Zipcar Lean Logistics

Design Team
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Abstract
Zipcar®, the world’s largest car-sharing provider, recognizes the need to improve the quality of their product by increasing the amount of time that vehicles are available for reservation by customers, called members. The purpose of this project is to study the operations of the company and to develop an enhanced system for the assignment of service and maintenance activities performed on vehicles in Zipcar’s Boston vehicle fleet. In achieving this, Zipcar can maximize reservation revenues while providing superior customer service to their members in the form of vehicle availability. This objective is achieved by optimizing the scheduling of vehicle maintenance with an understanding of system capacity while streamlining system management and communication. The goal of the project is to decrease the lead time for completing service on vehicles, measured from opening to closing of each service need. The team has developed a prioritization algorithm to optimize the routing of vehicles for service activities, which has improved the responsiveness of vehicle service from the time of service need to the time of service completion. The solution specification has also included the implementation of process redesigns that direct real-time system monitoring by closing service reservations sooner after completion of service to increase vehicle availability to members. Along with our involvement, Zipcar’s Engineering Department has planned to implement real-time service reservation closure through integration of SMS text message notifications in the back-end of Zipcar’s administrative system. This decision to implement is based on this project’s results during a system pilot period lead by the Capstone project team. Further, Zipcar’s Boston Operations have implemented a standardized format for communicating daily service activities between the Zipcar office and its vehicle transport vendor. The team’s chosen approach employs several Industrial Engineering tools, including value stream mapping to evaluate current state, simulation methods to model and verify system modifications, computer programming to prioritize vehicle servicing activities, and Lean initiatives to create standards, reduce errors, and facilitate flow. The solution design will improve the management of the network of people involved in the maintenance processes by implementing improved system control and monitoring mechanisms that drive quality into the fleet management structure.

Figure 1: Vehicle Service Process Flow & Lean Implementation Pilot Metrics
The Need for Project

Zipcar faces the challenge of managing the maintenance of its large and growing Boston vehicle fleet while continuing to provide its members with consistent and high quality service. A key element of daily operations is scheduling and performing both preventative maintenance (oil changes, etc.) and member-generated services (minor damage, etc.) on over 900 vehicles in the Boston fleet. In addressing service requirements for each vehicle, Zipcar’s Boston field operations are currently constrained by several factors that limit the efficiency of the present operations model. Inconsistencies in communication, unpredictable frequency of service needs, and a lack of standard procedures each add stress to the monitoring and control of this complex system. This project will address these challenges to enable Zipcar to continue to provide quality service to its members and raise it to a higher level in keeping with their dedicated service philosophy.

The Design Project Objectives and Requirements

The design objective is to decrease the lead time of a vehicle service request in the system by 80% for drivability-related service, 59% for safety-related service, and 39% for cosmetic-related service (Rep. 3).

**Design Objectives**

The overarching objective of this project is to decrease the time it takes for a service to be completed once the need for service is reported to the Zipcar administrative system. By enabling real-time monitoring of the administrative system, vehicles will be unavailable to members for a minimum amount of time as opposed to the current standard of booking out vehicles from 9:00am to 6:00pm for each service reservation. The system presently prioritizes the service tasks that affect vehicle operability and safety of the member, followed by cosmetic service needs. Additional factors will be considered when prioritizing services to be completed each day to minimize the time a vehicle is unavailable to customers and to minimize the length of time a service request is open in the system. Gaining an understanding of the system and its constraints will enable improvement in communication and standardization. Expanded objectives are to identify opportunities to improve the service in general.

**Design Requirements**

Performance metrics used to determine the project’s success are:

- **System monitoring** - time it takes for the system to be updated to reflect completed service
- **System responsiveness** - time it takes for service to be completed once the request is in the system
Vehicle unavailability - time that a vehicle is unavailable to a customer when it is not being serviced

Figure 2 shows the target metrics for each of the design requirements.

<table>
<thead>
<tr>
<th>Key Performance Indicators</th>
<th>Baseline* (hrs)</th>
<th>Target (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Monitoring</td>
<td>99.18</td>
<td>0</td>
</tr>
<tr>
<td>System Control: Responsiveness</td>
<td>132.51</td>
<td>24, 48, or 72</td>
</tr>
<tr>
<td>System Control: Vehicle Unavailability</td>
<td>19.22</td>
<td>0</td>
</tr>
</tbody>
</table>

*Baselines calculated using Dec 2009-March 2010 data

The ideal value for system monitoring and vehicle unavailability is zero time; in the ideal state, the system would be updated immediately after service was completed and vehicles would be available as long as they were not being serviced. The target for responsiveness is 1 day, 2 days, or 3 days depending on level of severity as determined by Zipcar. (Rep. 7). Figure 1: shows the baseline data for these metrics that correspond to each phase of the vehicle service process, and the improvement as a result of this project.

### Design Concepts considered

The design team considered linear programming, simulation, advanced information systems, and Lean methodology to streamline Zipcar’s maintenance process. Several proposed approaches were evaluated based on potential application or perceived impact on the problem. Advanced Information Systems was proposed for improved data management, but this method was not feasible as a primary approach because Zipcar uses proprietary systems to integrate solutions into the back-end of their system. Linear programming is ineffective to reach an accurate solution because the methodology is difficult to apply to real-life solutions and service requests are unpredictable. Lean methodology would improve efficiency but could not obtain statistically significant baseline measures on its own. The team realized that using simulation as the primary approach would allow for accurate analysis of the processes. However, it would not sufficiently contribute to a comprehensive implementation of solutions at project completion.

An ordinal ranking method was used to assess the pros and cons of each proposed method. The results of the analysis of this ranking yielded a decision as to which approaches would be most effective in
meeting project goals and objectives (Rep. 8).

**Recommended Design Concept**

The design team chose to employ Lean (Toyota Production System) techniques along with discrete-event simulation and routing algorithm design to approach the problem from multiple sides and develop a holistic solution path.

(1) **Design Description**

Based on the in-depth analysis of proposed approaches, the team determined that a holistic, system approach was required and that the best approach was to employ multiple concepts from several angles (Rep. 8). The team adopted Lean methodology and discrete-event simulation to work in concert in order to achieve project goals. Lean implementations were designed to engage staff from Zipcar and from Details, Etc., the Boston vehicle transport contractor, to reduce system waste in order to streamline daily work flow and improve quality on the front-end of fleet operations. Meanwhile, discrete-event simulation computer modeling and scheduling algorithm development were intended to optimize the back-end of fleet operations to tighten system responsiveness and improve overall system control. Data collected from Lean implementations in the field was intended to inform the simulation modeling with representative data (these will be explained below) so that the results of the project design could be understood and analyzed from an entire systems perspective.

(2) **Analytical Investigations**

Raw data was extracted from Zipcar’s administrative system to feed the simulation and determine performance metrics. The team organized the data and created databases to query the raw values and translate them into multiple usable inputs for the simulation. Using this data, the team utilized Microsoft® Excel macro functions to test and analyze weighted factors that affect service operations. From this, a comprehensive service priority system was developed to efficiently schedule vehicle transporters to the next most logical service activity to perform. Called the Prioritized Routing Operation System, or PROS, this algorithm calculates travel times between each vehicle and prioritizes service activities based on highest severity (drivability and safety issues take highest priority), closest service location, shortest service time, least amount of variation in service time, and highest vehicle utilization (Rep. 10).

(3) **Experimental Investigations**

During construction and analysis of the simulation, the team
initiated a Lean program with the process stakeholders from Zipcar and from Details, Etc. Using Lean techniques like direct observation, visual management, elimination of system waste, and rapid improvement, the team was able to interact with and engage all key members of the Boston maintenance process. Working together, the team created a standardized format for the service assignment list that is given to vehicle transporter staff several times a day. This standard format saved an average of 29.57 minutes/day, 6 errors/day, and 160 motions/day by using conditional formatting, visual management techniques, and newly implemented dropdown menus to eliminate human error (Rep 10). Another important investigation completed was an official one-week pilot period in which the Boston market refined standard procedures to include updating the system in real-time to make vehicle available to Zipcar members as soon as service was complete. During the one week pilot, vehicle availability was increased by 174.5 hours. Based on the success of the pilot, the Boston market will continue to operate in this way until reservation closure capability is automated. Efforts to ensure sustainability have been continuously underway with all process stakeholders.

(4) Key Advantages of Recommended Concept

The chosen approach enabled the Capstone team to implement changes in the system using Lean methodologies and then test the long-term effects using simulation prior to Zipcar investing time and effort in automating the recommendations. The implementation of a standardized format for service assignments and the process for making vehicles available immediately after service completion allowed the team to quantify actual time savings through detailed time studies. To test the long-term impact of making vehicles available in real-time, the team used simulation to verify system responsiveness. The simulations and macro functions for prioritization systems enabled both the Capstone team and Zipcar to see the impact of the system of priorities in assigning tasks to vehicle transporters based on weighted factors, which improves the efficiency of maintenance activities and monitoring.
Financial Issues

Engineering time is needed to automate the solutions by integrating with the back-end system. Currently, solutions are manually implemented through buy-in of key stakeholders. Zipcar requires its Engineering Department to integrate the real-time service reservation closure procedure with its administrative system. The cost incurred by Zipcar is the engineers’ time to integrate this project’s codes and algorithm to its back-end system. All other solutions recommended as a result of this project have been implemented. The system of priorities is in the form of an Excel macro that is transportable for daily use by Zipcar employees. The process to make vehicles available in real-time will be completed manually until automation is complete.

Recommended Improvements

The improvements made to the Boston market should be expanded to Zipcar’s other markets to promote standardization and increase availability across all markets.

Standardizing the process by introducing consistent communication methods, closing service reservations in real-time, and developing a system of priorities increased availability of vehicles by 28 hr/vehicle/year, saved 184 man-hours/year, prevented 59,893 errors/year, reduced 2,279 motions/year, and generated $64,000 in expected revenue/year (Rep. 10.3).

The next phase of this project expands these solutions to be implemented across other Zipcar’s markets. Using similar logic to improve standard operating procedures is feasible once the constraints of a particular market are defined. Using SMS text messages to update vehicle service status in the system is a seamless expansion across other markets because the vehicle transporters would interact directly with the interface built into the administrative system. The system of priorities algorithm can be built into the back end data system in order to output prioritized routing information directly from the Zipcar system. It can also be easily expanded to other markets once data from the other fleets is defined within the parameters of the Excel macro.