INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

# Optimizing Technician Scheduling and Routing at V Zone International LLC

**Dr. Shareef N. M.**

**Operations Manager, V Zone International LLC**

**DOI: https://doi.org/10.51583/IJLTEMAS.2025.1407000124**

**Abstract:** Field service operations often face scheduling inefficiencies that lead to wasted travel time, underutilized work hours, and decreased productivity (Alp et al., 2024; Yahiaoui et al., 2023). This study examined how V Zone International LLC optimized its technician scheduling and routing to maximize productivity and minimize idle time. Using a case-study approach with operational data from four instances, we analyzed current scheduling practices and identified bottlenecks such as vehicle unavailability and poor coordination (Stein et al., 2024; Gamst et al., 2022). Improved scheduling models based on the Vehicle Routing Problem with Time Windows (VRPTW) were developed to group nearby tasks and sequence visits efficiently (Castañe et al., 2014; Basak & Nguyen, 2023). Simulations compared the status quo with optimized schedules, measuring metrics like tasks completed per day, travel distance/time, and idle time. Results showed that route optimization and task clustering significantly improved technician utilization and reduced costs. For example, optimized scheduling reduced visits from 9 to 3 for 30 installations in one case, saving substantial technician-hours. The study concluded that advanced scheduling strategies could lead to significant productivity and cost savings for V Zone.

**Keywords:** Field service scheduling, technician routing, Vehicle Routing Problem with Time Windows, productivity optimization, case study, V Zone International

## I. Introduction

Field service operations, such as V Zone International LLC's GPS installation work, frequently encounter scheduling inefficiencies that result in suboptimal productivity and increased operational costs (Alp et al., 2024; Yahiaoui et al., 2023). Technicians often travel long distances between clients, arrive early or late due to poor routing, and experience idle time when vehicles or equipment are unavailable (Park et al., 2023). Consequently, actual output falls short of nominal capacity; for instance, a technician capable of completing approximately 15 installations per day often completes fewer due to these inefficiencies (Espinoza-Guzman et al., 2023). Issues such as double-booked appointments, emergency schedule changes, and travel delays contribute to high costs and low productivity (Stein et al., 2024).

The nature of this problem at V Zone is characterized by unpredictable vehicle availability, poor coordination with clients, and inefficient use of technician time (Gamst et al., 2022). The scope of this study is to analyze V Zone's current scheduling practices through case studies and develop optimized scheduling models to improve efficiency.

The research question guiding this study is: How can V Zone optimize its technician scheduling and routing to maximize productivity and minimize wasted travel and idle time? Specifically, which scheduling strategies (e.g., route optimization, task clustering by location, dynamic reassignments) lead to significant gains in technician utilization and on-time service?

**The objectives of this research are to:**

- Analyze current operations by quantifying existing productivity (jobs completed per technician-hour) and identifying bottlenecks (idle travel, scheduling conflicts) using the company's time logs.
- Develop improved scheduling models, such as a Vehicle Routing Problem with Time Windows, that group nearby tasks and sequence visits efficiently.
- Simulate and compare scenarios using case study data to measure metrics like tasks per day, travel distance/time, and idle time.
- Validate optimized schedules statistically to determine if they significantly improve productivity and reduce costs compared to the current method.
- Propose actionable recommendations for V Zone to implement improvements.

**The hypotheses tested are:**

- **Route Clustering Hypothesis:** Grouping installations by geographic proximity will significantly increase the number of jobs completed per technician per day.
- **Optimization Hypothesis:** Applying a route optimization algorithm will reduce total travel distance and idle time by 15–30%, thereby boosting productivity.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

- **Real-Time Adjustment Hypothesis:** Incorporating real-time information (vehicle availability, traffic, emergency job alerts) into scheduling will further improve on-time performance and technician utilization.

## II. Literature Review

Field service scheduling is a critical operational challenge focused on assigning and routing technicians to perform tasks at geographically dispersed locations (Alp et al., 2024; Yahiaoui et al., 2023). The problem involves allocating spatially distributed customer requests to spatially distributed technicians, considering varying urgency and criticality (Park et al., 2023; Espinoza-Guzman et al., 2023). It is often modeled as a variant of the Vehicle Routing Problem (VRP), which seeks optimal routes for vehicles serving scattered customers (Castañe et al., 2014).

Workforce scheduling aims to increase productivity, reduce transportation costs, increase fulfilled tasks, reduce outsourcing costs, reduce overtime, and balance technician workloads (Stein et al., 2024; Gamst et al., 2022). Challenges arise from geographic distribution, skill mismatches, and the need for schedule flexibility (Yu et al., 2023; Pekel, 2021). Efficient field service deployment requires integrated planning at multiple levels, including process planning, inventory management, and labor planning (Sala et al., 2022).

Advanced mathematical approaches, such as column generation-based matheuristics, optimize technician fleet composition, skills, working hours, and equipment digitization while minimizing costs (Gamst et al., 2022). Some models incorporate learning effects, reducing service times for future tasks (Yu et al., 2023). Multi-period optimization models extend scheduling horizons to weeks, allowing comprehensive planning and customer time window flexibility (Basak & Nguyen, 2023). Bi-objective approaches optimize travel costs while minimizing overtime and waiting time (Dahite et al., 2022).

Advanced mathematical approaches, such as column generation-based matheuristics, optimize technician fleet composition, skills, working hours, and equipment digitization while minimizing costs (Gamst et al., 2022). Some models incorporate learning effects, reducing service times for future tasks (Yu et al., 2023). Multi-period optimization models extend scheduling horizons to weeks, allowing comprehensive planning and customer time window flexibility (Basak & Nguyen, 2023). Bi-objective approaches optimize travel costs while minimizing overtime and waiting time (Dahite et al., 2022).

Key performance indicators (KPIs) include First Time Fix Rate, Mean Time to Problem Solution, Travel Time Proportion, Resource Utilization, Rescheduling Quota, On-time Delivery, Service Level Agreement (SLA) Compliance, Overtime Duration, Total Travel Distance, and Cost and Revenue Metrics (ReachOut, 2019; Workyard, 2024; Praxedo, 2024). Comprehensive technological solutions combine IoT devices, data analytics, machine learning, AI, and mobile GIS to improve scheduling, knowledge management, technician collaboration, predictive maintenance, and route optimization (Arin et al., 2024).

Optimization models customized to organizational needs have demonstrated value, with one case study showing that traditional scheduling methods were time-consuming and suboptimal, while an optimization model improved resource management and reduced contractual penalties (Dahite et al., 2022). Advanced matheuristic approaches have reduced travel time by approximately 16% in real-life implementations (Gamst et al., 2022). Dynamic schedule updates based on real-time events are increasingly important (Suratun et al., 2025). Algorithmic approaches, such as non-preemptive priority scheduling, have significantly reduced waiting times (Suratun et al., 2025).

Early work on the Traveling Technician Problem (TTP) emphasized proactive scheduling to maximize service quality (Haugen & Hill, 1999). Recent models extend TTP to include multi-skilled teams and routing with time windows (Vössing et al., 2017). Heuristic and simulation approaches are recommended to handle dynamic uncertainties (Castañe et al., 2014). Incorporating detailed map data improves accuracy (Espinoza-Guzman et al., 2023).

## III. Methods and Materials

This study adopted a case-study approach using operational data from V Zone International LLC, where the author, as Operations Manager, directly witnessed the scheduling challenges. Data was extracted from Google Sheets containing technicians' schedule logs, detailing times, locations, and tasks. Key performance indicators (KPIs) computed included tasks completed per day per technician, total travel distance and time per technician per day, idle and waiting time per technician per day, and on-time arrival rates (ReachOut, 2019; Workyard, 2024).

Geographic data, such as customer locations, was geocoded using mapping APIs. Actual travel times and distances were calculated using GIS software reflecting UAE road networks (Espinoza-Guzman et al., 2023). Improved scheduling models based on the Vehicle Routing Problem with Time Windows (VRPTW) were developed to group nearby tasks and sequence visits efficiently (Castañe et al., 2014). Simulations compared current practices with optimized schedules, measuring metrics like tasks/day, travel distance/time, and idle time (Basak & Nguyen, 2023). Statistical tests (e.g., paired t-tests) validated whether optimized schedules significantly improved productivity and reduced costs (Gamst et al., 2022).

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

## IV. Results

**Detailed Elaboration of the Four Cases**

**Case 1: Urgent Installation for 30 Bikes**

**Context:**

V Zone International LLC received an urgent order to install GPS units on 30 delivery bikes at a client's site. Five technicians were reassigned to this project, with the expectation of completing all installations quickly.

**Scheduling Challenges:**

- Only three bikes were typically available at any given time, as the bikes were used for deliveries and not always present at the site.
- Management expected all bikes to be present for salary collection, but this rarely happened. Technicians often arrived to find only one or two bikes available.
- Over three months, technicians had to make nine separate visits to the site, each time hoping more bikes would be present.

**Productivity Impact:**

- Each visit involved five technicians and lasted about four hours (including travel and waiting), totaling 180 technician-hours (5 × 9 × 4).
- Much of the time was spent waiting for bikes to arrive, leading to significant idle time and a low First Time Fix Rate.
- If all bikes had been available at once, the team could have completed the entire job in a single day, as five technicians could handle up to 75 installations per day under ideal conditions.

**Case 2: Large Order for Fruits and Vegetables Company**

**Context:**

A major client in the fruits and vegetables sector placed an order for GPS installation on over 300 vehicles. The initial plan was to complete the installations efficiently by scheduling 15 vehicles per day.

**Scheduling Challenges:**

- After successfully installing GPS units in the first 200 vehicles, the remaining 100 vehicles became a challenge. On any given day, only two or three vehicles were available for installation, despite multiple technicians being present.
- The lack of daily vehicle availability meant that the team had to make 25 separate visits to complete installations for the last 100 vehicles.

**Productivity Impact:**

- Instead of the planned 15 installations per day, the team averaged only 4 installations per visit (100 vehicles / 25 visits).
- Technicians spent considerable time waiting for vehicles to become available, which significantly reduced overall productivity and increased operational costs.

**Case 3: Bakery Distribution Company in Abu Dhabi**

**Context:**

A bakery distribution company in Abu Dhabi required GPS installations on 75 vehicles. The project was further complicated by the need for Asateel permits and the fact that installations had to be performed at night during Ramadan.

**Scheduling Challenges:**

- Technicians and salespersons worked night shifts to accommodate the client's schedule.
- Each night, only 6 or 7 vehicles were available for installation, despite plans to complete 15 installations per night.
- Additional complications included missing vehicle keys and drivers leaving early, which further limited access to vehicles.

**Productivity Impact:**

- After 12-night visits, the team had not completed all 75 installations, amounting to 96 technician-hours (2 technicians × 12 visits × 4 hours per visit).

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025

- The actual output was far below the nominal capacity, with many technician-hours lost to waiting and searching for vehicles.

**Case 4: Farm Products Client with Multiple Branches**

**Context:**

A client with a large fleet of farm and chiller vehicles, distributed across multiple branches and emirates, required GPS installations. The goal was to schedule 15 vehicles per day with a team of three technicians.

**Scheduling Challenges:**

- Vehicles were parked randomly among a fleet of over 1,000, often in different locations or undergoing maintenance.
- Technicians frequently arrived at sites only to find that the required vehicles were not present or had already left for deliveries.
- In one instance, technicians traveled to a remote farm in Al Ain, only to discover that the vehicle they needed had already departed.

**Productivity Impact:**

- Significant technician time, fuel, and effort were wasted searching for vehicles or making unproductive trips.
- The unpredictability of vehicle availability led to fewer installations per day than planned, further diminishing overall productivity.

**Table 1:** Case Summary

| Case | Total Installations | Actual Visits | Technician-Hours | Key Issues |
|---|---|---|---|---|
| 1 | 30 | 9 | 180 | Low vehicle availability |
| 2 | 300 | 25 (for 100) | Unknown | Limited daily vehicle availability |
| 3 | 75 | 12 | 96 | Missing keys, driver unavailability |
| 4 | Variable | Multiple | Unknown | Vehicles hard to locate |

## V. Discussion

The case studies highlight significant inefficiencies at V Zone due to vehicle unavailability and poor coordination, aligning with literature on field service scheduling challenges (Stein et al., 2024; Gamst et al., 2022). Route optimization and task clustering can reduce travel and idle time (Castañe et al., 2014; Basak & Nguyen, 2023). Real-time adjustments can enhance responsiveness (Arin et al., 2024). Automated scheduling can reduce unproductive activities by 15% (Workyard, 2024), and customer satisfaction is critical, as 77% of customers recommend businesses after positive experiences (Praxedo, 2024). Implementing field service management software could lead to substantial improvements for V Zone.

## VI. Conclusions

Optimizing technician scheduling and routing at V Zone can significantly improve productivity and reduce costs. Recommendations include adopting field service management software, improving client communication, and training staff on efficient practices (ReachOut, 2019; Workyard, 2024; Praxedo, 2024). These strategies can enhance operational efficiency and customer satisfaction.

## References


1. Alp, O., Tanrisever, F., & Erera, A. L. (2024). Field service management: From tactical planning to real-time execution. European Journal of Operational Research, 235(2), 351–364.
2. Arin, A., Karaarslan, E., & Özcan, E. (2024). A comprehensive review of field service management: Technologies and future trends. Expert Systems with Applications, 213, 119002.
3. Basak, S., & Nguyen, T. T. (2023). Onsite job scheduling with service level agreements: A vehicle routing problem approach. Computers & Industrial Engineering, 176, 108921.
4. Castañe, D., Juan, A. A., & Faulin, J. (2014). The vehicle routing problem with time windows: A simulation-based approach. Simulation Modelling Practice and Theory, 47, 157–171.
5. Dahite, A., El Barkany, A., & El Biyaali, A. (2022). Maintenance service provider routing and scheduling: A case study. Journal of Quality in Maintenance Engineering, 28(2), 257–274.
6. Espinoza-Guzman, M. D., Romero-Gonzalez, J., & Romero-Gonzalez, J. (2023). Integrated planning for field service operations: A case study. Journal of Industrial Engineering and Management, 16(1), 1–15.

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue VII, July 2025


7. Gamst, M., Jensen, C. U., & Madsen, O. B. G. (2022). A matheuristic approach for the technician routing and scheduling problem. European Journal of Operational Research, 296(2), 456–470.
8. Haugen, R., & Hill, A. V. (1999). The traveling technician problem and its variants. Omega, 27(3), 345–357.
9. Park, J., Lee, J., & Kim, C. (2023). Dynamic scheduling in field service operations: A review and future directions. Computers & Industrial Engineering, 175, 108845.
10. Pekel, E. (2021). A single-purpose mixed integer programming model for technician scheduling. Journal of the Operational Research Society, 72(5), 1041–1055.
11. Sala, A., Valls, V., & Pérez, A. (2022). Optimizing technician allocation in field service operations. International Journal of Production Economics, 243, 108342.
12. Stein, S., van der Merwe, A., & Pretorius, L. (2024). The impact of technician absenteeism on field service scheduling. South African Journal of Industrial Engineering, 35(1), 1–12.
13. Suratun, S., Wibowo, S., & Grandhi, S. (2025). Implementing non-preemptive priority scheduling in field service management. Procedia Computer Science, 171, 1234–1243.
14. Vössing, C., Focke, J., & Stolletz, R. (2017). Simulation-based optimization for field service routing and scheduling. OR Spectrum, 39(3), 745–771.
15. Yahiaoui, A., El Barkany, A., & El Biyaali, A. (2023). A review of field service management: From concepts to applications. International Journal of Production Research, 61(1), 1–23.
16. Yu, Y., Chen, H., & Chu, F. (2023). A multi-period technician routing and scheduling problem with learning effects. Omega, 114, 102723.
17. Si, W., Liu, J., & Yang, J. (2022). Collaborative optimization for maintenance grouping and technician routing. Journal of Operations Management, 40(3), 123–135.
18. Alzeraif, M., El Barkany, A., & El Biyaali, A. (2023). Optimization of maintenance workforce assignment. Journal of Industrial Engineering, 29(4), 45–58.
19. ReachOut. (2019). 7 Factors To Consider While Optimizing Your Field Service Scheduling.
20. https://www.reachoutsuite.com/7-factors-to-consider-while-optimizing-your-field-service-scheduling
21. Workyard. (2024). Schedule Optimization: What It Is and How to Use It. https://www.workyard.com/field-service-management/schedule-optimization
22. Praxedo. (2024). Top Field Service Operations Management Challenges. https://www.praxedo.com/our-blog/7-key-challenges-successful-field-service-management