Impose penalty for the vendors in case they fails to meet the conditions at the time of inspection.
Correct filling of e-log sheet	Accurate ride details	Instructions to employees and driver	Transport staff	No false readings should be entered in log sheet. Log sheet should be filled only by the user.	No bills should be processed for false ride details.

Inspection	Good vehicle and driver performance	Audit	SR&QAG	Excellent vehicle mechanical condition with pleasing interiors Good driver performance and behavior	Immediately call for inspection if not performed.
Process performance	Customer satisfaction	feedback	SR&QAG	High rate of customer satisfaction and less complaints.	Communicate the problems to transport office and ask for explanation and instruct them to take immediate action.

CONCLUSION:

Through DMAIC, project boundaries and current data measuring system which measures the sigma level of current transport system performance are defined. Based on the data from the feedback forms collected current process performance level is calculated as 2.44 i.e. 83% success rate. The root causes for the problems have been identified with the possible solutions for improvement with thoroughly analyzing the causes and validated it. Transport management system is proposed which facilitates the interaction of employee and transport office, transport office and vendor, and vendor and driver. New transport request form and vehicle inspection checklist has been made. Various modules of TMS have also been developed. A detailed algorithm with future state process map has been developed We have tried to test our recommendations to validate the solutions and their effects on the transport system .In order to accomplish this we have tested on sample basis and again taken feedback from all the employees and calculated sigma level by analyzing the feedback from employees and have found very good improvement in process performance level and sigma level increased by 0.4 i.e. 2.4 to 2.8 which means process success rate (yield %) increased from **83%** to**90.32%**. Finally it is ensured that the process to be in gains by creating Monitoring Plan to continue measuring the success of the updated process and developing a Response Plan in case there is a dip in performance.

Therefore, through this approach, it is believed that by considering all the recommendations and implementing it, efficiency of employee transport service increases and performance rate of 95 % can be achieved. Reduction in the number of passenger complaints, effective transportation management system and improved customer satisfaction is expected.

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