The Impact of SITM Vehicle Breakdowns on Economic Losses and Perceived Service Quality in Cartagena

Impacto de las varadas de vehículos del SITM en las pérdidas económicas y la percepción del servicio en Cartagena

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Abstract

Background:

Aims:

General Objective:

To analyze the impact of vehicle breakdowns within the Integrated System of Mass Transit (SITM) of the city of Cartagena on the economic losses of the operating company and on the perceived service quality by users.

Specific Objectives:

1. Identify the routes and locations with the highest frequency and costs of breakdowns.
2. Determine the main operational causes associated with breakdowns and their relationship with user satisfaction.
3. Quantify the economic losses caused by vehicle breakdowns in the SITM, taking into account operational and maintenance costs, as well as unproductive time.

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Methods:

Analysis of breakdown records, analysis of economic losses, assessment of impact by route and location, statistical analysis.

Results:

Conclusions:

Keywords: Stranded, Economic losses, Service quality, Users, SITM (Integrated System of Mass Transit).

Resumen

Antecedentes:

Objetivos:

Objetivo general:

Analizar el impacto de las varadas de los vehículos del Sistema Integrado de Transporte Masivo (SITM) de la ciudad de Cartagena en las pérdidas económicas de la empresa operadora y en la calidad del servicio percibida por los usuarios.

Objetivos específicos:

1. Identificar las rutas y ubicaciones con mayor frecuencia y costos de varadas.
2. Determinar las principales causas operativas asociadas a las varadas y su relación con la satisfacción del usuario.
3. Cuantificar las pérdidas económicas generadas por las varadas de los vehículos del SITM, considerando costos operativos, de mantenimiento y los tiempos improductivos.

Método:

Análisis de registros de varadas, análisis de pérdidas económicas, evaluación del impacto por ruta y ubicación, análisis estadístico.

Resultados:

Conclusión:

Palabras clave: Varadas, Pérdidas económicas, Calidad del servicio, Usuarios, SITM (Sistema Integrado de Transporte Masivo).

1. Introduction

The Integrated System of Mass Transit (SITM) in the city of Cartagena plays a fundamental role in urban mobility. Its proper functioning largely depends on the condition of the fleet and the operational efficiency of the vehicles. Consequently, one of the most recurring challenges faced by these systems is vehicle breakdowns or operational disruptions, which generate significant impacts for both the operating company and the users.

These breakdowns entail operational and maintenance costs associated with unproductive time. For users, such failures translate into delays, discomfort, and a loss of trust in the system.

This study aims to comprehensively analyze these failures within the SITM, starting with the identification of associated costs, as well as the routes and locations where they occur most frequently, in order to identify critical operational patterns.

Finally, the study seeks to quantify the economic losses resulting from breakdowns, highlight the main areas of impact, and assess the negative consequences for users, with the ultimate goal of enhancing transparency and rebuilding trust in the system.

Based on this context, the following research question arises: What is the impact of vehicle breakdowns in Cartagena's Integrated System of Mass Transit (SITM) on the operating company's economic losses and on the perceived quality of service by users?

2. Data

The collected data corresponds to a representative sample of buses and routes within the city's Integrated Mass Transit System (SITM); therefore, it does not cover the system in its entirety. Additionally, the analysis is limited to a six-month period. The information was provided by one of the system's operating companies. Both qualitative and quantitative data were gathered, although the latter predominates. Below is a detailed summary of the types and amounts of the final data to be used in the analysis.

Tabla 1: Number of Variables by Type

Type	Count
Quantitative	10
Qualitative	23
Date/Time	4
Boolean	2

Tabla 2: List of Variables with Descriptions

Type	Variable	Description
Quantitative	costo_x_perdida	Cost associated with vehicle downtime
Quantitative	num_max_viajes	Maximum number of trips made
Quantitative	num_min_viajes	Minimum number of trips made
Quantitative	total_usuarios_por_ruta	Total number of users per route
Quantitative	retrazo	Delay time in minutes or hours
Quantitative	dia_varados	Day when the vehicle was stranded
Quantitative	num_min_pasajeros	Minimum number of passengers
Quantitative	num_max_pasajeros	Maximum number of passengers
Quantitative	costo_opot_min	Cost of downtime (minimum estimate)
Quantitative	costo_opot_max	Cost of downtime (maximum estimate)
Qualitative	sistema_reportado	Report System by the operating area
Qualitative	ruta	Route number or identifier
Qualitative	ubicacion	Location where the failure occurred
Qualitative	vehiculo	Vehicle identifier or license plate
Qualitative	tipologia	Category or typology of the failure
Qualitative	kilometraje	Distance traveled before the failure
Qualitative	nombre_de_conductor	Name of the vehicle operator
Qualitative	hora_novedad	Time of the incident
Qualitative	observacion_de_la_novedad	Details or notes about the incident
Qualitative	decision	Decision taken regarding the failure
Qualitative	ot	Work order associated with the failure
Qualitative	tenico_responsable	Responsible technician
Qualitative	sistema	System involved in the failure
Qualitative	subsistema	Subsystem involved in the failure
Qualitative	ref_comp	Reference component causing the failure
Qualitative	componente	Component affected
Qualitative	adjetivo	Adjective describing the failure
Qualitative	consecuencia	Consequence of the failure
Qualitative	estado	State or status of the failure resolution
Qualitative	observacion	Additional observations
Qualitative	dia_habil	Whether the day was a business day or not
Qualitative	mes_falla	Month in which the failure occurred
Qualitative	nueva_hora	Time when it resumes operation.
Date/Time	fecha	Date when the failure occurred
Date/Time	fecha_hora_retrazo	Datetime of the delay caused by the failure
Date/Time	nueva_fecha	New date assigned after the failure
Date/Time	year_falla	Year in which the failure occurred
Boolean	varado	Whether the vehicle was stranded (Yes/No)
Boolean	afectacion_al_usuario	Whether the user was affected (Yes/No)

3. Materials and Methods

4. Results and Discussion

5. Conclusion and Recommendations

Acknowledgments

Appendix A. Dataset link

References

[1] Referencia número uno.

[2] Referencia número dos.

[3] Referencia número tres.

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