

Transerve: A Linear Programming–Based Decision Support System for Optimizing Vehicle Reservation Operations

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Abstract

A university has experienced persistent inefficiencies in its vehicle reservation system, with operational efficiencies of only 72.91% and 68.39% over the past two years, falling short of the 90% target. These inefficiencies, coupled with a driver shortage (driver-to-vehicle ratio of 4:11), have led to suboptimal resource allocation and increased operational costs. Specifically, the total cost of rented vehicle trips (₱12,128,223.00) was 162.02% higher than that of in-house trips (₱4,627,952.00), primarily due to manual vehicle and driver assignment processes. This study employed a mixed-method research approach integrating quantitative data analysis and qualitative insights to guide a data-driven solution. Three linear programming (LP) models were developed and embedded into a decision support system (DSS) using Excel VBA to optimize vehicle and driver allocation. Seasonal demand forecast revealed an optimal driver-to-vehicle ratio to minimize reliance on rented vehicles. Simulation results demonstrated that implementing the proposed DSS can significantly enhance system performance. The optimized model achieved full reservation processing (100% efficiency), reduced average trip reservation cycle time by 70.85%, improved vehicle utilization by 17.52%, and is projected to generate annual cost savings of ₱509,181.71. Overall, the integration of optimization modeling and decision automation effectively streamlines the reservation process, reduces user workload, and enhances operational efficiency.

Keywords

Linear Programming, Vehicle Reservation, Decision Support System, Monte Carlo Simulation

Biographies

Gilbert Calosa is an Assistant Professor and Program Chair of the Industrial Engineering Department at De La Salle Lipa. He also serves as a faculty member in the DLSU Graduate Programs, teaching in both the MBA and MMT programs. He graduated Magna Cum Laude with a Bachelor of Science in Industrial Engineering from the Polytechnic University of the Philippines – Sto. Tomas Campus and earned his Master of Science in Industrial Engineering from Lyceum of the Philippines University – Batangas, where he was recognized with an Academic Excellence award. Currently, he is pursuing a Doctorate in Engineering Management at the Polytechnic University of the Philippines – Open University System. A distinguished professional, he holds multiple certifications, including Professional Industrial Engineer (PIE), Certified Industrial Engineer (CIE) – where he ranked Top 6, Associate ASEAN Engineer, Certified Specialist in Data Analytics, Certified Kaizen Professional, and Certified Lean Six Sigma Green Belt. His expertise spans Operations Research, Business and Data Analytics, Lean Six Sigma, Total Quality Management, and Operations Management, reflecting his commitment to advancing the industrial engineering profession through teaching, research, and professional engagement.

Aira Marie Aguila graduated with a Bachelor of Science in Industrial Engineering from De La Salle Lipa and earned the honor of Cum Laude. She gained practical experience as a Quality Control Intern at Atlantic, Gulf & Pacific Company, where she applied her skills in quality assurance, process analysis, and operational efficiency. Through her involvement in the Junior Philippine Institute of Industrial Engineers – De La Salle Lipa Chapter, she contributed to organizational initiatives that strengthened her abilities in leadership, strategic planning, and collaboration. A Certified Lean Six Sigma Yellow Belt, Continuous Improvement Fundamentals Certified, Project Management Fundamentals Certified, and Safety Officer 2, she is committed to applying her knowledge and skills as an industrial engineer to support organizational growth and continuous improvement.

Cassey Atasha Silang graduated with a Bachelor of Science in Industrial Engineering from De La Salle Lipa. She is a Certified Lean Six Sigma Yellow Belt and is currently working as a Senior Assistant / VAS Planner under the Value-Added Services Department at A.P. Moller – Maersk. Through her consistent involvement in official Industrial Engineering organizations, she has developed strong leadership, collaboration, and communication skills that complement her technical foundation. She has also participated in several academic and research competitions, which have enhanced her analytical thinking, creativity, and problem-solving capabilities. Driven by her passion for operations research, process improvement, and decision systems, she aspires to apply her expertise in developing innovative and data-driven solutions that advance organizational efficiency and excellence.

Carl Benedict Sarmiento is a graduate of the Bachelor of Science in Industrial Engineering from De La Salle Lipa. He is a Certified Lean Six Sigma Yellow Belt and holds a certification in Project Management Fundamentals. Throughout his academic journey, he developed a strong foundation in process improvement, project coordination, and analytical problem-solving. His exposure to core Industrial Engineering methodologies has strengthened his ability to evaluate systems, optimize operations, and support data-driven decision-making.