



**Trabajo de integración Curricular previa a la
obtención de título de Master en Ingeniería
Automotriz con mención en procesos y calidad de
servicio automotriz.**

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**EVALUACIÓN DE LA SATISFACCIÓN DEL CLIENTE Y PROPUESTAS DE
MEJORA EN LOS SERVICIOS DE MANTENIMIENTO DE VEHÍCULOS DE
MICROMOVILIDAD ELÉCTRICA.**

Quito, Julio 2025

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DEDICATORIA

Dedico este trabajo a todas aquellas personas que, de una u otra forma, han sido parte de mi camino y en especial a mi familia. Quienes me brindaron su apoyo en silencio, con una palabra oportuna, un gesto de ánimo o simplemente confiando en mis capacidades. Esta tesis representa no solo un logro académico, sino también el reflejo de esfuerzo, constancia y aprendizajes acumulados a lo largo del tiempo. A quienes inspiran con su ejemplo y motivan con su presencia, gracias por ser parte de este proceso.

José Luis Moreno

Quiero dedicar este trabajo a mi familia, quienes con esfuerzo, sabiduría y paciencia han sido mi mayor ejemplo de constancia y perseverancia. Gracias por enseñarme a mantener la humildad en los momentos de logro y el coraje en las dificultades.

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EVALUACIÓN DE LA SATISFACCIÓN DEL CLIENTE Y PROPUESTAS DE MEJORA EN LOS SERVICIOS DE MANTENIMIENTO DE VEHÍCULOS DE MICROMOVILIDAD ELÉCTRICA.

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RESUMEN

Introducción: La presente investigación tuvo como objetivo evaluar la satisfacción del cliente en los servicios de mantenimiento de vehículos de Micromovilidad eléctrica en un taller especializado de Quito, considerando la creciente demanda de este tipo de transporte y la falta de mecanismos formales de evaluación del servicio en el sector. Se buscó además identificar oportunidades de mejora que fortalezcan la calidad del servicio y la fidelización del usuario. **Metodología:** El estudio adoptó un enfoque cuantitativo, de tipo descriptivo. Se aplicó una encuesta estructurada a 35 clientes, evaluando tres bloques: aspectos técnicos, administrativos y percepción global del servicio. Se utilizó una escala Likert del 1 al 10 y se incluyó una pregunta abierta para captar sugerencias cualitativas. **Resultados:** Los resultados evidenciaron altos niveles de satisfacción en motos y scooter eléctricos (promedios cercanos a 8), mientras que en otros tipos de vehículos de movilidad personal (VMP), las calificaciones descendieron a promedios de 6. Este grupo representa menos del 10% de los clientes, pero sus respuestas revelan debilidades en disponibilidad de repuestos, tiempos de atención y comunicación. El Net Promoter Score general alcanzó un valor de 57.2 aceptable dentro de una industria en desarrollo, el NPS para los vehículos oficiales de la marca es 67,7 considerado excelente en el sector. **Conclusión:** Se concluye que, aunque el taller ofrece un servicio sólido para la mayoría de vehículos atendidos, es

necesario adoptar un enfoque más inclusivo y flexible para mejorar la experiencia de usuarios con VMP menos convencionales y fortalecer el posicionamiento del servicio en un mercado en expansión.

PALABRAS CLAVE: Vehículo de movilidad personal (VMP), Micromovilidad eléctrica, Satisfacción del cliente, Servicio técnico.

ABSTRACT

Introduction: This research aimed to evaluate customer satisfaction in maintenance services for electric micromobility vehicles at a specialized workshop in Quito, considering the growing demand for this type of transportation and the lack of formal service evaluation mechanisms in the sector. The study also sought to identify improvement opportunities to enhance service quality and foster customer loyalty.

Methodology: A quantitative, descriptive approach was adopted. A structured survey was applied to 35 customers, evaluating three blocks: technical aspects, administrative aspects, and overall service perception. A Likert scale from 1 to 10 was used, along with an open-ended question to collect qualitative suggestions. **Results:** The results showed high satisfaction levels for electric motorcycles and scooters (averages close to 8), while other types of personal mobility vehicles (PMVs) received significantly lower ratings, averaging around 6. Although this group represents less than 10% of customers, their feedback highlighted weaknesses in spare parts availability, service times, and communication. The overall Net Promoter Score (NPS) reached a value of 57.2, which is acceptable for a developing industry, while the NPS for official brand vehicles was 67.7, considered excellent in the sector. **Conclusion:** It is concluded that while the workshop delivers solid service for most commonly serviced vehicles, a more inclusive and flexible approach is necessary to improve the experience of users with less conventional PMVs and to strengthen the workshop's position in an expanding market.

KEYWORDS: Personal Mobility Vehicle (PMV), Electric Micromobility, Customer Satisfaction, Technical Service

INTRODUCCIÓN

En los últimos años, la movilidad eléctrica ha adquirido un papel protagónico en la transformación del transporte urbano, destacándose por su enfoque en la sostenibilidad ambiental y la eficiencia energética. Sin embargo, este auge plantea desafíos importantes, especialmente en la calidad del servicio posventa relacionado con el mantenimiento preventivo y correctivo de los vehículos de micromovilidad eléctrica. En ciudades como Quito, el crecimiento del parque de scooter, bicicletas, motos y otros vehículos de movilidad personal (VMP) ha superado la capacidad de respuesta de los talleres especializados, muchos de los cuales carecen de mecanismos formales para evaluar la satisfacción del cliente.

Diversos estudios han evidenciado que una atención al cliente inadecuado puede generar elevados niveles de insatisfacción, afectando directamente la fidelización del usuario y la sostenibilidad del negocio (Pinto & Aggarwal, 2022; Sitinjak & Ober, 2025). La literatura reciente resalta que aspectos como la calidad técnica del mantenimiento, el cumplimiento de tiempos de entrega y la comunicación efectiva son determinantes para

la percepción del servicio (Martínez-Gómez & Espinoza (2024). Sin embargo, la mayoría de estudios se centran en servicios de movilidad tradicional, dejando una brecha en el análisis de los servicios técnicos para micromovilidad.

Ante esta problemática, el objetivo general de este estudio es evaluar la satisfacción del cliente en los servicios de mantenimiento de vehículos de micromovilidad eléctrica en un taller especializado ubicado en Quito, con el fin de identificar oportunidades de mejora y desarrollar propuestas concretas que optimicen la calidad del servicio. Los objetivos específicos incluyen: identificar el tipo de vehículos más frecuentes en el taller, medir la percepción de los usuarios respecto a aspectos técnicos, administrativos y de atención, y proponer mejoras en base a los resultados obtenidos.

Este estudio se diferencia de investigaciones previas al enfocarse específicamente en un taller de micromovilidad en un contexto urbano latinoamericano, aplicando una encuesta estructurada con escala Likert y un análisis cualitativo de sugerencias abiertas. Además, se reconoce que uno de los factores clave para la satisfacción del cliente es la alineación entre sus expectativas y la capacidad del taller para gestionarlas eficazmente (Padilla-Angulo, Lasarte-Lopez & Caldentey, 2022; Grönroos, 1994).

La presente investigación no solo contribuye al conocimiento académico en torno a la calidad del servicio en la micromovilidad eléctrica, sino que también ofrece una herramienta práctica para la toma de decisiones estratégicas dentro del taller, considerando las necesidades reales de los usuarios. El principal aporte del estudio radica en la aplicación de un instrumento de medición basado en el modelo SERVQUAL combinado con análisis estadístico descriptivo y herramientas de gestión de calidad como el diagrama de Pareto y el análisis causa-raíz (Ishikawa). Estos elementos permitieron diseñar un plan de mejora enfocado en estandarizar procesos, capacitar al personal, establecer alianzas con proveedores de repuestos, mejorar la comunicación y extender los

horarios de atención. Se espera que estas propuestas favorezcan la fidelización del cliente y posicionen al taller como referente en un mercado emergente y altamente competitivo.

MARCO TEÓRICO

Antecedentes

Esta investigación se estructura en torno a cinco ejes clave que sustentan el análisis de los servicios técnicos relacionados con la **Micromovilidad eléctrica**. En primer lugar, se aborda la Micromovilidad como una alternativa de transporte urbano sostenible mediante vehículos como scooter, bicicletas y motos eléctricas, cuya creciente adopción ha generado una nueva demanda de atención técnica especializada (Cavallo, Powell & Serebrisky, 2020). En este contexto, la **calidad del servicio** se vuelve fundamental, ya que su percepción, tanto en aspectos tangibles como intangibles, influye directamente en la confianza del cliente y en la competitividad del taller (Aprigliano, Barros, Santos & de Oliveira, 2023). Complementariamente, autores como Wulf y Meierhofer (2024) resaltan la necesidad de desarrollar competencias específicas en atención al cliente para garantizar una experiencia satisfactoria y profesional.

En esa línea, se aborda la **satisfacción del cliente**, influida por la experiencia recibida frente a sus expectativas. Esta percepción está estrechamente relacionada con la calidad del servicio y con los procesos **postventa** (Gonçalves et al., 2020). El cuarto eje se centra precisamente en la atención postventa, destacando su importancia en la fidelización del cliente mediante el seguimiento, la resolución de problemas y el mantenimiento preventivo (Mohd Nasir et al., 2023). Finalmente, se consideran las **estrategias de mejora**, orientadas a la implementación de herramientas de **gestión de calidad**, retroalimentación del cliente y formación continua del personal técnico, como mecanismos para optimizar procesos y elevar la experiencia del usuario.

Micromovilidad Eléctrica

La Micromovilidad eléctrica comprende vehículos ligeros diseñados para recorridos urbanos cortos, promoviendo modos de transporte limpios y accesibles. Según Muhammad y Knowles (2020), esta modalidad contribuye significativamente a la descongestión del tráfico y a la reducción de ruido urbano. La implementación de políticas públicas, como incentivos fiscales y creación de infraestructura ciclista, ha potenciado su adopción (Paredes & Fernández, 2022). Sin embargo, esta rápida expansión ha evidenciado brechas en la cadena de suministro de repuestos y en la formación técnica de los operarios, aspectos que inciden directamente en la experiencia del usuario y en la percepción de profesionalidad del servicio (Zhang, Wang, & Li, 2023).

Calidad del Servicio

La calidad del servicio es un componente esencial en los procesos de atención técnica, especialmente en sectores innovadores como el de la Micromovilidad. Esta se puede analizar en dos dimensiones: tangible que incluye elementos como instalaciones, herramientas y presentación del personal; e intangible que abarca la confianza, empatía y capacidad de respuesta.

Para evaluar dicha calidad, se utiliza frecuentemente el modelo SERVQUAL, desarrollado por Parasuraman, Zeithaml y Berry (1988), el cual contempla cinco dimensiones clave: tangibilidad, fiabilidad, capacidad de respuesta, seguridad y empatía. Una atención técnica de calidad genera confianza en los clientes, fidelización y una percepción positiva de la marca.

La calidad del servicio, de acuerdo con la norma ISO 9000 (Organización Internacional de Normalización, 2015), se define como el grado en que un conjunto de

características inherentes cumple con los requisitos del cliente. En el ámbito específico de la micromovilidad, Hamerska, Ziółko y Stawiarski (2022) distinguen entre dimensiones tangibles: como instalaciones adecuadas, herramientas específicas y presentación profesional y dimensiones intangibles, que incluyen la empatía, la fiabilidad y la capacidad de respuesta.

Por su parte Grönroos (2021) sostiene que la coherencia en la comunicación y la personalización del servicio contribuyen significativamente a fortalecer la lealtad del cliente. Asimismo, Egbue y Long (2023) adaptaron el modelo SERVQUAL a un contexto de micromovilidad eléctrica, incorporando la seguridad técnica como un componente clave, dado que el uso de baterías y sistemas eléctricos requiere protocolos de mantenimiento especializados.

Tabla 1.

Dimensiones del Modelo SERVQUAL aplicadas a talleres de micromovilidad eléctrica

Dimensión	Definición	Aplicación en talleres de Micromovilidad eléctrica (VMP)
Tangibilidad	Elementos físicos visibles del servicio	Herramientas, instalaciones, apariencia del personal técnico
Fiabilidad	Capacidad de cumplir lo prometido	Exactitud y consistencia en la reparación: Cumplimiento del tiempo de entrega, Precisión en la reparación
Capacidad de respuesta	Rapidez y eficacia en la atención	Rapidez en atención y diagnóstico: Tiempo de espera, Rapidez en la solución de fallas
Seguridad	Confianza y garantía del servicio	Protocolos técnicos, uso correcto de repuestos originales y homologados
Empatía	Atención personalizada y comprensión del cliente	Escucha activa, Seguimiento postventa, Trato amable y profesional

Nota: Adaptado de Parasuraman, Zeithaml y Berry (1988) y actualizaciones recientes, aplicado al contexto de talleres de micromovilidad eléctrica.

Satisfacción del Cliente

La satisfacción del cliente refleja la evaluación global del servicio comparada con sus expectativas previas. Según Oliver (2010), esta percepción surge de la diferencia entre expectativas y resultados percibidos. En el sector de la micromovilidad, Gonçalves et al. (2020) evidenciaron que factores como la claridad en la comunicación, la disponibilidad de repuestos y la atención al cliente son determinantes para una alta satisfacción. Egbue y Long (2023). demostró que una experiencia positiva no solo incide en la decisión de compra futura, sino que también promueve la recomendación boca a boca, incrementando la reputación del taller.

En la Figura 1 se muestra cómo una buena percepción en cada dimensión del servicio influye directamente en la satisfacción del cliente, lo cual a su vez potencia la fidelización, las recomendaciones y el retorno económico.

Figura 1.

Relación entre calidad del servicio, satisfacción del cliente y fidelización



Fuente: Autores aplicado al contexto de talleres de Micromovilidad eléctrica.

Atención Postventa y Servicio al Cliente

La atención postventa es un elemento clave para generar confianza y asegurar la continuidad del vínculo entre cliente y proveedor de servicios. Un referente actual lo aporta UScale GmbH (2024), cuyos resultados muestran que el seguimiento tras la reparación, las actualizaciones de software y el diagnóstico remoto son componentes clave para fortalecer la confianza del usuario en talleres y líneas de atención técnica de vehículos eléctricos.

Grau Escolano, Bassolas y Vicens (2024) analizan talleres especializados en micromovilidad, donde con frecuencia se requieren servicios recurrentes, la atención continua es un factor diferencial. La postventa no solo busca resolver problemas, sino también anticiparse a ellos mediante diagnósticos preventivos y predictivos, fortaleciendo así la percepción de compromiso con el cliente.

Fórmula 1. Cálculo de la satisfacción total (adaptada del modelo SERVQUAL)

$$\text{Satisfacción Total} = (1/n) \sum (P_i - E_i)$$

Dónde:

- P_i : Percepción del cliente en la dimensión i
- E_i : Expectativa del cliente en la dimensión i
- n : Número total de dimensiones evaluadas (usualmente 5 en SERVQUAL)

Estrategias de Mejora

Para abordar las brechas identificadas, Castañeda Pacheco y Lugo García (2022) recomiendan implementar encuestas periódicas de satisfacción, indicadores clave de desempeño (KPIs) y programas de formación continua del personal. Asimismo, Zhang, Wang, & Li (2023) proponen la integración de plataformas digitales de retroalimentación en tiempo real, que permitan al taller responder proactivamente a incidencias y ajustar procesos. La literatura sugiere que estas estrategias, combinadas con un sistema de seguimiento postservicio, favorecen la mejora continua y la fidelización del cliente.

MATERIALES Y MÉTODOS

Con el objetivo de cumplir con el propósito general de la presente investigación, se adoptó un enfoque cuantitativo de tipo descriptivo, orientado a medir la percepción de los clientes sobre la calidad del servicio recibido en talleres especializados en micromovilidad eléctrica. La herramienta principal fue una encuesta estructurada, diseñada con una escala de Likert del 1 al 10, que permitió recolectar datos en torno a aspectos técnicos, administrativos y de percepción general del servicio. Posteriormente, la información fue procesada mediante análisis estadístico descriptivo, utilizando medidas de tendencia central, frecuencias y desviaciones estándar, con el fin de interpretar los niveles de satisfacción y formular estrategias de mejora basadas en evidencia empírica Hernández-Sampieri, Fernández y Baptista (2021).

Para atender los objetivos específicos, se combinó un enfoque metodológico integral compuesto por tres métodos complementarios: bibliográfico, observacional y estadístico. El método bibliográfico sustentó el marco teórico mediante el análisis de literatura especializada en calidad del servicio y satisfacción del cliente (Grönroos, 2021; Parasuraman, Zeithaml y Berry, 2018). El método observacional, de tipo no experimental, se llevó a cabo mediante encuestas aplicadas a clientes, sin intervención en las condiciones del entorno. Finalmente, se empleó un método estadístico para analizar los datos recolectados, fortaleciendo la validez del estudio a través de una visión más integral del fenómeno investigado. Como señala Bisquerra (2014), la combinación de distintos métodos fortalece la validez de los estudios aplicados, al ofrecer una visión más completa y fundamentada de los fenómenos sociales investigados.

Materiales

Población y Muestra

La población correspondió al conjunto de clientes que accedieron a servicios técnicos de mantenimiento preventivo y correctivo de vehículos de micromovilidad eléctrica, con edades comprendidas entre los 18 y 60 años. Esta población fue seleccionada por representar directamente a los usuarios que experimenta el servicio técnico en condiciones reales. Se consideró adecuada para garantizar que la información recolectada reflejara las percepciones auténticas del público objetivo del taller, permitiendo evaluar la calidad del servicio desde la experiencia del cliente final y formular mejoras con base en sus expectativas y valoraciones Grönroos (2021).

Lugar

La investigación se llevó a cabo en un taller especializado en micromovilidad eléctrica, ubicado en el centro norte de Quito, específicamente en la intersección de las avenidas Gaspar de Villarroel y Shyris, edificio Datapro E9-19. Este lugar fue seleccionado por ser un centro de atención técnica con alta afluencia de clientes y una operación representativa en el mantenimiento de scooter y motocicletas eléctricas. El taller fue utilizado para observar y aplicar la encuesta dentro de un entorno real de trabajo, lo cual aporta mayor validez ecológica al estudio y permite que los resultados reflejen con mayor fidelidad las condiciones del servicio evaluado (Parasuraman, Zeithaml & Berry, 2018).

Figura 2.

Ubicación del taller



Fuente: Google Maps

Instrumento de recolección de datos

El instrumento principal de recolección de datos fue una encuesta estructurada, diseñada con preguntas cerradas en escala de Likert del 1 al 10 y una pregunta abierta final. Se utilizó este instrumento porque permite obtener datos cuantificables y comparables sobre aspectos técnicos, administrativos y de percepción general. Su finalidad fue recopilar, sistematizar y analizar de forma objetiva la opinión de los clientes sobre la calidad del servicio, facilitando la identificación de áreas de mejora mediante un enfoque estadístico Hernández-Sampieri, Fernández y Baptista (2021).

Las preguntas de la encuesta fueron construidas a partir del modelo SERVQUAL (Parasuraman et al., 1988), el cual permite medir la percepción del cliente en torno a cinco dimensiones de la calidad del servicio: fiabilidad, capacidad de respuesta, seguridad, empatía y aspectos tangibles. Además, se consideraron adaptaciones al sector de micromovilidad con base en estudios recientes (López et al., 2023). La estructura del cuestionario busca evaluar de manera integral la experiencia del cliente en el área de postventa, incluyendo aspectos tangibles, atención, cumplimiento y confianza.

Herramientas digitales

Las herramientas digitales utilizadas fueron Google Forms para el diseño del cuestionario, y WhatsApp y correo electrónico para su distribución. Estas herramientas permiten el acceso inmediato y remoto de los participantes, además de facilitar la recolección automática y centralizada de los datos. Se emplearon con el objetivo de optimizar el tiempo, mejorar el alcance de la muestra, y reducir los costos logísticos, asegurando así una recolección eficiente, segura y sin barreras físicas Flick (2022).

Procedimiento

El procedimiento seguido en esta investigación se estructuró en cinco etapas: revisión bibliográfica, diseño del cuestionario, validación por expertos, aplicación digital de la encuesta y análisis de los datos. Se siguió este procedimiento porque garantiza la coherencia entre el marco teórico y la aplicación práctica del estudio. Su propósito fue asegurar la validez, fiabilidad y aplicabilidad de los resultados, permitiendo que las conclusiones se fundamenten en un proceso metódico y replicable Bisquerra (2014).

Tabla 2.

Variables e indicadores de evaluación de la calidad de servicio

Dimensión	Variable	Indicador
Técnica	Claridad del diagnóstico	Nivel de comprensión del cliente
	Profesionalismo del técnico	Nivel de confianza y conocimiento percibido
	Tiempo de entrega	Percepción sobre cumplimiento de plazos
Administrativa	Claridad en la facturación	Comprensión de cobros y desglose
	Satisfacción general	Evaluación global del servicio recibido
Percepción cliente	Recomendación del servicio	Disposición a recomendar el taller

RESULTADOS Y DISCUSIÓN

Para facilitar un análisis estructurado y objetivo de los datos recolectados, las variables evaluadas en el presente estudio fueron agrupadas en tres bloques principales: aspectos técnicos, aspectos administrativos y de gestión, y percepción global del servicio. Esta clasificación fue complementada con un apartado adicional de sugerencias de mejora, obtenidas a partir de una pregunta abierta. Dicha organización permitió estructurar la información de forma clara y evaluar de manera independiente los factores clave dentro de cada dimensión.

La recolección de datos se llevó a cabo mediante una encuesta dirigida a clientes que visitaron el taller especializado en Micromovilidad eléctrica durante el año 2025. El instrumento utilizó una escala de Likert del 1 al 10, donde 1 representa total desacuerdo y 10 acuerdo completo con las afirmaciones. La investigación midió el nivel de satisfacción del cliente en los servicios de mantenimiento preventivo y correctivo, con el propósito de identificar las áreas de mayor y menor rendimiento percibido, y así comparar la valoración de los distintos bloques de atención. Esta información busca orientar mejoras que fortalezcan la excelencia del servicio y consoliden la confianza del usuario.

La Tabla N.º 3 presenta los resultados obtenidos a partir de la encuesta aplicada, donde se muestran los promedios registrados para cada una de las variables evaluadas, organizadas por bloques temáticos, junto con una recopilación de las principales sugerencias formuladas por los usuarios en relación con la mejora del servicio.

Tabla 3.

Datos de entrada encuesta de satisfacción taller micromovilidad

Variables de satisfacción al cliente	Situación ideal	Diagnóstico de la empresa
Aspectos Técnicos		
El técnico explicó claramente el diagnóstico o problema de mi vehículo.	El técnico explica el diagnóstico de forma clara y sencilla, asegurando que el cliente comprenda el problema y su solución.	La mayoría de los clientes percibió una explicación clara del diagnóstico, reflejada en un promedio de 8,31/10 . Esto indica una comunicación técnica en general positiva. Sin embargo, algunas calificaciones bajas muestran oportunidad de mejorar la comprensión del cliente.
El personal técnico mostró conocimiento y dominio del trabajo.	El técnico demuestra conocimiento especializado y seguridad en el diagnóstico, reparación y	La mayoría de los clientes percibió que el personal técnico demostró conocimiento y dominio del trabajo, con un promedio de 8,47/10 . Esto refleja una percepción positiva de la capacidad técnica del taller.

	mantenimiento de vehículos eléctricos.	Sin embargo, algunas respuestas bajas indican oportunidades para reforzar la confianza técnica en ciertos casos.
El mantenimiento o reparación solucionó completamente el problema reportado.	El servicio de mantenimiento o reparación resuelve de manera completa y efectiva el problema reportado por el cliente.	La mayoría de los clientes consideró que el mantenimiento o reparación solucionó completamente el problema reportado, con un promedio de 8,19/10 . Aunque la percepción general es positiva, algunas calificaciones bajas reflejan que existen casos donde la solución no fue percibida como totalmente efectiva.
Aspectos Admirativos y de Gestión		
El tiempo de agendamiento de la cita fue adecuado.	La cita fue agendada en un tiempo razonable y acorde a la necesidad del cliente.	La mayoría de los clientes consideró adecuado el tiempo de agendamiento de su cita, reflejado en un promedio de 8,36/10 . Aunque la percepción general es positiva, algunas respuestas bajas evidencian que en ciertos casos podría mejorarse la rapidez o disponibilidad de las citas.
Me entregaron el vehículo en el tiempo prometido.	El vehículo fue entregado puntualmente según el plazo acordado con el cliente.	Los usuarios valoraron positivamente el cumplimiento del tiempo de entrega prometido, alcanzando un promedio de 8,47/10 . Aunque la percepción general es favorable, algunas bajas calificaciones indican que hubo retrasos en ciertos casos.
La facturación fue clara y sin errores.	La facturación fue precisa, detallada y comprensible para el cliente.	Los usuarios calificaron de forma favorable la claridad y exactitud en la facturación, alcanzando un promedio de 8,50/10 . No obstante, algunas valoraciones bajas sugieren que en casos puntuales se detectaron errores o falta de claridad.
Me notificaron oportunamente sobre cualquier cambio en el proceso.	El cliente fue informado de manera oportuna sobre cualquier cambio en el servicio o tiempos de entrega.	La gestión de la comunicación sobre cambios en el servicio fue bien valorada, reflejando un promedio de 8,36/10 . En términos generales, los clientes manifestaron sentirse informados durante el proceso. Sin embargo, algunas calificaciones bajas indican que en ciertos casos no se notificó de manera oportuna, lo cual podría afectar la percepción de confianza y atención personalizada.
El personal administrativo fue amable y resolvió mis dudas.	El personal administrativo atendió con amabilidad y resolvió todas las dudas del cliente de forma efectiva.	El trato recibido por parte del personal administrativo fue valorado de manera positiva, con un promedio de 8,50/10 . Aunque la mayoría de los usuarios percibió amabilidad y claridad en la atención, algunas respuestas bajas indican que existen oportunidades para mejorar la resolución de dudas en ciertos casos.
Percepción Global del Servicio		
Considero que el servicio recibido fue de buena calidad.	El cliente percibe que el servicio recibido cumple con altos estándares de calidad.	El servicio recibido fue percibido como de buena calidad por los usuarios, alcanzando un promedio de 8,47/10 . A pesar de esta valoración favorable, algunas respuestas bajas evidencian que existen oportunidades de mejora para asegurar un estándar de calidad aún más alto.
Estoy satisfecho con la atención general brindada.	El cliente se siente plenamente satisfecho con toda la atención recibida durante el servicio.	La pregunta obtuvo un promedio de 8,47/10 en una muestra de 36 respuestas. Este resultado refleja un nivel de satisfacción general positivo, aunque algunas respuestas bajas evidencian experiencias aisladas de insatisfacción. La satisfacción general se considera un indicador clave del desempeño del servicio.
Recomendaría este taller a otras personas. (NPS)	El cliente está dispuesto a recomendar el taller gracias a su experiencia positiva.	El promedio de 8,61/10 obtenido en la intención de recomendar el taller refleja una percepción mayormente positiva de los usuarios respecto al servicio recibido. No obstante, algunas calificaciones bajas indican la necesidad de trabajar en ciertos aspectos de la experiencia para asegurar que todos los clientes se conviertan en promotores del taller, fortaleciendo así su imagen y posicionamiento.
En general, mi experiencia con el taller de servicio fue positiva.	El cliente valora su experiencia general en el taller como positiva y satisfactoria.	El promedio de 8,39/10 la evaluación de la experiencia general refleja una opinión positiva por parte de la mayoría de los usuarios. Sin embargo, la dispersión en las respuestas, evidenciada por calificaciones bajas, sugiere que algunos clientes no vivieron una experiencia plenamente satisfactoria. Estos resultados resaltan la necesidad de implementar acciones que aseguren una atención más homogénea y eleven la percepción global del servicio.

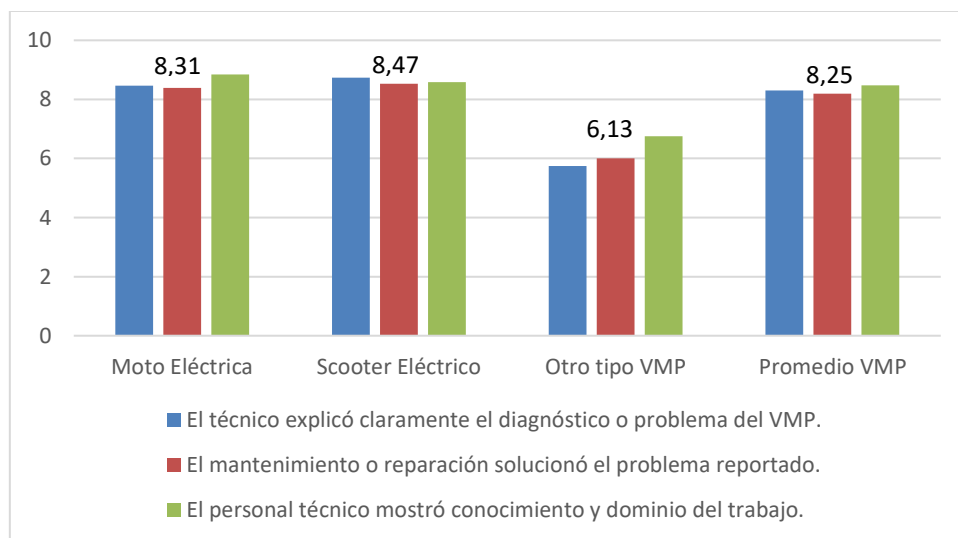
Pregunta Abierta	¿Qué sugerencias o comentarios adicionales tiene para mejorar nuestros servicios?	19 respuestas a la pregunta abierta. Los principales temas sugeridos por los clientes incluyen:
	El cliente aporta sugerencias constructivas que permiten identificar oportunidades de mejora en el servicio	- Extensión de horarios, especialmente atención los sábados y fines de semana. - Mejora en la comunicación, como confirmar el diagnóstico y la disponibilidad de repuestos de forma oportuna. - Implementación de nuevos servicios, como asistencia de emergencia en sitio y servicio de lavado.

Fuente: Autores

Al aplicar la encuesta se midió el nivel de satisfacción de los clientes en relación con los servicios de mantenimiento de vehículos de Micromovilidad eléctrica, evaluando aspectos técnicos, administrativos y de atención general. Así mismo, se compararon las percepciones de los usuarios entre los distintos bloques de servicio, identificando las áreas de mayor y menor desempeño, con el propósito de plantear estrategias de mejora orientadas a optimizar la experiencia del cliente.

Figura 3.

Resultados de Aspecticos Técnicos primer trimestre 2025



Fuente: Autores

La figura 3 correspondiente a los aspectos técnicos muestra los resultados obtenidos en tres dimensiones fundamentales del servicio de mantenimiento: la claridad del diagnóstico, la solución efectiva del problema reportado y el nivel de conocimiento

del personal técnico. Las respuestas fueron analizadas según el tipo de vehículo de movilidad personal (VMP), diferenciando entre motos eléctricas, scooter eléctrico y otros tipos de VMP. Los resultados revelan que tanto las motos como los scooter eléctricos recibieron calificaciones altas y constantes, con promedios cercanos a los 8 puntos sobre 10. Esta evaluación positiva indica que el servicio técnico es percibido como eficiente y confiable en los tipos de vehículos más comunes, lo cual refleja un proceso bien establecido y ejecutado con regularidad.

Tabla 4.

Ingreso de VMP taller de servicio micromovilidad eléctrica

Tipo de vehículo	Scooter	Moto	Otros
	56,70%	36,70%	6,70%
Servicio realizado	Mantenimiento Preventivo	60%	
	Mantenimiento Correctivo	40%	

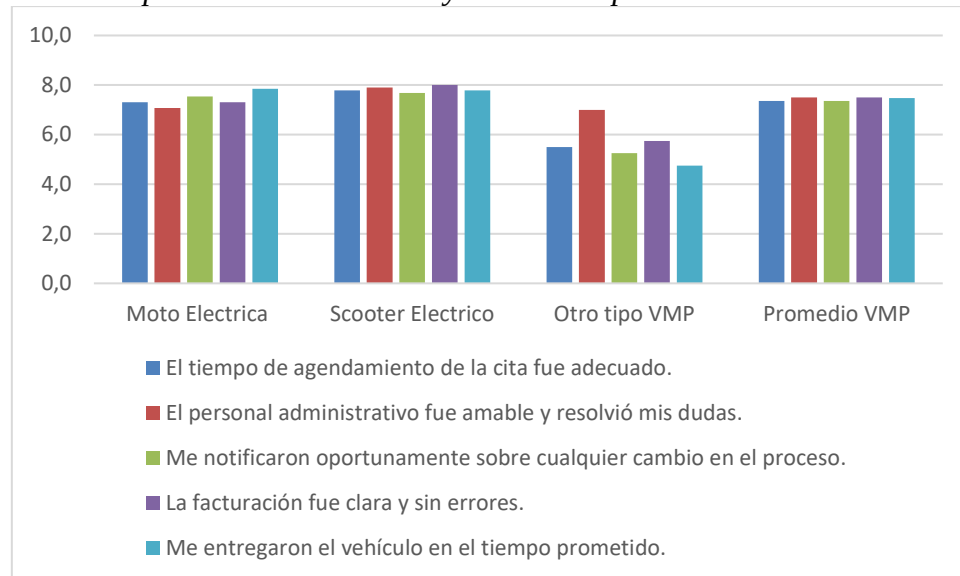
Fuente: Autores

En cambio, los resultados obtenidos para otros VMP muestran una diferencia significativa, con una calificación promedio de 6 sobre 10. Esta brecha sugiere debilidades en la atención de vehículos menos convencionales, posiblemente vinculadas a la escasa disponibilidad de repuestos o la falta de información técnica específica. Aunque el promedio general es de 8 puntos, las diferencias entre tipos de VMP evidencian la necesidad de ajustar el servicio para garantizar una atención equitativa.

El taller ha consolidado una experiencia técnica sólida en motos y scooter eléctricos, pero persiste una menor efectividad en otros VMP. Esto resalta la importancia de ampliar la capacitación del personal técnico y facilitar el acceso a información actualizada para atender modelos menos comunes. Mejorar el servicio técnico en toda la gama de vehículos no solo elevará la satisfacción del cliente, sino que también fortalecerá la fidelización y el posicionamiento del taller en un mercado de Micromovilidad en constante crecimiento.

Figura 4.

Resultados de Aspectos Administrativos y de Gestión primer trimestre 2025



Fuente: Autores

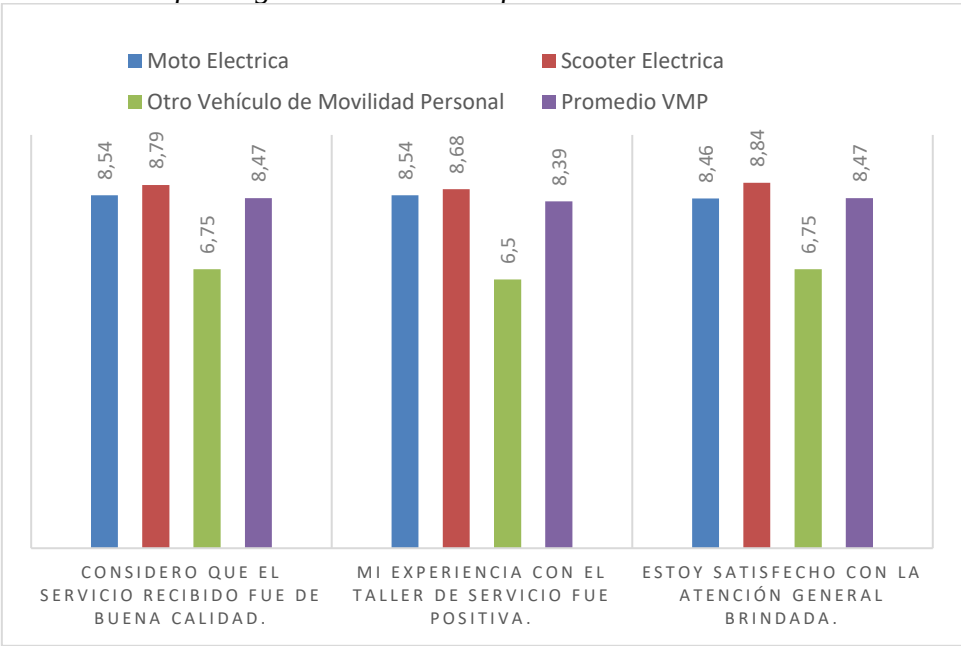
La figura 4, correspondiente a los aspectos administrativos y de gestión, presenta los resultados de cinco variables clave: agendamiento de citas, amabilidad del personal, notificación de cambios, claridad en la facturación y entrega oportuna del vehículo. Estas dimensiones fueron valoradas según el tipo de vehículo (moto eléctrica, scooter eléctrico y otros VMP), incluyendo un promedio general. Los resultados muestran un desempeño homogéneo y positivo para motos y scooter eléctricos, con calificaciones cercanas a 8 sobre 10. En contraste, los otros VMP obtuvieron puntuaciones más bajas, entre 5 y 6, especialmente en notificación, facturación y cumplimiento de tiempos.

Esta diferencia evidencia una brecha en la calidad del servicio administrativo según el tipo de vehículo. Los usuarios de motos y scooter eléctricos perciben procesos organizados y efectivos, mientras que los de otros VMP reportan experiencias menos satisfactorias. Esta disparidad podría deberse a la menor frecuencia de atención de estos vehículos, lo que genera falta de familiaridad, ausencia de protocolos específicos o escaso acceso a información y repuestos. Asimismo, es posible que el personal administrativo no esté completamente preparado para gestionar casos fuera de lo habitual. Todo ello

impacta en la confianza del cliente y evidencia la necesidad de fortalecer los procesos internos mediante la estandarización, capacitación continua y mejora en la comunicación, a fin de ofrecer un servicio equitativo y eficiente.

Figura 5.

Resultados de Percepción global del servicio primer trimestre 2025



Fuente: Autores

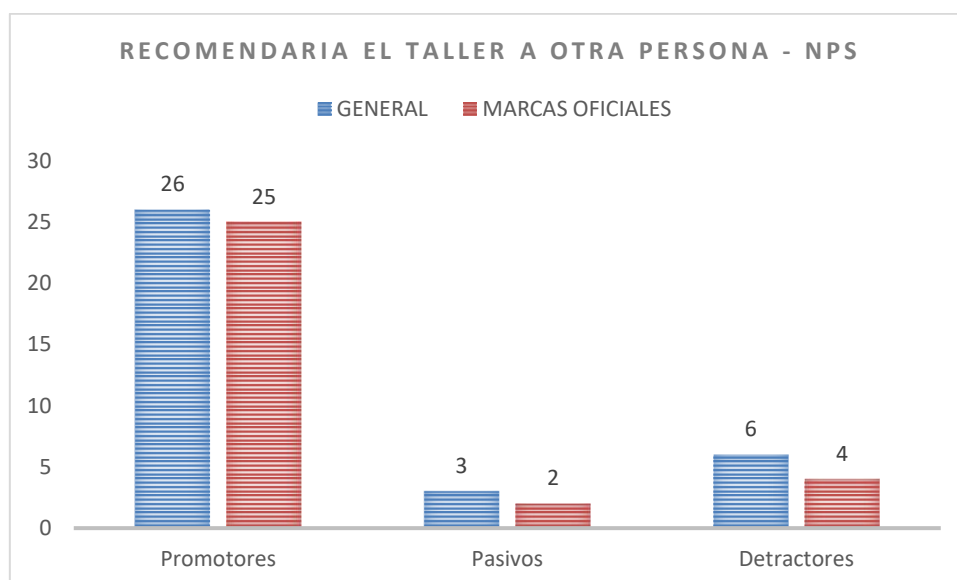
La figura 5 presenta los resultados consolidados de tres preguntas relacionadas con la calidad percibida del servicio del taller de Micromovilidad eléctrica. Las afirmaciones evaluadas fueron: “Considero que el servicio recibido fue de buena calidad”, “Mi experiencia con el taller de servicio fue positiva” y “Estoy satisfecho con la atención general brindada”. Estas fueron calificadas por los clientes según el tipo de VMP (moto eléctrica, scooter eléctrico y otros), incluyendo también un promedio general. Los resultados reflejan una tendencia muy positiva en motos y scooter eléctricos, con calificaciones entre 8,29 y 8,54 sobre 10, lo que indica una percepción estable y favorable.

En contraste, los otros VMP alcanzan promedios cercanos a los 6,75 puntos, mostrando una diferencia considerable en la experiencia percibida.

Estos datos permiten identificar una alta satisfacción en usuarios de motos y scooter, demostrando que el taller ha consolidado una atención efectiva y alineada con las expectativas. Sin embargo, la menor calificación otorgada por usuarios de otros VMP evidencia una debilidad estructural que va más allá de lo técnico o administrativo. Este segmento, aunque reducido, experimenta un servicio menos satisfactorio, posiblemente por la falta de familiaridad del personal, escasez de recursos específicos o procedimientos poco adaptados. Esta situación exige una gestión más inclusiva que considere las particularidades de todos los VMP. Mejorar la experiencia de estos clientes no solo implica eficiencia operativa, sino también fortalece la fidelización, la reputación y la posición competitiva del taller.

Figura 6.

Resultados de NPS primer trimestre 2025



Fuente: Autores

En la figura 6 y tabla 5 se detallan los resultados del NPS obtenido a partir de la encuesta aplicada a 35 clientes del taller especializado en Micromovilidad eléctrica

Tabla 5.*Datos tabulados NPS taller Micromovilidad*

Categoría	General	Porcentaje (%)	VMP Oficiales	Porcentaje (%)
Promotores	26	74.3	25	80,6
Pasivos	3	8.6	2	6,4
Detractores	6	17.1	4	12,9

Fuente: Autores

El resultado obtenido en la evaluación del Net Promoter Score (NPS) global, con un valor de 57.2, refleja un nivel aceptable de satisfacción y lealtad por parte de los usuarios del taller. En color rojo se observa los valores obtenidos para los VMP de posventa oficial retirando “otros VMP” obteniendo un NPS para marcas oficiales de 67,7, este valor es considerado excelente en la industria automotriz, adquiere mayor relevancia al tratarse de un segmento emergente como la Micromovilidad, donde los estándares de servicio aún se están consolidando.

El hecho de que más del 74% de los encuestados se identifiquen como promotores del servicio no solo evidencia la calidad técnica y humana del taller, sino también una percepción positiva sobre la experiencia integral del cliente. Esto resulta fundamental en un entorno donde la confianza y la recomendación juegan un rol determinante para la consolidación del mercado (Reichheld, 2003).

Siendo uno de los pocos talleres especializados en Micromovilidad eléctrica en la ciudad, este resultado representa una oportunidad para sentar un precedente en cuanto a la excelencia en la atención, proyectando un modelo de servicio centrado en el usuario como base para el crecimiento sostenible del sector. Esta investigación no solo busca evaluar la situación actual, sino también sembrar un punto de partida para el desarrollo futuro de servicios técnicos de calidad dentro de la movilidad eléctrica urbana.

Figura 7.

Resultados pregunta abierta encuesta primer trimestre 2025



Fuente: Autores

La figura 7 corresponde al apartado de sugerencias y recoge las respuestas de la pregunta abierta incluida en la encuesta, donde los usuarios indicaron recomendaciones para mejorar el servicio. Se identificaron cinco temáticas principales, siendo la más reiterada la “Atención día sábado”, con cinco menciones. Le siguen “Garantizar disponibilidad de repuestos” dos menciones, y otras como “Emergencia en sitio”, “Mejorar la atención al informar sobre el diagnóstico” y “Horarios extendidos”, cada una con una mención.

Estas sugerencias evidencian áreas de mejora percibidas por los clientes. La alta demanda por atención los sábados refleja una necesidad no cubierta, especialmente considerando que muchos usuarios utilizan estos vehículos a diario y requieren opciones fuera del horario laboral convencional. Atender esta solicitud puede representar una ventaja competitiva para el taller, al ofrecer mayor flexibilidad y mejorar la experiencia del cliente.

La disponibilidad de repuestos también se identifica como un factor crítico. La escasez de piezas para ciertos VMP, particularmente aquellos sin representación en el país, afecta la efectividad del servicio, sobre todo en reparaciones complejas. Establecer alianzas con nuevos proveedores y diversificar fuentes de repuestos permitiría reducir tiempos de espera y optimizar la percepción del servicio.

Análisis de la causa raíz del problema técnico

Los resultados de esta investigación evidencian factores que afectan la satisfacción del cliente en los servicios técnicos de Micromovilidad eléctrica. Aunque la percepción fue positiva en motos y scooter eléctricos, se registró una menor satisfacción en usuarios de otros VMP, lo que revela una problemática estructural que impacta tanto los procesos técnicos como administrativos del taller.

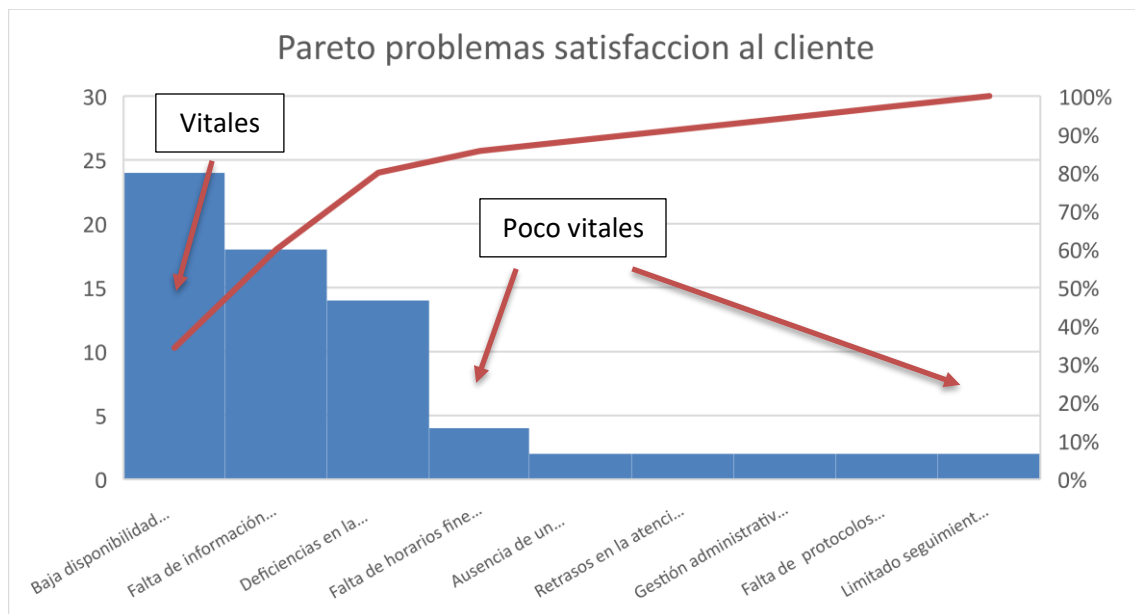
La causa raíz se relaciona con la limitada capacidad de adaptación del servicio ante la creciente diversidad de VMP. Si bien el personal técnico posee experiencia comprobada en los modelos más comunes, las dificultades surgen especialmente en la atención de vehículos menos convencionales como monociclos, bicicletas eléctricas de diseño especial o modelos de tres ruedas. Este problema no responde a una falta de conocimiento por parte del taller, sino a que muchas de las empresas que introdujeron estos modelos ya no operan en el país, lo que ha dejado una escasa disponibilidad de repuestos e información técnica oficial. Esta situación genera retrasos, diagnósticos menos precisos, en consecuencia, una experiencia menos satisfactoria para el cliente.

Las respuestas abiertas de los clientes evidencian carencias relevantes en el servicio, como la falta de atención los días sábado, la escasa disponibilidad de repuestos y deficiencias en la comunicación durante el proceso de reparación. Estas observaciones reflejan debilidades estructurales que afectan la experiencia del usuario y evidencian la

ausencia de un enfoque de mejora continua. En consecuencia, la raíz del problema radica en la falta de un modelo integral y flexible que responda a las nuevas exigencias del mercado y a la diversidad de vehículos atendidos.

Figura 8.

Diagrama Pareto problemas de satisfacción al cliente



Fuente: Autores

Para analizar los problemas vitales se procede a realizar un diagrama Ishikawa que permita identificar la causa origen de los cuatro problemas más relevantes

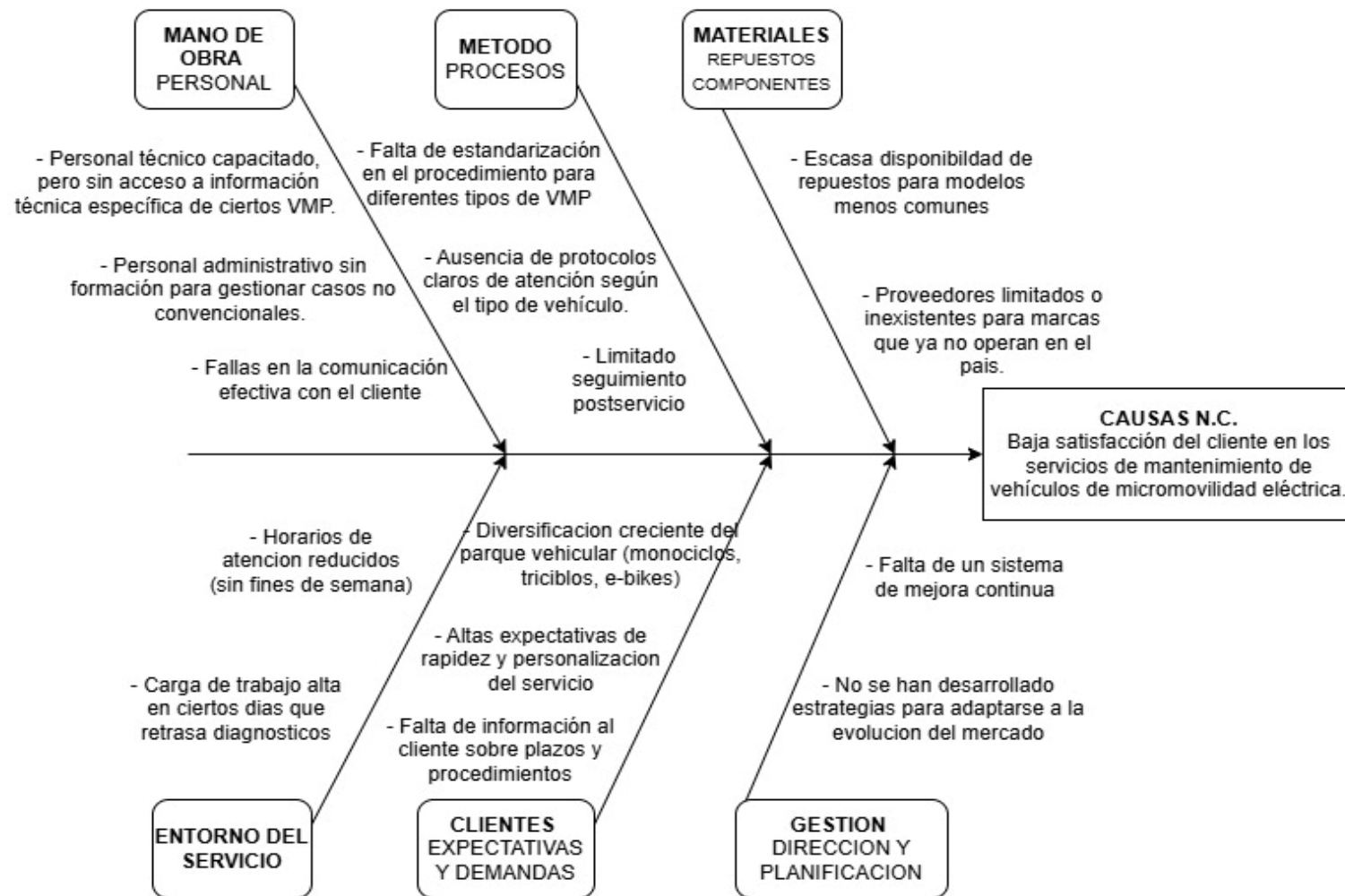
1. Baja disponibilidad repuestos VMP no comunes
2. Falta de información técnica oficial
3. Deficiencias en la comunicación durante el servicio
4. Falta de atención fines de semana (sábado)

Las categorías principales que se considera para estructurar las posibles causas son:

- Personal
- Métodos
- Equipos
- Materiales
- Medio Ambiente
- Mediciones

Figura 9.

Análisis causa raíz Ishikawa problemas de satisfacción al cliente.



Fuente: Autores

PROPUESTA DE MEJORA Y PROYECCIÓN DE RESULTADOS

Con base en los hallazgos obtenidos a lo largo del estudio, se propone la implementación de un Plan Integral de Mejora para la Atención de Vehículos de Micromovilidad Personal (VMP) no convencionales, con el objetivo de reducir las insatisfacciones identificadas en la experiencia del cliente y asegurar una atención técnica homogénea, eficiente y satisfactoria para todos los tipos de VMP.

Propuesta de Mejora

Tabla 6.

Datos tabulados propuesta de mejora para taller Micromovilidad

Línea de acción	Actividades principales	Impacto esperado
Estandarización de protocolos técnicos para VMP no convencionales	- Elaboración de fichas técnicas con pasos mínimos de revisión. - Recopilación de información técnica (manuales, foros, experiencias del taller). - Creación de un repositorio digital para diagnósticos.	Mayor precisión técnica y mejora en la atención de VMP, especialmente no convencionales.
Capacitación continua y específica del personal técnico / administrativo	- Diseño de módulos cortos de formación continua sobre VMP, nuevas tecnologías. - Plan de talleres de atención al cliente, escucha activa y resolución de conflictos.	Mejora en la experiencia del cliente, fortalecimiento de la confianza técnica del personal.
Alianzas estratégicas con proveedores de repuestos alternativos	- Establecimiento de convenios con proveedores internacionales a través de catálogos, ferias o marketplaces. - Gestión de pedidos programados o importaciones según demanda.	Disminución en la espera por repuestos y mejora en la atención de VMP especiales.
Extensión de horarios de atención y disponibilidad en fines de semana	- Implementación de un plan piloto de atención los sábados por la mañana. - Evaluación periódica de la demanda para ajustar la disponibilidad técnica. - Envío de mensajes automatizados para actualizaciones, diagnósticos y solicitudes de retroalimentación.	Mayor flexibilidad horaria para los usuarios y ventaja competitiva frente a otros talleres.
Implementación de un sistema de seguimiento digital post-servicio	- Envío de mensajes automatizados para actualizaciones, diagnósticos y solicitudes de retroalimentación. - Integración de encuestas de satisfacción breves tras cada servicio.	Mejora en la comunicación con el cliente y fortalecimiento de mejora continua mediante retroalimentación.

Fuente: Autores

Implementación de una metodología de mejora continua con enfoque en KPIs y un tablero de control

Con base en los hallazgos obtenidos en este estudio, se propone implementar una metodología de mejora continua que permita monitorear, analizar y optimizar los procesos clave del servicio técnico ofrecido en el taller especializado en micromovilidad eléctrica. Se sugiere adoptar el ciclo PHVA (Planificar – Hacer – Verificar – Actuar), complementado con un tablero de control adaptado a los indicadores obtenidos en la evaluación de la satisfacción del cliente. Con esta estrategia se busca cerrar las brechas identificadas en cuanto a disponibilidad de repuestos, comunicación, atención diferenciada por tipo de vehículo y cobertura en fines de semana.

La mejora continua no solo permitirá mantener estándares de calidad sostenibles, sino también reaccionar con agilidad ante los cambios en las expectativas de los usuarios.

Tabla 7.

Tablero de control propuesto para taller de micromovilidad eléctrica

Indicador	Descripción	Fuente de datos	Meta sugerida
Nivel de satisfacción promedio	Promedio de calificaciones VMP (escala 1- 10)	Encuestas post-servicio	Superior a 8
NPS general	% Promotores - % Detractores	Pregunta NPS Encuesta post-servicio	Superior a 60
Disponibilidad de repuestos críticos	Porcentaje de repuestos disponibles vs requeridos	Inventario y requisiciones	Superior a 90%
Solicitudes fuera de horario	Número de clientes que requieren atención Sábado/Domingo	CRM y Chatbot	Implementar Cobertura

Fuente: Elaboración propia.

La implementación de un sistema de mejora continua con un tablero de control permitirá al taller monitorear su desempeño de manera constante como se observa en la tabla 7. Permitirá tomar decisiones basadas en datos objetivos y adaptar sus procesos a las necesidades reales de los clientes. Esto favorecerá una mejora sostenida en la calidad del servicio, incrementará la satisfacción del usuario y fortalecerá la fidelización en un mercado en expansión como el de la micromovilidad eléctrica.

Proyección de Resultados

La implementación de este plan integral permitirá una mejora significativa en los indicadores clave identificados a lo largo de la investigación. Se espera que, en un plazo de tres a seis meses, se logren los siguientes resultados proyectados:

Tabla 8.

Proyección de indicadores clave tras la implementación del plan de mejora

Indicador	Situación Actual	Meta Propuesta
Satisfacción promedio en VMP no convencionales	6.0	Superior a 7.5
Tiempo promedio de resolución (VMP complejos)	6 días	Menor a 72 horas
NPS general	57.2	Superior a 65
NPS marcas oficiales	67,7	Superior a 75
Reclamos por falta de comunicación	Media/ Baja frecuencia	Baja frecuencia

Fuente: Elaboración propia.

Esta propuesta busca cerrar el ciclo de análisis de causa raíz mediante una acción concreta que permita no solo corregir deficiencias puntuales, sino también construir una

cultura de mejora continúa orientada a la excelencia del servicio. El impacto esperado trasciende lo técnico, posicionando al taller como un referente en atención especializada, inclusiva y adaptable en el ecosistema de la Micromovilidad eléctrica urbana.

La implementación exitosa del plan representará un paso determinante hacia la profesionalización del servicio técnico en el sector, promoviendo prácticas sostenibles y centradas en la experiencia del usuario.

CONCLUSIONES

El análisis evidenció que los clientes de motos y scooter eléctricos presentan un alto nivel de satisfacción con el servicio de mantenimiento, con promedios cercanos a 8 sobre 10. En contraste, los usuarios de otros vehículos de movilidad personal calificaron el servicio con promedios alrededor de 6, lo que indica diferencias en la percepción del servicio según el tipo de vehículo atendido.

Se identificó que la disponibilidad de repuestos, los tiempos de atención y la calidad de la comunicación con el cliente son factores determinantes que influyen en la experiencia de servicio. Estos aspectos mostraron mayor incidencia en los usuarios de vehículos menos comunes, quienes señalaron dificultades en el proceso de atención y seguimiento técnico.

El Net Promoter Score (NPS) general alcanzó un valor de 57.2, considerado aceptable en el contexto de una industria en desarrollo. Los usuarios de unidades oficiales de la marca registraron un NPS de 67.7, lo cual refleja una excelente disposición a recomendar el servicio. Estos resultados respaldan el buen desempeño del taller en términos de lealtad del cliente y satisfacción percibida.

Las sugerencias aportadas por los clientes destacan la importancia de mejorar la comunicación, acortar los tiempos de respuesta y ofrecer un trato más cercano. Una solicitud recurrente fue la ampliación del horario de atención, especialmente los días sábado y domingo, con el fin de facilitar el acceso al servicio para usuarios que no pueden acudir entre semana. Asimismo, se reconoce la necesidad de establecer protocolos diferenciados según el tipo de vehículo, lo que permitiría brindar un servicio más eficiente, personalizado y alineado con las expectativas de una clientela cada vez más diversa.

Bibliografía

- Aprigliano, V., Barros, G. T., Santos, M. V. S. M., Toro, C., Rojas, G., Seriani, S., da Silva, M. A. V., & de Oliveira, U. R. (2023). *Sustainable mobility challenges in the Latin American context*. *Sustainability*, 15(20), 14748
- Bisquerra, R. (2014). *Metodología de la investigación educativa*. Madrid: La Muralla.
- Castañeda Pacheco, J. N., & Lugo García, J. (2022). Servicio posventa y capacidad de respuesta como factores de satisfacción del cliente de productos tecnológicos. *AlfaPublicaciones*, 4(3.2).
- Cavallo, E. A., Powell, A., & Serebrisky, T. (2020). *From structures to services: The path to better infrastructure in Latin America and the Caribbean*. Inter-American Development Bank.
- Egbue, O., & Long, S. (2023). Identifying critical factors in smart service quality evaluation: A multi-criteria decision approach. *Journal of Decision Systems*, 32(2), 115–132.
- Flick, U. (2022). *Introducción a la investigación cualitativa* (6. ed.). Morata.
- GrauEscolano, J., Bassolas, A. & Vicens, J. (2024). *Cycling into the workshop: predictive maintenance for Barcelona's bike-sharing system*. *arXiv*, apr 2024.
- Gonçalves, L., Patrício, L., Teixeira, J. G., & Wunderlich, N. V. (2020). Understanding the customer experience with smart services. *Journal of Service Management*, 31(4), 723–744.
- Grönroos, C. (1994). From marketing mix to relationship marketing: *Towards a paradigm shift in marketing*. *Management Decision*, 32(2), 4–20.
- Grönroos, C. (2021). *Service Management and Marketing: Managing the service profit logic* (5th ed.). Wiley.
- Hamerska, M., Ziółko, M., & Stawiarski, P. (2022). A sustainable transport system—The MMQUAL model of shared micromobility service quality assessment. *Sustainability*, 14(7), 4168.
- Hernández-Sampieri, R., Fernández-Collado, C., & Baptista-Lucio, M. del P. (2021). *Metodología de la investigación* (7.a ed.). McGraw-Hill.
- Martínez-Gómez, J., & Espinoza, V. S. (2024). Challenges and opportunities for electric vehicle charging stations in Latin America. *World Electric Vehicle Journal*, 15(12), 583
- Mohd Nasir, M., Adil, M., & Dhamija, A. (2023). The synergetic effect of after-sales service, customer satisfaction, loyalty and repurchase intention on word of mouth. *International Journal of Quality and Service Sciences*.
- Muhammad, A., & Knowles, P. (2020). Micromobility and public transport integration: The current state of research and prospects for sustainable urban mobility. *Transportation Research Part D: Transport and Environment*, 81, 102292.

- Oliver, R. L. (2010). *Satisfaction: A behavioral perspective on the consumer* (2nd ed.). McGraw-Hill.
- Padilla-Angulo, L., Lasarte-López, J. M., & Caldentey, P. (2022). Policy evaluations of microenterprise business support services in Latin America: a systematic review. SSRN.
- Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). *SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality*. *Journal of Retailing*, 64(1), 12–40.
- Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (2018). *Delivering Quality Service: Balancing customer perceptions and expectations*. Free Press.
- Paredes, J., & Fernández, M. (2022). *Política pública y movilidad eléctrica urbana*. Universidad Tecnológica Indoamérica.
- Pinto, F. M., & Aggarwal, A. (2022). Quality management systems in electric vehicle maintenance: A case study in Latin America. *International Journal of Quality & Reliability Management*, 39(6), 798–818.
- Schweickardt, G. (2023). Percepción de la calidad de servicio técnico en sistemas de distribución eléctrica: un análisis multi-grupo entre clientes residenciales urbanos y suburbanos. *LATAM Revista Latinoamericana de Ciencias Sociales y Humanidades*, 4(2), 3885–3909.
- Sitinjak, C., & Ober, J. (2025). Examining the impact of service quality and product innovation on willingness to buy electric vehicles: The mediating role of customer satisfaction. *Production Engineering Archives*, 31(2), 163–172.
- UScale GmbH (2024). *Automotive after-sales for electromobility: Experiences and expectations of workshops and the manufacturer hotline. (EV After-Sales Study 2024)*. UScale.
- Wulf, J., & Meierhofer, J. (2024). Exploring the potential of large language models for automation in technical customer service. *ArXiv*, May 15, 2024.
- Zhang, Y., Wang, Q., & Li, X. (2023). A quantitative study on factors influencing user satisfaction of shared micro-mobility in China in the post-sharing era. *Sustainability*, 16(4), 1637.

ANEXOS

Micromovilidad Eléctrica

Encuesta de Satisfacción del Cliente

[Acceder a Google](#) para guardar el progreso. [Más información](#)

Tipo de vehículo

- ☐ Scooter
- ☐ Moto
- ☐ Otro Vehículo de Movilidad Personal

Servicio utilizado

- ☐ Mantenimiento Preventivo
- ☐ Mantenimiento correctivo (Reparación)

El técnico explicó claramente el diagnóstico o problema de mi vehículo.



El personal técnico mostró conocimiento y dominio del trabajo.



El mantenimiento o reparación solucionó completamente el problema reportado.



El tiempo de agendamiento de la cita fue adecuado.

1	2	3	4	5	6	7	8	9	10

Me entregaron el vehículo en el tiempo prometido.

1	2	3	4	5	6	7	8	9	10

La facturación fue clara y sin errores.

1	2	3	4	5	6	7	8	9	10

Me notificaron oportunamente sobre cualquier cambio en el proceso.

1	2	3	4	5	6	7	8	9	10

El personal administrativo fue amable y resolvió mis dudas.

1	2	3	4	5	6	7	8	9	10

Considero que el servicio recibido fue de buena calidad.

1	2	3	4	5	6	7	8	9	10

Estoy satisfecho con la atención general brindada.

1	2	3	4	5	6	7	8	9	10

Recomendaría este taller a otras personas.

1	2	3	4	5	6	7	8	9	10

En general, mi experiencia con el taller de servicio fue positiva.

1	2	3	4	5	6	7	8	9	10

¿Qué sugerencias o comentarios adicionales tiene para mejorar nuestros servicios?

Tu respuesta

Enviar

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METODOLOGÍA DE LA INVESTIGACIÓN EDUCATIVA



6ª edición



editorial
LA MURALLA, S. A.

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SERVQUAL: A Multiple-Item Scale for Measuring Consumer Perceptions of Service Quality

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This paper describes the development of a 22-item instrument (called SERVQUAL) for assessing customer perceptions of service quality in service and retailing organizations. After a discussion of the conceptualization and operationalization of the service quality construct, the procedures used in constructing and refining a multiple-item scale to measure the construct are described. Evidence of the scale's reliability, factor structure, and validity on the basis of analyzing data from four independent samples is presented next. The paper concludes with a discussion of potential applications of the scale.

Intensifying competition and rapid deregulation have led many service and retail businesses to seek profitable ways to differentiate themselves. One strategy that has been related to success in these businesses is the delivery of high service quality (Rudie and Wansley 1985; Thompson,

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DeSouza, and Gale 1985). Delivering superior service quality appears to be a prerequisite for success, if not survival, of such businesses in the 1980s and beyond.

Unlike goods quality, which can be measured objectively by such indicators as durability and number of defects (Crosby 1979; Garvin 1983), service quality is an abstract and elusive construct because of three features unique to services: intangibility, heterogeneity, and inseparability of production and consumption (Parasuraman, Zeithaml, and Berry 1985). In the absence of objective measures, an appropriate approach for assessing the quality of a firm's service is to measure consumers' perceptions of quality. As yet, however, no quantitative yardstick is available for gauging these perceptions.

The purpose of this article is twofold: (1) to describe the development of a multiple-item scale for measuring service quality (called SERVQUAL) and (2) to discuss the scale's properties and potential applications. The basic steps employed in constructing the scale closely parallel procedures recommended in Churchill's (1979) paradigm for developing better measures of marketing constructs. Figure 1 provides an overview of the steps.

This article is divided into five sections. The first section delimits the domain of the service-quality construct and describes the generation of scale items (Steps 1, 2, and 3 in Figure 1). The second section presents the data-collection and scale-purification procedures (Steps 4 through 9), while the third section provides an evaluation of the scale's reliability and factor structure (Step 10). The next section deals with assessment of the scale's validity (Step 11). The final section discusses potential applications of the scale.

DOMAIN OF THE SERVICE-QUALITY CONSTRUCT

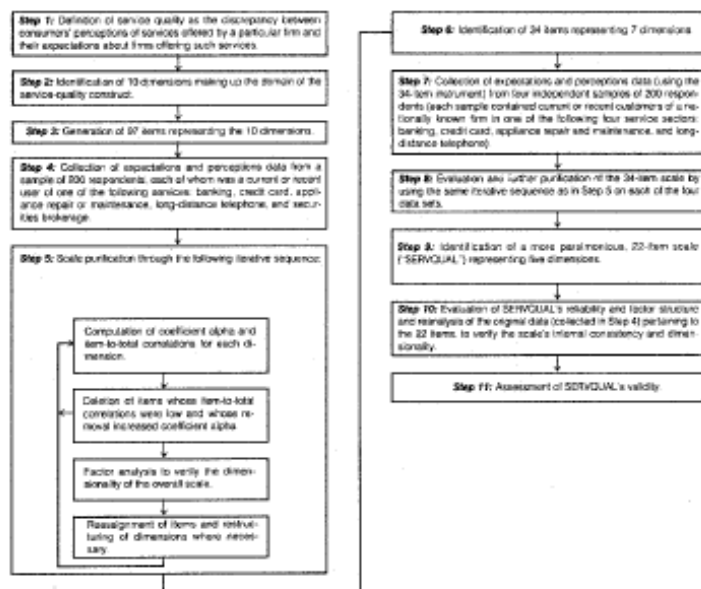
In deploring the inadequacy of measurement procedures used in the marketing discipline Jacoby (1978) wrote:

Many of our measures are developed at the whim of a researcher with nary a thought given to whether or not it is meaningfully related to an explicit conceptual statement of the phenomena or variable in question. In most instances, our concepts have no identity apart from the instrument or procedures used to measure them. (p. 92)

The need for scale development to be preceded by, and rooted in, a sound conceptual specification of the construct being scaled has been emphasized by other scholars as well (e.g., Churchill 1979; Peter 1981). The

FIGURE 1

Summary of Steps Employed in Developing the Service-Quality Scale



conceptual foundation for the SERVQUAL scale was derived from the works of a handful of researchers who have examined the meaning of service quality (Sasser, Olsen, and Wyckoff 1978; Gronroos 1982; Lehtinen and Lehtinen 1982) and from a comprehensive qualitative research study that defined service quality and illuminated the dimensions along which consumers perceive and evaluate service quality (Parasuraman, Zeithaml, and Berry 1985).

Conceptualization of Service Quality

The construct of quality as conceptualized in the services literature and as measured by SERVQUAL, the scale that is the focus of this article, involves perceived quality. Perceived quality is the consumer's judgment about an entity's overall excellence or superiority (Zeithaml 1987). It differs from objective quality (as defined by, for example, Garvin 1983 and Hjorth-Anderson 1984); it is a form of attitude, related but not equivalent to satisfaction, and results from a comparison of expectations with perceptions of performance.

Perceived quality versus objective quality. Researchers (Garvin 1983; Dodds and Monroe 1984; Holbrook and Corfman 1985; Jacoby and Olson 1985; Zeithaml 1987) have emphasized the difference between objective and perceived quality. Holbrook and Corfman (1985), for example, note that consumers do not use the term quality in the same way as researchers and marketers, who define it conceptually. The conceptual meaning distinguishes between mechanistic and humanistic quality: "mechanistic (quality) involves an objective aspect or feature of a thing or event; humanistic (quality) involves the subjective response of people to objects and is therefore a highly relativistic phenomenon that differs between judges" (Holbrook and Corfman 1985, p. 33). Garvin (1983) discusses five approaches to defining quality, including two (product-based and manufacturing-based) that refer to objective quality and one (user-based) that parallels perceived quality.

Quality as attitude. Olshavsky (1985) views quality as a form of overall evaluation of a product, similar in many ways to attitude. Holbrook concurs, suggesting that quality acts as a relatively global value judgment. Exploratory research conducted by Parasuraman, Zeithaml, and Berry (1985) supports the notion that service quality is an overall evaluation similar to attitude. The researchers conducted a total of twelve focus group interviews with current or recent consumers of four different services—retail banking, credit card, securities brokerage, and product repair and maintenance. The discussions centered on issues such as the

meaning of quality in the context of the service in question, the characteristics the service and its provider should possess in order to project a high-quality image, and the criteria customers use in evaluating service quality. Comparison of the findings from the focus groups revealed that, regardless of the type of service, customers used basically the same general criteria in arriving at an evaluative judgement about service quality.

Quality versus satisfaction. Oliver (1981) summarizes current thinking on satisfaction in the following definition: "[satisfaction is a] summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the consumer's prior feelings about the consumption experience" (p. 27). This and other definitions (e.g., Howard and Sheth 1969; Hunt 1979) and most all measures of satisfaction relate to a specific transaction. Oliver (1981) summarizes the transaction-specific nature of satisfaction, and differentiates it from attitude, as follows:

Attitude is the consumer's relatively enduring affective orientation for a product, store, or process (e.g., customer service) while satisfaction is the emotional reaction following a disconfirmation experience which acts on the base attitude level and is consumption-specific. Attitude is therefore measured in terms more general to product or store and is less situationally oriented. (p. 42)

Consistent with the distinction between attitude and satisfaction, is a distinction between service quality and satisfaction: perceived service quality is a global judgment, or attitude, relating to the superiority of the service, whereas satisfaction is related to a specific transaction. Indeed, in the twelve focus group interviews included in the exploratory research conducted by Parasuraman, Zeithaml, and Berry (1985), respondents gave several illustrations of instances when they were satisfied with a specific service but did not feel the service firm was of high quality. In this way, the two constructs are related, in that incidents of satisfaction over time result in perceptions of service quality. In Oliver's (1981) words, "satisfaction soon decays into one's overall attitude toward purchasing products."

Expectations compared to perceptions. The writings of Sasser, Olsen, and Wyckoff (1978); Gronroos (1982); and Lehtinen and Lehtinen (1982), and the extensive focus group interviews conducted by Parasuraman, Zeithaml, and Berry (1985), unambiguously support the notion that service quality, as perceived by consumers, stems from a comparison of what they feel service firms should offer (i.e., from their expectations) with their perceptions of the performance of firms providing the services.

Perceived service quality is therefore viewed as the degree and direction of discrepancy between consumers' perceptions and expectations.

The term "expectations" as used in the service quality literature differs from the way it is used in the consumer satisfaction literature. Specifically, in the satisfaction literature, expectations are viewed as *predictions* made by consumers about what is likely to happen during an impending transaction or exchange. For instance, according to Oliver (1981), "It is generally agreed that expectations are consumer-defined probabilities of the occurrence of positive and negative events if the consumer engages in some behavior" (p. 33). In contrast, in the service quality literature, expectations are viewed as desires or wants of consumers, i.e., what they feel a service provider *should* offer rather than *would* offer.

Dimensions of service quality. Exploratory research of Parasuraman, Zeithaml, and Berry (1985) revealed that the criteria used by consumers in assessing service quality fit 10 potentially overlapping dimensions. These dimensions were tangibles, reliability, responsiveness, communication, credibility, security, competence, courtesy, understanding/knowing the customer, and access (a description of the dimensions can be found in Parasuraman, Zeithaml, and Berry 1985, p. 47). These 10 dimensions and their descriptions served as the basic structure of the service-quality domain from which items were derived for the SERVQUAL scale.

Generation of Scale Items

Items representing various facets of the 10 service-quality dimensions were generated to form the initial item pool for the SERVQUAL instrument. This process resulted in the generation of 97 items (approximately 10 items per dimension). Each item was recast into two statements—one to measure expectations about firms in general within the service category being investigated and the other to measure perceptions about the particular firm whose service quality was being assessed. Roughly half of the statement pairs were worded positively and the rest were worded negatively, in accordance with recommended procedures for scale development (Churchill 1979). A seven-point scale ranging from "Strongly Agree" (7) to "Strongly Disagree" (1), with no verbal labels for scale points 2 through 6, accompanied each statement (scale values were reversed for negatively worded statements prior to data analysis). The expectation statements were grouped together and formed the first half of the instrument. The corresponding perception statements formed the second half. An abbreviated version of the instrument, containing a set of expectation statements (labeled as E's) and a corresponding set of perception

statements (labeled as P's), along with directions for responding to them, is included in the appendix. Negatively worded statements are identified by a minus sign within parentheses in the appendix.

DATA COLLECTION AND SCALE PURIFICATION

The 97-item instrument was subjected to two stages of data collection and refinement. The first stage focused on: (1) condensing the instrument by retaining only those items capable of discriminating well across respondents having differing quality perceptions about firms in several categories, and (2) examining the dimensionality of the scale and establishing the reliabilities of its components. The second stage was primarily confirmatory in nature and involved re-evaluating the condensed scale's dimensionality and reliability by analyzing fresh data from four independent samples. Some further refinements to the scale occurred in this stage.

Data Collection, First Stage

Data for initial refinement of the 97-item instrument were gathered from a quota sample of 200 adult respondents (25 years of age or older) recruited by a marketing research firm in a shopping mall in a large metropolitan area in the Southwest. The sample size of 200 was chosen because other scale developers in the marketing area had used similar sample sizes to purify initial instruments containing about the same number of items as the 97-item instrument (e.g., Churchill, Ford, and Walker 1974; Saxe and Weitz 1982). The sample was about equally divided between males and females. Furthermore, the respondents were spread across five different service categories—appliance repair and maintenance, retail banking, long-distance telephone, securities brokerage, and credit cards. These categories were chosen to represent a broad cross-section of services that varied along key dimensions used by Lovelock (1980, 1983) to classify services. For each service category, a quota of 40 recent users of the service was established. To qualify for the study, respondents had to have used the service in question during the past three months.

Screened and qualified respondents self administered a two-part questionnaire consisting of a 97-statement expectations part followed by a 97-statement perceptions part. For the first part, respondents were instructed to indicate the level of service that should be offered by firms within the service category in question. For the second part, respondents were first asked to name a firm (within the service category) that they had used and with which they were most familiar. Respondents were then instructed to express their perceptions about the firm.

Scale Purification, First Stage

The 97-item instrument was refined by analyzing pooled data (i.e., data from all five service categories considered together). The pooling of data was deliberate and appropriate because the basic purpose of this research stage was to develop a concise instrument that would be reliable and meaningful in assessing quality in a variety of service sectors. In other words, the purpose was to produce a scale that would have general applicability.

Purification of the instrument began with the computation of coefficient alpha (Cronbach 1951), in accordance with Churchill's (1979) recommendation. Because of the multidimensionality of the service-quality construct, coefficient alpha was computed separately for the 10 dimensions to ascertain the extent to which items making up each dimension shared a common core.

The raw data used in computing coefficient alpha (and in subsequent analyses) were in the form of difference scores. Specifically, for each item a difference score Q (representing perceived quality along that item) was defined as $Q = P - E$, where P and E are the ratings on the corresponding perception and expectation statements, respectively. The idea of using difference scores in purifying a multiple-item scale is not new. This approach has been used in developing scales for measuring constructs such as role conflict (Ford, Walker, and Churchill 1975).

The values of coefficient alpha ranged from .55 to .78 across the 10 dimensions and suggested that deletion of certain items from each dimension would improve the alpha values. The criterion used in deciding whether to delete an item was the item's corrected item-to-total correlation (i.e., correlation between the score on the item and the sum of scores on *all other* items making up the dimension to which the item was assigned). The corrected item-to-total correlations were plotted in descending order for each dimension. Items with very low correlations and/or those whose correlations produced a sharp drop in the plotted pattern were discarded. Recomputation of alpha values for the reduced sets of statements and examination of the new corrected item-to-total correlations led to further deletion of items whose elimination improved the corresponding alpha values. The iterative sequence of computing alphas and item-to-total correlations, followed by deletion of items, was repeated several times and resulted in a set of 54 items, with alpha values ranging from .72 to .83 across the 10 dimensions.

Examining the dimensionality of the 54-item scale was the next task in this stage of scale purification and was accomplished by factor analyzing

the difference scores on the 54 items. The principal axis factoring procedure (Harman 1967) was used and the analysis was constrained *a priori* to 10 factors. When the 10-factor solution was rotated orthogonally, no clear factor pattern emerged. Many of the items had high loadings on several factors, thereby implying that the factors may not be independent of one another. Moreover, some degree of overlap among the 10 conceptual dimensions was anticipated by the researchers who initially identified and labeled the dimensions (Parasuraman, Zeithaml, and Berry 1985). Therefore the 10-factor solution was subjected to oblique rotation (using the OBLIMIN procedure in SPSS-X) to allow for intercorrelations among the dimensions and to facilitate easy interpretation.

The oblique rotation produced a factor-loading matrix that was by and large easy to interpret. However, several items still had high loadings on more than one factor. When such items were removed from the factor-loading matrix, several factors themselves became meaningless because they had near-zero correlations with the remaining items, thereby suggesting a reduction in the presumed dimensionality of the service-quality domain. Furthermore, the highest loadings of a few of the remaining items were on factors to which they were not originally assigned. In other words, the factor loadings suggested reassignment of some items.

The deletion of certain items (and the resultant reduction in the total number of factors or clusters of items) and the reassignment of certain others necessitated the recomputation of alphas and item-to-total correlations and the reexamination of the factor structure of the reduced item pool. This iterative sequence of analyses (Step 5 in Figure 1) was repeated a few times and resulted in a final pool of 34 items representing seven distinct dimensions. The alpha values and factor loadings pertaining to the 34-item instrument are summarized in Table 1.

As shown in Table 1, five of the original 10 dimensions—tangibles, reliability, responsiveness, understanding/knowing customers, and access—remained distinct. The remaining five dimensions—communication, credibility, security, competence, and courtesy—collapsed into two distinct dimensions (D4 and D5), each consisting of items from several of the original five dimensions. The average pairwise correlation among the seven factors following oblique rotation was .27. This relatively low correlation, along with the relatively high factor loadings shown in Table 1, suggested that service quality might have seven fairly unique facets.

The high alpha values indicated good internal consistency among items within each dimension. Moreover, the combined reliability for the 34-item scale, computed by using the formula for the reliability of linear combinations (Nunnally 1978), was quite high (.94). Therefore, the 34-item in-

TABLE 1

Summary of Results from First Stage of Scale Purification

Dimension	Label	Reliability Coefficients (Alphas)	Number of Items	Factor Loadings of Items on Dimensions to Which They Belong ^a
Tangibles	D1	.72	4	63
				75
				62
				47
Reliability	D2	.83	5	74
				56
				73
				71
Responsiveness	D3	.84	5	47
				60
				73
				59
Communication	D4	.79	4	76
				66
				56
				56
Credibility	D5	.85	7	41
				62
				47
				50
Security	D6	.85	4	75
				52
				54
				80
Competence	D7	.85	7	76
				62
				77
				77
Courtesy	D8	.85	7	77
				77
				77
				77
Understanding/	D9	.85	7	77
				77
				77
				77
Knowing	D10	.85	7	77
				77
				77
				77
Customers	D11	.85	7	77
				77
				77
				77

Access	D7	.78	5	57
				50
				75
				52
				71
Reliability of Linear				
Combination				
(Total-Scale Reliability)				
		.94		

* Numbers are the magnitudes of the factor loadings multiplied by 100. The loadings of items on dimensions to which they did not belong were all less than .3. The percentage of variance extracted by the seven factors was 61.7%.

strument was considered to be ready for further testing with data from new samples.

Data Collection, Second Stage

To further evaluate the 34-item scale and its psychometric properties, data were collected pertaining to the service quality of four nationally-known firms: a bank, a credit-card company, a firm offering appliance repair and maintenance services, and a long-distance telephone company. For each firm, an independent shopping-mall sample of 200 customers 25 years-of-age or older were recruited by a marketing research firm in a major metropolitan area in the East. To qualify for the study, respondents had to have used the services of the firm in question within the past three months. Each sample was divided about equally between males and females. As in the first stage of data collection, questionnaires were self-administered by qualified respondents.

Scale Purification, Second Stage

A major objective of this stage was to evaluate the robustness of the 34-item scale when used to measure the service quality of the four firms. Therefore the data from each of the four samples were analyzed separately to obtain alpha values (along with corrected item-to-total correlations) and a factor-loading matrix following oblique rotation of a seven-factor solution. The results from each sample facilitated cross-validation of the results from the other samples.

The results of the four sets of analyses were quite consistent, but differed somewhat from the first-stage findings summarized in Table 1. Spe-

cifically, two differences emerged. First, the corrected item-to-total correlations for several items (particularly among items making up the dimensions labeled D4 and D7 in Table 1) and the alphas for the corresponding dimensions were lower than those obtained from the first stage. Second, the factor-loading matrices obtained from all four analyses showed much greater overlap between dimensions D4 and D5, and between dimensions D6 and D7. Because these differences occurred consistently across four independent samples and data sets, further purification of the 34-item scale was deemed necessary.

A few items with relatively low item-to-total correlations were deleted. Furthermore, as suggested by the factor analyses, the items remaining in D4 and D5, as well as those in D6 and D7, were combined to form two separate dimensions. For each sample, alpha values were recomputed for the reduced set of five dimensions and a factor analysis (involving extraction of five factors followed by oblique rotation) was performed. In examining the results of these analyses, an iterative sequence similar to the one shown in Step 5 in Figure 1 was followed. This procedure resulted in a refined scale ("SERVQUAL") with 22 items spread among five dimensions (D1, D2, D3, a combination of D4 and D5, and a combination of D6 and D7). The expectation and perception statements in the final SERVQUAL instrument are shown in the appendix.

An examination of the content of the final items making up each of SERVQUAL's five dimensions (three original and two combined dimensions) suggested the following labels and concise definitions for the dimensions:

Tangibles:	Physical facilities, equipment, and appearance of personnel
Reliability:	Ability to perform the promised service dependably and accurately
Responsiveness:	Willingness to help customers and provide prompt service
Assurance:	Knowledge and courtesy of employees and their ability to inspire trust and confidence
Empathy:	Caring, individualized attention the firm provides its customers

The last two dimensions (assurance and empathy) contain items representing seven original dimensions—communication, credibility, security, competence, courtesy, understanding/knowning customers, and access—that did not remain distinct after the two stages of scale purification.

Therefore, while SERVQUAL has only five distinct dimensions, they capture facets of all 10 originally conceptualized dimensions.

SERVQUAL'S RELIABILITY AND FACTOR STRUCTURE

Table 2 shows the component and total reliabilities of SERVQUAL for each of the four samples. The reliabilities are consistently high across all four samples, with the possible exception of a couple of values pertaining to the tangible dimension. The total-scale reliability (i.e., reliability of linear combination) is close to .9 in each of the four instances.

Results of the factor analyses of data from the four samples are summarized in Table 3. The overall patterns of factor loadings are remarkably similar across the four independent sets of results. With few exceptions, items assigned to each dimension consistently have high loadings on only one of the five factors extracted. The distinctiveness of SERVQUAL's five dimensions implied by the results in Table 3 was further supported by relatively low intercorrelations among the five factors—the average pairwise correlations between factors following oblique rotation were .21, .24, .26, and .23 for the bank, credit card, repair and maintenance, and long-distance telephone samples, respectively.¹

As an additional verification of the reliabilities and factor structure of SERVQUAL, the first-stage data set that resulted in the 34-item instrument with seven dimensions was reanalyzed after deleting the 12 items that dropped out during the second stage of scale purification. The results of this reanalysis are summarized in Table 4 and reconfirm the high reliabilities and dimensional distinctiveness of the scale. The average pairwise correlation among the five factors following oblique rotation was .35.

It is worth noting that the iterative procedure used to refine the initial instrument was guided by empirical criteria and by the goal of obtaining a concise scale whose items would be meaningful to a variety of service firms. The reliabilities and factor structures indicate that the final 22-item scale and its five dimensions have sound and stable psychometric properties. Moreover, by design, the iterative procedure retained only those items that are common and relevant to all service firms included in the study. However, by the same token, this procedure may have deleted certain "good" items relevant to some but not all firms. Therefore, while SERVQUAL can be used in its present form to assess and compare service

¹ Complete matrices of the interfactor correlations can be obtained from the first author.

TABLE 2

**Internal Consistencies of the Five Service-Quality Dimensions
Following Second Stage of Scale Purification**

Dimension	Label	Number of Items	Reliability Coefficients (Alphas) ^a				Items ^b
			B	CC	R&M	LDT	
Tangibles	F1	4	.52	.62	.64	.64	Q1 Q2 Q3 Q4
Reliability	F2	5	.80	.78	.84	.74	Q5 Q6 Q7 Q8 Q9
Responsiveness	F3	4	.72	.69	.76	.70	Q10 Q11 Q12 Q13
Assurance	F4	4	.84	.80	.87	.84	Q14 Q15 Q16 Q17
Empathy	F5	5	.71	.80	.72	.76	Q18 Q19 Q20 Q21 Q22
Reliability of Linear Combination (Total-Scale Reliability)			.87	.89	.90	.88	

^a B = Bank; CC = Credit Card Company; R&M = Repair and Maintenance Company;
LDT = Long-Distance Telephone Company

^b The item numbers correspond to those of the expectation and perception statements in the appendix.

TABLE 3

Factor Loading Matrices Following Oblique Rotation of Five-Factor Solutions^a

Items	FACTOR LOADINGS																			
	Bank					Credit Card Co.					Repair & Maintenance Co.					L-D Telephone Co.				
	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5	F1	F2	F3	F4	F5
Q1	34	28	—	—	—	36	—	35	—	—	34	—	—	—	—	42	—	—	—	—
Q2	64	—	—	—	—	70	—	—	—	—	70	—	—	—	—	72	—	—	—	—
Q3	39	—	—	28	—	52	—	—	—	—	53	—	—	—	—	51	—	—	—	—
Q4	28	—	—	28	—	52	—	—	—	—	65	—	—	—	—	59	—	—	30	—
Q5	—	72	—	—	—	—	54	—	—	—	—	73	—	—	—	—	52	—	—	—
Q6	—	63	—	—	—	—	43	27	—	—	—	51	—	—	—	—	40	—	—	—
Q7	—	71	—	—	—	—	87	—	—	—	—	84	—	—	—	—	79	—	—	—
Q8	—	80	—	—	—	—	83	—	—	—	—	88	—	—	—	—	59	—	—	—
Q9	—	39	—	—	—	—	49	—	—	—	—	29	—	30	—	—	54	—	—	—

Q10	—	—	37	—	—	—	—	43	—	26	—	—	56	—	—	—	—	39	—	—
Q11	—	—	55	—	—	—	—	48	—	—	—	—	52	—	—	—	—	43	—	—
Q12	—	—	62	—	—	—	—	54	—	—	—	—	74	—	—	—	—	92	—	—
Q13	—	—	69	—	—	—	—	33	—	—	—	—	71	—	—	—	—	53	—	—
Q14	—	—	—	68	—	—	—	—	65	—	—	—	—	86	—	—	—	—	69	—
Q15	—	—	—	84	—	—	—	—	76	—	—	—	—	89	—	—	—	—	81	—
Q16	—	—	—	72	—	—	—	—	73	—	—	—	—	65	—	—	—	—	61	—
Q17	—	—	—	64	—	—	—	—	61	—	—	—	—	64	—	—	—	—	66	—
Q18	—	—	—	—	37	—	—	—	64	—	—	—	—	42	—	—	—	—	—	59
Q19	—	—	—	—	48	—	—	—	72	—	—	—	—	61	—	—	—	—	—	79
Q20	—	—	—	—	41	—	—	—	63	—	28	34	—	46	—	—	—	—	—	55
Q21	—	—	—	—	33	—	—	—	59	—	—	—	—	32	—	—	—	—	—	36
Q22	—	—	—	—	68	—	—	—	64	—	—	—	—	61	—	—	—	—	—	59

* All numbers in the table are magnitudes of the factor loadings multiplied by 100. Loadings that are .25 or less are not shown. The percentage of variance extracted by the five factors in the bank, credit card, repair and maintenance, and long-distance telephone samples were 56.0%, 57.5%, 61.6%, and 56.2%, respectively.

quality across a wide variety of firms or units within a firm, appropriate adaptation of the instrument may be desirable when only a single service is investigated. Specifically, items under each of the five dimensions can be suitably reworded and/or augmented to make them more germane to the context in which the instrument is to be used.

ASSESSMENT OF SERVQUAL'S VALIDITY

SERVQUAL's high reliabilities and consistent factor structures across several independent samples provide support for its trait validity (Campbell 1960; Peter 1981). However, while high reliabilities and internal consistencies are necessary conditions for a scale's construct validity—the extent to which a scale fully and unambiguously captures the underlying, unobservable, construct it is intended to measure—they are not sufficient (Churchill 1979). The scale must satisfy certain other conceptual and empirical criteria to be considered as having good construct validity.

The basic conceptual criterion pertaining to construct validity is face or content validity. (Does the scale appear to measure what it is supposed to? Do the scale items capture key facets of the unobservable construct being measured?) Assessing a scale's content validity is necessarily qualitative rather than quantitative. It involves examining two aspects: (1) the thoroughness with which the construct to be scaled and its domain were explicated and (2) the extent to which the scale items represent the construct's domain. As discussed in earlier sections, the procedures used in developing SERVQUAL satisfied both these evaluative requirements. Therefore the scale can be considered to possess content validity.

The scale's validity was also assessed empirically by examining its convergent validity—i.e., the association between SERVQUAL scores and responses to a question that asked customers to provide an overall quality rating of the firm they were evaluating. Respondents in the second stage of data collection rated the service firm's overall quality (referred to hereafter as "Overall Q") by checking one of four categories—excellent, good, fair, poor. The correspondence between the Overall Q ratings and the SERVQUAL scores was examined using one-way ANOVA. The treatment variable in the ANOVA's was Overall Q—with three categories instead of four because very few respondents checked "poor," thereby necessitating creation of a combined "fair/poor" category. The dependent variable was the average difference score (i.e., perception-minus-expectation score) on each SERVQUAL dimension as well as on the total SERVQUAL scale (separate ANOVA's were conducted for each dimension and for the total scale). Significant ANOVA results were investigated further

Reanalysis of First-Stage Data for the Five-Dimensional Scale

^a Numbers are magnitudes of the factor loadings multiplied by 100. The loadings of items on dimensions to which they did not belong were all less than .3. The percentage of variance extracted by the five factors was 63.2%.

The numbers reported in Table 5 are average SERVQUAL scores

within each Overall Q category, measured on a -6 to +6 scale on which the higher (less negative) the score, the higher is the level of perceived service quality. In each of the four samples, the combined SERVQUAL score for those in the "excellent" category is significantly higher (less negative) than for those in the "good" category. Furthermore, respondents in the "good" category have a significantly higher combined SERVQUAL score than those in the "fair/poor" category. A similar pattern of findings is evident for the scores on the individual SERVQUAL dimensions as well. The strength and persistence of the linkage between the Overall Q categories and the SERVQUAL scores across four independent samples offer strong support for SERVQUAL's convergent validity.

SERVQUAL's validity was further assessed by examining whether the construct measured by it was empirically associated with measures of other conceptually related variables. Respondents in each sample answered two general questions that provided measures of variables (labeled "Recommend" and "Problem" in Table 5) which one could expect to be related conceptually to perceived service quality: (1) whether the respondents would recommend the service firm to a friend and (2) whether they had ever reported a problem with the services they received from the firm. Respondents answering yes to the first (Recommend) question and no to the second (Problem) question could be hypothesized to perceive higher service quality than other respondents. As Table 5 shows, the results are consistent with this hypothesis. These findings provide additional support for SERVQUAL's validity.

APPLICATIONS OF SERVQUAL

It is difficult to identify any retailer that offers no services whatsoever. Some retailers offer facilitating services, such as sales assistance and delivery, to help sell goods. Some retailers sell services directly, in addition to offering facilitating services. Some retailers sell only services. Quality of service is an important issue for all of these retailers. Competing goods retailers (department stores, supermarkets) may sell many identical products and quality of service is a primary means of competitive differentiation. Retailers that sell only services (telephone companies, airlines) have little to offer if their service is poor (Berry 1986).

SERVQUAL is a concise multiple-item scale with good reliability and validity that retailers can use to better understand the service expectations and perceptions of consumers and, as a result, improve service. The instrument has been designed to be applicable across a broad spectrum of services. As such, it provides a basic skeleton through its expectations/

perceptions format encompassing statements for each of the five service-quality dimensions. The skeleton, when necessary, can be adapted or supplemented to fit the characteristics or specific research needs of a particular organization.

SERVQUAL is most valuable when it is used periodically to track service quality trends, and when it is used in conjunction with other forms of service quality measurement. A retailer, for example, would learn a great deal about its service quality and what needs to be done to improve it by administering both SERVQUAL and an employee survey three or four times a year, plus systematically soliciting and analyzing customer suggestions and complaints. The employee survey should include questions concerning perceived impediments to better service, e.g., what is the biggest problem you face trying to deliver high-quality service to your customers? If you could be president for a day, what one change would you make in the company to improve quality of service?

SERVQUAL can be used to assess a given firm's quality along each of the five service dimensions by averaging the difference scores on items making up the dimension. It can also provide an overall measure of service quality in the form of an average score across all five dimensions. Because meaningful responses to the perception statements require respondents to have some knowledge of or experience with the firm being researched, SERVQUAL is limited to current or past customers of that firm. Within this constraint, a variety of potential applications are available.

One potential application of SERVQUAL is to determine the *relative importance* of the five dimensions in influencing customers' overall quality perceptions. An approach for doing this is to regress the overall quality perception scores on the SERVQUAL scores for the individual dimensions. The results of such a regression analysis for the four companies in the present study are shown in Table 6 (the dependent variable was Overall Q, coded as excellent = 4, good = 3, fair = 2, and poor = 1).

The adjusted R^2 values are statistically significant in all four cases and are also quite respectable, particularly in view of the fact that the dependent variable had only four categories, and the first three accounted for most of the responses. A striking result in terms of the relative importance of the five dimensions in predicting overall quality is that reliability is consistently the most critical dimension. Assurance is the second most important dimension in all four cases. Tangibles is more important in the case of the bank than in the other three firms, while the reverse is true for responsiveness. Empathy is the least important dimension in all four cases. However, the relatively small magnitudes of the regression coeffi-

TABLE 5

**Significant Differences in Mean Scale Values for Respondents—Segmented According to the Variables
Overall Q, Recommend, and Problem^a**

Bank							
Individual Scale Dimensions	Overall Q			Recommend		Problem	
	Excellent	Good	Fair/Poor	Yes	No	Yes	No
Tangibles	−0.04 ^b	−0.52 ^c	−1.08 ^d	−0.41 ^b	−0.98 ^c	−0.75 ^b	−0.45 ^b
Reliability	−0.25 ^b	−0.96 ^c	−2.30 ^d	−0.82 ^b	−2.21 ^c	−1.55 ^b	−0.92 ^c
Responsiveness	−0.32 ^b	−0.97 ^c	−1.54 ^c	−0.74 ^b	−1.81 ^c	−1.22 ^b	−0.84 ^b
Assurance	−0.49 ^b	−1.03 ^c	−1.98 ^d	−0.88 ^b	−2.12 ^c	−1.52 ^b	−0.96 ^c
Empathy	−0.30 ^b	−1.02 ^c	−1.52 ^c	−0.76 ^b	−1.88 ^c	−1.07 ^b	−0.91 ^b
Combined scale	−0.22 ^b	−0.92 ^c	−1.61 ^d	−0.72 ^b	−1.77 ^c	−1.22 ^b	−0.80 ^c
Sample size	46	112	40	164	33	47	151
Credit Card Company							
Individual Scale Dimensions	Overall Q			Recommend		Problem	
	Excellent	Good	Fair/Poor	Yes	No	Yes	No
Tangibles	0.06 ^b	−0.61 ^c	−0.79 ^c	−0.39 ^b	−0.80 ^b	−0.76 ^b	−0.29 ^c
Reliability	−0.42 ^b	−0.94 ^c	−2.32 ^d	−0.82 ^b	−2.50 ^c	−1.42 ^b	−0.82 ^c
Responsiveness	−0.08 ^b	−1.13 ^c	−1.71 ^c	−0.75 ^b	−2.59 ^c	−1.31 ^b	−0.77 ^c
Assurance	−0.59 ^b	−1.31 ^c	−2.29 ^d	−1.08 ^b	−2.83 ^c	−1.49 ^b	−1.15 ^b
Empathy	−0.50 ^b	−1.38 ^c	−1.94 ^c	−1.03 ^b	−2.77 ^c	−1.62 ^b	−1.01 ^b
Combined Scale	−0.32 ^b	−1.10 ^c	−1.79 ^d	−0.83 ^b	−2.27 ^c	−1.29 ^b	−0.83 ^c
Sample Size	60	112	28	183	17	50	149

Repair and Maintenance Company

Individual Scale Dimensions	Overall Q			Recommend		Problem	
	Excellent	Good	Fair/Poor	Yes	No	Yes	No
Tangibles	-0.15 ^b	-0.40 ^{b,c}	-0.86 ^c	-0.36 ^b	-0.85 ^b	-0.58 ^b	-0.34 ^b
Reliability	-0.48 ^b	-1.30 ^c	-3.20 ^d	-1.14 ^b	-3.48 ^c	-2.14 ^b	-1.18 ^c
Responsiveness	-0.08 ^b	-1.08 ^c	-2.41 ^d	-0.83 ^b	-2.54 ^c	-1.71 ^b	-0.80 ^c
Assurance	-0.33 ^b	-1.35 ^c	-2.84 ^d	-1.16 ^b	-2.91 ^c	-2.04 ^b	-1.13 ^c
Empathy	0.15 ^b	-1.11 ^c	-2.17 ^d	-0.85 ^b	-2.19 ^c	-1.67 ^b	-0.74 ^c
Combined Scale	-0.16 ^b	-1.07 ^c	-2.30 ^d	-0.88 ^b	-2.40 ^c	-1.65 ^b	-0.85 ^c
Sample Size	45	114	40	168	30	65	132

Long-Distance Telephone Company

Individual Scale Dimensions	Overall Q			Recommend		Problem	
	Excellent	Good	Fair/Poor	Yes	No	Yes	No
Tangibles	-0.08 ^b	-0.44 ^c	-0.50 ^c	-0.26 ^b	-0.95 ^c	-0.42 ^b	-0.26 ^b
Reliability	-0.45 ^b	-1.42 ^c	-2.53 ^d	-1.05 ^b	-2.71 ^c	-1.54 ^b	-1.03 ^c
Responsiveness	-0.30 ^b	-1.43 ^c	-1.90 ^c	-1.00 ^b	-2.03 ^c	-1.46 ^b	-0.86 ^c
Assurance	-0.39 ^b	-1.45 ^c	-2.10 ^d	-1.00 ^b	-2.64 ^c	-1.62 ^b	-0.87 ^c
Empathy	-0.33 ^b	-1.19 ^c	-2.10 ^d	-0.86 ^b	-2.34 ^c	-1.16 ^b	-0.90 ^b
Combined Scale	-0.30 ^b	-1.15 ^c	-1.83 ^d	-0.83 ^b	-2.13 ^c	-1.24 ^b	-0.76 ^c
Sample Size	69	104	25	178	19	78	120

* Numbers are mean values on a scale ranging from -6 to +6, on which zero implies that consumer perceptions and expectations coincide, negative values imply that perceptions fall short of expectations, and positive values imply that perceptions exceed expectations.

^{b,c,d} Means with the same superscripts are not significantly different. Means with different superscripts are significantly different.

TABLE 6

**Relative Importance of the Five Dimensions in Predicting
Overall Quality**

Dimension	Standardized Slope Coefficient	Significance Level of Slope ^a	Adjusted R ²
Bank			
Tangibles	.13	.07	.28 (<i>p</i> < .00)
Reliability	.39	.00	
Responsiveness	.07	.35	
Assurance	.13	.09	
Empathy	.01	.89	
Credit Card Co.			
Tangibles	.07	.26	.27 (<i>p</i> < .00)
Reliability	.33	.00	
Responsiveness	.12	.11	
Assurance	.17	.02	
Empathy	.04	.58	
Repair & Maintenance Co.			
Tangibles	.04	.48	.52 (<i>p</i> < .00)
Reliability	.54	.00	
Responsiveness	.11	.09	
Assurance	.16	.02	
Empathy	.01	.81	
L-D Telephone Co.			
Tangibles	.08	.17	.37 (<i>p</i> < .00)
Reliability	.45	.00	
Responsiveness	.12	.09	
Assurance	.15	.03	
Empathy	.02	.78	

^a Significance levels are for two-tailed tests.

cients for empathy and their lack of statistical significance should be interpreted with caution because empathy did have a statistically significant simple correlation with overall quality, ranging from .20 in the case of the bank to .40 in the case of the repair and maintenance company. Empathy also had significant correlations of the same order of magnitude with reli-

ability and assurance (the two most important dimensions), thereby implying that its importance in the regression analyses may have been masked somewhat by possible multicollinearity. Therefore, while empathy is apparently the least important of the five SERVQUAL dimensions, it is by no means *unimportant*.

Another application of the instrument is its use in categorizing a firm's customers into several perceived-quality segments (e.g., high, medium, and low) on the basis of their individual SERVQUAL scores. These segments then can be analyzed on the basis of (1) demographic, psychographic and/or other profiles; (2) the relative importance of the five dimensions in influencing service quality perceptions; and (3) the reasons behind the perceptions reported. For example, suppose a department store found that a large number of SERVQUAL respondents falling in the "medium" perceived-quality group fit its prime target market based on demographic and psychographic criteria. Suppose further that reliability and assurance were found to be the most important quality dimensions and, based on perception-expectation gap scores for items concerning these dimensions, the items relating to record-keeping accuracy and behavior of contact personnel revealed the biggest gaps. With these data, the department store's management would understand better what needs to be done to improve its image in the eyes of a very important group—customers within the firm's prime target market who give the firm "medium" service quality scores and who are in position to either respond to improved service from the firm or defect to the competition.

SERVQUAL can also be used by multi-unit retail companies to track the level of service provided by each store in the chain. By asking respondents to indicate the particular store in the chain with which they are most familiar, and to provide perception responses for that unit, the researcher can compare each store's average SERVQUAL score with the scores from other stores. Service quality scores can then be a factor in store manager performance appraisals and compensation, among other uses. Also, SERVQUAL scores for the individual stores can be used to group outlets into several clusters with varying quality images. A careful examination of the characteristics of the stores in the different clusters may reveal key attributes that facilitate—or hinder—the delivery of high quality service.

A retailer can also use SERVQUAL to assess its service performance relative to its principal competitors. The two-section format of the instrument, with separate expectation and perception sections, makes it convenient to measure the quality of several firms simply by including a set of perception statements for each firm. The expectations section does not have to be repeated for each firm. For example, a supermarket chain could

include its two principal competitors in a total market survey, asking respondents to provide perception ratings for each of the companies with which they have shopping experience. A retailer that uses SERVQUAL to identify the most salient service quality dimensions for its target markets, and to compare itself to the competition in terms of strengths and weaknesses on these particular dimensions, will certainly have a sense of what its priorities should be with regard to service quality.

In summary, SERVQUAL has a variety of potential applications. It can help a wide range of service and retailing organizations in assessing consumer expectations about and perceptions of service quality. It can also help in pinpointing areas requiring managerial attention and action to improve service quality. In addition, we hope the availability of this instrument will stimulate much-needed empirical research focusing on service quality and its antecedents and consequences.

REFERENCES

- Berry, Leonard L. (1986), "Retail Businesses Are Service Businesses," *Journal of Retailing*, 62 (Spring), 3-6.
- Campbell, Donald T. (1960), "Recommendations for APA Test Standards Regarding Construct, Trait, or Discriminant Validity," *American Psychologist*, 15 (August), 546-53.
- Churchill, Gilbert A., Jr. (1979), "A Paradigm for Developing Better Measures of Marketing Constructs," *Journal of Marketing Research*, 16 (February), 64-73.
- Churchill, Gilbert A., Jr., Neil M. Ford, and Orville C. Walker, Jr. (1974), "Measuring the Job Satisfaction of Industrial Salesmen," *Journal of Marketing Research*, 11 (August), 254-260.
- Cronbach, Lee J. (1951), "Coefficient Alpha and the Internal Structure of Tests," *Psychometrika*, 16 (October), 297-334.
- Crosby, Philip B. (1979), *Quality Is Free: The Art of Making Quality Certain*, New York: New American Library.
- Dodds, William B. and Kent B. Monroe (1984), "The Effect of Brand and Price Information on Subjective Product Evaluations," *Advances in Consumer Research* XII.
- Ford, Neil M., Orville C. Walker, Jr., and Gilbert A. Churchill, Jr. (1975), "Expectation-Specific Measures of the Intersender Conflict and Role Ambiguity Experienced by Industrial Salesmen," *Journal of Business Research*, 3 (April), 95-112.
- Garvin, David A. (1983), "Quality on the Line," *Harvard Business Review*, 61 (September-October), 65-73.
- Gronroos, Christian (1982), *Strategic Management and Marketing in the Service Sector*, Helsingfors: Swedish School of Economics and Business Administration.
- Harman, Harry H. (1967), *Modern Factor Analysis*, 2nd ed., Chicago: The University of Chicago Press.
- Hjorth-Anderson, Chr. (1984), "The Concept of Quality and the Efficiency of Markets for Consumer Products," *Journal of Consumer Research*, 11 (September), 708-718.
- Holbrook, Morris B. and Kim P. Corfman (1985), "Quality and Value in the Consumption Experience: Phaldrus Rides Again," in *Perceived Quality*, J. Jacoby and J. Olson (eds.), Lexington, Massachusetts: Lexington Books, 31-57.

assumes that digitalization takes place at the household level, controlling all inputs and energy withdrawals. Consumers optimize production (probably through solar technologies), storage (with batteries), and the use of multiple services (through smart home appliances and electrical vehicles).

Digitalization is used to optimize and allow the system to operate (as in the super-grid scenario). However, it is not used to aggregate or manage demand; high transaction costs translate into less consumer interaction and, therefore, trading platforms do not develop.

In this scenario, utilities that sell services through the electric grid become obsolete and eventually disappear. Even more than in the community-based scenario, utilities' services must transform. New business models, such as battery-swapping stations, are created.

The off-grid scenario is already happening on a small scale. In Latin America and the Caribbean, where in 2019 about 20 million people still lacked access to reliable electricity, off-grid solutions have already been proven a cost-effective option to solve access to electricity in rural and isolated areas (see Chapter 4).

But the real challenge for utilities is that off-grid solutions are becoming an attractive option for high-income consumers seeking zero net energy homes. Led partially by the decrease in the cost of the technology needed, this trend also responds to the fact that this type of consumer (at least under most of the predominant tariff schemes in the region) pays higher electricity prices to cross-subsidize low-income users. If these consumers could run completely off-grid by generating their own solar power and using highly efficient appliances and high-capacity batteries, the utilities in the region would become underfunded. However, for that to happen on a large scale would require a disruptive drop in the cost of batteries. Implementing tariff schemes that avoid this pervasive effect should be a priority for the future.

Which Scenario Will Prevail?

Any one of the four scenarios could materialize in the future depending on how digitalization and decentralization trends unfold. Digital utilities and community-based systems will most likely be the prevailing scenarios if digitalization trends persist. The degree of decentralization is less certain, and trends may vary even within countries as rural and urban areas may be suitable for different models. However, governments can influence the outcomes. Policies and regulation will determine the costs of the technologies behind the digitalization and decentralization trends.

Scenarios should not be considered static; transitions from one to another will probably be common. For instance, the digital utilities scenario could evolve into the community-based scenario, as digital technologies are increasingly adopted and the cost for small-scale solutions comes down gradually.

Off-grid solutions can become the most efficient mechanism for generating and storing energy, especially in more isolated (rural or peri-urban) areas. But in urban areas where grids already exist, empowering consumers within the energy system may help discourage costly off-grid solutions. Regulatory and policy incentives that neglect consumer participation, or push for too much or too little centralization, could lead the system to lock in an undesirable solution. Avoiding lock-in at this tipping-point moment requires understanding the current state of technology adoption, future trends, and the effects of regulation.

Adapting Regulatory Frameworks to a Changing Sector

The transformation of regulation needs to consider both governance and regulatory substance. Policymakers must prepare institutions and the regulatory system to deal with a much more dynamic and competitive industry. New tools should be developed and applied to open the regulatory decision process to new players (including empowered consumers and players from other industries). The speed of innovation in the sector also makes it critical for regulators to have updated knowledge in order to constantly update policies and instruments in a transparent and credible way. Tools for assessing regulatory impact should also be embraced for continuous learning and adaptation.

All tools allowing adaptability demand strong and resourceful regulatory agencies. Most countries in Latin America and the Caribbean actively regulate the electricity sector, but the lack of well-established legal frameworks and resources has produced institutions with limited power (Rodríguez Pardina and Schiro, 2018). In an environment without disruptive innovation, the regulator could gain credibility and predictability through well-designed and stable regulatory frameworks, for which some of the functions have usually been outsourced to sector experts. The effectiveness of this strategy may be lessened in a context that requires adaptable regulations. In such environment, credibility must come from the regulator, and therefore cannot be outsourced.

As for regulatory substance, innovation calls for urgent action to update regulatory instruments. Digitalization and decentralization are disrupting the grid's business model. Historically, transmission and distribution

networks were the most efficient methods of transporting electricity. Electricity flowed in a single direction, starting in generation plants before being transmitted and distributed to consumers as the final stop. For years, the network business was a secure and stable service, impervious to innovation or disruption.

In a prosumer framework, the network exists as an interactive platform into which grid users can inject and withdraw energy; system balancing becomes necessary but achieving it is challenging. The emergence of prosumers and the growing possibility of disconnecting from the grid threaten the sustainability of the network. They will force regulators to redesign tariffs and incentives in order to balance the competing objectives of financial sustainability, efficiency, and social equity.

The emerging transformation of the electricity sector will be reflected in the transformation of the network. New services will be offered using the grid at the same time that its financial sustainability will be under threat, compelling regulators to redefine market failures, reconceive market segments, and determine which instruments can best protect users, foster competition, and safeguard the quality of service. Regulators will have to start working on several new challenges, including network service transformation, pricing restructuring, and network and service integration of other services, mainly electric mobility.

Regulating the Transformation of Network Services

In Latin America and the Caribbean and elsewhere, transmission and distribution were built to deliver electricity in the most efficient way to consumers. Electricity was regulated in order to protect consumers while allowing utilities to recover their investment. Capital cost was recovered through tariffs, and utilities faced no (or very little) market risk.

This straightforward logic no longer holds. In a context of digitalization and decentralization, the power network business is changing in at least three ways:

- *Electricity consumption no longer has a one-to-one relationship with grid usage.* With the emergence of prosumers, storage, and digitalization, the use of the network will change. Consumers will not demand all the electricity required to satisfy their needs from the utility, as some of them will generate their own electricity. Moreover, many consumers will sometimes generate more electricity than needed and will want to use the grid to trade electricity. The grid will play an important role as a back-up service provider for prosumers

when their own systems fail to produce electricity, providing a new type of insurance service. Other services, such as security of supply (that is, making sure that electricity keeps flowing to those who need it), may have public good features, in which case regulators need to reconsider how to allocate cost, which can no longer be based on use. Redesigning prices in ways that take into account the economic features of the new services will be a challenge that requires a long learning process. An interesting example of this process is the evolution of regulation in the United Kingdom (see Box 9.3).

- *Turning the electricity network into a smart asset: the challenge of data regulation and management.* The network will generate a huge amount of data, which will facilitate a new level of understanding of consumer behavior. Control and efficiency will be vastly increased, but ownership, usage rights, security, and privacy issues associated with these data will demand a new role for power network regulation that goes beyond the traditional areas of prices, quality, and infrastructure access.
- *Asset choice will become more complex.* Utilities may face new investment choices due to newly available technological possibilities. For instance, they will need to choose between investing in storage or in grid reinforcement. Historically, regulators have closely controlled the type of assets utilities were allowed to invest in (type and quantity of distribution lines, substations, transformers). In an increasingly dynamic environment, regulators should tie incentives much more closely to service performance, by focusing on specifying utilities' performance and outcomes while remaining agnostic (as much as possible) about the means of delivery (see Box 9.3).

Box 9.3

The United Kingdom's Framework for Regulating Changing Network Services

The Office of Gas and Electricity Markets (Ofgem)—a nonministerial government department and independent national regulatory authority governed by the Great Britain Energy Regulatory Agency (GERA)—is known for its continuous innovation. The agency has a long record of successfully using new and existing regulatory tools to provide high-quality services. According to Ofgem (2010),

Britain's electricity sector will be facing significant challenges due to disrupting technological changes. Consequently, the agency called for an update to its regulatory approach in order to be ready for the expected transformation and the uncertainties inherent in the transition.

In 2013, Ofgem began transforming the logic of its regulation. The previous model, frequently cited as a textbook example of incentive regulation, was based on a five-year tariff adjustment scheme; tariffs were allowed to increase at a rate equal to the increase in the retail price index (RPI) minus the efficiency savings target (X). The main objective was to increase predictability for utilities, while providing incentives to increase the efficiency of the network and guarantee the transfer of benefits to consumers. In 2010, however, Ofgem concluded that RPI - X price control could not deliver the incentives to invest in innovation required for the energy transition.

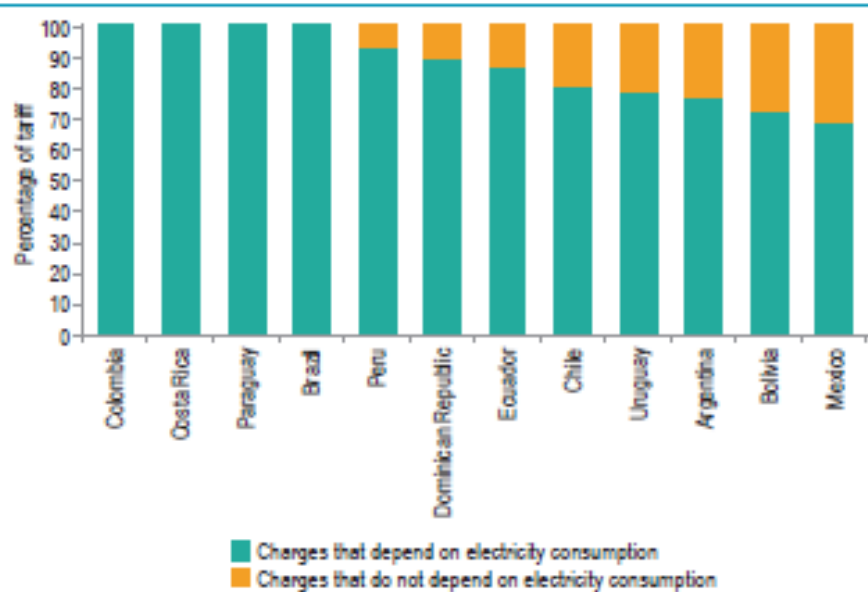
Ofgem replaced the RPI-X model with a new one denominated RIIO (revenue = incentives + innovation + outputs). This performance-based framework sets targets to encourage more innovation (through financial rewards); takes better account of consumers' final services features (targeted incentives that adjust revenues up/down if companies deliver better/worse outputs for consumers); and provides incentives to networks to minimize costs. RIIO extends the price control period from five to eight years with the objective of providing more incentives to adopt innovations that both reduce costs and improve services to users.

Evaluation of the results of RIIO has been mixed, although the consensus is that it spurred utilities to improve their business plans. Analysis by external experts noted increased stakeholder engagement, greater performance risk borne by utilities, and higher efficiency incentives due to a longer regulatory period. The benefits of innovation incentives established through RIIO remain unclear, however. As part of the ongoing RIIO revision, suggestions and improvements are being made that should be implemented by 2021 (CEPA, 2018). Despite unclear conclusions on its effectiveness, RIIO is a benchmark that regulators in Latin America and the Caribbean should consider as they ponder modifying regulatory systems sooner rather than later to be ready for upcoming technological changes.

Flipping the Switch on Pricing

Historically, electricity prices were designed to comply with two simultaneous objectives: cost recovery and affordability. The regulator chose a set of prices that would allow total revenues to cover the cost of service provision. The price structure of choice in Latin America and the Caribbean has been an energy charge—that is, the electricity bill depends on the quantity of electricity demanded (Figure 9.6). A few countries also include a

Figure 9.6
Composition of Electricity Tariffs, 2017



Source: CIER (2017).

fixed component that is independent of consumption; when included, this accounts for a small share of the bill.⁷

In a context in which all consumers are connected to the grid, the prevailing price structure allows for cross-subsidies among consumers (urban vs rural, industrial vs residential, high- vs low-income areas) without compromising the objective of financial sustainability of the utility while promoting fairness and equity. Cross-subsidies in Latin America and the Caribbean are ubiquitous (Foster and Rana, 2019).

Technological innovations will render the prevailing pricing structure unsustainable. Those consumers that currently pay more using the grid than they do generating their own electricity will find it attractive to disconnect from the network. Thus, the ability of the pricing structure to deliver on the two objectives of cost recovery and affordability will be jeopardized.

To avoid developing unsustainable electricity markets, tariffs will have to change. The uncompromising principle for tariffs of the future is to be

⁷ This section focuses on the pricing structure of residential consumers and does not include an analysis of possible changes in the pricing structure of industrial and commercial consumers.

cost reflective. Table 9.1 compares the prevailing electricity price structure in Latin America and the Caribbean with the one needed to face the challenges of the future.

Current electricity price structures that mostly rely on charges depending on electricity consumption incorporate two costly distortions. First, every time consumers decide to use an extra unit of electricity, they face prices that are higher than the incremental cost of producing it as they also need to cover fixed costs. This disincentivizes electricity consumption and hampers the transition to electrified infrastructure services, from home appliances to electric vehicles. Second, as consumers can avoid paying their share of fixed costs by decreasing their electricity consumption, they are over-incentivized to produce their own electricity even if it is not

 **Table 9.1**
Electricity Price Structure Transformation: Elements to Increase Cost Reflectiveness

	Tariffs today	Tariffs for the future
Charges that do not depend on electricity consumption	Account for a small share of the electricity bill. If included in the bill, the charge is not related to cost characteristics of service provision (e.g., load capacity).	Account for a substantial share of the electricity bill. Fixed charge set to reflect the cost structure of electricity provision. Different cost drivers should be set separately and proper information about their level and changes should be transparent (e.g., right to use the network, right to trade using the network, insurance services).
Charges that depend on electricity consumption	Account for most of the total electricity bill. Set to provide enough revenues to the utility to cover long-run variable and fixed costs. Differentiated among users (e.g., rural vs urban, residential vs industrial) with the intention of fulfilling equity and fairness objectives (cross-subsidies).	Account for a small share of the electricity bill. Increased price “granularity”: prices reflect the marginal cost of providing the services at the time and location of use. Prices set exclusively to fulfill efficiency goals. Equity and fairness goals are addressed with other instruments.
Taxes and sectorial charges	Can represent a high share of total bills. Instrument used to attend policy objectives that are usually beyond the electricity sector (e.g., to contribute to fund general tax revenues).	Taxes and sectorial charges should not distort cost reflectivity ^a
Subsidies	Subsidies to achieve equity and fairness objectives are mostly funded using cross-subsidies. Mostly set as discounts to the price of electricity.	Subsidies to achieve equity and fairness objectives are funded from general tax revenues. Mostly set as discounts to the fixed charge of the electricity bill.

Sources: Authors’ elaboration.

^a Some taxes or charges like carbon taxes, must be included in tariffs because they make prices reflective of the social costs of electricity generation.

efficient systemwide.⁸ Solving these distortions requires introducing into the electricity bill charges that do not depend on electricity consumption to remunerate fixed costs.

The fine tuning on which part of the costs should be covered by each type of charge is not univocal, but some general guidelines can be drawn. To design proper tariff structures requires cost drivers to be set separately and transparency of information about their level and charges. For instance, remuneration to network services can be recovered by capacity charges (when the cost is associated with the size/volume of the consumer) or by fixed charges (when it does not actually depend on consumption at all). The network services that depend on network or consumer characteristics, like the ability to use the distribution network to buy and sell electricity, are more appropriately covered by some type of capacity charge. Other network services that are independent of the characteristics of the consumer, such as the right to access the network, some elements of security of supply, and public lighting, should be covered by a fixed charge.

Increasing tariff's cost reflectiveness also means recognizing that time and location matter for the cost of providing services. Adequate tariff design must provide consumers with real-time information on costs, externalities, and opportunities associated with the time and location of electricity generation and consumption.

Better locational price signals are already technically possible, as well as hourly pricing schemes. Dynamic prices are an option to assure that retail electricity prices pass on at least part of the hourly wholesale price variation to consumers. They can take different formats, such as time of use pricing, real time pricing, variable peak pricing, and critical peak pricing,⁹ but the intuition behind these schemes is the same: users adapt their consumption habits to match the availability of resources. These demand responses to prices become even more important when the proportion of renewable energy in electricity generation matrices all over the region is increasing rapidly, making resource availability less predictable.

Finally, to ensure that the new electricity price structures are cost reflective, they must remain free of other price distortions such as taxes,

⁸ In California, where adoption of decentralized energy is high and done mostly by high-income households, the impact on tariffs is already being felt disproportionately by poor households. The revenue shortfall caused by prosumers in California led to an estimated US\$65-per-year increase in the electricity bills of consumers that are not prosumers (Davis, 2018).

⁹ Many countries are adapting their regulation to allow dynamic pricing; these countries include Estonia, Finland, Germany, Norway, the United Kingdom, and the United States (EURELECTRIC, 2017; IRENA, 2019).

sectoral charges, and subsidies. Achieving this objective may be one of the most challenging parts of transitioning to new tariffs. Nowadays, taxes and sectoral charges can represent a significant part of the electricity bill (e.g. in Brazil and Argentina, taxes and sectoral charges represent more than 50 percent of electricity bills) and cross-subsidies are regulators' weapon of choice to deal with fairness and equity concerns. In a new environment in which consumers are free to dispense of the network and produce their own electricity, increasing the electricity bill beyond the cost needed to cover service provides incentives to abandon the grid.

In this context, the government's ability to raise funds through the electricity bill to finance cross-subsidies is severely reduced. As explained in Chapters 1 and 4, regulators will have to work closely with policymakers to define objectives and to design means-targeted subsidies with a predictable and dedicated source of funding (Cont and Navajas, 2019).

Coordinating Regulation across Sectors

As digitalization and decentralization create new interfaces between energy and other infrastructure sectors, coordinated regulation will be required. Planning and regulating the energy, transportation, telecommunication, and water sectors is now done separately. However, as infrastructure services become more dependent and interrelated, the lines defining the reach of sectoral regulation become blurred. For instance, many of the challenges of electric mobility are associated with the electricity pricing system, charger accessibility, and even power quality incentives that are usually under the watch of the energy regulator, but in the near future may become key elements in defining the efficiency of transport choices.

Another rapidly growing intersectoral relation is between energy and water. The growing importance of hydroelectricity dams to accommodate variable renewables will make decisions on how to use water resources more challenging, particularly in the context of an electrified energy sector and increasingly scarce water due to climate change (see Chapter 11). In this regard, integrating regulation between both sectors will become crucial to avoid coordination failures that could compromise firm and household access to water or electricity.

A more synergistic convergence is taking place between information technology (IT) and the energy sector. Some energy equipment manufacturers are looking at IT acquisitions to increase the pace of their digital transition. Meanwhile, well-established IT players are moving aggressively into the energy sector. Electric system optimization and operation will increasingly depend on new technologies to allow for the collection and

analysis of big data. The ownership, use, and security of these data will affect the potential of new energy services and competitiveness (see Chapter 13).

Integrating regulation across sectors creates challenges, but first steps to start the integration include the following:

- Acknowledge the existence of cross-sectorial interdependencies and create coordination mechanisms among regulators to pursue joint regulatory impact assessments.
- Coordinate planning across cities, regions, and countries. One example of such coordination is the use of climate goals as a tool to coordinate planning objectives in different sectors. For instance, in the energy sector, many countries in the region have aligned their electric generation expansion plans with the objectives of their Nationally Determined Contributions (NDCs) under the Paris Agreement (see Chapter 7).
- Integrate planning for system resilience and security, taking into account hardware and software interdependencies. For instance, planning telecommunications systems should anticipate the consequences of a cyberattack that could trigger a blackout.

The Future Starts Now

The fast pace at which the electricity sector is changing means countries face unprecedented and technically difficult challenges. Failing to act now will be an expensive mistake, as countries need to make the most of new opportunities presented by the declining costs of new generation and storage technologies, the proliferation of electrification in different energy usages, and digitalization. These advances can be at the heart of a strategy to solve long-standing issues related to affordability, quality of service, and efficiency.

Regulators need to start now by generating more and better information and build a flexible approach into their frameworks that allows them to cope with innovations and uncertainty. Regulatory policies, institutions, and instruments need a richer understanding of what electricity services are and how they are provided. Many times, this implies redefining regulators' competences. In all cases, countries will need a new approach to tariff design and subsidies that does not compromise financial sustainability and efficiency.



The Road to Better Transportation

It is a time of unprecedented change for the transportation sector. In coming decades, digital technologies will dramatically shape the future of both mobility (movement of people) and logistics (movement of goods), presenting major opportunities and challenges for economies and societies. Autonomous, connected, electric, and shared transportation promises to disrupt the sector in a way not seen since cars replaced horses in the early 20th century. Cars fundamentally changed the way people lived, allowing them to access jobs, schools, shops, and entertainment in distant places, in a fraction of the time it took using a horse-drawn carriage or walking. However, people are uncertain about how the future will look and what specific benefits and risks it will bring. This uncertainty is not fundamentally different from the early stages of past technology revolutions; in 1885 Karl Benz could not have anticipated the changes that his gasoline-powered car would bring decades later. That is why governments around the world have launched programs to ensure that new technologies help achieve a transportation system that is efficient (providing lower-cost, higher-quality services), inclusive (accessible and affordable to all), and sustainable (fostering a safer, cleaner, and more livable urban environment).

In this context, the challenge facing Latin American and Caribbean countries is to join other governments in planning the technological transition today or face, tomorrow, the consequences of lagging behind. In fact, should current trends remain unchanged, transportation in Latin American and Caribbean cities will not face a promising future. By 2030, motorization rates are expected to increase by almost 40 percent, reaching 276 vehicles per thousand inhabitants. Together with population growth (9 percent higher by 2030) and urban sprawl, congestion will rise rapidly.

These projections are not to be taken lightly when, according to the INRIX 2018 Global Traffic Scorecard database, already four of the ten most congested cities on the planet are in Latin America and the Caribbean: Bogotá (every driver loses 272 hours each year to congestion), Mexico City (218), Rio de Janeiro (199), and São Paulo (154) (compared to 45 hours in La Paz, the least congested capital city in the region). In turn, product demand from a growing urban population (84 percent of the region's people will live in cities by 2030), together with the boom in e-commerce (650 percent growth by 2030) and consumers' preferences for faster and smaller shipments, will trigger more freight traffic on urban roads.

Without structural changes, negative trends in public transportation may worsen (see Chapter 4). As they do, those who can afford it will shift to individual transportation, while those who cannot will be increasingly underserved by a system of limited accessibility, affordability, and quality. Likewise, without the incentive to be more energy-efficient, the transportation sector will continue to be one of the main sources of greenhouse gas (GHG) emissions: CO₂ emissions will rise 25 percent by 2030, limiting the ability of Latin American and Caribbean countries to achieve their Paris Agreement commitments (see Chapter 7). Finally, if current trends in road safety are not reversed, a million lives may be lost to traffic accidents between 2020 and 2030. The toll on public health may be higher, with a spike in cardiovascular diseases and lung cancer resulting from sedentarism and dangerous air quality in cities. With more time spent commuting, mental health may deteriorate as well: longer commutes reduce job satisfaction and productivity, increase commuters' overall levels of stress, and make them less happy (UK Office for National Statistics, 2014). It is no wonder then that, among the factors affecting quality of life, residents of the region's megacities put transportation among the top five priority concerns, together with safety, transparency, inequality, and participation (Serebrisky, 2014).

There is reason for hope, however. New technologies can become an ally to avert this somber scenario. Electric mobility can reduce CO₂ emissions. Connected and shared mobility can optimize vehicle usage, reduce solo rides, and decrease congestion. Autonomous vehicles can expand mobility for non-drivers and the disabled and increase the productivity of public transport. This chapter describes the trends at work in the transportation sector, the opportunities they present, and policy actions to enable Latin American and Caribbean countries to achieve an efficient, inclusive, and sustainable transportation system underpinned by 21st century technologies.

Disruptive Trends In Transportation

Four converging trends—automation, connectivity, electrification, and sharing (ACES)—will radically change the way people and goods move (Voegel, 2019).¹

Automation is at the forefront of these trends. In the transportation field, automation takes a variety of forms, including the driverless or autonomous vehicle (AV). The Society of Automotive Engineers classifies vehicle automation into six levels, from 0 to 5. At level 0, all driving functions require human intervention; at levels 4 and 5, the vehicle can autonomously cope with all driving situations.

Connectivity refers to the use of information and communication technologies to generate and exchange data among vehicles, roads, and other parts of the transportation system. Its forms are vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-everything (V2X) connectivity.

Electrification involves the use of electric motors to propel vehicles. They receive electricity by plugging into the grid and store it in batteries. They are also charged in part by regenerative braking, which generates electricity from some of the energy normally lost when braking.

Sharing includes both shared use and shared ownership of cars, bicycles, scooters, and trucks. Currently, the most common forms of sharing are: (i) business-to-consumer car sharing, where a company maintains a vehicle fleet that is rented out to customers; (ii) ride-sourcing services (also known as ride-hailing companies), which offer on-demand rides by connecting drivers using their personal vehicles with passengers hailing a ride, typically via smartphone; (iii) bike-sharing programs; and (iv) micro-mobility programs, whereby a company provides urban transportation services with a fleet of small, electric vehicles such as e-bicycles and e-scooters (Shaheen, Totte, and Stocker, 2018).

Assuming a high market penetration, each of these trends is expected to bring significant benefits to the transportation system by increasing its efficiency, inclusiveness, and sustainability (Table 10.1).

¹ For the past few years, the future of transportation has been gaining the attention of specialized and general audiences. Data from digital sources (Twitter, news, blogs, forums, Facebook) show that, between 2016 and 2018, the conversation about electric vehicles in Latin American and Caribbean countries grew by 48 percent. In turn, the conversation on autonomous vehicles grew by 13 percent. Likewise, data from academic search engines show that, for the same period, global research on electric and autonomous vehicles grew by 30 percent and 250 percent, respectively.

Table 10.1

ACES Potential to Make Transportation More Efficient, Inclusive, and Sustainable

	Autonomous	Connected	Electric	Shared
Efficiency	Improved comfort and productivity for travelers, who will be able to perform other tasks (sleeping, working) while traveling.	Enhanced infrastructure utilization (e.g., smart traffic lights that send traffic information to vehicles and to public agencies for dynamic traffic management decisions).^a	Lower operating costs due to higher energy efficiency and less maintenance than internal combustion engines (ICE).	Fewer vehicles and higher vehicle utilization, reducing the number of cars on streets.
	Enhanced traffic management and city planning by using big data generated by A/s.	Better enforcement of segregated infrastructure (bus lanes, cycle paths, low-emission zones).	Increased passenger comfort with quieter, smoother operation.	Improved convenience of public transportation (e.g., by offering first-mile/last-mile services, and labor-made mobility solutions based on individual needs through mobility as a service or pay-as-you-go programs).
	Lower mobility and logistical costs owing to lower labor costs and better vehicle routing enabled by big data.	Vehicles able to travel closer to each other (lower safety distance needed), thus increasing infrastructure capacity.	Batteries used as additional storage for the national grid (see Chapter 9).	Better match of the supply and demand for logistics assets (e.g., fewer trucks running empty on city streets).
Inclusiveness	Increased mobility for senior citizens, non-drivers, and the disabled. In Latin America and the Caribbean, these segments will account for approximately 138 million people by 2030.^b	New revenue mechanisms enabled by technology (e.g., dynamic congestion pricing according to congestion levels).	Improved planning of public transit through the use of sensors and big data, enabling on-demand public transit to serve low-density areas.	Improved convenience of public transportation, as noted above.

(continued on next page)

Table 10.1
ACES Potential to Make Transportation More Efficient, Inclusive, and Sustainable (continued)

	Autonomous	Connected	Electric	Shared
Sustainability	Improved road safety due to less reliance on human factors that account for 90 percent of accidents.	Improved road safety through incident warnings that prevent collisions (warnings 3 seconds before impact can prevent up to 70 percent of car crashes).	Lower local emissions and noise pollution leading to improved urban livability and lower impact on climate change.	Fewer vehicles and higher vehicle utilization, reducing the number of cars on streets.
	Greater eco-driving to lower environmental impact and reap fuel savings of up to 20 percent.			More active mobility with shared bicycles.
	Less parking required by shared A/Vs, freeing up urban space for sustainable, citizen-friendly developments.			

Source: Authors' elaboration based on Millard-Ball, Weinberger, and Hampshire (2016); U.S. Energy Information Administration (2018); Olla et al. (2018); IQ Air (2019); Manners-Ball (2019); and Vogue (2019); and CEPALSTAT database, 2018.

• Data for the United States show that smart parking systems that generate information on available spots can reduce cruising by 50 percent (Millard-Ball, Weinberger, and Hampshire, 2016).

• By 2030, Latin America and the Caribbean will have nearly 105 million adolescents (10–19 years), 9 million seniors (over 80), and 4.5 million people with disabilities who might benefit from new mobility services.

cuencia, para la elección del estadístico se utilizó la prueba de normalidad de Kolmogorov-Smirnov en donde los datos obtenidos, revelan en cuanto al p valor, para todas las variables y dimensiones fueron menores a 0.05 ($p < 0.05$), demostrando que la distribución de los datos es no normal y lo más adecuado para la relación entre las variables, es usar el coeficiente de Rho de Spearman.

Resultados y Discusión

Los resultados descritos en este capítulo son el análisis descriptivo e inferencial de las variables estudiadas, es a saber la Calidad de Servicio y la Satisfacción del cliente. Y así también la descripción de los variables socio demográficos del estudio realizado.

En la Tabla 2, se presentan los resultados de la información sociodemográfica de los clientes que respondieron al cuestionario. Ahora bien, con respecto a la mo-

dalidad por la que recibe el servicio el cliente, el 56.5% obtiene el servicio por medio de un contrato y el 43.5%, lo recibe sin un contrato establecido. En lo que respecta a las solicitudes del usuario para ejecución de los servicios por ubicación, Lima realiza la mayor cantidad de solicitudes con el 66.7%, solo las provincias el 15.9% y para ambas Lima y provincias el 17.4%. Se observa según el tiempo que el cliente tiene recibiendo el servicio, que el 8.7% recibe el servicio menos de 1 año, el 49.3% lo recibe de 1 a 5 años, el 26.1% lo recibe de 6 a 10 años, el 11.6%, recibe el servicio de 11 a 15 años, y el 4.3% recibe el servicio de 16 a 20 años. En cuanto a la frecuencia con la que se solicitan los servicios, el 24.6% requiere el servicio 1 vez al año, el 18.8% pide el servicio 1 vez cada seis meses, el 15.9%, demanda el servicio 1 vez cada tres meses, el 24.6%, recibe el servicio 1 vez al mes, mientras que el 15.9% pide el servicio más de 1 vez al mes.

Tabla 2
Información sociodemográfica de la población

Información social		Frecuencia	Porcentaje
Modalidad por la que recibe el servicio	Por contrato	39	56.5%
	Sin contrato	30	43.5%
	Total	69	100.0%
Los servicios que solicita son para	Lima	46	66.7%
	Provincia	11	15.9%
	Lima y provincia	12	17.4%
	Total	69	100.0%
Tiempo recibiendo el servicio	Menos de 01 año	6	8.7%
	De 1 a 5 años	34	49.3%
	De 6 a 10 años	18	26.1%
	De 11 a 15 años	8	11.6%
	De 16 a 20 años	3	4.3%
	Total	69	100.0%
Frecuencia con la que solicita el servicio	1 vez al año	17	24.6%
	1 vez cada seis meses	13	18.8%
	1 vez cada tres meses	11	15.9%
	1 vez al mes	17	24.6%
	Más de 1 vez al mes	11	15.9%
	Total	69	100.0%

En la Tabla 3, se presentan los resultados obtenidos en las dimensiones de la variable Calidad de servicio, en la cual se observa que la primera dimensión de Fiabilidad, obtuvo un promedio de 4.49 puntos, cuyo indicador principal menciona que la Empresa Alpecorp desempeña bien el servicio por primera vez, con un promedio de 4.64 puntos, y el indicador menos favorecido es, Alpecorp brinda un servicio cero defectos y/o errores, obteniendo un promedio de 4.23 puntos. La segunda dimensión de Sensibilidad tiene un promedio de 4.67 puntos, el indicador con mayor puntaje es, Los colaboradores muestran disposición para ayudar con 4.72 puntos, y el menor es el indicador Los colaboradores de la empresa prestan un servicio rápido con 4.62 puntos. La tercera dimensión Seguridad alcanzó como promedio de 4.67 puntos y su indicador con mayor puntuación es, Los colaboradores, son corteses de manera constante con Ud., con 4.74 puntos, mientras que el indicador con menor puntuación es, Los colaboradores de Alpecorp, tienen conocimiento para responder a sus preguntas de forma precisa, con 4.57 puntos, se puede observar que

la dimensión Seguridad tiene muy bien establecido sus procesos. En la cuarta dimensión que es Empatía, el promedio es de 4.56 puntos, el indicador con mayor puntaje corresponde a, Los colaboradores entienden las necesidades específicas de lo que requiere, con 4.58 puntos, y con mejor puntaje tenemos al indicador, La empresa se preocupa por mejorar la atención con 4.51 puntos.

La última dimensión son los Elementos tangibles, con un promedio de 4.54 puntos, y el indicador que se destaca en puntaje es, Los colaboradores de la empresa están correctamente uniformados, con 4.61 puntos, seguido de Los equipos asociados con el servicio, son visualmente atractivos con 4.55 puntos y, por último, Los transportes que usa la empresa, son modernos con 4.45 puntos. Se concluye que las cinco dimensiones tuvieron promedios altos, en función a la escala del 1 a 5, donde 1 es nunca, 2 casi nunca, 3 a veces, 4 casi siempre y 5 siempre; y todas presentaron una frecuencia con tendencia que va entre Casi siempre a Siempre.

Tabla 3
Promedios de la variable calidad de servicio según dimensiones

Dimensiones	Ítems	Promedio
Fiabilidad (Prom 4.49)	1. Alpecorp cumple con el tiempo indicado.	4.54
	2. Al presentarse un problema con el servicio, Alpecorp muestra interés en resolverlo.	4.57
	3. La empresa Alpecorp desempeña bien el servicio por primera vez.	4.64
	4. Alpecorp brinda un servicio cero defectos y/o errores.	4.23
Sensibilidad (Prom 4.67)	5. Alpecorp le informa respecto a la ejecución de los servicios.	4.67
	6. Los colaboradores de la empresa prestan un servicio rápido.	4.62
	7. Los colaboradores muestran disposición para ayudar.	4.72

Seguridad (Prom 4.67)	8. El comportamiento de los colaboradores, infunde confianza.	4.67
	9. Usted se siente seguro de los servicios que presta Alpecorp.	4.72
	10. Los colaboradores, son corteses de manera constante con Ud.	4.74
	11. Los colaboradores de Alpecorp, tienen conocimiento para responder a sus preguntas de forma precisa.	4.57
Empatía (Prom 4.56)	12. Considera que Alpecorp le da atención individualizada.	4.57
	13. La empresa se preocupa por mejorar la atención.	4.51
	14. Los colaboradores entienden las necesidades específicas de lo que requiere.	4.58
	15. Alpecorp tiene horarios de atención convenientes con sus requerimientos solicitados.	4.59
Elementos tangibles (Prom 4.54)	16. Los transportes que usa la empresa, son modernos.	4.45
	17. Los colaboradores de la empresa están correctamente uniformados.	4.61
	18. Los equipos asociados con el servicio, son visualmente atractivos.	4.55

En la Tabla 4, se presentan los resultados obtenidos en las dimensiones de la variable Satisfacción del cliente. En la primera dimensión, la Calidad funcional percibida, con un promedio de 4.63, se puede decir que tiene una alta aceptación de parte de los clientes. Los indicadores con mayor puntuación, son tres que tienen un promedio es de 4.65, los cuales son, El personal de Alpecorp conoce mis intereses y necesidades como usuario, Me siento seguro del servicio que brinda Alpecorp y Alpecorp presta un servicio satisfactorio en comparación con otras empresas. La Calidad técnica percibida, como segunda dimensión presente un puntaje promedio de 4.44, donde el indicador con mayor puntaje es, La calidad de los servicios automatizados son buenos (teléfono, redes sociales, email, etc.), con 4.54 puntos y el menor puntaje lo presente el indicador, Usted ha observado mejoras en el servicio ofrecido por parte de su proveedor, con 4.28 puntos.

La tercera dimensión es el Valor percibido, con un puntaje promedio de 4.08, el indi-

cador con mayor puntaje promedio tiene 4.71 puntos, que menciona, Usted tiene confianza en esta empresa, y el menor puntaje de 2.55 lo presenta el indicador, ha tenido problemas o inconvenientes con los servicios prestados por Alpecorp.

La cuarta dimensión es la Confianza, con un puntaje promedio de 4.47, y su el indicador con mayor puntaje promedio es si, usted recomendaría a Alpecorp a otras empresas, con un puntaje de 4.62. Finalmente, la dimensión Expectativa con un puntaje promedio de 4.63, y, los indicadores con mayor puntaje promedio son, El personal de esta empresa es claro en las explicaciones o información dada y El personal de esta empresa posee los conocimientos acerca de los servicios prestados, con un puntaje de 4.64. Finalmente, los resultados de las cinco dimensiones de la satisfacción del cliente presentan promedios altos, en función a la escala del 1 a 5, donde 1 es nunca, 2 casi nunca, 3 a veces, 4 casi siempre y 5 siempre; y todas presentaron una frecuencia con tendencia que va entre Casi siempre a Siempre.

Tabla 4
Promedios de la variable satisfacción del cliente según dimensiones

	Ítems	Promedio
Calidad funcional percibida (Prom 4.63)	1. El personal de Alpecorp ha solucionado satisfactoriamente mis consultas.	4.61
	2. El personal de Alpecorp ha solucionado satisfactoriamente mis quejas.	4.58
	3. El personal de Alpecorp conoce mis intereses y necesidades como usuario.	4.65
	4. Me siento seguro del servicio que brinda Alpecorp.	4.65
	5. Alpecorp presta un servicio satisfactorio en comparación con otras empresas.	4.65
Calidad técnica percibida (Prom 4.44)	6. Usted ha observado mejoras en el servicio ofrecido por parte de su proveedor.	4.28
	7. La calidad de los servicios automatizados son buenos (teléfono, redes sociales, email, etc.).	4.54
	8. Sus expectativas son satisfechas con los servicios prestados por esta empresa.	4.51
Valor percibido (Prom 4.08)	9. Usted tiene confianza en esta empresa.	4.71
	10. La calidad de los servicios prestados en esta empresa son buenos, dadas sus tarifas.	4.55
	11. Ha tenido problemas o inconvenientes con los servicios prestados por Alpecorp.	2.55
	12. Si otra empresa me ofrece los mismos servicios, prefiero permanecer con Alpecorp.	4.49
Confianza (Prom 4.47)	13. Con Alpecorp sé que no tendré problemas o inconvenientes con los servicios.	4.35
	14. Usted recomendaría a Alpecorp a otras empresas.	4.62
	15. Los servicios prestados por esta empresa están cerca de los ideales.	4.36
	16. Esta empresa se preocupa por las necesidades de sus clientes	4.55
Expectativas (Prom 4.63)	17. El servicio que se ofrece en esta empresa se adapta a mis necesidades como usuario	4.61
	18. El personal de esta empresa es claro en las explicaciones o información dada.	4.64
	19. El personal de esta empresa posee los conocimientos acerca de los servicios prestados.	4.64

En la Tabla 5, se presenta la relación entre la calidad del servicio y la satisfacción en los clientes de la empresa Alpecorp, en la que ambas variables tienen un coeficiente Rho de Spearman de 0.821, lo que indica una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), que expresa que es altamente significativa.

En conclusión, tanto la calidad de servicio y la satisfacción del cliente están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si la calidad de servicio se incrementa, también se incrementará la Satisfacción del cliente o viceversa.

Tabla 5
Relación entre la calidad del servicio y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Calidad de servicio	.821**	.000	69

** La correlación es significativa en el nivel 0,01 (bilateral).

En la Tabla 6, se presenta la relación entre la fiabilidad y la satisfacción del cliente de la empresa Alpecorp, en la cual se observa que la relación tiene un coeficiente Rho de Spearman de 0.756, evidenciando una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), por lo que la relación es altamente significativa.

En conclusión, tanto la fiabilidad y la satisfacción están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si la fiabilidad mejorase, también se incrementará la satisfacción del cliente o viceversa.

Tabla 6
Relación entre la fiabilidad y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Fiabilidad	.756**	.000	69

** La correlación es significativa en el nivel 0,01 (bilateral).

En la Tabla 7, se presenta la relación entre la sensibilidad y la satisfacción del cliente de la empresa Alpecorp, en la cual se observa que la relación tiene un coeficiente Rho de Spearman de 0.622, lo que indica una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), por lo que la relación es altamente significativa.

En conclusión, tanto la sensibilidad y la satisfacción están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si la sensibilidad mejorará, también se incrementará la Satisfacción del cliente o viceversa.

Tabla 7
Relación entre la sensibilidad y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Sensibilidad	,622**	.000	69

** . La correlación es significativa en el nivel 0,01 (bilateral).

En la Tabla 8, se presenta la relación entre la seguridad y la satisfacción del cliente de la empresa Alpecorp, en la cual se observa que la relación tiene un coeficiente Rho de Spearman de 0.749, lo que indica una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), por lo que la relación es altamente significativa.

En conclusión, tanto la seguridad y la satisfacción están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si la seguridad mejorará, también se incrementará la Satisfacción del cliente o viceversa.

Tabla 8
Relación entre la seguridad y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Seguridad	,749**	.000	69

En la Tabla 9, se presenta la relación entre la empatía y la satisfacción del cliente de la empresa Alpecorp, en la cual se observa que la relación tiene un coeficiente Rho de Spearman de 0.705, lo que indica una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), por lo que la relación es altamente significativa.

En conclusión, tanto la empatía y la satisfacción están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si la empatía mejorará, también se incrementará la satisfacción del cliente o viceversa.

Tabla 9
Relación entre la empatía y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Empatía	,705**	.000	69

En la Tabla 10, se presenta la relación entre los elementos tangibles y la satisfacción del cliente de la empresa Alpecorp, en la cual se observa que la relación tiene un coeficiente Rho de Spearman de 0.637, lo que indica una relación directa y positiva, y un p valor igual a 0.000 ($p < 0.05$), por lo que la relación es altamente significativa.

Tabla 10
Relación entre los elementos tangibles y la satisfacción del cliente

	Satisfacción del cliente		
	Rho de Spearman	p valor	n
Elementos tangibles	.637**	.000	69

** La correlación es significativa en el nivel 0,01 (bilateral).

Discusión

El propósito de la presente investigación es la de confirmar la relación entre la calidad de servicio y la satisfacción de los clientes de la empresa Alpecorp S.A., 2018. De los objetivos propuestos en la investigación se pueden destacar varios aspectos relacionados con la calidad de servicio y satisfacción del cliente de la empresa Alpecorp S.A.

Del total de clientes encuestados se mostró que, existe relación entre la calidad de servicio y la satisfacción del cliente, el cual es positivo, directo y altamente significativo ($\rho = 0.821$, $p < 0.05$) es decir, que si existe una buena calidad el cliente estará satisfecho.

A propósito de ello Quispe (2015), en el estudio realizado en una clínica sobre calidad y servicio, aporta alimentar el resultado del objetivo general que se presenta en este estudio, coincidiendo que hay una correlación positiva moderada entre la variable calidad de servicio y la variable satisfacción del usuario y se afirma que la

En conclusión, tanto los elementos tangibles y la satisfacción están muy relacionado en la percepción de los clientes de Alpecorp, al ser una relación lineal y positiva se estima que, si los elementos tangibles mejorarán, también se incrementará la satisfacción del cliente o viceversa.

calidad de servicio se relaciona directamente con la satisfacción del usuario.

Asimismo, Coronel (2016) y González (1999) en sus investigaciones obtuvieron una correlación positiva mostrando que sea cual fuere el escenario la calidad siempre será causal de satisfacción. Es por ello que Cervantes (2003), utiliza la siguiente analogía "los billetes que entregan todos los bancos son los mismos; la diferencia entre un banco y otro radica en las personas que actúan como cajeros" mostrando que las empresas se distinguen por la atención al cliente, pueden existir diversas empresas ofreciendo el mismo servicio, pero no todas tienen el éxito de suplir la necesidad del cliente.

Es por ello que (Botero, 2006), resalta que las empresas no deberían cambiar todo o innovar de nuevo para llegar al cliente, sino que deben mejorar ya que si aún se conservan en el mercado es porque una de sus prácticas es valiosa, el cliente según Pepper y Martha Rogers desean exactamente lo que desean en el momento, lugar y forma como lo desean, donde Pizzo (2013), menciona que cali-

dad de servicio es un hábito que se desarrolla y practica por las organizaciones con el fin de interpretar necesidades y expectativas de sus clientes ofreciéndoles en consecuencia un servicio accesible, adecuado, ágil, flexible, apreciable, oportuno, seguro y confiable.

Es aquí donde se desarrolla el concepto de que el cliente tiene la razón y las empresas deben adecuarse a la necesidad de este, es así como una empresa llega a posicionarse y tener éxito en el mercado empresarial. La empresa Alpecorp ha sabido mostrar la calidad que ofrecen.

Además, la sensibilidad y seguridad son las dimensiones que más participación tuvieron dentro de la calidad de servicio en la cual se muestra que los clientes del Alpecorp, aseguran en su percepción, seguido de la empatía, los elementos tangibles y finalmente, la fiabilidad. De estos factores se ha de resaltar que para los clientes es muy importante acudir a quien le muestre seguridad.

Por su parte, Duque (2005), menciona que la seguridad es el sentimiento que tiene el cliente cuando pone sus problemas en manos de una organización y confía en que serán resueltos de la mejor manera posible. Entonces, seguridad implica credibilidad, que a su vez incluye integridad, confiabilidad y honestidad.

Viéndolo de manera concreta vendría a ser inexistencia de peligros, riesgos o dudas (Avalos et al 2014). Es por ello que Alpecorp al mostrar sensibilidad y seguridad está creando en su cliente confianza que le generará fidelizar a su cliente.

En palabras más sencillas, con respecto a la satisfacción del cliente, los

participantes en la investigación nombraron cuáles son las dimensiones con mayor énfasis, la calidad funcional percibida y las expectativas van en primer lugar, seguido de la Confianza, la calidad técnica percibida y el valor percibido, sin embargo, todas las dimensiones tienen una alta percepción con respecto a las bondades de la empresa.

De modo que la conceptualización de calidad funcional percibida hace referencia a la brecha existente entre el valor de las expectativas antes de recibir el servicio y la percepción luego de haberlo recibido (Cardenas, 2013). Y Liljander y Strandvik (1995) sugiere que los clientes conforman sus expectativas al respecto del desempeño de las características del producto o servicio antes de realizar la compra.

Que estas dos dimensiones resalten en la empresa Alpecorp le genera credibilidad si esta cumple con las expectativas del cliente, de los ítems analizados estas dimensiones son las más completas.

Finalmente, otro aspecto a favor de la empresa, es que la modalidad de cómo recibe el servicio el 56.5% es por contrato, lo cual asegura poder tener la calidad y llegar a la satisfacción de los clientes ya que crea en ellos confianza.

Según Infante (2015), confianza se puede determinar en distintos aspectos ya sea confianza organizacional, social, cliente-organización, confianza con los mercados entre otros, llegando a concluir que sea el aspecto que influya requiere una imagen presentada por la empresa, basándose en reputación, ayuda social, calidad entre otros. El cual lleva a formar cohesión o asociatividad por un fin individual tanto de la empresa como del cliente.

Conclusiones

Con base en los resultados obtenidos de la percepción de los clientes de Alpecorp, en la Investigación se concluye como sigue:

- Del total de clientes encuestados en Alpecorp, ($\rho = 0.821$, $p < 0.05$) mostraron que existe relación entre la calidad de servicio y la satisfacción del cliente el cual es positivo, directo y altamente significativo, lo cual se traduce como una relación directa en donde, si la calidad de servicio mejorará, la satisfacción del cliente también mejorará, no obstante, puede pasar lo contrario.
- Se observó que hay una relación directa, positiva y altamente significativa entre la fiabilidad y la satisfacción del cliente; en la que los clientes aseguran su satisfacción con base en un buen desempeño en la primera vez del servicio.
- Así también, se determinó que entre la sensibilidad y la satisfacción de cliente hay una relación directa, positiva y altamente significativa. Y se caracteriza principalmente por la disposición que muestran los colaboradores de Alpecorp para ayudar e informar la ejecución del servicio.
- La relación entre la seguridad y la satisfacción del cliente de Alpecorp es directa positiva y altamente significativa. Y su satisfacción se ve influenciada por la cortesía, que a su vez infunde confianza y hace que se sientan seguros.
- Quedó en evidencia una relación entre la empatía y la satisfacción del cliente, que es directa positiva y altamente significativa. En esta dimensión los clientes enfatizan que se sienten satisfechos con Alpecorp porque los horarios que ofrece son convenientes y se adaptan a su necesidad.
- Con respecto a los elementos tangibles y la variable satisfacción del cliente, la relación es directa, positiva y altamente significativa. La satisfacción del cliente se incrementa en esta dimensión cuando observan que el colaborador está correctamente uniformado y los equipos y herramientas se adaptan a las necesidades.
- Con respecto a la satisfacción del cliente, los participantes en la Investigación nombraron cuáles son las dimensiones con mayor énfasis, la calidad funcional percibida y las expectativas van en primer lugar, seguido de la Confianza, la calidad técnica percibida y el valor percibido, sin embargo, todas las dimensiones tienen una alta percepción con respecto a las bondades de la empresa.

Recomendaciones

Mediante el desarrollo de la Investigación se han identificado aspectos fundamentales, los cuales se deben mejorar para brindar una mejor calidad de servicio y en función a la satisfacción del cliente.

- Es menester destacar que Alpecorp, según los resultados de la investigación, es una empresa que brinda un servicio fiable pero que a la vez comete errores que son notorios para el cliente, con base en ello, se recomienda que puedan identificar sus nodos críticos, actividades o decisiones que estén afectando el ofrecer un servicio con cero errores.
- Sin duda alguna, Alpecorp muestra sensibilidad al público y está presta a brindar sus servicios, no obstante, es recomendable tener siempre un plan de contingencia en caso de urgencias de los clientes y de este modo evitar mostrar al público la falta de eficacia en la ejecución del servicio.
- Para generar mayor seguridad en el cliente, se debe capacitar y actualizar constantemente a los colaboradores respecto a la calidad de servicio, así como también considerar los procesos de la organización, información técnica del funcionamiento y operatividad de los servicios de acuerdo con lo pactado en función de los clientes, para que sus respuestas hacia el usuario tengan mayor precisión.
- En la dimensión de empatía se recomienda Alpecorp, demostrar y hacer que el cliente perciba la preocupación de la empresa por mejorar el servicio mediante el uso de herramientas de post venta, y establecer una encuesta breve en base a los ítems que detectan los aspectos que la empresa debería reforzar para alcanzar una calidad de servicio y satisfacción del cliente óptimo.
- En cuanto a la dimensión de elementos tangibles, se le sugiere a Alpecorp acondicionar sus equipos y vehículos de transporte con los diferentes espacios geográficos y de logística de los lugares en donde se ofrece un servicio in situ.
- Realizar un plan de trabajo que ayude a fidelizar al cliente con estrategias de mejora bajo el análisis de esta investigación.

Investigación cualitativa: Relevancia, historia y rasgos

La investigación cualitativa se está estableciendo en las ciencias sociales y en la psicología. Actualmente se dispone de una gran variedad de métodos específicos cada uno de los cuales parte de diferentes premisas y persigue propósitos distintos. Cada método se basa en una comprensión específica de su objeto. Sin embargo, los métodos cualitativos no se pueden considerar independientemente del proceso de investigación y el problema en estudio. Están incrustados específicamente en el proceso de investigación y se comprenden y describen mejor utilizando una perspectiva de proceso. Por tanto el objetivo primordial de este libro consistirá en presentar los diferentes pasos en el proceso de investigación cualitativa. En este marco de proceso se localizarán los procedimientos más importantes para recoger e interpretar los datos y para evaluar y presentar los resultados. Esto proporcionará a los lectores una visión general del campo de la investigación cualitativa, de las opciones metodológicas concretas y de sus afirmaciones, aplicaciones y límites. Esto debería permitir a los lectores escoger la estrategia metodológica más apropiada con respecto a su pregunta y sus problemas de investigación.

Relevancia de la investigación cualitativa

La investigación cualitativa tiene relevancia específica para el estudio de las relaciones sociales, debido al hecho de la pluralización de los mundos vitales. Expresiones clave para esta pluralización son la "nueva oscuridad" (Habermas, 1996), la creciente "individualización de las maneras de vivir y los patrones biográficos" (Beck, 1992) y la disolución de las "viejas" desigualdades sociales en la nueva diversidad de medios, subculturas, estilos de vida y maneras de vivir (Hradil, 1992). Esta pluralización requiere una nueva sensibilidad para el estudio empírico de los problemas. Los defensores del postmodernismo han afirmado que la era de las grandes narraciones y teorías ha pasado: en la actualidad se requieren narraciones limitadas local, temporal y situacionalmente. Con respecto

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a la pluralización de los estilos de vida y los patrones de interpretación en la sociedad moderna y postmoderna, la afirmación de Herbert Blumer es pertinente otra vez y tiene nuevas implicaciones: "La posición inicial del científico social y el psicólogo es, prácticamente siempre, una falta de familiaridad con lo que está teniendo lugar realmente en la esfera de vida escogida para estudio" (1969, página 33).

El rápido cambio social y la diversificación resultante de los mundos vitales están enfrentando cada vez más a los investigadores sociales con nuevos contextos y perspectivas sociales. Estos son tan nuevos para ellos que sus metodologías deductivas tradicionales —derivar las preguntas de investigación y las hipótesis a partir de modelos teóricos y ponerlas a prueba frente a los datos empíricos— no tienen éxito en la diferenciación de los objetos. Así, la investigación se ve forzada cada vez más a hacer uso de estrategias inductivas: en lugar de partir de teorías y comprobarlas, se requieren "conceptos sensibilizadores" para enfocar los contextos sociales que deben estudiarse. Sin embargo, contrariamente a un extendido error de comprensión, estos conceptos están influidos ellos mismos por el conocimiento teórico previo. Pero aquí, las teorías se desarrollan a partir de estudios empíricos. El conocimiento y la práctica se estudian como conocimiento y práctica *locales* (Geertz, 1983).

Con respecto a la investigación en psicología en particular, se propone que carece de relevancia para la vida cotidiana porque no se dedica lo suficiente a describir con exactitud los hechos de un caso (Dörner, 1983). El estudio de los significados subjetivos y la experiencia y la práctica cotidianas es tan esencial como la contemplación de las narraciones (Bruner, 1991; Sarbin, 1986) y los discursos (Harré, 1998).

Límites de la investigación cuantitativa como punto de partida

Tradicionalmente, la psicología y las ciencias sociales han tomado las ciencias naturales y su exactitud como modelo, prestando particular atención al desarrollo de métodos cuantitativos y estandarizados. Se han utilizado principios rectores de la investigación y de la planificación de la investigación para los propósitos siguientes: aislar claramente las causas y los efectos, operacionalizar adecuadamente las relaciones teóricas, medir y cuantificar los fenómenos, crear diseños de investigación que permitan la generalización de los hallazgos y formular leyes generales. Por ejemplo, se seleccionan muestras aleatorias de las poblaciones para asegurar la representatividad. Se hacen afirmaciones generales con la mayor independencia posible de los casos concretos que se han estudiado. Los fenómenos observados se clasifican según su frecuencia y distribución. Para clasificar las relaciones causales y su validez con la mayor claridad posible, las condiciones en las que se producen los fenómenos y las relaciones bajo estudio se controlan hasta donde cabe la posibilidad. Los estudios se diseñan de manera que la influencia del investigador (del entrevistador, del observador, etc.) pueda excluirse al máximo. Esto debería garantizar la objetividad del estudio, por la que las opiniones subjetivas del investigador así como las de los individuos investigados se eliminan en gran parte. Se han formulado estándares

obligatorios generales para realizar y evaluar la investigación social empírica. Procedimientos del tipo de cómo construir un cuestionario, cómo diseñar un experimento y cómo analizar estadísticamente los datos se han depurado cada vez más.

Durante mucho tiempo, la investigación psicológica ha utilizado casi exclusivamente diseños experimentales. Por medio de ellos, se han producido grandes cantidades de datos y resultados, que demuestran y someten a prueba las relaciones psicológicas entre las variables y las condiciones en las que son válidas. Por las razones mencionadas antes, durante un largo periodo la investigación social empírica se basó sobre todo en encuestas estandarizadas. El propósito era documentar y analizar la frecuencia y la distribución de los fenómenos sociales en la población, por ejemplo, algunas actitudes. En una medida cada vez menor, los estándares y los procedimientos de la investigación cuantitativa han sido examinados y analizados fundamentalmente para clarificar para qué objetos y preguntas de investigación son apropiados y para cuáles no.

Cuando la investigación llevada a cabo con los objetivos anteriores se sopesa en conjunto, los resultados vienen a ser bastante negativos. Hay un considerable desencanto con los ideales de objetividad: hace algún tiempo Max Weber (1919) proclamó el "desencanto del mundo" como tarea de la ciencia. Más recientemente, Bonß y Hartmann (1985) han propuesto el desencanto creciente de las ciencias, sus métodos y sus hallazgos. En el caso de las ciencias sociales, el bajo grado de aplicabilidad y capacidad de conexión de los resultados se toma como un indicador de esto. Menos extensamente de lo que se esperaba —y sobre todo de una manera muy diferente— los hallazgos de la investigación social se han abierto camino en contextos políticos y cotidianos. La "investigación de la utilización" (Beck y Bonß, 1989) ha demostrado que los hallazgos científicos no se llevan a las prácticas políticas e institucionales tanto como se esperaba. Cuando se adoptan, están obviamente interpretados y desmenuzados: "La ciencia no produce ya 'verdades absolutas', que se puedan adoptar sin crítica. Proporciona ofertas limitadas para la interpretación, que llegan más allá de las teorías cotidianas pero se pueden utilizar en la práctica de modo comparativamente flexible" (1989, página 31).

Está claro también que los resultados de las ciencias sociales rara vez se perciben y utilizan en la vida cotidiana porque —para cumplir los estándares metodológicos— sus investigaciones y hallazgos a menudo están muy alejados de las preguntas y los problemas cotidianos. Por otro lado, los análisis de la práctica de la investigación han demostrado que una gran parte de los ideales de objetividad formulados con antelación no se pueden satisfacer. A pesar de todos los controles metodológicos, en la investigación y sus hallazgos intervienen inevitablemente los intereses y el fondo social y cultural de los implicados. Estos factores influyen en la formulación de las preguntas e hipótesis de investigación lo mismo que en la interpretación de los datos y las relaciones.

Por último, el desencanto que Bonß y Hartmann plantean tiene consecuencias para la forma de conocimiento por la que la psicología y las ciencias sociales pueden esforzarse y, sobre todo, la que pueden producir: "Bajo el estado de desencanto de los ideales objetivistas, ya no podemos partir irreflexivamente de la noción de oraciones objetivamente verdaderas. Lo que resta es la posibilidad de expresiones que estén relacionadas con los sujetos y las situaciones, y que un

Bibliografía recomendada

La indicación, la evaluación del proceso y la gestión de la calidad de la investigación cualitativa se plantean en los siguientes textos.

- FLICK, U. (2005): *Qualitative Research in Psychology: A Textbook*. Londres: Sage.
FLICK, U. (2002b): "Qualitative Research: State of the Art", *Social Science Information*, 41(1): págs. 5-24.

Aprendizaje y enseñanza de métodos cualitativos

En esta fuente se pueden encontrar ejemplos de enseñanza de investigación cualitativa haciendo investigación concreta.

- FLICK, U. y BAUER, M. (2004): "Teaching Qualitative Research", en U. FLICK, E. V. KARDOFF y STEINKE, I. (Comps.), *A Companion to Qualitative Research*, Londres: Sage, páginas 340-348.

El futuro de la investigación cualitativa: Arte o método

En su perspectiva, los autores hacen evidente la tensión de arte y método de una forma específica.

- LINCOLN, Y. S. y DENZIN, N. K. (2000): "The Seventh Moment", en N. DENZIN e Y. S. LINCOLN (Comps.), *Handbook of Qualitative Research* (2.ª ed.). Londres: Sage, págs. 1047-1065.

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- Fecha: 20 noviembre 2020 16.10
- Título: El futuro de la movilidad Sostenible es Ahora.

Resumen de la intervención:

TÍTULO: El Futuro de la Movilidad Sostenible es Ahora

Actualmente la sociedad se enfrenta una nueva movilidad, derivada de la diversificación de transporte que han emergido en los últimos años (plataformas de prestación de servicios); transporte masivo; inclusión de vehículos eléctricos, entre otros. Una movilidad que el usuario espera sea eficiente que se centre en el valor del tiempo de desplazamiento, calidad ambiental, calidad del entorno. Adicionalmente, la movilidad debe estar en sincronía a las respuestas de los diferentes desafíos que se enfrentan, como es el caso del presente año con el Covid 19, donde implica la implementación de nuevas formas y tecnologías de movilidad que ofrezcan una solución de seguridad vial y personal, riesgo de contagio, manejo de congestión, contaminación, etc.

A nivel mundial, se han establecido metas donde la movilidad eléctrica se presenta como una de las soluciones más atractivas ambientalmente y de sostenibilidad; por ejemplo, se proyecta que al 2040 cerca del 90 % del parque automotor serán VE o el acuerdo realizado por los fabricantes en EU donde a partir del 2035 solo fabricarán VE. Según IHS Markit, en el primer semestre del presente año, uno de cada 5 coches eléctricos vendidos en todo el mundo era un Tesla, concentrando el 21 % de las matriculas mundiales de coches eléctricos e híbridos, donde BMW y Volkswagen le siguen con un 7 % cada una de ellas y volvo, Renault, Hyundai, BYD, Kia y Audi todas con un 4 %.

Pero la inclusión de vehículos eficientes y amigables ambientalmente son solo un eslabón de toda la cadena que se debe implementar para un cambio radical de la movilidad, donde la implementación de estrategias de mediano y largo e diferentes ámbitos deben ser abordadas: en el mediano plazo se hace necesario un cambio en las prioridades y en las políticas públicas, armonizadas con las empresas y el estado (teletrabajo, flexibilidad en las jornadas laborales; educación virtual.); mayor uso y cobertura del internet; Cambios en los industria automotriz, asociada a fabricación de medios de transporte eléctricos: motos, Bicis, VE para carga y pasajeros, individuales y colectivos, VH; mayor preferencia por uso de vehículos individuales particulares; mayor interés por proteger el medio ambiente y demanda intensiva de mano de obra para cadena logística y de movilidad eléctrica, por nombrar algunos.

En el caso especial de la región metropolitana el nuevo modelo de movilidad se fundamenta en tres niveles: estratégico; táctico y operativo. El nivel estratégico se respalda con políticas que orienten el ordenamiento territorial y visión regional de la Región Metropolitana: TM, y logística como estructurante; la política de crecimiento verde Conpes 3934 de 2018 es una de las estrategias que se han establecido a nivel gubernamental o la creación de la Región Metropolitana Bogotá como una entidad administrativa de asociatividad de régimen especial, con el objetivo de ejecutar planes y programas de desarrollo sostenible, entre otras actividades.

El nivel táctico se aborda la necesidad de tener un sistema de transporte que este al nivel de la región la cual representa el 25 % del PIB; con un ritmo de crecimiento del 3 % (al 2019 según DANE); con una concentración del 20 % de la población del país con una proyección al 2050 de 13'872.000 habitantes. El Plan Maestro de Transporte Intermodal-PMTI es una estrategia táctica nacional que pretende articular el servicio de transporte e infraestructura en construcción, con el sistema logístico nacional, se espera se convierta en la herramienta de planeación de largo plazo del sector, teniendo en cuenta criterios que faciliten el comercio exterior, la promoción de mercados internos e integración del territorio y contempla los modos vial, férreo, aéreo, portuario y aeroportuario, además del componente logístico, enfocado en la primera fase, a las necesidades nacionales.

A nivel operativo la implementación del sistema inteligente de transporte para la ciudad de Bogotá, que busca tener un control y gestión de incidentes, control centralizado, monitoreo de tránsito; que contribuyan a la disminución de accidentes e identificación de infracciones, lo que implica una inversión en obras civiles y sistemas de control (sensores vehiculares, semaforización, controladores y postes). Bogotá y la región afrontará en los próximos años cambios es diferentes ámbitos: Consolidar un SITMP con la experiencia ganada; el nuevo plan de ordenamiento para Bogotá; el caso de corabastos y el plan maestro de abastecimiento; revisión del plan maestro de movilidad para Bogotá, el nuevo aeropuerto el dorado II previsto en Mosquera y faca; la avenida longitudinal de occidente ALO; la continuidad de la red vial hacia la sabana y la región; infraestructuras logísticas vs proyectos de desarrollo inmobiliario; el paso de los usos de suelo con visión local a visión regional, entre otros.

Finalmente, se hace necesario prepararnos para un futuro incierto, lleno de oportunidades, detectar los posibles cambios, por medio del entendiendo, estudiando, pensando y actuando muy rápido, cuando las tendencias cambian de manera cierta. Es preciso preferir decisiones que puedan adaptarse a condiciones cambiantes; dar un alto valor preponderante a la flexibilidad, a la versatilidad, y al cambio.

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- Fecha: 20 noviembre 2020 16.10
- Título: El futuro de la movilidad cero emisiones

Resumen de la intervención:

TÍTULO: El Futuro de la Movilidad Cero Emisiones

ANDEMOS es la organización gremial de naturaleza privada que agrupa a importadores y ensambladores de vehículos automotores de Colombia y que busca conciliar los intereses de las empresas representadas y el gobierno Colombiano incidiendo en el desarrollo de las políticas relativas a los vehículos automotores y a la movilidad. Andemos ha sido pionera en el país en la importación y promoción de vehículos de cero emisiones, eléctricos e híbridos como una contribución a la movilidad sostenible. Andemos incide en el desarrollo de la legislación y normativa nacional relacionada con el uso de vehículos eléctricos. Esto ha contribuido a que Colombia sea el país con mayor cantidad de vehículos eléctricos de la región.

La industria automotriz mundial ha venido trabajando en el desarrollo de tecnologías y productos que reduzcan su dependencia de los hidrocarburos como fuente energética teniendo en cuenta la importante contribución de las fuentes móviles a la contaminación del aire, principalmente los vehículos pesados para el transporte masivo de personas y de mercancías. Las leyes europeas que regulan las emisiones desde los años 90's han jalonado este esfuerzo, no solamente en la reducción de las emisiones de los vehículos sino también en la renovación del parque automotor que en la actualidad es de menos de 10 años en Europa, en contraste con la edad promedio de los vehículos en Colombia que es de 16 años para vehículos particulares y de 23 años para el transporte pesado. Un hito importante en el cambio de paradigma fue el "diesel gate", en el cual se revelaron malas prácticas de un importante fabricante en el manejo de las emisiones de sus vehículos. Este escándalo reforzó el endurecimiento de las normativas relacionadas con las emisiones. Se pueden nombrar como ejemplos la intención del Reino Unido de eliminar los vehículos de combustión interna para el 2030, la de la ciudad de París que se propuso no tener vehículos diesel circulando en su casco urbano para el 2025 o los planes de reducción de emisiones de estados americanos como el de California.

Frente a esta situación y teniendo en cuenta que las innovaciones tecnológicas para la reducción de material particulado y de óxidos de nitrógeno de los vehículos de combustión interna están llegando a su límite, los principales fabricantes de vehículos están reorientando sus políticas y sus procesos de producción. En el corto plazo se ha revertido la tendencia de la “dieselización” de los vehículos y hay una reorientación de la industria hacia los vehículos de bajas emisiones como los híbridos o de cero emisiones. Los vehículos de cero emisiones que han visto un mayor desarrollo y sustituirán a los de combustión interna, son los eléctricos; aunque la industria trabaja en otras tecnologías promisorias como los vehículos impulsados con hidrógeno. La masificación de los vehículos eléctricos enfrenta algunos retos como la reducción de los precios tanto de los vehículos como de las baterías y el andamiaje normativo de los países. Se ha visto una tendencia a la mejora de las tecnologías de baterías y a la reducción de su huella ambiental y en la reducción de los costos de fabricación de los vehículos eléctricos e híbridos. China es en la actualidad el mayor fabricante mundial de vehículos eléctricos y ha incidido en dicha reducción de precios. Finalmente se han hecho ajustes a las normativas y leyes locales como la reducción de la carga arancelaria en Colombia para los vehículos híbridos y eléctricos. Además del cambio en la industria automotriz tradicional se ha visto una diversificación en los medios de transporte con el crecimiento de patinetas y bicicletas eléctricas y un enorme crecimiento del uso de bicicletas convencionales.

06 | El estado de la investigación científica sobre movilidad urbana en Ecuador

The state of scientific research in urban mobility in Ecuador

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Resumen

En la última década, en Ecuador, la transferencia de competencias de planificación, regulación y control del tránsito y el transporte a los municipios obliga a incrementar y mejorar la investigación en el ámbito de la movilidad, para garantizar que políticas públicas, planes, programas y proyectos se basen en evidencias. Este texto revisa la literatura científica al respecto para conocer el estado de la investigación sobre movilidad urbana y transporte en Ecuador. Se recopiló bibliografía de revistas indexadas de los últimos diez años. Se concluye que los principales temas abordados han sido la eficiencia energética, la movilidad no motorizada, el transporte público y los sistemas inteligentes. No obstante, es claro que aún hay varias temáticas, principalmente sociales, que deben ser estudiadas y analizadas; estudios de carácter interdisciplinar que apliquen instrumentos tanto cuantitativos como cualitativos podrían aportar a salvar las brechas existentes.

Palabras claves:

movilidad, transporte, Ecuador, investigación, revisión de literatura

Abstract

In the last decade in Ecuador, the transfer of planning, regulation and control of transit and transport competencies to municipalities, forces to increase and improve research in the field of mobility to ensure that public policy, plans, programs and projects are based on evidence. This text describes a review of scientific literature conducted to know the status of urban mobility and transport research in Ecuador. Bibliography of indexed journals of the last 10 years was compiled. It is concluded that the main issues that have been addressed are energy efficiency, non-motorized mobility, public transport and intelligent systems. However, it is clear that there are still several themes, mainly social, that must be studied and analyzed; to do this, interdisciplinary studies that apply both quantitative and qualitative instruments could help to approach existing gaps.

Keywords:

mobility, transport, Ecuador, research, literature review

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En las últimas décadas, con el cambio de paradigma en la planificación hacia un urbanismo sustentable, desde el punto de vista ambiental, social y económico, el concepto de movilidad ha entrado en el radar de académicos, técnicos y ciudadanía. Se entiende a la movilidad como la suma de todos los desplazamientos individuales; por lo tanto, no depende solo de los medios de transporte, sino de las características de la demanda: distancias, motivos, nivel de renta, edad y género, así como también de las características de la oferta: medios de transporte, posibilidad de ir a pie o en bicicleta (Miralles-Guasch, 2002). El concepto de movilidad incorpora a los modos motorizados y no motorizados, e inclusive a la inmovilidad.

En el caso ecuatoriano, la normativa a nivel nacional no ha estado ajena a estos cambios de paradigma. A pesar de que aún no incluye la palabra "movilidad" en su título, la nueva Ley Orgánica de Transporte Terrestre, Tránsito y Seguridad Vial³, expedida en 2008, se fundamenta en "la equidad y solidaridad social, derecho a la movilidad de personas y bienes, respeto y obediencia a las normas y regulaciones de circulación, atención al colectivo de personas vulnerables, recuperación del espacio público en beneficio de los peatones y transportes no motorizados y la concepción de áreas urbanas o ciudades amigables". Esto se diferencia de leyes anteriores, en las cuales no se incluían estos preceptos. Uno de los aspectos más interesantes de los cambios de legislación en los últimos años ha sido la transferencia de competencias de planificación, regulación y control del tránsito y el transporte a los municipios del Ecuador. Es decir, las funciones que anteriormente ejercía el Estado ahora las ejercen los municipios grandes, intermedios y pequeños. Esta transferencia de competencias tiene sus inicios con la expedición del Código Orgánico de Organización Territorial, Autonomía y Descentralización (COOTAD)⁴, de 2010.

Por otro lado, varias ciudades ecuatorianas han apostado en este inicio de siglo por nuevos e importantes proyectos de transporte público, lo cual obliga a recopilar, procesar y analizar de forma periódica datos cuantitativos y cualitativos no solo sobre la operación de los sistemas, sino sobre los impactos positivos y negativos que se pueden producir en los usuarios, en sus áreas de influencia y en la ciudad en general. Tal es el caso de los sistemas de buses de tránsito rápido (BRT, por sus siglas en inglés) en Quito

y Guayaquil, el metro y el tranvía en Quito y Cuenca, respectivamente⁵, y aquellos menos tradicionales, como el Quito-Cable y la aerovía en Guayaquil⁶.

Por todo lo anterior, se ha vuelto aún más necesaria la investigación sobre la movilidad en las ciudades ecuatorianas. De acuerdo a una revisión de bibliografía y a encuestas a investigadores y grupos académicos, se detecta que la investigación en materia de movilidad y transporte en nuestras ciudades inició con más intensidad aproximadamente en el 2010. A pesar de su relativa juventud, se pueden encontrar aportes importantes; no obstante, hay todavía un largo camino por recorrer y brechas por salvar.

El texto a continuación relata un levantamiento de bibliografía realizado para detectar el estado de la investigación sobre movilidad y transporte en el país. Para ello, se recopilaron artículos científicos publicados en revistas indexadas hasta mayo de 2019, utilizando como motores de búsqueda las palabras "movilidad", "mobility", "transporte" y "transport", conjuntamente con "Ecuador". El criterio de inclusión para las palabras "movilidad" y "mobility" fue que los artículos se refirieran a la movilidad urbana (excluyendo de esta manera la movilidad socioeconómica o humana). Las bases de datos utilizadas para la búsqueda fueron Scopus, ScienceDirect y Google Scholar. En este punto es importante destacar que, a pesar de que existen contribuciones valiosas en formato de libro, tesis de pre y posgrado y otro tipo de documentos, para este estudio se ha limitado la búsqueda a las publicaciones indexadas. Se encontraron 43 artículos que abordan la movilidad y/o el transporte en Ecuador, escritos por autores tanto nacionales como internacionales. Se destacan aquellos sobre eficiencia energética, movilidad no motorizada, transporte público y sistemas inteligentes. Los estudios se realizaron principalmente en las ciudades de Quito y Cuenca.

¿Qué se ha explorado?

Eficiencia energética

En la literatura revisada se encontraron varios estudios relacionados con la eficiencia energética. Dentro de ellos, la transportación eléctrica ocupa un lugar importante.

⁵ Estos dos proyectos aún no se encuentran operando al momento de redactar este texto (septiembre de 2019). El metro de Quito se encuentra en construcción. Las obras del tranvía de Cuenca están concluidas, pero todavía no ha iniciado su operación.

³ Disponible en: <https://bit.ly/2F7ZdeO>.

Por ejemplo, se han estudiado las motocicletas eléctricas mediante comparaciones entre técnicas de control: control directo de torque y campo de control orientado (Fernández y Coello, 2017a; Fernández y Coello, 2017b).

En cuanto al transporte público eléctrico, Ramírez, Arcentales y Boero (2019) realizan una comparación entre las emisiones producidas por los BRT de Guayaquil y por los buses eléctricos (simulando un reemplazo parcial de la flota); de esta forma, presentan una oportunidad para reducir las emisiones de gases de efecto invernadero (GEI). Díez et al. (2012) proponen la inserción de sistemas de transporte eléctrico masivo en las ciudades, mediante redes eléctricas inteligentes (*smart grids*) que gestionen de manera eficiente la electricidad. A partir de esto, ofrecen un método para evaluar la efectividad de la electrificación con el fin de mitigar los efectos del calentamiento global.

En Cuenca, Medina y Merchán (2017) efectúan un pronóstico sobre la cantidad de vehículos eléctricos que se podrían incorporar en el mercado de la ciudad. Ellos concluyen que, si bien el panorama es prometedor en cuanto al aumento en la adquisición de vehículos eléctricos, posiblemente la ciudad no cuente con la infraestructura necesaria para su introducción masiva. En el estudio realizado en Cuenca por González, Siavichay y Espinoza (2019) se determinó que 23 estaciones de carga rápida podrían ser suficientes para satisfacer la penetración de un 10 % de vehículos eléctricos (11 500 unidades) en la zona urbana. Así también, existe un estudio que propone el diseño y la implementación de una estación de carga solar fotovoltaica para vehículos eléctricos, y concluye con características de su aplicación dentro del país (Ríos et al., 2017). Esta es información que puede ayudar a dar el primer paso a la electrificación en esta y en otras ciudades.

Otras investigaciones se concentran en analizar el impacto económico como una forma de demostrar los beneficios de las acciones a favor de la eficiencia energética. Tal es el caso de Posso et al. (2015), quienes analizan el potencial de la producción de hidrógeno como combustible de los vehículos. Sin embargo, si bien un análisis económico llega a determinar la factibilidad de un sistema dentro de la ciudad, el estudio de las políticas públicas también es relevante para la incorporación de soluciones que disminuyan las emisiones de GEI. Para esto, Vera, Clairand y Álvarez (2017) vieron la necesidad de una política que facilite la adopción de los vehículos eléctricos dentro de las ciudades, con base en un análisis de mercado y de impactos sobre la electricidad. Los autores describen acciones que se pueden tomar para desarrollar

una propuesta de política que impulse la movilidad eléctrica en Ecuador.

En lo referente a los patrones de consumo de combustible, demanda de energía e incidencia en la contaminación ambiental, existen algunos textos que demuestran los impactos y proponen recomendaciones que podrían ser asumidas por las instituciones para el planteamiento de políticas públicas (Corral et al., 2017; Alarcón, 2011; Cevallos, 2016).

Movilidad no motorizada

Uno de los temas en los que se evidencia un gran interés tanto en Quito como en Cuenca es la movilidad no motorizada. En una revisión de literatura llevada a cabo por Orellana, Hermida y Osorio (2016), los autores plantean la necesidad de que la movilidad activa sea estudiada en tres componentes: metodológico, conductual y perceptual; para ello, señalan, que deben aplicarse diversas herramientas tanto cualitativas como cuantitativas. Solo así, consideran, se pueden plantear políticas y prácticas para la planificación de la movilidad sostenible.

Los estudios encontrados en Ecuador emplean en su mayor parte metodologías mixtas. Así, por ejemplo, se utilizan instrumentos de carácter etnográfico (diarios de fotografías participativas más procesamiento de datos cartográficos) para explorar las experiencias de los ciclistas en Quito. Se llega a concluir sobre la importancia de la centralidad y de la existencia de infraestructura para bicicletas y de espacios verdes (Gamble, Snizek y Sick Nielsen, 2017). En la misma línea, Vivanco (2018) estudia desde la teoría de la práctica social a los ciclistas de Quito. El autor comenta que, además de factores instrumentales como el tiempo y la distancia, otros aspectos como la seguridad vial y la seguridad personal impactan decisivamente en los ciclistas, creando barreras psicológicas. Sostiene que para contrarrestar este fenómeno se debe trabajar en la creación de espacios amigables para los ciclistas.

En el caso de Cuenca, se han probado varias metodologías para analizar la movilidad no motorizada. Un estudio desarrollado en la ciudad con ciclistas voluntarios utiliza técnicas de minería de datos en la plataforma ArcGIS para conocer sobre patrones de movilidad; a partir de la gran cantidad de información obtenida se pueden plantear estrategias espacio-temporales para promover el uso de la bicicleta (Abad y Orellana, 2018). Así también, Orellana et al. amplían el tradicional

análisis de infraestructura ciclista, incorporando la variable del esfuerzo humano al momento de pedalear. Los autores resaltan "la importancia de considerar el tipo de superficie de rodadura adicionalmente a la topografía y a las intersecciones en el cálculo de la energía consumida por el ciclista como valor de impedancia en los análisis de movilidad ciclista basados en la capacidad para realizar dicho trabajo. En el caso de estudio analizado se demostró que la omisión de este factor puede sobreestimar en promedio un 24 % el área de servicio de la infraestructura ciclista" (2019: 289). Además, su proyecto concluye con la recomendación de una herramienta automatizada de análisis utilizando sistemas de información geográfica.

En cuanto a peatones, Hermida, Cordero y Orellana (2019) realizan una observación de varios tramos de la ciudad de Cuenca, a través de un levantamiento físico-espacial y un conteo. Los autores determinan, mediante un procesamiento estadístico inferencial, que el ancho de la vereda se correlaciona de manera positiva con el flujo peatonal, pero que, contrariamente a esto, el retiro frontal y el estacionamiento en la vía tienen una correlación negativa. Sugieren, además, que la intervención en estos aspectos mencionados no es costosa, por lo que podría ser asumida por los Gobiernos locales a través de normativa urbana.

Es interesante comprobar que existe una curiosidad cada vez mayor por entender el impacto de la accesibilidad peatonal a las paradas de transporte colectivo como una condición fundamental para el éxito de los sistemas de transporte público. Así, Núñez (2017), utilizando sistemas de información geográfica, analiza la situación peatonal para un radio de cobertura de 500 metros alrededor de las paradas de transporte público en Quito en zonas de alto tráfico. Los resultados demuestran la importancia de la ubicación de las paradas con relación al acceso peatonal, y establece las calles que deberían ser intervenidas para mejorar la accesibilidad. La autora, en un estudio similar realizado en coautoría con Natalia Martins, compara la ciudad de Quito con Criciúma, en Brasil, y concluye que en ambas ciudades, a pesar de las mejoras implementadas, aún existen dificultades a salvar para las personas con movilidad reducida (Martins y Núñez, 2017).

Transporte público

El transporte público ha sido examinado en Ecuador desde diferentes aristas. En Quito, por ejemplo, se han estudiado las características de los viajes de múltiples etapas a partir

de la información recogida en la Encuesta de Movilidad de 2011, y su relación con los aspectos demográficos, socioeconómicos y de transporte. Se detecta que un tercio de los viajes diarios totales son de múltiples etapas, por lo que se considera fundamental su exploración para el planteamiento de políticas públicas (Bastidas-Zelaya y Ruiz, 2016).

Existen varios trabajos que comparan ciudades ecuatorianas con ciudades de otros países. Por ejemplo, un estudio realizado en Quito (Ecuador), Haifa (Israel) y Valencia (España) explora la confianza que tienen los estudiantes universitarios, usuarios del transporte público, en las frecuencias y los horarios de las unidades de transporte. Los resultados muestran que, en las tres ciudades, los estudiantes consideran vital llegar a tiempo, por lo que el nivel de confiabilidad es determinante al momento de seleccionar este modo de transporte para su movilidad cotidiana (Loyola et al., 2019). Otra publicación interesante que compara varias ciudades es la de Pager-Seekins y Tironi (2016), en la cual, tras el análisis de cuatro sistemas de transporte público en Latinoamérica (Quito, Santiago, Bogotá y Ciudad de México), concluyen que existe un fenómeno común entre ellos: si bien se priorizan las inversiones en transporte público para mejorar la movilidad, la participación ciudadana, de acuerdo a los autores, ha sido pequeña. Es decir, la coordinación y gestión para la implementación de estos proyectos se ha dado entre los operadores y el Gobierno, pero muy poca atención se ha puesto a la relación de los sistemas con el público.

En la misma línea de los estudios comparativos, está el realizado por Essadeq, Dubail y Jeanniere (2016), quienes analizan el hacinamiento en el transporte público basándose en la asimetría que existe entre la oferta y la demanda. Sostienen que algunos proyectos de transporte no contemplan el hacinamiento dentro del modelado; por ello, los autores adoptan la metodología de multitudes en tres de estos casos: en el proyecto para la línea de cable en Guayaquil (Ecuador), en el estudio de extensión de metro y reestructuración de bus en Bakú (Azerbaiján), y en el modelo para la asignación de transporte público en Saint-Étienne (Francia).

Se destacan tres estudios que vinculan el desarrollo urbano alrededor de los sistemas de transporte público masivo. El primero, a través de información primaria y secundaria, estudia el desarrollo urbano alrededor de algunas paradas de BRT en las ciudades de Quito, Guayaquil, Bogotá, Curitiba, Guatemala, São Paulo y

Goñán. Los autores concluyen que aquellas paradas con un desarrollo urbano orientado al transporte público tienen un mayor número de usuarios que aquellas cuyos usos de suelo cercanos son incompatibles o tienen barreras de accesibilidad (D. Rodríguez y Vergel-Tovar, 2018).

Los mismos autores desarrollan un estudio en Quito y Bogotá para determinar los impactos en el desarrollo urbano debido a la construcción del trole, en el primer caso, y del BRT Transmilenio, en el segundo. Concluyen que no se pueden generalizar los resultados en ninguna de las dos ciudades, ya que los cambios urbanos son heterogéneos. Los autores expresan que existen paradas que demuestran un incremento en la actividad inmobiliaria con la implantación de los proyectos de transporte, y otras que no; es decir, las transformaciones dependen fuertemente del contexto (D. Rodríguez, Vergel-Tovar y Camargo, 2016).

Finalmente, en Cuenca se busca establecer una línea base para determinar, en el futuro, el impacto de la implementación de un sistema tranviario sobre los valores inmobiliarios. Este estudio, en su primera fase, determina que "los precios de alquiler de las viviendas aumentan a medida que su ubicación se aleja del eje principal del sistema (aún en construcción al momento de la toma de datos) y que, por el contrario, los arriendos para propiedades comerciales aumentan con una mayor proximidad al eje. Con respecto al precio de venta de las propiedades residenciales o comerciales, en función de esta distancia, no hubo evidencia de cambios" (Hermida et al., 2018: 1).

Sistemas inteligentes

En cuanto a los sistemas inteligentes, se destacan estudios que proponen aplicaciones para mejorar la movilidad y el transporte. Así por ejemplo, a nivel nacional, Chato et al. (2018) se enfocan en los conteos de usuarios dentro del transporte público, a partir de un algoritmo para identificar y contar personas en los videos de una cámara. La finalidad de esta investigación es elaborar una herramienta tecnológica que ayude a cumplir con la Ley de Tránsito en Ecuador. En otra línea, A. Rodríguez et al. (2017) proponen una aplicación que funcione con un GPS y que permita facilitar los desplazamientos de las personas con discapacidad visual. Este asistente de navegación es amigable con el usuario y ayuda a conocer su última ubicación, las rutas y las paradas de bus más cercanas.

Por otra parte, en la ciudad de Quito, el trabajo de Stolfi et al. (2016) busca guiar a los conductores en calles urbanas mediante paneles LED inteligentes denominados "enjambre amarillo", con el objetivo de aliviar la congestión del tráfico, mejorar los tiempos de viaje y disminuir las emisiones de gases. En la misma ciudad, en lo que respecta a señalización, a partir de algoritmos y simulaciones se optimizan semáforos para reducir el impacto en tres áreas: tiempo, emisiones y consumo de combustible (Armas et al., 2017).

En otras ciudades como Loja, se propone el uso de una red inalámbrica de sensores para el diseño de un estacionamiento inteligente. Esta plataforma tecnológica lojana es un prototipo que, con base en el sistema actual de estacionamiento, busca adaptarse a las condiciones de la ciudad; además, el proyecto apunta a brindar conectividad con una aplicación web (Quiñones et al., 2015). Por otro lado en Cuenca, se han utilizado redes sociales como Twitter para obtener datos de tránsito en tiempo real (Arias et al., 2019); esta herramienta depende de la cantidad de usuarios que usen la red social para aportar al proyecto.

Temas misceláneos

Finalmente, se han abordado en Ecuador otros asuntos en relación con la movilidad y el transporte, pero se ha podido encontrar apenas uno o dos artículos al respecto en revistas indexadas (bajo los criterios de búsqueda señalados en la introducción de este texto): por ejemplo, la contaminación por ruido (Bravo-Moncayo et al., 2017 y 2019), la vulnerabilidad de las infraestructuras (Demoraes, 2009), el transporte informal (Guerra, Skuzinski y Shealy, 2017), la accesibilidad para movilidad reducida (Gudiño, Caicedo y Lara, 2018), los estacionamientos (Naranjo et al., 2019) y la logística del transporte (Martínez et al., 2018).

En el tema del ruido provocado por el tráfico en la ciudad de Quito, el trabajo de Bravo-Moncayo et al. (2019) concluye con el primer mapa de ruido utilizando un modelo asistido por computadora. Los resultados arrojan que, a lo largo del día, el 25 % de la población urbana sufre niveles de contaminación auditiva superiores a los 65 dBA, lo cual lleva a la necesidad urgente de incluir esta variable dentro de las planificaciones urbanas y de la movilidad. El mismo grupo de investigación realizó un estudio utilizando encuestas para determinar la percepción de los ciudadanos con respecto al ruido provocado por

el tráfico y, además, conocer la disponibilidad de pago para reducir estos impactos. Se encontró que un 83 % de la población estaría dispuesta a pagar para reducir la contaminación auditiva, lo cual es un resultado interesante que puede llevar a plantear nuevas estrategias de implantación de política pública sobre la recuperación de los costos ambientales (Bravo-Moncayo et al., 2017).

Con respecto a los otros temas, Demoraes (2009) analiza la vulnerabilidad en las infraestructuras de movilidad y transporte, y concluye que esta fragilidad contribuye a la vulnerabilidad general del territorio, en el caso de Quito. En la misma ciudad, en lo referente al transporte informal, el estudio de Guerra, Skuzinski y Shealy (2017) evidencia que, por falta de accesibilidad al transporte formal, se crean sistemas irregulares de vehículos privados que ofrecen el servicio. Los autores sostienen que, si bien se satisface en parte la demanda, existen problemas con respecto a la seguridad de los usuarios y la sostenibilidad de los sistemas formales.

En cuanto a la publicación relacionada con la movilidad reducida, se trata de una investigación llevada a cabo en la ciudad General Villamil (Playas), en la cual los autores demuestran que, aunque se ha incentivado el turismo, la ciudad y las instalaciones no brindan facilidades para personas con movilidad reducida, lo cual dificulta disfrutar en familia de los espacios de esparcimiento y ocio (Gudiño, Caicedo y Lara, 2018).

Finalmente, el trabajo de Naranjo et al. (2019) analiza el estacionamiento dentro del campus de la Escuela Superior Técnica de Chimborazo, para proponer soluciones que mejoren la movilidad. En el de Martínez et al. (2018), por su parte, los autores diseñan y aplican una metodología para evaluar la logística de transporte, aumentar el rendimiento de las organizaciones y proponer soluciones para disminuir los costos de distribución en Quito.

Conclusiones

Este texto ha buscado reflejar, de alguna manera, lo producido desde la literatura científica sobre movilidad y transporte en los últimos años en Ecuador. Somos conscientes de las limitaciones de lo expuesto en párrafos anteriores, al haber reducido la búsqueda a artículos indexados en bases de datos científicas hasta el año 2019. Es importante anotar que, en el proceso de recopilación de información, encontramos textos pertinentes y valiosos en otros formatos como libros, tesis de grado y posgrado,

así como en artículos en documentos no indexados. Esto nos lleva a concluir que las iniciativas de investigación van mucho más allá de las expuestas en este texto y, por ende, tenemos una mirada optimista sobre el escenario futuro.

De la literatura revisada para este artículo, se puede concluir que desde aproximadamente el año 2010 existe interés en incursionar en la temática de la movilidad y el transporte en Ecuador, a través de variadas metodologías. Se evidencia, además, por el número de artículos relacionados con eficiencia energética, movilidad no motorizada y transporte público, una tendencia hacia una movilidad más sostenible. No obstante, el texto también nos lleva a reflexionar sobre la necesidad de profundizar la investigación en temáticas que aún no están lo suficientemente estudiadas; tal es el caso de los aspectos sociales, demográficos, económicos, políticos, de percepción, modelos de gestión y de participación ciudadana, entre varios otros. Es vital que se prueben nuevos instrumentos, tanto cuantitativos como cualitativos, que permitan entender de manera integral al ser humano en su movilidad cotidiana.

Los resultados expuestos nos permiten diagnosticar que Quito y Cuenca tienen un camino, aunque reciente, recorrido en investigación, pero que aún hay que incentivar y promover la investigación en los restantes municipios, tanto grandes como intermedios y pequeños; de cierta manera, estas dos ciudades se convierten en precursoras para el resto de ciudades del país. Se debe poner especial atención en las ciudades intermedias y pequeñas, pues es justamente en ellas donde su tamaño permite incidir en cuanto a planificación urbana y de movilidad para evitar que ocurran los problemas de las grandes ciudades. Pero no para todas las urbes serán válidas las mismas estrategias, por ello la relevancia de explorar las diferentes realidades.

Otro aspecto muy importante para considerar en cuanto a la investigación en el futuro, es que este artículo resume resultados obtenidos previo a la crisis sanitaria provocada por el COVID-19. Este virus ha provocado cambios en múltiples temas urbanos, entre ellos la movilidad y el transporte, que deberán ser estudiados minuciosamente para evitar que la desigualdad social se profundice. Es así que serán necesarias investigaciones que aporten a garantizar la bioseguridad en el transporte público, pero que no satanicen su utilización, ya que son los grupos de población más vulnerables los que justamente dependen del transporte público para el acceso a empleo, bienes y servicios. Así también, será interesante que se generen estudios para demostrar las ventajas de la

incorporación de ciclovías en diversas ciudades del país, que si bien surgieron como emergentes por la pandemia, aparentemente han demostrado ser eficientes para una "nueva normalidad". Finalmente, será importante que los grupos de investigación a nivel nacional, examinen las posibilidades de potenciar la proximidad y la vida barrial, que durante los meses de confinamiento, demostraron ser estrategias importantes, tanto para evitar el contagio, como para la reactivación económica de los ciudadanos, y para la sostenibilidad ambiental, social y económica.

Estas brechas motivan los estudios de carácter interdisciplinar, porque la movilidad es un fenómeno con múltiples aristas. En este sentido, la academia debe estar presta para trabajar conjuntamente con los Gobiernos Autónomos Descentralizados y con la ciudadanía, en aras de mejorar la movilidad en nuestras ciudades. Además, se deberá procurar un trabajo coordinado entre grupos de investigación del país, para que los esfuerzos sean más eficientes y efectivos. Solo una planificación conjunta entre los diversos actores de la movilidad en las ciudades, permitirá que se camine hacia adelante generando cambios que traigan beneficios para los ciudadanos y los diversos usuarios de los medios de transporte.

En el contexto actual ecuatoriano, con los municipios como responsables de la planificación, la regulación y el control del tránsito y el transporte, el rol de la academia resulta fundamental: la implementación de políticas públicas y sus consecuentes planes de movilidad deberán estar basados en evidencias. Los municipios, por sus actividades de gestión cotidiana, no cuentan con el tiempo ni los recursos humanos para hacer investigación; por ende, son las universidades las responsables de llevarla adelante. En este sentido, Ecuador tiene un gran potencial: hemos encontrado en las universidades ecuatorianas nueve laboratorios y grupos de investigación que incursionan en temas de movilidad³, lo cual nos lleva a concluir que, sin duda, si se coordinaran acciones, se podrían alcanzar resultados de gran envergadura.

³Laboratorios y grupos de investigación connotados, interesados en la movilidad urbana en Ecuador (al momento de redactar este texto): UlaLab-Ciudades Sostenibles, de la Universidad de Cuenca; el Grupo de Investigación en Tránsito y Actividad, de la Universidad de las Américas; el Grupo de Investigación en Sistemas de Transporte y Automoción (GISTA), de la Universidad Técnica del Norte; Centro de Investigación y Desarrollo en Ingeniería Automotriz ERGON, de la Universidad del Azuay; Movilidad Activa y Sostenible, de la Universidad de Cuenca; LIDI, de la Universidad del Azuay; Sistemas Alternativos de Propulsión e Impacto Medioambiental de los Vehículos Automotrices, de la Universidad Tecnológica Equinoccial; el Centro de Etnografía Interdisciplinaria KALEIDOS, de la Universidad de Cuenca; y el Laboratorio de Arquitectura y Urbanismo (LAU), de la Universidad del Azuay.

Bibliografía

- Abad, Lorena y Daniel Orellana (2018). "Análisis exploratorio de comportamientos de ciclistas voluntarios mediante minería de patrones espacio-temporales en Cuenca, Ecuador". *MASKANA* n.º 1, Vol. 9: 141-151. Disponible en: <https://doi.org/10.18537/maskn.09.01.13> [Visitado el 6 de septiembre de 2020].
- Alarcón, Pedro (2011). "Movilidad urbana, consumo de energía y calidad del aire". *Letras Verdes* n.º 8: 15-17. Disponible en: <https://bit.ly/3h73Vqr> [Visitado el 6 de septiembre de 2020].
- Arias, Belén, Gerardo Orellana, Marcos Orellana y María Inés Acosta (2019). "A Text Mining Approach to Discover Real-Time Transit Events from Twitter". *ITCEC 2018. Advances in Intelligent Systems and Computing*, Vol. 884: 155-169. Disponible en: https://doi.org/10.1007/978-3-030-02828-2_12 [Visitado el 7 de septiembre de 2020].
- Armas, Rolando, Hernán Aguirre, Fabio Daolio y Kiyoshi Tanaka (2017). "Evolutionary design optimization of traffic signals applied to Quito city". *PloS One* n.º 12, Vol. 12. Disponible en: <https://doi.org/10.1371/journal.pone.0188757> [Visitado el 6 de septiembre de 2020].
- Bastidas-Zelaya, Efraín y Tomás Ruiz (2016). "Analysis of Multistage Chains in Public Transport: The Case of Quito, Ecuador". *Transportation Research Procedia* n.º 18: 180-188. Disponible en: <https://doi.org/10.1016/j.trpro.2016.12.025> [Visitado el 6 de septiembre de 2020].
- Bravo-Moncayo, Luis, Ignacio Pavón-García, José Lucio-Naranjo y Roberto Mosquera (2017). "Contingent valuation of road traffic noise: A case study in the urban area of Quito, Ecuador". *Case Studies on Transport Policy* n.º 4, Vol. 5: 722-730. Disponible en: <https://bit.ly/33ahNeG> [Visitado el 6 de septiembre de 2020].
- , Miguel Chávez, Virginia Payana, José Lucio-Naranjo, Christian Garzón e Ignacio Pavón-García (2019). "A cost-effective approach to the evaluation of traffic noise exposure in the city of Quito, Ecuador". *Case Studies on Transport Policy* n.º 1, Vol. 7: 128-137. Disponible en: <https://bit.ly/2QYedP1> [Visitado el 6 de septiembre de 2020].

Has today's dominant marketing mix paradigm become a strait-jacket? A relationship building and management approach may be the answer.

From Marketing Mix to Relationship Marketing:

Towards a Paradigm Shift in Marketing

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The marketing mix management paradigm has dominated marketing thought, research and practice since it was introduced almost 40 years ago. Today, this paradigm is beginning to lose its position[1-3]. New approaches have been emerging in marketing research. The globalization of business and the evolving recognition of the importance of customer retention and market economics and of customer relationship economics, among other trends, reinforce the change in mainstream marketing.

Relationship building and management, or what has been labelled *relationship marketing*, is one leading new

approach to marketing which eventually has entered the marketing literature[2, 4-14]. A paradigm shift is clearly under way. In services marketing, especially in Europe and Australia but to some extent also in North America, and in industrial marketing, especially in Europe, this paradigm shift has already taken place. Books published on services marketing[15-17] and on industrial marketing[18-20] as well as major research reports published are based on the relationship marketing paradigm.

A major shift in the perception of the fundamentals of marketing is taking place. The shift is so dramatic that it can, no doubt, be described as a paradigm shift[21]. Marketing researchers have been passionately convinced about the paradigmatic nature of marketing mix management and the Four P model[22]. To challenge marketing mix management as the basic foundation for all marketing thinking has been as heretic as it was for Copernicus to proclaim that the earth moved[23, 24].

The purpose of this report is to discuss the nature and consequences of the dominating marketing paradigm of today, marketing mix management of the managerial school (cf.[25]) and how evolving trends in business and modern research into, for example, industrial marketing, services marketing and customer relationship economics demand a relationship-oriented approach to marketing. Relationship building and management are found to be an underlying facet in the research into these areas. Relationship marketing is suggested as one new marketing paradigm, and a number of consequences for marketing and management of a relationship-type marketing strategy is discussed based on the notion of a marketing strategy continuum. Finally, the possibility of building a general theory of marketing based on the relationship approach is examined. A further discussion of the nature of the relationship marketing paradigm is, however, beyond the scope of this report.

Marketing Mix and the Four Ps

Marketing the way most textbooks treat it today was introduced around 1960. The concept of the marketing mix and the Four Ps of marketing – product, price, place and promotion – entered the marketing textbooks at that time[26]. Quickly they also became treated as the unchallenged basic model of marketing, so totally overpowering previous models and approaches, such as, for example, the organic functionalist approach advocated by Wroe Alderson[27, 28] as well as other systems-oriented approaches (e.g.[29, 30]) and parameter theory developed by the Copenhagen School in Europe (e.g.[31, 32]) that these are hardly remembered, even with a footnote in most textbooks of today. Earlier approaches, such as the commodity (e.g.[33]), functional (e.g.[34]), geography-related regional (e.g.[35]) and institutional

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schools (e.g.[36]) have suffered a similar fate. Only a few models from these approaches have survived. American Marketing Association, in its most recent definition, states that "marketing is the process of planning and executing the conception, pricing, promotion and distribution of ideas, goods and services to create exchange and satisfy individual and organizational objectives" (emphasis added)[37].

Eventually the Four Ps of the marketing mix became an indisputable paradigm in academic research, the validity of which was taken for granted[10,16,38]. For most marketing researchers in large parts of the academic world it seems to remain the marketing truth even today. Kent[38] refers to the Four Ps of the marketing mix as "the holy quadruple...of the marketing faith...written in tablets of stone" (p. 146). For an academic researcher looking for tenure and promotion, to question it has been to stick out his or her neck too far. Prospective authors of textbooks, who suggest another organization than the Four P solution for their books, are quickly corrected by most publishers. As a result, empirical studies of what the key marketing variables are, and how they are perceived and used by marketing managers, have been neglected. Moreover, structure has been vastly favoured over process considerations[38]. In marketing education, teaching students how to use a toolbox has become the totally dominating task instead of discussing the meaning and consequences of the marketing concept and the process nature of market relationships. Marketing in practice has to a large extent been turned into managing this toolbox instead of truly exploring the nature of the firm's market relationships and genuinely catering to the real needs and desires of customers.

How Did the Marketing Mix Emerge?

A paradigm like this has to be well founded by theoretical deduction and empirical research; otherwise much of marketing research is based on a loose foundation and the results of it questionable. The marketing mix developed from a notion of the marketer as a "mixer of ingredients"[39]. The marketer plans various means of competition and blends them into a "marketing mix" so that a profit function is optimized, or rather satisfied. The "marketing mix", concept was introduced by Neil Borden in the 1960s (e.g.[40]), and the mix of different means of competitions was soon labelled the Four Ps[26].

The marketing mix is actually a list of categories of marketing variables and, to begin with, this way of defining or describing a phenomenon can never be considered a very valid one. A list never includes all relevant elements, it does not fit every situation, and it becomes obsolete. And indeed, marketing academics every now and then offer additional Ps to the list, since they have found the standard "tablet of faith" too

limited[41-54]. It is, by the way, interesting to notice that since the Four Ps were definitely canonized sometime in the early 1970s, new items to the list almost exclusively have been in the form of Ps[55, 56]. Advocators of the marketing mix management paradigm have sometimes suggested that service should be added to the list of Ps (e.g.[53,57]). This would be disastrous, because it would isolate customer service as a marketing variable from the rest of the organization, just as has happened with the Four P marketing mix variables. It would effectively counteract all attempts to make customer service the responsibility of everyone and not of a separate department only.

In fact, the Four Ps represent a significant oversimplification of Borden's original concept, which was a list of 12 elements not intended to be a definition at all. Moreover, the elements of this list would probably have to be reconsidered in any given situation. McCarthy either misunderstood the meaning of Borden's marketing mix, when he reformulated the original list in the shape of the rigid mnemonic of the Four Ps where no blending of the Ps is explicitly included, or his followers misinterpreted McCarthy's intentions. In many marketing textbooks organized around the marketing mix, such as Philip Kotler's well-known *Marketing Management* [58], the blending aspect and the need for integration of the Four Ps are discussed, even in depth, but such discussions are always limited owing to the fact that the model does not explicitly include an integrative dimension.

In the 1960s in Europe, researchers within the so-called Copenhagen School approached marketing in a similar way to the notion of the marketing mix, based on the idea of *action parameters* presented in the 1930s by von Stackelberg[59]. Arne Rasmussen[31] and Gösta Mickwitz[32] developed what became known as *parameter theory*, which was a dynamic marketing mix approach linked to the product life cycle and where the parameters were integrated by means of varying market elasticities. Moreover, Mickwitz also stated that the demand side has to be connected to the supply side in a managerial marketing theory. This was done using an economic approach rather than a behavioural approach. Parameter theory was a much more developed model than the Four P version of the marketing mix notion. Unfortunately, it never received enough international attention, and eventually it was overwhelmed by the Four Ps that were much easier to comprehend and teach. Today, the key aspects of parameter theory, dynamism and an integration of consumer behaviour and managerial decision making are pointed out as important research topics (cf.[3]).

Probably Borden's original idea of a list of a large number of marketing mix ingredients that have to be reconsidered in every given situation was shortened for pedagogical

reasons and because a more limited number of marketing variables seemed to fit typical situations observed in the late 1960s and in the 1990s by the initiators of the short list of four standardized Ps. These typical situations can be described as involving consumer packaged goods in a North American environment with huge mass markets, a highly competitive distribution system and very commercial mass media. However, in other markets the infrastructure is to varying degrees different and the products are only partly consumer packaged goods. Nevertheless the four Ps of the marketing mix have become the universal marketing model or even theory and an almost totally dominating paradigm for most academics, and they have had a tremendous impact on the practice of marketing as well. Is there any justification for this?

The Nature of the Marketing Mix

Any marketing paradigm should be well set to fulfil the *marketing concept*, i.e. the notion that the firm is best off by designing and directing its activities according to the needs and desires of customers in chosen target markets. How well is the marketing mix fit to do that?

One can easily argue that the four Ps of the marketing mix are not well able to fulfil the requirements of the marketing concept. As Dixon and Blois[60] put it, "...indeed it would not be unfair to suggest that far from being concerned with a customer's interests (i.e. somebody for whom something is done) the views implicit in the Four P approach is that the customer is somebody to whom something is done" (emphasis added) (p. 4). To use a marketing metaphor, the marketing mix and its four Ps constitute a *production-oriented* definition of marketing, and not a *market-oriented* or *customer-oriented* one (see[10, 16]). Moreover, although McCarthy[26] recognizes the interactive nature of the Ps, the model itself does not explicitly include any interactive elements. Furthermore, it does not indicate the nature and scope of such interactions.

The problems with the marketing mix management paradigm are not the number or conceptualization of the decision variables, the Ps, as American Marketing Association as well as the authors of most publications criticizing the marketing mix management paradigm argue. Rather, the problem is of a theoretical nature. The Four Ps and the whole marketing mix management paradigm are, theoretically, based on a loose foundation, which in a recent *Journal of Marketing* article was also demonstrated by van Waterschoot and Van den Bulte[61]. They conclude: "To our knowledge, the classification property(-ies) or rationale for distinguishing four categories labelled 'product', 'price', 'place' and 'promotion' have never been explicated... Though casual observation of practitioners, students, and textbooks suggest a general consensus to classify marketing mix

elements in the same categories, the lack of any formal and precise specification of the properties or characteristics according to which marketing mix elements should be classified is a major flaw". Van Waterschoot and Van den Bulte[61] recognize three flaws in the Four P model: "The properties or characteristics that are the basis for classification have not been identified. The categories are not mutually exclusive. There is a catch-all subcategory that is continually growing" (p. 85) (see also[38,62]). Many marketing-related phenomena are not included[63]. Moreover, as Johan Arndt[64,65] has concluded, marketing research remains narrow in scope and even myopic, and methodological issues become more important than substance matters. "Research in marketing gives the impression of being based on a conceptually sterile and unimaginative positivism... The consequence... is that most of the resources are directed toward less significant issues, overexplaining what we already know, and toward supporting and legitimizing the status quo"[64, p. 399]. Unfortunately, far too little has changed in mainstream marketing research since this was written over a decade ago.

The usefulness of the Four Ps as a general marketing theory for practical purposes is, to say the least, highly questionable. Originally, although they were largely based on empirical induction and earlier lists of marketing functions of the functional school of marketing (cf.[66]), they were probably developed under the influence of microeconomic theory and especially the theory of monopolistic competition of the 1930s (e.g.[67]), in order to add more realism to that theory. However, very soon the connection to microeconomic theory was cut off and subsequently totally forgotten. Theoretically, the marketing mix became just a list of Ps without roots.

Even in the area of consumer goods marketing in North America some doubts concerning marketing mix management has been expressed. Regis McKenna[68], a respected marketing consultant and writer, concludes in a discussion about the decline in North America of advertising, the flagship of traditional marketing, that "the underlying reason behind... (this decline)... is advertising's dirty little secret: it serves no useful purpose. In today's market, advertising simply misses the fundamental point of marketing – adaptability, flexibility, and responsiveness" (p. 13). Undoubtedly, this is to take it a little bit to the extreme, but the point is well taken. An interest in turning anonymous masses of potential and existing customers into interactive relationships with well-defined customers is becoming increasingly important (see e.g.[68-70]).

Consequences of the Marketing Mix

Managing the marketing mix makes marketing seem to easy to handle and organize. Marketing is separated

from other activities of the firm and delegated to specialists who take care of the analysis, planning and implementation of various marketing tasks, such as market analysis, marketing planning, advertising, sales promotion, sales, pricing, distribution and product packaging. Marketing departments are created to take responsibility for the marketing function of the firm, sometimes together with outside specialists on, for example, market analysis and advertising. Both in the marketing literature and in everyday marketing vocabulary the expression "marketing department", and organization unit, is used as a synonym for marketing function, which is the process of taking care of the fulfilment of customer needs and desires. However, the organizational approach inherent in the marketing mix management paradigm is not very useful either (see e.g. [15,16,71-73]). The psychological effect on the rest of the organization of a separate marketing department is, in the long run, often devastating to the development of a customer orientation or market orientation in a firm. A *marketing orientation* with, for example, high-budget advertising campaigns may be developed, but this does not necessarily have much to do with true *market orientation* and a real appreciation for the needs and desires of the customers. The existence or introduction of such a department may be a trigger that makes everybody else lose whatever little interest in the customers they may have had [15]. The marketing department approach to organizing the marketing function has isolated marketing from design, production, deliveries, technical service, complaints handling, invoicing and other activities of the firm. As a consequence, the rest of the organization has been alienated from marketing. Therefore, it has made it difficult, often even impossible, to turn marketing into the "integrative function" that would provide other departments with the market-related input needed in order to make the organization truly market oriented and reach a stage of "co-ordinated marketing" (cf. [72, pp. 19-24]).

Furthermore, the marketing specialists organized in a marketing department may get alienated from the customers. Managing the marketing mix means relying on mass marketing. Customers become numbers for the marketing specialists, whose actions, therefore, typically are based on surface information obtained from market research reports and market share statistics. Frequently such marketers act without ever having encountered a real customer.

The marketing department concept is obsolete and has to be replaced by some other way of organizing the marketing function, so that the organization will have a chance to become market-oriented. A traditional marketing department will always, in the final analysis, stand in the way of spreading market orientation and an

interest in the customer throughout the organization (cf. [15,16,71,72]).

Sometimes the term marketing has become a burden for the marketing function. Managers as well as their subordinates in other departments and functions do not want to take part in the marketing function. But according to the relationship marketing approach and contemporary models of industrial marketing and service marketing they do undoubtedly belong to this function. The use of the marketing mix management paradigm and the Four Ps has made it very difficult for the marketing function to earn credibility. Some firms have solved this problem not only by downscaling or altogether terminating their marketing departments but also by banning the use of the term marketing for the marketing function (cf. [15]). Perhaps we even need this kind of semantics.

Contemporary Theories of Marketing

In most marketing textbooks the marketing mix management paradigm and its Four Ps are still considered *the* theory of marketing. Indeed, this is the case in much of the academic research into marketing, especially in North America but also to a considerable extent in other parts of the world as well. However, since the 1960s alternative theories of marketing have been developed. As Möller [63] observes in a recent overview of research traditions in marketing, "from the functional view of marketing 'mix' management our focus has extended to the strategic role of marketing, aspects of service marketing, political dimensions of channel management, interactions in industrial networks; to mention just a few evolving trends" (p. 197). Some of these theories have been based on studies of the market relationships of firms in specific types of industries. In this section the emerging theories and models of the *interaction/network approach to industrial marketing* and the *marketing of services* will be discussed. The growing interest in focusing on *customer relationship economics* and the long-term profitability of customer retention and market economics will also be touched on.

The Interaction and Network Approach to Industrial Marketing

The *interaction/network* approach to industrial marketing was originated in Sweden at Uppsala University during the 1960s [74] and has since spread to a large number of countries. Between the parties in a network various interactions take place, where exchanges and adaptations to each other occur. A flow of goods and information as well as financial and social exchanges takes place in the network [18,75,76]. In such a network the role and forms of marketing are not very clear. All exchanges, all sorts of interactions have an impact on the position of the parties

from other activities of the firm and delegated to specialists who take care of the analysis, planning and implementation of various marketing tasks, such as market analysis, marketing planning, advertising, sales promotion, sales, pricing, distribution and product packaging. Marketing departments are created to take responsibility for the marketing function of the firm, sometimes together with outside specialists on, for example, market analysis and advertising. Both in the marketing literature and in everyday marketing vocabulary the expression "marketing department", and organization unit, is used as a synonym for marketing function, which is the process of taking care of the fulfilment of customer needs and desires. However, the organizational approach inherent in the marketing mix management paradigm is not very useful either (see e.g. [15,16,71-73]). The psychological effect on the rest of the organization of a separate marketing department is, in the long run, often devastating to the development of a customer orientation or market orientation in a firm. A *marketing orientation* with, for example, high-budget advertising campaigns may be developed, but this does not necessarily have much to do with true *market orientation* and a real appreciation for the needs and desires of the customers. The existence or introduction of such a department may be a trigger that makes everybody else lose whatever little interest in the customers they may have had [15]. The marketing department approach to organizing the marketing function has isolated marketing from design, production, deliveries, technical service, complaints handling, invoicing and other activities of the firm. As a consequence, the rest of the organization has been alienated from marketing. Therefore, it has made it difficult, often even impossible, to turn marketing into the "integrative function" that would provide other departments with the market-related input needed in order to make the organization truly market oriented and reach a stage of "co-ordinated marketing" (cf. [72, pp. 19-24]).

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in the network. The interactions are not necessarily initiated by the seller – the marketer according to the marketing mix management paradigm – and they may continue over a long period of time, for example, for several years.

The seller, who at the same time may be the buyer in a reciprocal setting, may of course employ marketing specialists, such as sales representatives, market communication people and market analysts but in addition to them a large number of persons in functions which according to the marketing mix management paradigm are non-marketing, such as research and development, design, deliveries, customer training, invoicing and credit management, has a decisive impact on the marketing success of the “seller” in the network. Gunnarsson[5-7] has coined the term *part-time marketers* for such employees of a firm. He observes that in industrial markets and in service businesses, the part-time marketers typically outnumber several times the full-time marketers, i.e. the marketing specialists of the marketing and sales departments. Furthermore, he concludes that “marketing and sales departments (the full-time marketers) are not able to handle more than a limited portion of the marketing as its staff cannot be at the right place at the right time with the right customer contacts” [7, p. 13]. Hence, the part-time marketers do not only outnumber the full-time marketers, the specialists; often they are the only marketers around.

The Marketing of Services

In the early 1970s the *marketing of services* started to emerge as a separate area of marketing with concepts and models of its own geared to typical characteristics of services. In Scandinavia and Finland, the Nordic School of Services, more than researchers into this field elsewhere, looked at the marketing of services as something that cannot be separated from overall management[77]. In North America, research into service marketing has to a much greater extent remained within the boundaries of the marketing mix management paradigm, although it has produced some creative results[17,78]. Grönroos brought quality back into a marketing context[79-81] by introducing the *perceived service quality* concept in 1982[15]. He introduced the concept of the *interactive marketing function*[15,82] to cover the marketing impact on the customer during the consumption of usage process, where the consumer of a service typically interacts with systems, physical resources and employees of the service provider. In France, Langeard and Riglier[83] developed the *aeraction* concept to describe this system of interactions. These interactions occur between the customer and employees who normally are not considered marketing people, either by themselves or by their managers, and who do not belong to a marketing or sales department. Nevertheless, they are part-time marketers.

In many situations long-lasting relationships between service providers and their customers may develop. Grönroos[15,84] developed the *customer relationship life-cycle* model, originally called the “marketing circle”, to cover the long-term nature of the establishment and evolution of the relationship between a firm and its customers. Managing this life-cycle is a relationship marketing task, although the term itself was not used at that time. Again, the marketing success of a firm is only partly determined by the “full-time marketers”. In fact, the “part-time marketers” of a service provider may often have a much more important impact on the future purchasing decisions of a customer than, for example, professional sales people or advertising campaigns (e.g.[5,16]).

The Interest in Customer Relationship Economics

During the last few years there has been a growing interest in studying the economics of long-lasting customer relationships. Heskett[85] introduced the concept of *market economies*, by which he means achieving results by understanding the customers instead of by concentrating on developing scale economies. Reichheld[86] gives an example of this: “At MBNA (in the credit card business in the US), a 5 per cent increase in retention grows the company’s profit by 60 per cent by the fifth year” (p. 65). More similar results from other industries are reported in a study by Reichheld and Sasser[87]. Long-term relationships where both parties over time learn how to best interact with each other lead to decreasing relationship costs for the customer as well as for the supplier or service provider. The relationship cost theory which is based on literature on, for example, quality costs (cf.[88]) and transaction costs (cf.[89]) has been suggested by Grönroos[90]. A mutually satisfactory relationship makes it possible for customers to avoid significant transaction costs involved in shifting supplier or service provider and for suppliers to avoid suffering unnecessary quality costs.

However, customer retention is not enough. Some long-lasting customer relationships, where the customers are obviously satisfied with what they get, are not profitable even in the long run, as Storbacka[91] demonstrates in a recent study in the retail banking industry (cf. also[92]). Therefore, segmentation based on *customer relationship profitability* analysis is a prerequisite for customer retention decisions. To conclude, there is clear evidence that from a profitability point of view intelligent relationship building and management make sense.

Relationship Building as a Cornerstone of Marketing

The interaction and network approach of industrial marketing and modern service marketing approaches,

especially the one by the Nordic School, clearly views marketing as an interactive process in a social context where *relationship building and management* are a vital cornerstone[93-95]. They are in some respects clearly related to the systems-based approaches to marketing of the 1960s (cf. e.g.[29]). The marketing mix management paradigm with its Four Ps, on the other hand, is a much more clinical approach, which makes the seller the active part and the buyer and consumer passive. No personalized relationship with the producer and marketer of a product is supposed to exist, other than with professional sales representatives in some cases. Obviously, this latter view of marketing does not fit the reality of industrial marketing and the marketing of services very well.

The concept relationship marketing[96-98] has emerged within the fields of service marketing and industrial marketing[4-8,10-14,16,78,99,100]. The phenomenon described by this concept is strongly supported by ongoing trends in modern business (cf.[95]). Grönroos defines relationship marketing[101,102] in the following way: "Marketing is to establish, maintain, and enhance relationships with customers and other partners, at a profit, so that the objectives of the parties involved are met. This is achieved by a mutual exchange and fulfilment of promises" (16, p. 138). Such relationships are usually but not necessarily always long term. Establishing a relationship, for example with a customer, can be divided into two parts: to *attract* the customer and to *build* the relationship with that customer so that the economic goals of that relationship are achieved.

An integral element of the relationship marketing approach is the *promise concept* which has been strongly emphasized by Henrik Calonijs[103]. According to him the responsibilities of marketing do not only, or predominantly, include giving promises and thus persuading customers as passive counterparts on the marketplace to act in a given way. A firm that is preoccupied with giving promises may *attract* new customers and initially *build* relationships. However, if promises are not kept, the evolving relationship cannot be *maintained and enhanced*. Fulfilling promises that have been given is equally important as means of achieving customer satisfaction, retention of the customer base, and long-term profitability (cf. also [87]). Calonijs also stresses the fact that promises are mutually given and fulfilled.

Another key element is *trust*. "The resources of the seller – personnel, technology and systems – have to be used in such a manner that the customer's trust in the resources involved and, thus, in the firm itself is maintained and strengthened"[99, p. 5] (cf. e.g.[104]). In a recent study of relationships on the market for one industrial service, Moorman *et al.*[105] define trust as "...a willingness to rely on an exchange partner in whom one has confidence"

(p. 3). This definition means, first of all, that there has to be a *belief* in the other partner's trustworthiness that results from the expertise, reliability or intentionality of that partner. Second, it views trust as a behavioural *intention* or behaviour that reflects reliance on the other partner and involves uncertainty and vulnerability on the part of the trustor. If there is no vulnerability and uncertainty trust is unnecessary, because the trustor can control the other partner's actions[106] (see also[106]). One should, however, bear in mind that in many relationship marketing situations it is not clear who is the trustor and who is the trustee; more likely, for example in a simple two-partner relationship, both partners are in both positions. Also, the relationships are often more complex than mere exchange relationships.

Relationship marketing is still in its infancy as a mainstream marketing concept, although it has established itself as an underlying paradigm in modern industrial marketing and services marketing. Its importance is recognized to a growing extent, however. Philip Kotler[107] concludes in a recent article that "companies must move from a short-term *transaction-oriented* goal to a long-term *relationship building* goal" (p. 1). In an interview in the *Marketing Science Institute Review* in 1991, Philip Kotler[108] states that "A paradigm shift, as used by Thomas Kuhn..., occurs when a field's practitioners are not satisfied with the field's explanatory variables or breadth...What I think we are witnessing today is a movement away from a focus on exchange – in the narrow sense of transaction – and toward a focus on building value-laden relationships and marketing networks...We start thinking mostly about how to hold on to our existing customers...Our thinking therefore is moving from a marketing mix focus to a relationship focus". (pp. 1,4). Frederick Webster[95], another prominent American opinion leader in marketing, comes to a similar conclusion in a recent analysis of the current developments in business and in marketing: "There has been a shift from a transactions to a relationship focus" (p. 14), and "from an academic or theoretical perspective, the relatively narrow conceptualization of marketing as a profit-maximization problem, focused on market transactions or series of transactions, seems increasingly out of touch with an emphasis on long-term customer relationships and the formation and management of strategic alliances" (p. 10). In his analysis he does not, however, include what has been published on relationship marketing issues in Europe.

So far, there seem to be only two books for textbook purposes based on this emerging paradigm (Christopher, *et al.*[13] in English and Blomqvist *et al.*[14] in Swedish). However, relationship marketing is clearly the underlying approach in several books on services marketing(e.g.[16, 17]) and industrial marketing (e.g.[18-20,109,110]). In a growing number of articles relationship issues are addressed (e.g.[4,5,9,10,12,58,95,99,102,111-114]). The

importance of relationship building is advancing even into books from the world of consumer goods marketing. There the existence of mass markets without any natural direct customer contacts for the firm causes certain consequences of their own. Market communication is a central means of reaching customers, and the focus on relationship building leads to an interest in emphasizing *dialogues* and creating, for example, advertising campaigns that facilitate various types of dialogues with identified customers (see, e.g.[69]). In the future, this marketing paradigm most certainly will be a focal point of marketing research, thus positioning itself as a leading marketing paradigm not only in services marketing and industrial marketing but in most or all marketing situations. In the rest of this article, some marketing and management consequences of a relationship-building and management approach will be discussed.

The Marketing Strategy Continuum

The major problem with the marketing mix and its Four Ps has been their position as the major, and in many situations as the only, acceptable marketing paradigm. Relationship marketing must not become such a strait-jacket. However, developing enduring customer relationships and achieving exchanges in such relationships through a relationship marketing approach (cf.[115]) is not only another addendum to marketing mix management. Rather, it is a different approach as compared to achieving exchanges in isolated transactions through the use of the Four Ps of the marketing mix. As Reichheld observes, "building a highly loyal customer base cannot be done as an add-on. It must be integral to a company's basic business strategy"[86, p. 64]. Hence, it should be useful to think about possible marketing approaches or strategies along a *marketing strategy continuum*[116]. *Relationship marketing* is placed at one end of the continuum. Here the general focus is on building relationships with customers (and other parties as well, although only customers are discussed in this context). At the other end of the continuum is *transaction marketing* where the focus of marketing is on one transaction at a time (cf.[4]). Thus marketing revolves around creating single transactions or exchanges at a time and not around building long-term relationships. The continuum and some marketing and management implications are illustrated in Figure 1.

Various types of goods and services can be placed along the continuum as indicated by the bottom part of Figure 1. The exact place and corresponding marketing approach cannot, of course, be located. This is indicated by the arrows. Marketers of consumer packaged goods will probably benefit most from a transaction-type strategy. Service firms, on the other hand, would normally, but probably not always, be better off by applying a relationship-type strategy. Manufacturers of

consumer packaged goods have mass markets but no immediate contacts with their ultimate customers, while service firms almost always have such contacts, sometimes on a regular basis, sometimes only at discrete points in time. Therefore, the interface between the firm and its customers is expanded far outside the marketing department of marketing and sales specialists.

In consumer durables the customer interface is broader than for consumer packaged goods, and a pure transaction-type strategy is not the only naturally available option. Industrial goods, ranging from mass-produced components to complex machines and projects, would probably fit best between consumer durables and services. However, in many industrial marketing situations the customer relationships are similar to many service situations, and here no distinctions between the industrial marketer and service marketer can be made on the continuum.

The time perspective of marketing differs depending on where on the continuum a firm is. As transaction marketing means that the firm focuses on single exchanges or transactions at a time, the time perspective is rather short. The unit of analysis is a single market transaction. Profits are expected to follow from today's exchanges, although sometimes some long-term image development occurs. In relationship marketing the time perspective is much longer. The marketer does not plan primarily for short-term results. His objective is to create results in the long run through enduring and profitable relationships with customers. In some cases single exchanges may even be unprofitable as such. Thus, relationships as such are equally the units of analysis.

Marketing Focus

Because of the lack of personal contacts with their customers and their focus on mass markets, firms pursuing a transaction-type strategy will probably benefit most from a traditional *marketing mix* approach. The Four P model will give guidance in most cases; and this model was indeed originally developed for consumer packaged goods marketing where transaction marketing is most appropriate.

For a firm applying a relationship strategy the marketing mix often becomes too restrictive. The most important customer contacts from a marketing success point of view are the ones outside the realm of the marketing mix and the marketing specialists. The marketing impact of the customer's contacts with people, technology and systems of operations and other non-marketing functions determines whether he or she (or the organizational buyer as a unit) will continue doing business with a given firm or not. All these customer contacts are more or less interactive. As has been said earlier, in services

Figure 1. *The Marketing Strategy Continuum: Some Implications*

<i>The strategy continuum</i>	Transaction marketing	Relationship marketing
Time perspective	Short-term focus	Long-term focus
Dominating marketing function	Marketing mix	Interactive marketing (supported by marketing mix activities)
Price elasticity	Customers tend to be more sensitive to price	Customers tend to be less sensitive to price
Dominating quality dimension	Quality of output (technical quality dimension) is dominating	Quality of interactions (functional quality dimension) grows in importance and may become dominating
Measurement of customer satisfaction	Monitoring market share (indirect approach)	Managing the customer base (direct approach)
Customer information system	Ad hoc customer satisfaction surveys	Real-time customer feedback system
Interdependency between marketing, operations and personnel	Interface of no or limited strategic importance	Interface of substantial strategic importance
The role of internal marketing	Internal marketing of no or limited importance to success	Internal marketing of substantial strategic importance to success
<i>The product continuum</i>	Consumer packaged goods → ← Consumer durables → ← Industrial goods → ← Services	
Source:[12]		

marketing literature, the marketing effects of these interactions are called the *interactive marketing function*. This marketing function can also be described as the *marketing activities outside the marketing mix*. It involves people who thus have dual responsibilities. Their main duties are in operations or some other non-marketing tasks. However, they also perform a crucial marketing task, because of their vital customer contacts. They have responsibilities as "part-time marketers". In relationship marketing interactive marketing becomes the dominating part of the marketing function. Of course, elements of the marketing mix are important here as well, but to a much lesser degree and merely supporting interactive marketing activities.

In transaction marketing there is not much more than the core product, and sometimes the image of the firm or its brands, which keeps the customer attached to the seller. When a competitor introduces a similar product, which is quite easily done in most markets today, advertising and image may help in keeping the customers, at least for some time, but price usually becomes an issue. A firm that offers a lower price or better terms is a dangerous competitor, because in transaction marketing the price sensitivity of customers is often high. A firm pursuing a relationship marketing strategy, on the other hand, has created more value for its customers than that which is

provided by the core product alone. Such a firm develops over time more and tighter ties with its customers. Such ties may, for example, be technological, knowledge-related or information-related, or social in nature. If they are well handled they provide customers with added value, something that is not provided by the core product itself. Of course, price is not unimportant but is often much less an issue here. Thus, *relationship marketing makes customers less price sensitive*.

Customer Perceived Quality

The quality customers perceive will typically differ, depending on what strategy a firm uses. According to the model of total perceived quality developed within the Nordic School of Services [15,117,118] the *customer perceived quality* is basically a function of the customer perceptions of two dimensions: the impact of the outcome or the technical solution (*what* the customer receives), and an additional impact based on the customer's perception of the various interactions with the firm (*how* the so-called "moments of truth"[119] are perceived). The former quality dimension is sometimes called the *technical quality* of the outcome or solution, whereas the latter dimension is called the *functional quality* of the interaction process[15].

A transaction marketing approach includes no or minimal customer contacts outside the product and other marketing mix variables. The benefits sought by the customers are embedded in the technical solution provided by the product. The customer will not receive much else that will provide him with added value, other than perhaps the corporate or brand image in some cases. Hence, the technical quality of the product, or what the customer gets as an outcome, is the dominating quality-creating source in transaction marketing.

In relationship marketing the situation is different. The customer interface is broader, and the firm has opportunities to provide its customers with added value of various types (technological, information, knowledge, social, etc.). Hence, the second quality dimension, how the interaction process is perceived, grows in importance. When several firms can provide a similar technical quality, managing the interaction processes becomes imperative also from a quality perception perspective. Thus, *in relationship marketing the functional quality dimension grows in importance and often becomes the dominating one*. Of course, this does not mean that the technical quality can be neglected, but it is no longer the only quality dimension to be considered as one of strategic importance.

Monitoring Customer Satisfaction

A normal way of monitoring customer satisfaction and success is to look at market share and to undertake *ad hoc* customer satisfaction surveys. A stable or rising share of the market is considered a measure of success and, thus, indirectly, of customer satisfaction. When the customer base remains stable, market share is a good measurement of satisfaction. However, very often one does not know whether it in fact is stable, or whether the firm is losing a fair share of its customers, who are replaced by new customers by means of aggressive marketing and sales. In such situations following market share statistics only may easily give a false impression of success, when in fact the number of unsatisfied customers and ex-customers is growing and the image of the firm is deteriorating.

For a consumer packaged goods marketing firm, which typically would apply a transaction marketing strategy, there are no ways of continuously measuring market success other than monitoring market share. A service firm and many industrial marketers, on the other hand, who more easily could pursue a relationship marketing strategy, have at least some kind of interactions with almost every single customer, even if they serve mass markets. Thus, customer satisfaction can be monitored directly. A firm that applies a relationship-type strategy can *monitor customer satisfaction by directly managing its customer base* [16]. *Managing the customer base* means that the firm has at least some kind of direct knowledge of how satisfied its customers are. Instead of thinking in

anonymous numbers, or market share, management thinks in terms of people with personal reactions and opinions. This requires a means of gathering the various types of data about customer feedback that are constantly, every day, obtained by a large number of employees in large numbers of customer contacts. In combination with market share statistics, such an intelligence system focusing on customer satisfaction and customer needs and desires forms a valuable source of information for decision making.

Consequently, in a relationship marketing situation the firm can build up an on-line, real-time information system. This system will provide management with a continuously updated database of its customers and continuous information about the degree of satisfaction and dissatisfaction among customers. This can serve as a powerful management instrument. In a transaction marketing situation it is impossible, or at least very difficult and expensive, to build up such a database.

The Strategic Importance of Intraorganizational Collaboration

The level of interdependency between functions and departments in an organization depends on whether the firm has chosen a transaction-type strategy or a relationship-type strategy. In transaction marketing, most or all of the firm's customer contacts are related to the product itself and to traditional marketing mix activities. Marketing and sales specialists are responsible for the total marketing function; no part-time marketers are involved. Thus, the internal interface between functions has no or very limited strategic importance to the firm.

In relationship marketing the situation is different. The customer interface is much broader involving often even a large number of part-time marketers in several different functions. This is the case, for example, in most industrial marketing and services marketing situations. A successfully implemented interactive marketing performance requires that all parts of the firm that are involved in taking care of customers can collaborate and support each other in order to provide customers with a good total perceived quality and make them satisfied. Thus, for a firm pursuing a relationship marketing strategy *the internal interface between marketing, operations, personnel and other functions is of strategic importance to success*.

Internal Marketing as a Prerequisite for External Marketing

The part-time marketers have to be prepared for their marketing tasks. *Internal marketing* is needed to ensure the support of traditional non-marketing people [15,16,99,

120-122]. They have to be committed, prepared and informed, and motivated to perform as part-time marketers. As Jan Carlzon of SAS noticed, "only committed and informed people perform" [123]. This does not go for the back-office and frontline employees only. It is, of course, equally important that supervisors and middle-level and top-level managers are equally committed and prepared [124]. The *internal marketing concept* states that "the internal market of employees is best motivated for service mindedness and customer-oriented performance by an active, marketing-like approach, where a variety of activities are used internally in an active, marketinglike and coordinated way" [16, p. 223] (first introduced in English in [15]).

Internal marketing as a process has to be integrated with the total marketing function. External marketing, both the traditional parts of it and interactive marketing performance, starts from within the organization. As compared to transaction marketing situations, a *thorough and on-going internal marketing process is required to make relationship marketing successful*. If internal marketing is neglected, external marketing suffers or fails.

Service Competition

The more a firm moves to the right on the marketing strategy continuum away from a transaction-type situation, the more the market offer expands beyond the core product. Installing goods, technical service, advice about how to use a physical good or a service, just-in-time logistics, customer-adapted invoicing, technical know-how, information, social contacts and a host of other elements of bigger or smaller magnitude are added to the relationship, so that it becomes more attractive and indeed profitable for the customer (and other parties as well) to engage in an on-going relationship with a given partner on the marketplace. All such elements are different types of services. The more the firm adopts a relationship marketing strategy, the more it has to understand how to manage these service elements of its market offer. As we have concluded in earlier contexts (cf. [16]; see also [119]), managing services is to a substantial degree, although of course not totally, different from traditional management of manufactured goods: "...every firm, irrespective of whether it is a service firm by today's definition or a manufacturer of goods, has to learn how to cope with the *new competition of the service economy*" [16, p. 7]. We have coined the term *service competition* for this new competitive situation [16]. In conclusion, relationship marketing demands a deeper understanding of how to manage service competition than what is required of firms pursuing a transaction-type strategy.

The Relationship Approach as a Foundation for a Theory of Marketing

Marketing has never had a general theory, although the managerial school based on the marketing mix management paradigm is frequently treated as one. However, would it be possible to develop a general theory of marketing, or middle-range theories [125], based on the relationship marketing approach? In fact, notably in Europe, relationship-based theories of the middle range, far beyond isolated empirical findings or theoretical deductions, have already been developed in industrial marketing and services marketing. As far as a general theory is concerned, it is controversial whether such an overall theory can be created. Referring to Shelby Hunt's [126, 127] criteria of a general theory, Sheth *et al.* [3] in their overview of the evolution of marketing schools argue that such a master theory indeed can exist. What is the potential of the relationship marketing perspective to serve as a foundation for such a theory?

Relationship marketing is systems-oriented, yet it includes managerial aspects. A systems approach is well suited as a basis for a general theory of marketing, because it makes it possible to include all relevant actors, environmental influence, and even the process nature of marketing (cf. [25]). The managerial facets facilitate actionable and normative elements that also are needed in such a theory. Furthermore, Sheth *et al.* express the following views about the scope of marketing and the dominant perspective in marketing: "...we need to expand our understanding of marketing to incorporate the basic tenets of marketing, that is, market behaviour, market transactions as the unit of analysis, marketing as a dynamic process of relationships between buyers and sellers, and the exogenous variables that influence market behaviour... What is needed is a perspective that reflects the *raison d'être* of marketing, a perspective that is the common cause that no stakeholder (consumer, seller, government, or social critic) can question. Indeed, that perspective should really reflect what marketing is all about" [3, p. 196]. Although we do not agree with the statement that single market transactions are the units of analysis, but rather the relationships themselves and their economic and noneconomic elements [93], we believe that this is a useful way of stating what marketing should be and what a theory of marketing should encompass.

According to the Grönroos definition of relationship marketing [10, 16], marketing is a process including several parties or actors, the objectives of which have to be met. This is done by a mutual exchange and fulfilment of promises, a fact that makes *trust* an important aspect of marketing (cf. [99]). Inherent in this definition is a view of the suppliers or service providers interacting in a

network with, among others, customers, suppliers, intermediaries, and environmental actors. It is possible to include the behaviour of the actors on the marketplace and in the nonmarket environment and to analyse the interactions and processes of the relationships in this system. Furthermore, managerial decisions and actions in the relationships are included. Relationship marketing is also dynamic, because of its process nature. Compare, for example, the dynamism of Howard's [128] managerial theory of marketing which also includes consumer behaviour ingredients. In conclusion, we think it is not unfair to say that the relationship building and management approach to marketing, relationship marketing, has the necessary ingredients for the development of a general theory of marketing. In such a theory the managerial approach with the notion of the marketing mix and other concepts and models become one facet.

Is There a Paradigm Shift in Marketing?

From a management point of view the Four Ps may have been helpful at one time, at least for marketers of consumer packaged goods. The use of various means of competition became more organized. However, the Four Ps were never applicable to all markets and to all types of marketing situations. The development of alternative marketing theories discussed in previous sections of this article demonstrates that even from a management perspective, the marketing mix and its Four Ps became a problem.

However, in the bulk of textbooks and in much of the ongoing marketing research this paradigm is still strong today. In a standard marketing text, services marketing, industrial marketing and international marketing, for example, are touched on in a few paragraphs or they may be presented in a chapter of their own. However, they are always occurring as add-ons, never integrated into the whole text. "Books become compilations of fragmented aspects, like services marketing is being piled on top of the original structure or relationship marketing getting a small paragraph or footnote" [129, p. 237]. Why has the marketing mix management paradigm and the Four P model become such a strait-jacket for marketers? The main reason for this is probably the pedagogical virtues of the Four Ps that makes teaching marketing so easy and straightforward. The simplicity of the model seduces teachers to toolbox thinking instead of constantly reminding them of the fact that marketing is a social process with far more facets than that. As a consequence of this, researchers and marketing managers are also constrained by the simplistic nature of the Four Ps. The victims are marketing theory and customers.

On the other hand, marketing is more and more developing in a direction where the toolbox thinking of the marketing mix fits less well. In industrial marketing, services marketing, managing distribution channels and even consumer packaged goods marketing itself, a shift is clearly taking place from marketing to anonymous masses of customer to developing and managing relationships with more or less well-known or at least somehow identified customers. In marketing research new approaches have been emerging over the last decades, although they have not yet been able to overthrow the paradigmatic position of the marketing mix. As has been advocated in this article, an underlying dimension in these types of research is relationship building and management with customers and other parties.

Marketing mix management with its four Ps is reaching the end of the road as a universal marketing approach. However, even if marketing mix management is dying as the dominating marketing paradigm and the Four P model needs to be replaced, this does not mean that the Ps themselves, and other concepts of the managerial approach such as market segmentation and indeed the marketing concept [130-133], would be less valuable than before. Relationships do not function by themselves. As McInnes [134] said already three decades ago, "the existence of a market relation is the foundation of exchange not a substitute for it" (p. 56). Only in extreme situations, for example when the computer systems of a buyer and a materials provider are connected to each other in order to initiate and execute purchase decisions automatically, the relationship, at least for some time, may function by itself. In such situations one comes close to what Johan Arndt [135] called "domesticated markets", where "transactions...are usually handled by administrative processes on the basis of negotiated rules of exchange" (p. 56). Normally, advertising, distribution and product branding, for example, will still be needed, but along with a host of other activities and resources. However, what marketing deserves is new perspectives, which are more market-oriented and less manipulative, and where the customer indeed is the focal point as suggested by the marketing concept.

Most certainly relationship marketing will develop into such a new approach to managing marketing problems, to organizing the firm for marketing, and to other areas as well. Today it is still an exotic phenomenon on the outskirts of the marketing map. In the future this will change. In fact, this change has already started. Marketing mix as a general perspective evolved because at one time it was an effective way of describing and managing many marketing situations. Before the marketing mix there were other approaches. Now time

has made this approach less helpful other than in specific situations. New paradigms have to come. After all, we live in the 1990s, and we cannot for ever continue to live with a paradigm from the 1950s and 1960s. However, bearing in mind the long-term damages of the marketing mix as the universal truth, we are going to need several approaches or paradigms (compare, however, Kuhn's[24] discussion of the possibility of simultaneously existing paradigms). Relationship marketing will be one of them.

Notes and References

1. The marketing mix management paradigm with its most central model, the Four P model, is frequently treated as if it always has existed and as if there have not been any other approaches to marketing. In a chapter named "Quo Vadis, Marketing?" [2] of an anthology we have discussed the background of the marketing mix and other theoretical approaches to marketing which existed at the time when the marketing mix was introduced. Sheth et. al [3] provide an extensive overview of the evolution of marketing thought. However, as they only observe the development in North America (out of well over 500 publications in their very elaborate reference list only six are published outside North America, and five of these are written by Americans), some important contributions are missing.
2. Grönroos, C., "Quo Vadis, Marketing? Towards a Neo-Classical Marketing Theory", in Blomqvist, H.C., Grönroos, C. and Lindqvist, L.J. (Eds.), *Economics and Marketing. Essays in Honour of Gösta Mickwitz*, Economy and Society, No. 48. Swedish School of Economics and Business Administration, Helsingfors, Finland, 1992, pp. 109-34.
3. Sheth, J.N., Gardner, D.M. and Garrett, D.R., *Marketing Theory: Evolution and Evaluation*, Wiley, New York, NY, 1988.
4. Jackson, R.R., "Build Customer Relationships That Last", *Harvard Business Review*, Vol. 63, November-December 1985, pp. 120-8.
5. Gunnarsson, E., "The New Marketing - Developing Long-term Interactive Relationships", *Long Range Planning*, Vol. 20 No. 4, 1987, pp. 10-20.
6. Gunnarsson, E., *Marketing - A Long-Term Interactive Relationship Contribution to a New Marketing Theory*, Marketing Technique Center, Stockholm, Sweden, 1987.
7. Gunnarsson, E., *The Part-time Marketer*, Center for Service Research, Kungälv, Sweden, 1990.
8. Gunnarsson, E., *Relationsmarknadsföring. Från 4 P till 30 R (Relationship Marketing. From 4 Ps to 30 Rs)*, Stockholm University, Sweden, 1993.
9. Dwyer, F.R., Shurr, P.H. and Oh, S., "Developing Buyer and Seller Relationships", *Journal of Marketing* Vol. 51, April 1987, pp. 11-27.
10. Grönroos, C., "Defining Marketing: A Market-oriented Approach", *European Journal of Marketing*, Vol. 23 No. 1, 1989, pp. 52-60.
11. Grönroos, C., "A Relationship Approach to Marketing: The Need for a New Paradigm", Working Paper 190, Swedish School of Economics and Business Administration, Helsingfors, Finland, 1989.
12. Grönroos, C., "The Marketing Strategy Continuum: A Marketing Concept for the 1990s", *Management Decision*, Vol. 29 No. 1, 1991, pp. 7-12.
13. Christopher, M., Payne, A. and Ballantyne, D., *Relationship Marketing: Bringing Quality, Customer Service and Marketing Together*, Butterworth, London, 1991.
14. Blomqvist, R., Dahl, J. and Haeger, T., *Relationsmarknadsföring. Strategi och metod för servicekonkurrens (Relationship marketing. Strategy and methods for service competition)*, IHM Förlag, Göteborg, Sweden, 1993.
15. Grönroos, C., *Strategic Management and Marketing in the Service Sector*, Swedish School of Economics and Business Administration, Helsingfors, Finland, (published in 1983 in the US by Marketing Science Institute and in the UK by Studentlitteratur/Chabwell-Bratt), 1982.
16. Grönroos, C., *Service Management and Marketing. Managing the Moments of Truth in Service Competition*, Free Press/Lexington Books, Lexington, MA, 1990.
17. Berry, L.L. and Parasuraman, A., *Marketing Services. Competing through Quality*, Free Press/Lexington Books, Lexington, MA, 1991.
18. Håkansson, H., (Ed.) *International Marketing and Purchasing of Industrial Goods*, Wiley, New York, NY, 1982.
19. Turnbull, P.W., and Valla, J.P. (Ed.), *Strategies for International Industrial Marketing*, Groom Helm, London, 1986.
20. Ford, D., (Ed.), *Understanding Business Markets: Interactions, Relationships and Networks*, Academic Press, London, 1990.
21. Kuhn, T.S., *The Structure of Scientific Revolutions*, University of Chicago Press, Chicago, IL, 1962.
22. A typical example of this paradigmatic position was expressed by a US professor at a services marketing conference in the late 1980s. When in a panel discussion the dominating role of marketing mix management and its four Ps were questioned, he responded by stating that he was a student of McCarthy and nothing could convince him that there could be anything wrong with the four Ps and the marketing mix.
23. As Kuhn[24] puts it: "Consider...the men who called Copernicus mad because he proclaimed that the earth moved...Part of what they meant by 'earth' was fixed position. Their earth, at least, could not be moved. Correspondingly, Copernicus's innovation was not simply to move the earth. Rather, it was a whole new way of regarding the problems of physics and

Review

Challenges and Opportunities for Electric Vehicle Charging Stations in Latin America

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Abstract: This research addresses the challenges and opportunities for electric vehicle charging stations in Latin America. The transition to electric mobility is crucial to reduce greenhouse gas emissions, modernize the quality of life in urban areas, update public policies related to transportation, and promote economic development. However, this is not an easy task in this region; it faces several obstacles, such as a lack of liquidity in governments, a lack of adequate infrastructure, high implementation costs, the need for clear regulatory frameworks, and limited public awareness of the benefits of electric mobility. To this end, the current panorama of electric mobility in the region is analyzed, including current policies, the state of the charging infrastructure, and the prospects for growth regarding electric vehicles in Latin America. Factors that could lead to their successful implementation are promoted, highlighting the importance of public policies adapted to Latin American countries, collaboration between the public-private industry, the industry's adoption of new technologies in this region, and the education of the population, and the benefits of these policies are considered. Successful case studies from the region are presented to provide us with an idea of practices that can be carried out in other countries. The implementation of a charging system in Latin America is also studied; the successful implementation of charging systems is found to depend largely on the existence of integrated public policies that address aspects other than the charging infrastructure. Finally, the value of the work and the research findings are presented to indicate what this study can help with. These strategies are key to overcoming the challenges and maximizing the benefits of electric mobility in Latin America.

Keywords: grid-connected charger; electric vehicles; charging station; charging infrastructure; policy; electric mobility



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1. Introduction

Sustainable mobility is increasingly playing a strategic and important role as a key element in the economic development and quality of life in cities, as well as contributing to the mitigation of climate change and improvements in air quality [1,2]. The various regulatory changes that are taking place, driving change in mobility habits and providing the means necessary for this change to occur, are positioning electric mobility as an alternative at global and national levels [3,4]. The future of driving is closely linked to electric vehicles (EVs); people are increasingly being encouraged to change their travel habits and the trend is to opt for electrification. However, for these changes to reach all users and represent a true automotive revolution in the short term, certain technical, technological, and administrative aspects must evolve, which should be emphasized. Countries in Europe, North America, and Asia have led this transformation, implementing ambitious policies,

offering tax incentives, and developing robust infrastructures to facilitate the mass adoption of EVs [5–12].

In the field of EV charging infrastructure, we believe that the most important thing is the expansion of the electric charging network and improving its management and accessibility. An aspect related to this topic is geographic coverage; it is essential to expand the availability of charging points in different geographic areas, including both urban and rural areas [13,14]. The lack of a charging infrastructure for electric vehicles is a major barrier to the mass adoption of electric vehicles; therefore, expanding this coverage is essential to encourage their use. Regarding the standards and compatibilities established to facilitate the charging of electric vehicles, it is necessary to establish common standards such as OCPP 2.0.1, ISO 15118-2, etc., and ensure interoperability between different charging service providers [15,16]. This implies the adoption of standardized charging plugs and protocols so that EV owners can charge their vehicles at any charging point. Improving charging speed is another important aspect. At present, there are different levels of charging, from slow charging (used mainly in homes) to fast charging (used at public charging stations) [17,18]. The expansion of fast charging stations, which allow for a vehicle to be charged in a matter of minutes, is absolutely necessary to make charging more attractive and competitive compared to filling up a car with gas. It is important that charging points are installed both in public spaces (streets, public parking lots, etc.) and in private spaces (homes, offices, shopping centers, etc.). By facilitating access to charging and making it easy and fast, the worries of EV owners will be eliminated [19,20]. The development of intelligent load management systems is another key aspect at present. This involves using technologies that allow for load demand to be balanced, preventing the electrical grid from becoming overloaded at times of high demand and optimizing the use of renewable energy. In addition, intelligent, easy, and accessible load management would facilitate scheduled charging, charging at times of lower demand, or load management through mobile applications through its established standards and ease of use.

The development of such an infrastructure not only represents a step forward in terms of environmental sustainability, but also offers economic and social benefits. Job creation, the development of new technological industries, and an improvement in urban quality of life are just some of these potential benefits [21–23]. However, these benefits come with significant challenges, ranging from financing and technological development to the need to establish adequate regulatory frameworks and foster public acceptance.

The establishment of public EV charging stations (EVCS) may have a wider impact on nearby communities, particularly regarding the economic vitality of the surrounding businesses. Some of the benefits of EVCS are the convenience and flexibility they offer. EVCS provide convenient charging solutions so that car owners do not need to frequently look for gas stations, and having a wider distribution network of charging piles increases the flexibility of the charging options. EVs replace traditional fuel vehicles and reduce exhaust emissions. EVCS use renewable energy for charging, reducing the associated carbon footprint. Smart electric vehicle charging piles can take advantage of low-peak electricity prices and can use charging pile monitoring functions to understand charging consumption and costs in real-time. The installation and development of electric vehicle charging piles support the construction of a sustainable transportation system, and the expansion of the distribution network of EVCS can provide the necessary infrastructure for the popularization and development of electric vehicles in the future.

This article aims to analyze the main challenges and benefits associated with the implementation of charging systems for electric vehicles in Latin America. Using a detailed approach, the current state of the charging infrastructure in the region will be explored in Section 2. The obstacles that must be overcome to allow for its development will be identified and the potential advantages of a well-implemented charging system will be discussed in Section 3. In addition, success stories will be presented, and practical recommendations will be offered to advance the creation of a robust and accessible charging

infrastructure, allowing the region to take full advantage of the benefits of electric mobility; this is presented in Section 4.

2. Electric Mobility in Latin America

Electric mobility has experienced a growth of more than 260% in the most representative countries of Latin America (Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, and Uruguay) in the last two years. During the first half of 2023, Mexico experienced a 30% increase in electric vehicle sales; Chile registered a cumulative increase of 17% between January and April; Ecuador and Uruguay stood out with a growth of 80% and 68%, respectively, in the first four months of 2023. Costa Rica showed significant growth, doubling its number of electric vehicles during this semester. These data reflect a marked trend of the adoption of electric vehicles in the region, driven by a combination of factors, including concern for the environment, reduced battery costs, and the increase in the availability of electric vehicle (EV) models. In Figure 1, a diagram of the electric and hybrid car market in Latin American countries is presented. However, the electric vehicle market is still in its infancy compared to developed countries. This is why these countries were chosen for the study. Furthermore, the electric vehicle charging infrastructure in Latin America is in the active development phase. The availability of charging stations is a crucial factor in the success of electric mobility in the region.

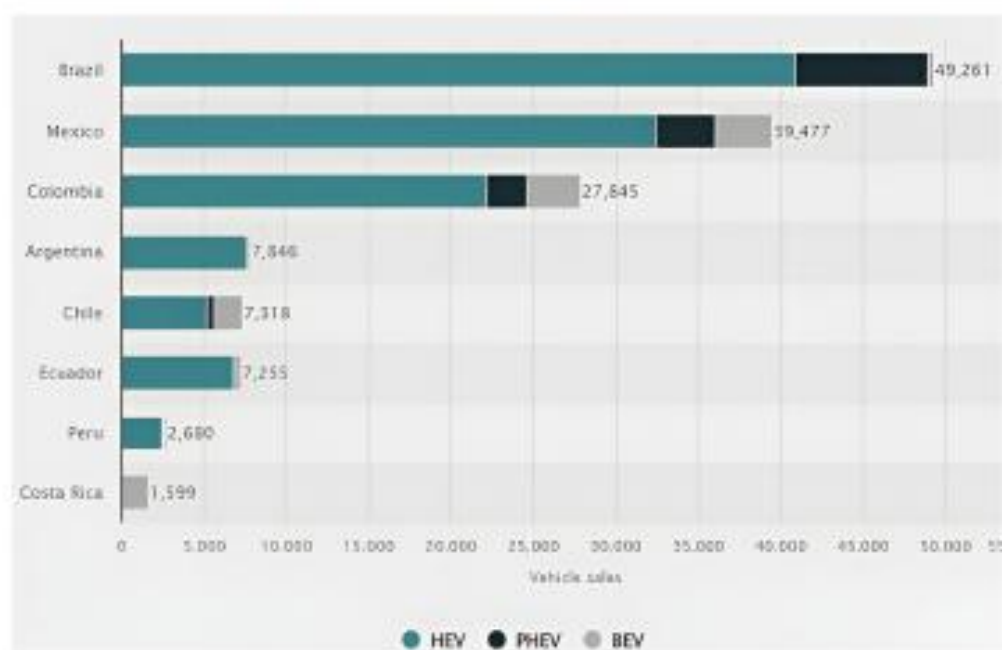


Figure 1. Diagram of the electric and hybrid car market in Latin American countries.

2.1. Current Infrastructure

Electromobility requires a good supply of charging stations and public connectors for the operation of electric vehicles. Different types of connectors for this type of mobile are available on the market: Type 1, Type 2, Schuko, Tesla, GBT and CHAdeMO are the main ones. Details of the public access charging points are provided below, with information

taken from Electromaps and from the different government reports [24,25]. Figure 2 shows the charging stations in Latin American countries.



Figure 2. Charging stations in Latin American countries.

2.1.1. Argentina

There have been important announcements regarding the development of a charging infrastructure (which is still non-existent in the country) as well as the launch of the first electric models (from Renault and the Chinese company, BAIC). Particularly, in terms of regulations, the design of guidelines, and procedural guides, Argentina has made important progress in regulating a market that does not yet exist. The Argentine automotive market is almost totally dominated by locally produced vehicles, or those produced within the Mercosur multilateral system, as well as imports from Mexico, with which Argentina is a trade agreement providing tariff exemptions [26–32].

In the hybrid segment, the main vehicle being sold is the Toyota Prius. At the same time, high-end products such as the Porsche Cayenne Hybrid can be found, as well as the recent launch of the Mercedes Benz C 350e and its plug-in hybrid version. Lexus has

announced that it will enter the Argentine market at the end of 2018, and its G540h hybrid is already available for reservations. As these are premium vehicles, they are not expected to make significant penetration into the market given their low inelastic demand. Due to the tax benefits of these vehicles, the possibility of other mass models in the European/North American markets entering Argentina in the coming years has been suggested. However, it is estimated that their entry will be delayed due to the fluctuations that the automotive market recently suffered in this country. Toyota has suggested that, by 2025, in accordance with the changes in the generation of the Hilux, they will begin to manufacture a hybrid version of the best-selling pick-up in Argentina. This suggests that the hybrid market may grow in the medium term. One obstacle that Argentina still faces regarding the introduction of electric vehicles is the need for charging infrastructure, which is practically non-existent at present. In certain cities in the region, the car manufacturers have installed public chargers in their dealerships to promote their portfolio of electric vehicles (such as BMW, BYD, Nissan, and KIA). However, this is not the case for Renault, which was the first company to market an EV (Kangoo ZE) in Argentina, at the beginning of 2018. The strategy of providing public chargers aims to create electric corridors. However, until the end of 2018, there was no major progress in the installation of a charging network for electric vehicles, nor were any deadlines or short-term objectives established [26–29].

Under these conditions, the market for alternative vehicles, particularly electric and plug-in hybrids, will see a massive take-off in Argentina after 2025. Given the strong fluctuations in vehicle sales and the growth trends of the last decade, Frost and Sullivan believes that, by 2025, the Argentine market will reach total sales of between 1 and 1.1 million vehicles, of which approximately 6700 will be hybrid or electric cars. This would represent around 0.6% of the total market [27,30].

Argentina has 23 charging locations and 37 connectors, of which 27 are type 2, four are CCS2, and three are CHAdeMO. The investments in electric routes by Scame, Vullietic, and Chargebox, and the chargers installed at Axion service stations, stand out in the public access infrastructure expansion plans. In addition to these, there is work being carried out in the provinces of Rio Negro and Neuquén. YPF is also working on two electric corridors. One would link Buenos Aires and Córdoba, and the second would link the south of the province of Buenos Aires, promoting connectivity with the Atlantic Coast. To carry out this project, the Argentine oil company awarded four manufacturers a contract to supply more than 30 fast chargers [26–32].

2.1.2. Brazil

Traditionally, this market is highly linked to the local industry, which has developed strongly in recent years, driven by promotional policies by the Brazilian government and the strength of its local consumption (around 89% of Brazil's sales are locally produced vehicles). During the rise of the so-called BRIC countries, the Brazilian automotive industry received strong investments to increase its production capacity to five million units per year, making it one of the five powers in terms of automotive production globally. Currently, Brazil is operating at 50% of its capacity, so it is working on strengthening trade ties with other countries, especially in LAC, such as Argentina, Colombia, and Mexico, to increase its exports while the local market recovers. Another possibility would be that this installed capacity could be used, for example, to produce electric vehicles. Looking at EV sales, unlike in 2014 (when the market was limited to pilot programs, with the most typical being taxi fleets and some B2B programs), in recent years, EVs have started to penetrate the consumer market. As in most Latin American countries, charging infrastructure and high vehicle prices have been the main constraints to the introduction of these vehicles to the general public. It is worth noting that EVs barely represent 0.01% of total car sales in Brazil [33–41].

Over the past few years, there has been a greater development of infrastructure, which has led to an increase in presence of this type of vehicle and their rapid adoption by both companies and consumers. In fact, excepting BYD, most of the activities of automotive

companies are oriented towards introducing their EVs at the consumer level, and working together with governments and companies to improve the charging infrastructure [33–37].

There are 284 charging locations in Brazil and 3800 connectors, of which 308 are type 2, 28 are CHAdeMO, 21 are type 1, 20 are CCS2, 9 are Schuko (EU Plug), and 4 are NEMA 5-20 (US Plug). Last month, the first fast-charging station was introduced in Brazil, with the Shell Recharge brand. It is located on Avenida Professor Celestino Bourroul, in the Limão neighborhood, in the north of São Paulo. According to Raizen, this point is the first of a network that aimed to have 35 stations spread throughout the country by March 2023.

There is a charging infrastructure for electric vehicles in 12 of the 27 states in Brazil, a situation that is not very common in markets that do not show a very high adoption of this type of vehicle. Most of the charging points are concentrated in the states of São Paulo, Santa Catarina, and Paraná. One relevant issue that has not yet taken an important role in the discussion regarding LAC is that of charging standards [34–38].

Hybrid and electric vehicles are expected to comprise around 1.8% of the total Brazilian market (around 61,700 units), which may seem relatively conservative, but as mentioned above, one of the restrictions to the adoption of this type of vehicle in Brazil is the significant push to use ethanol as a fuel [37–40].

2.1.3. Chile

According to the Superintendency of Electricity and Fuels, the country has 1032 public charging points, of which 405 are semi-fast, 194 are fast, 18 are ultra-fast and 2 are slow. These can be broken down into 329 type 2 sockets, 96 type 2 sockets, 79 Combo T2 sockets, 75 CHAdeMO sockets, 35 type 1 sockets, and 5 GB/T DC sockets. It is pertinent to note that Descon will link northern and central Chile with an intelligent route of chargers for electric vehicles. The expansion plan will be financed as a result of a project accelerator and will take around eight months from July, the estimated start month. Nissan aims to add between 12 and 14 new points during the year. This action is part of a commitment made by the automaker following the Public–Private Agreement regarding electromobility in Chile that was signed at the beginning of 2022 [42–54].

At the national level, there are already projects to expand public charging infrastructure networks in Valparaíso and other major cities in Chile. In 2016, Chilectra became a direct part of the Enel group (Enel Distribución Chile). This company is currently among the main agents promoting electric mobility technology in Chile and in other countries in the regions in which it is present. Its work is linked to the promotion of projects aiming to increase visibility in partnership with other agents (local municipalities, Renault, Nissan, Mitsubishi, BYD, Petrobras, the Copac and Shell gasoline companies, etc.). This mainly involves the installation of a charging infrastructure, as well as granting incentives for electric buses. The great challenge in establishing an extra-urban charging infrastructure network in Chile is its great geographic length, extending across the entire Andes mountain range, which makes it difficult to establish “green routes”. This challenge is shared with Brazil and Argentina, and has prevented the incorporation of +50 kW chargers or ultra-fast chargers from becoming widespread. However, various companies have committed to installing chargers: Enel Distribución planned to establish 40 electric charging stations by the end of 2018. Engie has committed to developing +100 charging points throughout the country and Chilquinta Energía will join the electric charging station business [45–54].

2.1.4. Colombia

Colombia has 206 charging locations and 480 connectors, of which 135 are type 2, 111 are type 1, 85 are Schuko (EU Plug), 44 are NEMA 5-15 (US Plug), 26 are CHAdeMO, and 14 are CCS2. The Autopistas del Café, the Caldas Hydroelectric Power Plant (CHEC), the Petrolera Energy Company and the Quindío Energy Company (EDECQ) recently presented the Eje Cafetero electrocorridor. This offers electric vehicle users the possibility of using three fast charging stations at the La Manuela dairy farms in Manizales; Caldas, El Privilegio in

Santa Rosa de Cabal; and Risaralda and the Jardín Filandia in Quindío. It extends 256 km and its main purpose is to position the Coffee Axis as a sustainable destination [55–65].

In general, charging stations are located in recreational areas such as shopping malls, parks, universities, and the José María Córdova airport in Medellín. Some of these sites offer additional incentives, such as exemptions from paying for parking (commercial center Oviedo in Medellín and Salitre in Bogotá), in addition to the non-monetary incentives of having specific parking spaces for electric cars. In addition, there are private charging stations, such as those that Gelsia installed in the central offices of Bancolombia in Medellín and Bogotá for the exclusive use of its employees [56–61].

The charging is achieved through a smart card that links the vehicle's license plate with the owner's address so that the fees for vehicles recharging at public stations are transferred to the electricity bill at the driver's home (EPM). At other stations, payment for recharging takes place through mobile applications such as EVA (Centro Comercial Unicentro in Bogotá). In other cases, recharging is free. Colombia is one of the countries in the region that shows the greatest commitment to promoting electromobility. The high level of concern about the increasing environmental pollution in the cities of Medellín and Bogotá, together with the objectives of COP21, have reinforced the commitment to focus on the use of cleaner transportation at a national level. The market has grown in recent years and although market penetration remains low, there is both regulatory and market readiness to replace internal combustion engine vehicles with hybrid or electric vehicles. There are still some important actions to be taken so that promotion and incentive policies are better coordinated and have a greater impact on the market and on the emission reduction objectives; however, the foundations are in place for the use of EVs to continue growing in the short-term while technologies advance so that prices become comparable with those of internal combustion vehicles. The biggest barrier to the growth of hybrid and electric vehicle sales in Colombia remains, and will continue to be, their high sales price. By 2025, around 2800 hybrid units (including PHEVs) and 2700 electric vehicles will be sold in Colombia, a total of 5500 units, which represents 1.6% of the total market [55–64].

2.1.5. Costa Rica

In December 2017, a law was passed in Costa Rica that eliminated virtually all taxes on electric vehicles. In Costa Rica, like in Colombia, reducing carbon emissions is the main reason for promoting and incentivizing electromobility. In the case of Costa Rica, the objective is to become a carbon-neutral country by 2022. The Law of Incentives and Promotion for Electric Transportation was valid until 2023 for vehicles and will be valid until 2028 for parts and assembly systems. This law only considers battery electric vehicles (BEV) in all their modalities: bicycles, motorcycles, cars, minibuses, buses, and trains. The law details the functions of the Ministry of Environment and Energy (MINAE), which is the entity in charge of monitoring and evaluating such vehicles, as well as promoting training and conducting educational campaigns to encourage the acquisition and use of electric vehicles. An important element is that the MINAE is also in charge of coordinating all efforts related to electric mobility between the different institutions. These two points are fundamental since, in other countries, commissions must be obtained to prevent the efforts of different institutions from being isolated, or different institutions moving in different directions. Although information campaigns may seem irrelevant, in countries such as Mexico and Ecuador, the lack of clarity and knowledge about such incentives has been noted as an inhibitor of these markets [66–74].

Regarding infrastructure, this law assumes that all levels of the government will be responsible for making the necessary investments for the promotion and strengthening of the use of electric vehicles in terms of charging infrastructure and additional lanes and parking spaces, among other factors. Regarding the charging infrastructure, the objective regarding the installation of chargers for national highways is for one charger to be present every 80 km, while in rural areas a charger must be installed at least every 120 km [67–71].

The 271 locations house around 440 connectors that are divided into 197 type 1, 83 NEMA 5-15, 47 CCS1, 46 CHAdeMO, 31 GB/T (DC), and 15 Type 1 (AU, NZ, CN Plug) connectors. It is worth noting that the Costa Rican Institute of Electricity (ICE), which has the largest network of fast chargers in Costa Rica, is looking for investors for a second fast charging network in the country. Charging for electricity used for recharging is only allowed for those companies that have a concession to sell electricity; these are allowed to partner with other entities in the installation of charging centers. The law stipulates that there must be charging centers not only in the parking lots of government entities, but also in public parking lots and shopping centers [69–73].

Although the effects of this law have yet to be felt, in terms of infrastructure, the commitment on the part of private organizations as well as public entities is already beginning to be appreciated, and the public charging infrastructure network for electric vehicles in Costa Rica is beginning to expand rapidly. The main actor in planning and developing the installation of chargers for electric vehicles is the ICE Group, which recently made commitments to expand its fast-charging network, as well as to acquire a fleet of electric vehicles [71–74].

2.1.6. Ecuador

Ecuador's distinctive feature regarding the development of electromobility in the region is its early experience in the implementation of tax benefits for the import of hybrid vehicles, and the rapid interest on the part of the consumer public. Ecuador has the largest stock of hybrid vehicles in South America. It currently has an extensive repertoire of tax incentives that will continue to drive the deployment of electric mobility. However, some of its main challenges are the need to define a national charging infrastructure plan with specific agents to address it, adjust aspects of the nomenclature on plug-in hybrid vehicles, and expand the available supply of vehicles with this type of technology. Being a country with an electrical matrix of primarily renewable sources (hydraulic), it also has the potential to shift the energy demand for fuels from the transport sector towards non-polluting sources with the development of an electromobility strategy in line with the recently published National Energy Efficiency Plan [75–81].

In Ecuador, no actor has positioned itself as a promoter of a plan to install a charging infrastructure for electric vehicles at the national level or in the different municipalities. In this sense, it is expected that the new Law of Productive Investments, which includes benefits such as tax exemptions for the import of chargers, will boost this activity. To date, KIA and BYD have taken on the role of installing a public charging infrastructure to meet the demand required by the growing fleet of vehicles sold by both companies. Likewise, the placement of these charging devices was part of their brand positioning strategy, so most of these chargers are located in KIA or BYD dealerships, shopping centers, and areas with high vehicle traffic [82–86].

Ecuador has 59 charging locations and around 130 connectors, of which 40 are type 1, 16 are type 2, 14 are NEMA 5-15 (US Plug), eight are Schuko (EU Plug), six are type 1 (AU, NZ, CN Plug), and four are CCS2. Although, last year, Ecuador launched its National Strategy for Ecuadorian Electromobility (ENEE), in which one of the main axes is the development of a charging infrastructure, the reality is that little progress has been made regarding public charging points and their respective regulations [85–89].

In 2025, it is expected that, in Ecuador, the total vehicle market may reach just over 150,700 units sold, while the sales of electric vehicles could reach 14,950 units (including HEV, PHEV, and BEV), representing the highest total market penetration for EVs in the region and 9.9% of total vehicle sales in Ecuador [75–89].

2.1.7. Uruguay

This country presents a promising outlook for the development of electric mobility from various perspectives. Fundamentally, it is a country that, in recent years, has transformed its energy matrix, with more than 95% of its energy coming from renewable sources.

At the same time, the state energy company adopted a program to promote and develop electromobility, which includes increasing the visibility of the offer and establishing a program to develop a public charging infrastructure in cities and road corridors, as well as providing preferential tariff rates. Although reductions in internal taxes have been legislated since 2010, the tax incentive regime for electric cars was formed in 2015 with the decree of an exemption from tariffs and the Specific Internal Tax (IMESI). With the extension of tax incentives, some automotive companies have launched electric product portfolios in the local market, covering the passenger vehicle and light utility vehicle segments. However, the offer is still limited. There is also a program to electrify the fleet of taxis in Montevideo. For several years now, various local entrepreneurs (start-ups) have been working on different ways to promote electromobility with innovative initiatives. Although, to date, the existing fleet of electric vehicles consists mainly of B2B purchases (tenders for the purchase of taxis and utility vehicles for local electricity companies), the possible scenarios regarding the mass adoption of this type of technology are quite promising in the medium term for Uruguay [90–97].

Following the application of some incentives provided by the authorities for the more competitive marketing of electric vehicles, the offerings of this type of technology have expanded: EVs were non-existent before 2015, when the Ruffino Group, a local distributor of the Chinese Original Equipment Manufacturer (OEM) Gac Gonow, which specialized in utility vehicles, incorporated a portfolio of 100% electric products from eMIN [91–95].

In partnership with the state oil company ANCAP, since 2017, UTE has been developing a public charging infrastructure for electric vehicles at a national scale called "Ruta Eléctrica". This system of green routes will be added to the existing system of public chargers installed in Montevideo. In the first phase, the Ruta Eléctrica will cover the distance from Colonia del Sacramento to Chuy, passing through Montevideo and the entire coastal region of Uruguay. The final section of Chuy has yet to be completed, but the other charging stations are already in operation [90–97].

The chargers are located at ANCAP service stations, every 60 km, and are Type 2 of 22 kW and 43 kW chargers, depending on the location. As in other countries in the region, and as the market in Uruguay is in its nascent stage, the projection for sales of hybrid and electric vehicles is based on three different scenarios, which differ, depending on both internal conditions and the global environment, in aspects such as the price of oil, progress in the development of hybrid and electric technologies, and their price. Frost and Sullivan estimate that sales of hybrid and electric cars will reach around 4000 units in 2025, comprising 8.0% of the total market [92–96].

2.1.8. Mexico

The Mexican market is still far from reaching its full potential, because even though vehicle prices are lower than in other countries in the region, there is a significant difference between the prices of internal combustion vehicles and EVs (except in the case of the Ford Fusion hybrid model, which is manufactured locally), and there is also a limited supply of vehicles with these technologies, particularly electric cars. In 2018, there was a charging infrastructure network in Mexico of approximately 900 stations distributed throughout the country, although there is a greater concentration in Mexico City and in the states of Nuevo León and Aguascalientes. The installation of this infrastructure was carried out by both private entities, mainly the brands that sell electric cars in Mexico (BMW, Nissan, and Tesla), and public entities, such as the Commission Federal Electricity (CFE, the state-owned company in charge of the generation, transmission, and distribution of energy in Mexico). Initially, when Nissan and BMW brought their first electric models to Mexico, they also began to install charging stations in all dealerships of both brands nationwide, which provided a greater degree of confidence to consumers regarding range anxiety, which was considered a major inhibitor of the market in other regions worldwide [98–104].

Subsequently, the CFE joined the efforts to promote electric vehicles in Mexico in two major areas: the installation of charging stations and increasing the ease of installing

independent energy meters directly in the homes of consumers so that the consumption of electricity related to vehicle charging does not interfere with the existing differentiated consumption rate for homes in Mexico. Regarding the development of a charging infrastructure, CFE invested in a joint installation, with BMW and Nissan, of 32 electric charging stations located in Mexico City and on the main highways of the country [105–109].

It should be noted that although the development of the charging infrastructure in Mexico was led by private companies (Nissan, BMW and Tesla), it is extremely important that other entities, both public and private, have joined, since this is how the infrastructure expands. It is not only important that different entities work together to install charging stations; the effort must go one step further to ensure that this effort is coordinated and that the growth of the network is not only efficient in terms of numbers but also in charging standards, so that more vehicles can use these charging points. Unlike other countries in the region, the development of charging infrastructure network is no longer a challenge for Mexico since EV users have also advanced in their learning about these vehicles (as in other global markets) and trust that electric vehicles depend more on domestic nighttime recharging than on the charging infrastructure in public places during the day. Mexico has 315 charging locations and 2083 connectors, of which 287 are Tesla Dest. Charger, 206 are type 1, 137 are Tesla Supercharger, 17 are type 2, 15 are Schuko (EU Plug), and 14 are CHAdeMO. The German manufacturer BMW is continuing with its expansion plans in Mexico. The firm is concentrating its efforts on establishing a charging infrastructure, and has ambitious projects. The challenge for Mexico, whose charging infrastructure could provide a point of reference for other countries in the region, is the standardization and optimization of this infrastructure. Around 57,200 hybrid and PHEV cars and 4200 electric cars will be sold in Mexico in a year. This is a total of 61,400 vehicles, representing around 2.9% of the total vehicle market in this country [98–113].

2.2. Current Policies and Regulations

The development of a charging infrastructure in Latin America is closely linked to current public policies and regulations, which vary considerably between countries. Some governments have taken the lead by implementing regulatory frameworks and policies that promote electric mobility, while others are beginning to design more comprehensive strategies.

Chile has been a pioneer in the region, taking a proactive approach with its “National Electromobility Strategy”, which includes tax incentives, reduced import taxes on electric vehicles, and specific programs to develop a charging infrastructure. Colombia has also adopted progressive policies, such as tax exemptions for electric vehicles and law 1964 of 2019, which promotes the use of electric vehicles and the construction of a charging infrastructure. In Mexico, despite the absence of a unified national policy, some states and cities have implemented incentives at the local level, such as exemptions from certain taxes and the creation of exclusive lanes for electric vehicles. Brazil, being the largest economy in the region, has started to introduce incentives, although it still faces regulatory challenges in facilitating the expansion of charging infrastructure [114–117].

On the other hand, countries such as Argentina and Peru are lagging in terms of implementing specific policies and regulations for electric mobility, which has resulted in a slower infrastructure development. In these countries, the lack of a clear regulatory framework and incentives has been a major obstacle to the expansion of the charging station network [114–117].

In some cases, such as in Chile, Costa Rica, and Colombia, these policies are the result of inter-ministerial coordination among the State (between energy, transport, and environment sector), together with a multitude of actors such as energy-generating and -distribution companies, automobile manufacturers, the academic sector, oil companies, and the mining sector, among others. These intersectoral coordination frameworks are the goals of other countries. In Brazil, however, the different States have developed alliances and individual pilot projects, although a relatively well-coordinated policy is observed at the national level. In the case of Argentina, the Argentine Association of Electric and

Alternative Vehicles (ANVEA) has, for years, supported, through its civil organization, debate and dialogue with different state, union, academic, and private sectors. In Uruguay, in addition to car manufacturers and entrepreneurs (start-ups) focused on electric mobility, the state-owned electricity distribution company (UTE) is the main actor articulating and developing the electromobility policy. However, at a regional level, as a whole, automotive companies are the leaders in promoting electromobility and the development of a charging infrastructure, and they present a joint vision of deploying electric mobility solutions. The fundamental objective is that the States in each country capture this multiplicity of local-global agents and manage to coordinate intersectoral working groups for the execution of specific commitments, regulations and agreed-upon standards within the framework of a joint strategy. Figure 3 presents a summary of the situation in each country regarding the regulations and incentives in place to promote the electric vehicle market in the region.

	Argentina	Uruguay	Brazil	Peru	Chile	Ecuador	Colombia	Costa Rica	México
Tariff Discount/Exemption	X	X	X	X	N/A	X	X	X	X
VAT Discount				X		X	X	X	
Discount/Exemption on other internal taxes		X		N/A	N/A	X	X	X	X
Discount/Exemption on registration/ownership/circulation		X	X			X		X	X
Preferential or free electricity rates	X*	X		X*	X*			X	X
Priority lanes/congestion zone						X	X	X	
Preferential Parking					X*	X	X	X	
Electric Taxis program		X	X		X	X	X	X	X

Figure 3. Summary of regulations and incentives in Latin American countries.

2.3. Current Trends and Projections

Current trends suggest an acceleration in the growth of electric mobility in Latin America in the coming years, driven by growing environmental awareness, decreasing battery technology costs, and an increasing supply of electric vehicles by automotive manufacturers [56].

In Latin America, the sale of battery electric vehicles (BEV) has been constantly and exponentially increasing in recent years. Colombia is positioned as one of the leaders in registrations of this type of vehicle in the region, with more than 3000 units being registered in 2022. One of the causes of these results for the Colombian automotive sector is the existing incentives for the purchase and ownership of electric vehicles. Mexico, Chile, and Costa Rica are other clear examples of the increase in the sale of electric cars due to the implementation of public policies. The Latin American countries whose economy depends most on the hydrocarbon sector are leading the way in the provision of a range of hybrids, vehicles that combine an internal combustion engine and an electric one. Brazil and Mexico lead in this area, with the highest volume of sales of hybrid vehicles (HEVs)

in 2022. However, these two powers of the region have lagged behind in the incorporation of completely electric cars in their vehicle fleet.

One of the factors hindering the adoption of electric vehicles in the Latin American market is the high price of the models, which are mostly imported, as well as the lack of tax incentives and, above all, the lack of an adequate charging infrastructure. The use of electric vehicles in public transport systems is not new in large Latin American cities. Since the last century, inhabitants of the region's metropolises have had access to underground train systems or metros, light rail, and trolleybuses that run on electricity. In recent years, the decision was made to modernize urban road transport fleets. In this regard, Colombia is one of the countries that invests the most in the electric segment of public transport on wheels, with more than 1500 electric buses in operation, followed by Chile and Mexico.

Infrastructure for EVs is essential to the expansion of electromobility in Latin America. The number of EVs is expected to rise significantly in the next few years. More time is required before the levels of development observed in nations in the US or Europe are observed; in these countries, there were approximately 160,000 EVs at the start of 2023.

The goal is to improve charging infrastructure and enhance the user experience, not only through the implementation of high-speed charging and smart charging, but also through the expansion of technologies such as wireless charging and the integration of electric vehicles with smart grids (Smart Grids), i.e., the ability of EVs to communicate and collaborate with existing electrical infrastructure [101].

The integration of renewable energies, such as solar energy, will assist in this. However, significant challenges will remain, especially in the implementation of electric mobility in urban and rural environments.

Countries such as Chile, Colombia, and Brazil are expected to continue to lead the development of charging infrastructure, with a focus on expanding networks in urban areas and key transportation corridors. The projection for Mexico is similar, with sustained growth being projected in the largest cities and the possible integration of charging stations into long-range road infrastructure projects. In addition, countries such as Ecuador and Costa Rica, which have a strong commitment to sustainability, are expected to significantly increase the installation of charging stations, supported by their energy policies and the promotion of renewable energy sources [56,101,102].

At the regional level, the electric vehicle fleet is expected to grow exponentially in the next decade, which will boost the demand for charging infrastructure. However, to achieve these objectives, it is crucial for governments to step up their efforts to create a coherent regulatory framework and promote public and private investment in charging infrastructure [101,102].

This outlook underscores the need for concerted action between governments, the private sector, and international organizations to overcome existing challenges and take advantage of the opportunities that electric mobility offers for Latin America.

3. Challenges in the Implementation of a Charging System in Latin America

3.1. Infrastructure and Technology

The implementation of an adequate charging infrastructure for electric vehicles in Latin America and the Caribbean faces several technical and logistical challenges, mainly derived from the geographic and urban diversity of the region [115,118].

Geographic diversity: The region presents a wide variety of terrains, from densely populated urban areas to remote rural areas. This geographic diversity complicates the planning and installation of charging stations, especially in rural and mountainous areas where connectivity to the electrical grid is limited. In addition, the existing infrastructure in some cities is not prepared to support the additional demand that a network of charging stations would generate, requiring significant upgrades to urban electrical grids [115,118–120].

Maintenance and technology: Charging stations require regular maintenance and access to advanced technology to ensure their operability and efficiency. The limited availability of technology and know-how in some parts of the region makes it difficult

to maintain and upgrade charging stations. Furthermore, the lack of standardization in connector types and charging power can lead to interoperability issues between different stations and vehicles [115,118–120].

Connectivity and digitalization: Integrating charging stations with smart energy management systems is another challenge, especially in countries with less developed telecommunications infrastructures. Digitalization is crucial for charging network optimization, demand management, and integration with renewable energy sources, but its implementation can be costly and technically complex.

3.2. Cost and Financing

One of the main challenges in the expansion of the charging infrastructure in Latin America is the high cost associated with the installation, operation, and maintenance of charging stations. The cost of installing charging stations, especially fast-charging ones, is high. This includes the costs of acquiring the equipment, the civil works required for their installation, and the connections to the electrical grid. In areas with a weak electrical infrastructure, the costs can be even higher due to the need to strengthen the grid [114,115].

Securing the necessary financing for these investments is a significant challenge, especially in the context of fiscal constraints and competition for public resources in the countries of the region. Sources of private financing are also limited, as investors may perceive charging infrastructure as a high-risk market due to uncertainty about the adoption of electric vehicles and long-term profitability [114,121].

For the business model, developing a viable business model for charging stations is another challenge, especially in areas where the adoption of electric vehicles is still low. Without a critical mass of users, charging stations could operate at a loss for a prolonged period, which discourages private investors.

The issue of asset ownership is crucial when assessing business models and future policy interactions for enterprises that operate in a variety of market functions. Certain businesses, such as ChargePoint and SemaConnect, concentrate on setting up and running a network of charging stations but do not maintain network ownership. This strategy is known as the “network-operator model” by Jonas et al. [120], wherein the business creates and manages a network but sells the hardware to host locations, who handle the billing and charging station access. Using this strategy, host sites can determine their own rates and payment schedules and keep their earnings after deducting operator fees. In these situations, the network operator transfers the business risk to the host organizations.

As an alternative, several businesses create, run, and own their own charging networks, such as EVGo and Blink Network. This strategy, which Jonas et al. [120], refer to as the “owner-operator model”, is a vertically integrated collection of operations where the charging company sells and owns the hardware, controls access and invoicing, and receives payments from the infrastructure. The owner-operator business model is comparable to that of a conventional mobile telecommunications provider that makes infrastructure investments and bills customers for the services the infrastructure provides. The network operator may collaborate with a private host in these situations to set up charging stations, but they still have control over the pricing and are subject to revenue risk.

In contrast to the network operators mentioned above, owner-operators may be better positioned to profit from future increases in charging demand or from favorable legislative changes, even though the negative risk resulting from poor utilization could pose a barrier to the adoption of this system.

More integrated approaches exist beyond the owner-operator model, as demonstrated by businesses such as Tesla and Aerovisionment, which operate in all four market functions, from manufacturing the equipment to setting up and maintaining networks to collecting revenue, although not always in an integrated manner. Companies are required to recoup their charging infrastructure expenses through user fees under these arrangements. As an alternative, Tesla provides free charging by including the expense of building the network of charging stations into the initial price of its cars. Managing a completely integrated EV

value chain may also prove to be a challenge for large equipment manufacturers who build, own, and run charging equipment, for instance, if they want to continue concentrating on their main business of unmanned aircraft and missile systems.

In addition to these strategies, Tesla and Better Places experimented with the separation concept. In this business model, the EV and battery are separated; the car is bought, while the battery is leased. This battery is simply swapped out when it needs to be recharged, eliminating the need to wait at a service station. The battery is now a standardized container that is rented as needed, so the consumer basically only buys the charge itself. Chinese automakers NIO and BLAC are re-examining the use of this strategy when implementing the model in China. Industry analysts are looking for new, more lucrative ways to guide the market as China reduces the governmental subsidies to EV manufacturers and EVSE providers.

The separation model may be a feasible path according to Yang et al. [121], who advise increased collaboration between the government and the participating enterprises as well as standardization in battery design. Although this strategy is still in its infancy, considering that China has the world's largest EV market and still continues to face profitability challenges, and the government is cutting back on financial assistance, this unorthodox method may at least be worth further investigation. China is home to several distinct business models. The second-biggest supplier there, the state-owned China Grid Corporation, operates on the owner-operator model. However, the biggest supplier of EV charging stations, TGOOD, manufactures, installs, and runs charging stations and equipment similarly to Tesla. Due to its market dominance in China, TGOOD is probably one of the biggest suppliers of this kind of service worldwide [121]. Although they have a much smaller market share, major automakers like BYD and SAIC also use the Tesla model. Although there are regional monopolies, the Chinese market is rather crowded. The main distinction between business models in China and those found elsewhere in the world is the strong backing provided by the federal, provincial, or state governments, whether in the form of subsidies, laws, or state-owned businesses. Additionally, State Grid and Potevio, the second and fourth biggest EVSE suppliers, are state-owned.

3.3. Regulation and Public Policies

The lack of clear and effective regulatory frameworks is a major obstacle to the implementation of charging infrastructure in Latin America. Many Latin American countries lack integrated policies that comprehensively address electric mobility and charging infrastructure. Existing policies are often fragmented or insufficient, making long-term planning and attracting investment difficult [114].

The lack of adequate incentives, such as subsidies, tax exemptions, or differentiated energy rates for charging stations limits the financial viability of projects. In addition, the absence of clear regulations regarding the installation and operation of charging stations can generate uncertainty among developers and operators [114,115,119].

The implementation of charging infrastructure requires coordination between different levels of government (national, regional, and local), which can sometimes be complex. A lack of alignment between national and local policies can slow down infrastructure development and create bureaucratic barriers.

3.4. Public Acceptance and Awareness

Public acceptance and awareness of electric mobility are essential for the success of the charging infrastructure, but in this region, these aspects still represent considerable challenges. Although environmental awareness is on the rise, there is still significant skepticism among the public about the viability and convenience of electric vehicles. Factors such as "range anxiety" (concern about how far an electric vehicle can travel on a single charge) and the perception that electric vehicles are expensive and impractical are significant barriers to their adoption. There is lack of accurate and accessible information about electric mobility and charging infrastructure, which is also a challenge. Many consumers are

unfamiliar with the benefits of electric vehicles and the location and availability of charging stations, limiting their willingness to make the transition [122–126].

Related to car culture, in many countries in this region, car culture is deeply entrenched, with internal combustion vehicles still being the norm. Changing these attitudes requires significant efforts in education and awareness, in addition to economic incentives and improvements in the charging infrastructure.

These challenges underscore the need for a comprehensive and coordinated approach to the implementation of a charging infrastructure in Latin America, including concerted efforts focusing on infrastructure, financing, regulation, and public awareness.

3.5. Benefits of a Well-Implemented Charging System and Its Environmental Impact

This region has great potential to increase its solar power capacity by a factor of 40 by 2050. Green hydrogen, in combination with solar power generation, thus represents an opportunity for Latin America, not only as a solution for “energy storage” in more remote areas, but also to accelerate the transition to low-emission transport. Even though almost all of Costa Rica’s energy is generated from renewable sources, 42% of total GHG emissions in Costa Rica come from vehicles that use fossil fuels. In Paraguay, 89% of the total emissions from the energy sector are linked to transport [117,126–130].

In short, the issue of transport is often seen as a challenge, but it can also be an opportunity when looking to reduce emissions quickly in the Latin American region.

One of the main benefits of a well-implemented charging system is its significant contribution to reducing carbon dioxide (CO₂) emissions and other pollutants, which helps to mitigate climate change and improve air quality in cities.

Electric vehicles generate zero direct CO₂ emissions, which contributes directly to the reduction in global greenhouse gas emissions, especially in regions where transport accounts for a significant share of these emissions. By reducing dependence on fossil fuels, the adoption of electric vehicles can play a crucial role in meeting international emissions reduction commitments, such as those set out in the Paris Agreement. Electric vehicles do not emit air pollutants such as nitrogen oxides (NO_x) and fine particulate matter (PM₁₀ and PM_{2.5}), which are common in internal combustion vehicles. This has a direct impact on public health, as it reduces the incidence of respiratory and cardiovascular diseases associated with air pollution [127–130].

The main source of environmental noise in cities vehicle traffic (Figure 4). It is known that the type and size of streets influence the noise levels, and with the introduction of electric propulsion vehicles into circulation, it is expected that, in the future, environmental noise levels will be reduced. In these vehicles, the engine is very silent, and noise from the tires is the main source of noise. Various studies indicate that a reduction in noise levels only occurs for speeds below 50 km/h. Electric vehicles are much quieter than their internal combustion counterparts, which contributes to a reduction of noise pollution in urban areas. This improves the quality of life in cities, creating quieter and more habitable environments [121–132].



Figure 4. Environmental benefits that can be implemented in the charging station infrastructure.

Electric vehicle production in Latin America has seen significant growth in recent years, driven by investments from both local and international companies. The expansion of electric vehicle production in Latin America is not only transforming the automotive industry, but is also having a significant economic impact. The multi-million USD investments by several companies that are setting up in the region are creating thousands of jobs and encouraging the development of new local supply chains. In addition, the adoption of electric vehicles is beginning to reduce the dependence of countries in the region on fossil fuels, which could translate into substantial economic savings in the long term. In Chile, the entry of BYD Auto is not only revolutionizing the automotive market but is also driving the development of a charging infrastructure and related services, creating an ecosystem that could attract even more investment and stimulate the economy. Mexico has become an epicenter of electric vehicle production in Latin America. This growth was driven by the arrival of industry giants such as Tesla and Jetour, which made multi-million USD investments to set up assembly plants and strengthen the infrastructure needed for EV production. These investments not only increase the production capacity, but also generate employment and develop local supply chains, strengthening the national economy. Stellantis, another major player in the automotive industry, has announced plans to produce hybrid and electric vehicles in Latin America. Its focus is on developing models specifically tailored to the needs of the local market, including the creation of “bio-hybrids”, a new generation of vehicles that combine alternative fuel and electric power technologies. This strategy not only diversifies the product offerings, but also positions Stellantis as an innovative company in the sustainable mobility sector. The implementation of an electric vehicle charging system can also generate a series of economic benefits, both at the macroeconomic level and in terms of local development [114–117].

Furthermore, the construction, operation, and maintenance of the charging infrastructure for electric vehicles can create a large number of direct and indirect jobs. These jobs are not only generated in the installation phase of the charging stations, but also in the manufacturing of equipment, software development, maintenance services, and other related sectors [114].

In addition, to increasing the growth of existing industries, electric mobility opens the door to the development of new industries, such as battery production, research and development regarding charging technologies, and the manufacture of specific components for electric vehicles. In addition, startups and technology companies that specialize in electric mobility and energy management solutions can find an expanding market in Latin America.

To attract the necessary investments, a well-implemented charging system can attract both domestic and foreign investments. Multinational companies in the automotive, energy, and technology sectors can be encouraged to invest in the region if there is a solid infrastructure and a favorable regulatory environment for electric mobility.

Another benefit is savings in operating costs. In the long term, electric vehicle users can benefit from lower operating costs, as electricity is generally cheaper than fossil fuels, and electric vehicles require less maintenance. This can translate into significant savings for companies that operate vehicle fleets and for individual consumers.

4. Case Studies for the Implementation of a Charging System in Latin America

Across Latin America, some countries and cities have made significant progress in implementing electric vehicle charging systems, providing valuable experiences that can serve as a model for other parts of the region.

4.1. Leadership in the National Electromobility Strategy by Chile

The state and characteristics of the transport sector in Chile in 2017 were analyzed, focusing on the opportunities presented by its electrification. With this, and after a participatory process, the first national Electromobility Strategy was developed, where long-term goals were established as follows: for 40% of private vehicles and 100% of urban public

transport to be electric by 2050. Electromobility and actions to promote energy efficiency in transport were established as some of the main factors that will allow Chile to achieve carbon neutrality by 2050, contributing to nearly 20% of the CO₂ reductions necessary for this. This state policy that aims to create a roadmap for the advancement of sustainable transportation that will directly benefit Chile. In order to produce the required rules for the safe and sustainable growth of electric mobility, new problems are presented, with the goal of promoting the use of more ecologically friendly and efficient automobiles. Lastly, Chile has objectives and aspirations to hasten the adoption of electric mobility, setting forth national policies, roadmaps, and international agreements pertaining to this.

Chile's success lies in the creation of a solid regulatory framework, the establishment of clear, long-term objectives, and collaboration between the public and private sectors. The integration of electric mobility with renewable energy policies has been key to its effective implementation. Other countries can learn from the Chilean experience, especially in terms of long-term policy formulation and the importance of charging infrastructure for public transport.

4.2. Commitment to Sustainability by Costa Rica

Costa Rica, a country known for its focus on sustainability, adopted electric mobility as a central part of its environmental policy. Since 2006, the purchase of EVs in Costa Rica was incentivized through tax rebates that exempt them from the "selective consumption tax" (which could range from 30% to 54% of the total value of a vehicle). Taxes on hybrids were also reduced from 15% to 10%. In 2015, debate began over a proposed bill on the incentives for and promotion of electric transport and, in January 2018, the government enacted the Law of Incentives and Promotion for Electric Transport, which offers tax exemptions and benefits for the import and purchase of electric vehicles, as well as for the installation of charging stations. The country also developed a growing network of public charging stations, driven by the state electricity company, which operates in conjunction with renewable energy sources [114].

Costa Rica demonstrates the importance of economic and regulatory incentives to encourage the adoption of electric vehicles and the development of a charging infrastructure. The integration of electric mobility policies with the energy sector and the use of renewable energy reinforces the sustainability of the system. The Costa Rican experience can serve as an example for countries that want to encourage the adoption of electric vehicles through proactive government policies and the use of clean energy.

4.3. Expansion of Charging Infrastructure in Key Cities in Colombia

Colombia has made significant progress in electric mobility, especially in cities such as Bogotá and Medellín. Bogotá has implemented policies for the adoption of electric buses in its public transport system and encouraged the installation of charging stations in strategic locations. In 2019, the city of Medellín launched a project to develop an "Electric Route" that includes the installation of fast-charging stations along major urban and suburban roads. Colombia's experience highlights the importance of public policies at the local level and coordination between municipal and national governments. In addition, it highlights the need to develop a charging infrastructure in urban and suburban areas to support the widespread adoption of electric vehicles. Other countries can emulate Colombia's strategy to implement electric routes and promoting electric public transport [56].

5. Perspective for the Implementation of a Charging System in Latin America

From these case studies, several good practices and lessons can be drawn that could be applied in other contexts within Latin America as the successful implementation of charging systems depends largely on the existence of integrated public policies that address not only the charging infrastructure, but also the promotion of electric vehicles, tax incentives, and integration with renewable energy. A holistic approach involving all relevant sectors is crucial to overcome these challenges and maximize the benefits. Collaboration between

the public and private sectors is essential for the development of a charging infrastructure. Governments can establish regulatory frameworks and offer incentives, while the private sector can provide innovation, investment, and technical expertise. This type of collaboration has proved effective in the countries that have made the most progress in the region [86,114].

It is essential that national and local governments develop regulatory frameworks that facilitate the installation of an electric vehicle charging infrastructure. This includes defining technical standards for charging stations, interoperability standards, and simplified procedures for obtaining installation permits. Public policies must be coherent at the national and local levels to avoid contradictions and facilitate investment. Governments can encourage the expansion of the charging infrastructure by implementing economic incentives, such as subsidies for the installation of charging stations, tax exemptions for the import of equipment, and preferential electricity rates for charging station operators. These incentives can reduce the upfront costs and make investing in charging infrastructure more attractive to the private sector. Electric mobility should be an integral part of urban mobility plans. Cities should include a charging infrastructure in their urban development and transportation plans, ensuring that charging stations are strategically located in high-demand areas and key transportation corridors. This will help optimize charging system efficiency and facilitate the mass adoption of electric vehicles [114,115,119].

Countries that have been successful in implementing charging systems have adopted long-term planning, with clear and well-defined objectives. This not only provides a roadmap for future development, but also builds confidence among investors and consumers. Since urban areas are often the first to adopt electric vehicles, initially focusing efforts on these areas can make a significant impact in terms of reducing emissions and improving quality of life. However, it is important not to neglect the eventual expansion into suburban and rural areas. The success of electric mobility also depends on public acceptance. Investing in education and awareness campaigns to inform the public about the benefits of electric vehicles and the charging options available is critical to increasing their adoption. Each country and city in the region has a unique context, so the solutions must be adaptable and flexible. What works in a highly urbanized city may not be suitable for rural areas. Policies and strategies must be tailored to local needs and characteristics [124,125].

Governments should promote strategic partnerships between the public and private sectors for the development of a charging infrastructure. This could include collaborative agreements with energy sector companies, electric vehicle manufacturers, and charging technology providers. These partnerships can share risks, leverage resources and expertise, and accelerate infrastructure deployment. Since many Latin American and Caribbean countries face fiscal constraints, it is crucial to leverage financing from international organizations, such as the Inter-American Development Bank (IDB) and the World Bank. These agencies can offer loans, grants, and technical assistance for charging infrastructure projects, especially in areas with a lower local investment capacity.

Public-private collaboration can facilitate the development of innovative business models, such as pay-as-you-go schemes, subscriptions to charging services, and renewable energy supply agreements. These models can help to ensure the financial sustainability of charging stations and increase their accessibility to users. Countries and cities are encouraged to adopt advanced charging technologies, such as fast- and ultra-fast-charging stations, which can significantly reduce the charging time for users. In addition, the implementation of smart charging systems, which optimize the use of the electrical grid and allow for the integration of charging stations, can help reduce the cost of charging [86,114].

Vehicle manufacturers take into account the safety and performance of EV batteries in order to guard against combustion, explosions, and other possible mishaps brought on by the battery's own malfunctions. From a safety perspective, a number of standards have also addressed the plugs and connectors, as well as the EVSE, providing electrical safety protection measures. For example, the Society of Automotive Engineering (SAE) released guidelines for plug-in electric vehicle (PEV) charging. The general electrical,

performance, and physical criteria for EV charging systems in North America are covered by the SAE J1772 standard [133–135]. EVs may completely utilize three-phase ac electricity to charge their batteries thanks to the SAE J3068 standard. A high degree of safety is offered. Policymakers and academic communities have also looked into the electrical safety issues surrounding EVCSs from the perspective of an EVCS operator. In addition to demanding that EVCSs undergo recurrent safety evaluations, guidelines were added mandating that the EVCS design adheres to the requirements of the previously described standard [136]. Ref. [134] talks about fire safety when charging EVs. An analysis of the transformer loss-of-life resulting from disorganized PIV charging in a parking garage may be found in [137]. Transformer aging and premature replacement can be prevented by integrating photovoltaic (PV) systems and using intelligent charging algorithms. Advanced EVCS communication systems open up new possibilities for the EVCS operator, as a communication-assisted protection approach can mitigate issues and guarantee a secure charging environment for the EVCS data and power quality assessments.

6. Value of the Work and Findings

Throughout this research, the main challenges and benefits associated with implementing an electric vehicle charging system in Latin America were presented. Although electric mobility has a bright future in Latin America, its success will primarily depend on how well governments, corporations, and citizens can overcome the present obstacles. There will be an increasing need for a sufficient charging infrastructure as more nations switch to electric automobiles. The region must transition to a more egalitarian and sustainable transportation system, with electric mobility playing a key role in lowering emissions and raising the standard of living for locals. This research addresses the challenges and opportunities for Electric Vehicle Charging Stations in Latin America. A transition to electric mobility is crucial to reduce greenhouse gas emissions, modernize the quality of life in urban areas, update public policies related to transportation, and promote economic development.

This research details how the development of charging networks for electric vehicles is one of the key pillars for the expansion of electromobility in Latin America. However, one of the major challenges is the profitability and accessibility of these infrastructures, especially in the public and business spheres. The debate surrounding the profitability and accessibility of charging networks in Latin America highlights the urgent need to find sustainable economic models and guarantee interoperability between different systems and networks. With the accelerated growth in electric mobility, the region must make strategic decisions to facilitate access to the charging infrastructure and ensure the economic viability of such projects in the long term. However, the growth of this infrastructure has not been sufficient to keep pace with the increase in the number of electric vehicles.

Education can support the adoption of electric vehicles, improve public awareness, and prepare the next generation of professionals to address the interdisciplinary challenges of sustainable energy systems. These educational dimensions are more prominently highlighted in [138]. Carrying out educational work that reaches citizens focusing on energy policies and the use of electric cars is an essential factor. This research attempts to carry out a survey of the available information on charging infrastructures in Latin America and see how this information could reach the society.

7. Conclusions

Latin America has a rare chance to spearhead the worldwide shift to clean and sustainable transportation by integrating a charging infrastructure with renewable energy sources. With an emphasis on public education, the development of regional standards, and technological innovation, the area could become a global example in the adoption of electric mobility. Latin America is located in a climate zone with increased solar activity, which is promising regarding the creation of solar energy that could partially or fully cover the needs of electric vehicle charging systems.

China. We collected comprehensive online comment data related to shared micro-mobility from January 2022 to June 2023. This nationwide dataset, distinct from traditional survey data, laid the foundation for establishing broad and objective thematic clustering. Subsequently, employing the latent dirichlet allocation (LDA) algorithm, which provides higher differentiation than traditional word frequency clustering methods, we performed a clustering analysis. This allowed us to further explore the key factors influencing user satisfaction (sub-topics) and to categorize them into four research topics constituting the product perceived value [11]. In Study 2, building on the conclusions from Study 1, we expanded the content of the American Customer Satisfaction Index (ACSI) [12]. We constructed a user satisfaction research model for the product perceived value of shared micro-mobility. Subsequently, we collected survey data through questionnaires and conducted empirical analysis using structural equation modeling (SEM) [13–15], aiming for innovation in the field of research methods. Additionally, this study integrated the concept of perceived value into the product dimension of shared micro-mobility, conducting detailed research from four perspectives: product quality, user expectations, interaction experience, and subjective consciousness. Based on the final research results, some recommendations will be proposed for the design, development, marketing, and promotion of shared micro-mobility so as to boost the sustainability of urban transportation.

The rest of this paper is organized according to the following structure. The second section will review the relevant literature and illustrate the theoretical basis of this study. The third section concerns Research No. 1, which uses the LDA to explore the factors influencing the shared micro-mobility users' satisfaction from online users' comments. The fourth section concerns Research No. 2, which aims to validate the authenticity and intrinsic relationship of various topics in Research No. 1; based on the ACSI model, an empirical study will be conducted to examine the factors that may affect the satisfaction of shared micro-mobility users while exploring the underlying mechanisms that influence users' continuous use of shared micro-mobility vehicles. And the fifth, sixth, and seventh sections will discuss the theoretical and practical implications of the findings of this study, as well as the limitations of this study and future research directions.

2. Literature Review

2.1. Micro-Mobility in the Background of Post-Sharing Era

The focus of academic research in the micro-mobility field is gradually becoming more refined and systematic. The evaluation of shared micro-mobility is a composite concept, with scholars conducting quantitative assessments by collecting a series of performance indicators from shared micro-mobility enterprises and comparing them with past performance standards [16]. Additionally, researchers can deduce the evolution of future micro-transportation systems by studying data such as city user travel rates and shared vehicle routes [17]. The mentioned studies primarily focus on evaluating the service quality of shared micro-mobility from a non-user perspective, and the indicators themselves do not provide specific qualitative results. Therefore, some scholars have constructed quality assessment models based on the user characteristics and service attributes of shared micro-mobility to assist companies in enhancing service quality from the user's perspective [18]. In the post-sharing era, an increasing number of studies are evaluating the product service experience of shared micro-mobility from the user's perspective. How to obtain more authentic and accurate user subjective experiences has become a hot topic in research. In summary, the post-sharing era provides a new context and opportunity for researching the micro-mobility phenomena, and the continued development of micro-mobility services is a response to the diverse demands of urban commuters in the post-sharing era. With the advancement of science and technology, as well as society's hiking concern over environmental protection, the travel modes in the post-sharing era will become more diversified as an important part of urban life [19,20]. The shared micro-mobility industry shall no longer rely on the blind expansion of resource scales; rather, they will have to address new market demands. Emphasizing the importance of research to user satisfaction is a key

point in ensuring that these products can deliver continued success in a rapidly changing market environment. This will not only help meet the diverse needs of users in order to boost the growth of enterprises; they will also help raise the social recognition of shared micro-mobility and promote the development of sustainable urban transportation.

2.2. Shared Micro-Mobility Satisfaction

The existing research results have greatly advanced the benign development of shared micro-mobility in all aspects. However, for a travel field such as this, with a high degree of freedom and flexibility, it is very important to undertake comprehensive evaluation research on the experience of travel products and services. User satisfaction is one of the important standards by which to measure the experience of shared micro-mobility, and it is also a comprehensive indicator when surveying the economic and social benefits of travel; in addition, it plays a key role in allocating travel resources, improving the quality of travel services, and meeting users' travel needs [21]. In recent years, many scholars have researched user satisfaction in the urban transportation domain from various perspectives. Zhang et al. approached the study via the characteristics of public transportation operators, demonstrating the impact of factors such as passenger expectations and perceived value on user satisfaction [22]. Fishman and Soltani, in contrasting bike-sharing with existing transportation modes, identified pricing and safety as crucial factors influencing user satisfaction [23,24]. However, existing research has predominantly explored the factors affecting and optimizing user satisfaction in shared micro-mobility from macro perspectives such as businesses or government, lacking the consideration of end-users' perspectives and the assessment of comprehensive product value [25]. Therefore, conducting a comprehensive evaluation of the product value in shared micro-mobility from the user's perspective and subsequently exploring the underlying mechanisms of user satisfaction is imperative. When individuals utilize shared mobility tools such as bike-sharing, they are engaging with shared micro-mobility services and can be considered customers of shared micro-mobility enterprises. Presently, the American Customer Satisfaction Index (ACSI) stands as the most widely applied model for measuring customer satisfaction. However, within the realm of shared micro-mobility research, there is a scarcity of studies examining satisfaction impact mechanisms from the user's perspective. Therefore, our research is grounded in the American Customer Satisfaction Index (ACSI) theory, which is a comprehensive evaluation index for customer satisfaction with perceived value at its core, based on the process of product and service consumption. It encompasses six variables: customer expectations, perceived quality, perceived value, customer satisfaction, customer complaints, and customer loyalty [13]. Building on the ACSI framework, Ibrahim et al. utilized structural equation modeling (SEM) to explore factors influencing passengers' satisfaction with mono-rail services and their willingness to continue using the service [26]. Chen et al., based on ACSI, constructed a research model involving heritage perception value, perceived enjoyment, visit satisfaction, and post-visit behavioral intentions, validating it through SEM [27]. Although ACSI has been maturely applied in customer satisfaction research, with high academic authority and wide applicability, it has been little implemented in the field of micro-mobility; moreover, in-depth research is still required for the theoretical interpretation of the current comments or reviews of shared micro-mobility users. Hence, it is possible to make appropriate adjustments to the ACSI to construct a shared micro-mobility user satisfaction model, aligning it more closely with the practicalities of the research. Furthermore, the utilization of SEM or path analysis to analyze the relationships between satisfaction or service quality and various attributes has become increasingly popular [28,29].

2.3. A Study of User Satisfaction Based on Online Reviews

With regard to the research on the evaluation of user satisfaction, the existing literature generally adopts certain qualitative (e.g., the grounded theory) and quantitative (e.g., questionnaire surveys) methods to identify the factors influencing satisfaction, along

with the dimensions of such factors. However, such methods tend to be operated in a costly manner, while collecting only limited samples, and the limited information from closed questions cannot provide rich data for more complex analyses [30]. In recent years, therefore, with the rapid development of Internet technology, academic results related to user-generated content (UGC) have increased significantly, and online reviews have gained widespread attention as an important component of UGC. UGC not only encompasses a broad range of factual information but also indirectly reflects the emotional needs of the commentators [31]. Dong and Kim, among others, have revealed the importance of online reviews in the hotel industry, and their studies have found that the information on customer experience showcased in online reviews is crucial for enhancing user satisfaction of hotel services [32,33]. Guo et al. have collected online reviews on rental apartments from social media and assessed the occupants' satisfaction via topic modeling and sentiment analysis [34]. As a kind of text data, online reviews have such characteristics as easy retrieval, wide range, low cost, and objectivity. With the feature of big data, online reviews contain a huge amount of valuable information, so they can effectively remedy the shortcomings of traditional econometric and statistical methods.

The vast textual data require further cluster analysis, and the latent dirichlet allocation (LDA) is a probabilistic model that utilizes topic modeling [35,36]. This topic model is capable of uncovering abstract themes latent in massive text and yields more distinctive results compared to traditional methods such as word frequency clustering statistics. Therefore, this study, based on the LDA model, conducts topic mining on online comment data to explore the dimensions of user evaluations and focal features regarding shared micro-mobility in the post-sharing era. Building on this, a research model for user satisfaction in Chinese shared micro-mobility is established based on the ACSL, and an SEM approach is employed to establish relevant quantitative models, conducting empirical research on the authenticity and correlation of these key factors. The overall research methodology framework is illustrated in Figure 1.

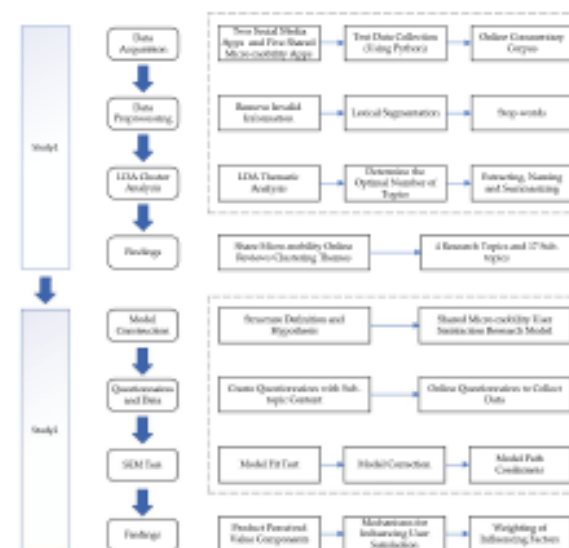


Figure 1. Research methodology framework.

3. Study 1: Exploring the Factors Based on Review Mining with Latent Dirichlet Allocation

In this section, the method of text mining is used to collect user reviews from shared micro-mobility platforms, and LDA is adopted to conduct clustering analysis on the results. The key factors affecting users' satisfaction will be identified from the users' perspective so as to lay the foundation for constructing a research model for shared micro-mobility users' satisfaction in the next section.

3.1. Data

Taking the shared micro-mobility app platforms in China as the research object, this study collected online users' reviews to identify relevant problems and concerns. In order to avoid the bias caused by narrow data, Python 3.8 was used to retrieve review contents from different shared micro-mobility app platforms, and reviews were also collected from third-party social media sites to enhance the diversity of the data. Specifically, this study selected data from two review channels in China: reviews by platform users and reviews on social media. And the following two principles were set for selecting appropriate target data sources: (1) the shared micro-mobility brands among the top 10 in terms of market shares; and (2) the social media presence of the top 10 in terms of user activity. Based on the above principles, two social media apps and five shared micro-mobility apps were finally selected. From Android and IOS app stores, five shared micro-mobility platform apps were screened out: namely, HelloBike, Meituan, Green Orange, Xiao Liu, and Song Guo, and the two social media platforms were Little Red Book and Zhi Hu. These apps have wide user coverage and a high utilization rate, and their data are publicly available. The apps can be downloaded from app stores for free. The user online comments from various platforms were selected from January 2022 to June 2023 (on social media platforms, keywords such as "shared mobility", "bike-sharing", and "electric scooter-sharing" were used for searching and collection). Considering that user comments, despite originating from different sources, represent the same type of subjective data, and that all online comments on various platforms are textual data, merging them directly enhances the generalizability of the results. A total of 7827 online reviews have been collected with Python. After de-duplication and screening of invalid reviews, a total of 6860 valid reviews were obtained, with some of them shown in Table 1.

Table 1. Data sources (partial content).

User ID	Source of Data	Comment Content	Comment Time	Follow-up Comment Content
82**65	HelloBike	Riding a monthly card is quite cost-effective when riding, but you need to pay attention to bicycle safety.	11 February 2023	The bicycles are quite beautiful, I like them!
24**92	Meituan	The seat is a bit hard and uncomfortable on bumpy roads.	5 January 2023	N/A
26**15	Green Orange	Returning the o-bike is easy, and o-bikes are often easy to find on the road, saving a lot of walking distance.	23 November 2022	N/A
48**56	Xiao Liu	I've already positioned the bike correctly but the system still asks me to adjust the bike's position.	19 January 2023	Can the GPS system be improved?
94**35	Song Guo	The bikes often have malfunctions, and customer service is all automated, quite frustrating.	16 December 2022	N/A
52**75	Little Red Book	I can't find the complaint entrance, and the bike lock malfunctioned, unable to unlock. Very disappointed!	14 January 2023	N/A
46**73	Zhi Hu	Riding is usually good, but there are not many types of bikes. I wish there were more models available.	21 December 2022	In the future, I plan to ride out often for a leisurely stroll.

In order to perform topic clustering analysis in a better manner, a series of data preprocessing operations are required: (1) manually remove some invalid information, such as emoticons, symbol labels, blank fields, etc.; (2) jieba, a third-party open source Python 3.8 toolkit, is used to perform Chinese lexical segmentation so as to transform textual data into discrete words and provide a basis for the subsequent textual analysis and feature extraction; and (3) perform stopword processing so as to remove the words that appear frequently in the text but lack actual meanings, including conjunctions, auxiliaries, prepositions, and the like. Simultaneously, a custom lexicon was established, incorporating abbreviations such as “5G” and “GPS”. The above data preprocessing methods can effectively improve the effectiveness and accuracy of topic clustering. After three rounds of adjustment by using the above methods, the final word frequency statistics were acquired, as shown in Table 2.

Table 2. Word frequency statistics (top 30).

Word	Frequency	Word	Frequency	Word	Frequency
service	1165	preserve	426	congestion	213
maintenance	903	health	407	big data	201
environment	822	positioning	391	traffic	196
smart	758	convenience	388	experience	184
travel	713	malfunction	351	interface	168
price	670	parking	337	technology	151
bike	597	aesthetics	323	community	147
cost	552	popularity	270	credit	143
rental	485	register	264	appearance	139
safety	432	economic	234	privacy	121

3.2. Methods

The word frequency results reflect the current hot topics that people are concerned about, but their distinctiveness and accuracy cannot be guaranteed. Therefore, we utilized the LDA for further cluster analysis of the vocabulary. The core idea of the LDA is to model the distribution of topics in a document as well as the distribution of words in a topic as random variables, and parameter estimation is performed through the observed text data so as to reveal the latent semantic structure in the text data. In the process of LDA modeling, the number of topics shall be set, and usually, the larger the volume of the text collection, the higher the number of topics. A large amount of practice and a large number of studies have proved that the topic-clustering effect of the LDA is directly related to the number of potential topics, and this number will directly affect the quality of the clustered document sets. In this paper, the perplexity degree, a widely used index, was used to determine the optimal number of topics. The perplexity degree is the deterministic judgment index when a model distinguishes topics, and it can demonstrate whether a model is applicable to new samples and whether a model can correctly distinguish topics [35]. The calculation formula is as follows:

$$P(\bar{W} | M) = \exp - \frac{\sum_{m=1}^M \log p\left(\frac{\bar{w}_m}{N_m} | M\right)}{\sum_{m=1}^M N_m}, \quad (1)$$

where M is the number of characters in the document; N_m is the length of document m ; and $\log p\left(\frac{\bar{w}_m}{N_m} | M\right)$ is the probability of a word in document m . If the model has a good classification effect for new samples as well, it will have a better generalization ability, and its value of perplexity will be small, and vice versa.

3.3. Topic Identification

The LDA was used to mine the implicit topic information from the text, and LDA analysis was performed through the sklearn library, a machine learning module in Python. The perplexity is calculated for different numbers of topics so as to determine the optimal number of topics. Figure 2 shows how the perplexity changes with the number of topics.

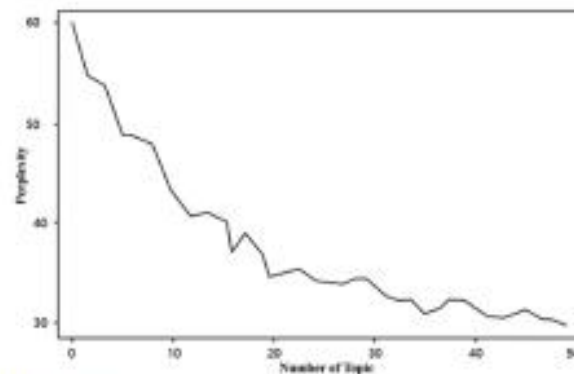


Figure 2. Perplexity–subject number curve.

As shown in the results, the value of perplexity will gradually decrease with the rising number of topics. And the perplexity's decreasing rate will be lowered when the number of topics exceeds 20. Therefore, the optimal number of topics for the LDA model was determined to be 20, and the Dirichlet allocation parameters are set as $\alpha = 20/20 = 1$ and $\beta = 0.01$. In addition, 20 topics were extracted by using the Gibbs sampling iteration method. After analyzing the extracted topics, it was revealed that some of the topics lacked practical significance or were not related to shared micro-mobility. Therefore, the topics were screened and named based on the word frequency results. Finally, this study identified 17 topics that are related to shared micro-mobility and have significance. The 17 potential topics were divided into dimensions to identify four prominent dimensions (research topics). The results of their affiliated topics and 10 keywords are shown in Table 3.

Table 3. Topic naming results of LDA.

Dimension	Topic Number	Topic Name	Topic Words
1. Product quality	1	Comfort	Vehicle Design, Quality, Fuel, Seating, Sound, Ride Experience, Comfort, Smoothness, Shock Absorption, Softness
	2	Reliability	Maintenance, Breakdowns, Durability, GPS Location, Real-Time, Battery Life, Mechanical Issues, Remote Control, Reliability, Security
	4	Aesthetics	Aesthetics, Color, Style, Novelty, Logo, Fashion, Personality, Appearance, Trend, Interface
	13	Stability	Service Response, Operations, Technology, Maintenance, Repair, Inspection, Failure, Maintenance, Troubleshooting, After Sales

Table 3. Cont.

Dimension	Topic Number	Topic Name	Topic Words
2. User expectation	6	Safety Standard	Safety, Accident Rate, Behavior, Insurance, Warning, Privacy, Credit, Legal, Regulation, Rushing
	9	Brand Image	Credibility, Culture, Marketing, public relation, Word of Mouth, Brand Recognition, Image, Popularity, Public Evaluation, Strategy
	10	Pricing Strategy	Fee Transparency, Fit, Offers, Discounts, Strategies, Payment Methods, Prices, Rentals, Billing Rules, Spending Service, Complaint Handling, Opinions, Satisfaction,
	15	Feedback Handling	Solutions, Customer Relations, Communication, Response Time, Attitude, Problems
	17	Dispatch Efficiency	Vehicle Distribution, Coverage, Time, Region, Dispatch, Efficiency, Waiting, Availability, Supply-Demand Balance, Real-Time
3. Interactive experience	3	General-purpose	Compatible, Cross-Platform, Device, Unified, Simple, User-Friendly, Universal, Adaptable, Accessible, Customized
	7	Social Interaction	Communication, Users, Networks, Platforms, Reviews, Sharing, Social, Likes, Activity, Communities
	8	Ease of use	Interface, Convenience, Steps, Self-help, Instructions, Adjustment, Understanding, Intuitive, Operation, Menus
	11	Technological Innovation	Technology, Innovation, Research, Services, Smart, Experience, 5G, Functionality, Premium, Internet
	12	Software Adaptability	Compatible, Application, Software, Feature, Registration, Mobile, System, Version, Operation, Upgrade
4. Subjective consciousness	5	Health Awareness	Health, Cycling, Exercise, Activity Level, Mental, Comfort, Environmental, Fitness, Habits, Motivation
	14	Green Motivation	Eco-Friendly, Carbon Reduction, Green Mobility, Energy Efficiency, Zero Emissions, Sharing, Sustainability, Community, Environment, Congestion
	16	Self-identification	Belonging, Community, Sharing, Engagement, Values, Responsibility, Socialization, Identity, Uniqueness, Perception

3.4. Results

Through text mining online user reviews, Research No. 1 delineates four research topics affecting user satisfaction. Research Topic No. 1 is product quality, specifically including Topic 1 (comfort), Topic 2 (reliability), Topic 4 (aesthetics), and Topic 13 (stability), and the related review keywords are vehicle design, comfort, smoothness, battery life, reliability, etc. Research Topic No. 2 is user expectation, specifically including Topic 6 (safety standard), Topic 9 (brand image), Topic 10 (pricing strategy), Topic 15 (feedback handling), and Topic 17 (dispatch efficiency), and the related review keywords are ease of use, credibility, communication, scheduling, cost, etc. Research Topic No. 3 is interactive experience, specifically including Topic 3 (general-purpose), Topic 7 (social interaction), Topic 8 (ease of use), Topic 11 (technological innovation), and Topic 12 (software adaptability), and the related review keywords are ease of operation, update, intelligence, software, easy to understand, etc. Research Topic No. 4 is subjective consciousness, specifically including Topic 5 (health awareness), Topic 14 (Green motivation), and Topic 16 (self-identification), and the related review keywords include health, environmental protection, value, sustainability, habits, etc. After the clustering analysis of the online user reviews, the external variables of the model for the shared micro-mobility user satisfaction were enriched. In order to verify the objectivity of these factors and their interactions, Research No. 2 adopted the empirical method of a questionnaire survey.

4. Study 2: Empirical Test of Influencing Factors Based on American Customer Satisfaction Index

Based on the results of clustering the topics of user online reviews from Research No. 1, and in combination with product perceived value, this section will conduct SEM for shared micro-mobility user satisfaction on the basis of the ACSI and conduct empirical research through questionnaire data.

4.1. Construct Definition and Hypothesis Development

Based on the ACSI, this section proposes some research hypotheses which take the perceived value of products as the core influencing factor. The research model constructed for shared micro-mobility user satisfaction is shown in Figure 3, which illustrates the paths of all hypotheses and their relevance. The details of these hypotheses are explained below.

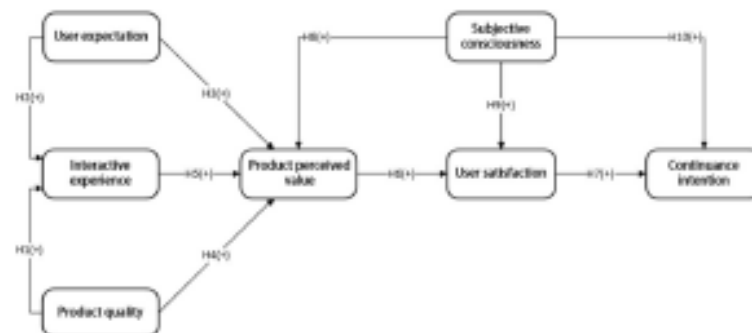


Figure 3. Conceptual model of user satisfaction with respect to shared micro-mobility.

(1) User expectation

User expectation is Research Topic No. 2, which refers to the overall expectation or hope that customers place on a product's quality, service, etc., before the product is used and after it is experienced [37]. Diehl and Meirovich et al. argued that in the field of micro-mobility, user expectation reflects people's demand for convenient, efficient, and sustainable transportation solutions, and its relevant factors can influence satisfaction through emotional fluctuations [38,39]. This study finds that user expectation is closely related to satisfaction with micro-mobility services, involving such aspects as price rationality, service efficiency, and safety sense.

(2) Product quality

Product quality is Research Topic No. 1, which mainly reflects the actual feelings of users on the quality and performance of vehicles' hardware. Lim and Ozkan et al. demonstrated that in daily consumption products, product quality has a significant positive impact on customers' attitudes and satisfaction [40,41]. Aggeman et al. revealed a strong relationship between the perceived quality and school bus services' accessibility, safety, efficiency, and other factors [42]. As a hypothesis variable, product quality can not only help us understand users' satisfaction with micro-mobility services but can also provide strong support for boosting service quality and promoting sustainable development in the micro-mobility sector.

(3) Interactive experience

Interactive experience is Research Topic No. 3, which refers to the sum of the interaction content that a person feels and obtains when using a product or accessing a service [43]. The design of interactive experience was initially focused on the development and research

of new products, aiming to enhance customers' satisfaction and loyalty by boosting usefulness, ease of use, and enjoyment in the process of product interactions [44,45]. Michalec et al. found that before using a product, people would form some expectations about the experience, and users tend to compare the actual experience of a product with their expectations [37]. This study believes that users' expectations and the perceived quality of a product would have a certain impact on the interactive experience of the product.

(4) Product perceived value

Product perceived value is the overall evaluation of the utility of a product or service after users weigh the perceived benefits against the costs incurred in obtaining the product or service [13]. Many scholars have also demonstrated that the perceived value takes the core position in users' consumption decisions. Noble et al. emphasized three types of perceived value in the process of product design and development: rationality, kinesthesia, and emotion [46]. In empirical research centered on perceived value, Fernandes et al. explored the design value proposition of product and service systems [47]. This study argues that shared micro-mobility enterprises can effectively increase the user satisfaction and sustained use intention for their products by enhancing their perceived value [48,49], and this process is influenced by user expectations, product quality, and interactive experience. Therefore, the following hypotheses are proposed:

Hypothesis 1 (H1): *Product quality has a significant positive impact on interactive experience.*

Hypothesis 2 (H2): *User expectation has a significant positive impact on interactive experience.*

Hypothesis 3 (H3): *User expectation has a significant positive impact on product perceived value.*

Hypothesis 4 (H4): *Product quality has a significant positive impact on product perceived value.*

Hypothesis 5 (H5): *Interactive experience has a significant positive impact on product perceived value.*

Hypothesis 6 (H6): *Product perceived value has a significant positive impact on user satisfaction.*

(5) User satisfaction

User satisfaction (US) refers to the subjective evaluation of users on an information system [50]. In this study, it refers to the subjective feelings of users after they use and experience the functions and services of shared micro-mobility vehicles. In theoretical models about continuance intention, many scholars have also demonstrated the positive effect of satisfaction on continuance intention. This study believes that users' satisfaction with shared micro-mobility will positively affect users' attitudes toward using shared micro-mobility services and that it is also an important source of continuance intention [51,52].

(6) Continuance intention

Continuance intention refers to the behavior or likelihood of repeated consumption of a product or service and the likelihood of recommending it to others if a user is satisfied with it [53]. Based on an integrated theoretical framework of expectation confirmation theory, Si et al. demonstrated that the key factors influencing consumers' continuance intention of using carpooling services include satisfaction, perceived utility, economic benefits, environmental awareness, and platform incentives [54]. Understanding the influencing factors for continuance intention could induce enterprises to establish their core competitiveness, while also offering references and suggestions for designing and promoting shared micro-mobility services; so, it is directly related to the success and sustainability of the services.

(7) Subjective consciousness

Subjective consciousness is Research Topic No. 4, which mainly reflects users' subjective perceptions and attitudes toward shared micro-mobility. Beeton et al. have demonstrated the importance of psychosocial factors that influence users' micro-mobility decisions; such nonfunctional factors as environmental issues, innovation, and a sense of belonging may even have a stronger impact on individuals than such traditional functional factors as speed, cost, and time savings [55]. Subjective consciousness involves not only an individual's moral responsibility and self-identity but also the social sustainability of micro-mobility. Together, these factors can shape people's subjective experience of micro-mobility and, in turn, influence their choices and behaviors. Therefore, the following hypotheses are proposed:

Hypothesis 7 (H7): *User satisfaction has a significant positive impact on continuance intention.*

Hypothesis 8 (H8): *Subjective consciousness has a significant positive impact on product perceived value.*

Hypothesis 9 (H9): *Subjective consciousness has a significant positive impact on user satisfaction.*

Hypothesis 10 (H10): *Subjective consciousness has a significant positive impact on continuance intention.*

4.2. Questionnaires and Data

Wenjuanxing 2.0 software was used to create a questionnaire, and online surveys were conducted. The proposed research model and hypotheses were validated. The scales in this study were all developed based on the mature scales of the model in combination with the topic clustering results of Research No. 1. The questionnaire adopted 7-level Likert scales, and the survey subjects were the people who had used shared micro-mobility vehicles. The interviewees were mostly located in regions in central China (Hubei, Hunan, and Henan provinces), and 429 valid questionnaires were collected. The questionnaire content includes the following two parts. The first part is about basic personal information: males are dominant in the sample (53.8%); most of the interviewees are between 18 and 35 years old (80.5%); and their education level is generally above the undergraduate level (84.8%). Meanwhile, it can be seen that students are the main user group of shared micro-mobility (52.7%). This feature not only involves the travel preferences of young users but may also be related to the deployment areas selected by shared micro-mobility enterprises. The statistical information for the sample description is shown in Table 4. The second part of the questionnaire consists of seven items of latent variables: (1) product quality; (2) user expectations; (3) interactive experience; (4) subjective consciousness; (5) product perceived value; (6) user satisfaction; and (7) continuance intention. Based on the literature review and the 17 clustering results, a total of 26 measured variables were set. The questionnaire design is shown in Table A1.

The reliability of the questionnaire was assessed with Cronbach's alpha coefficients. Generally, the reliability of a questionnaire will meet the requirement when the Cronbach's α value is greater than 0.8. As shown in Tables 5 and 6, the overall Cronbach's α value of the questionnaire is 0.829, so the variables have good internal consistency, indicating that the questionnaire has high reliability. Additionally, the Kaiser-Meyer-Olkin (KMO) value is 0.874, greater than the optimal critical value of 0.8, and the significance index is 0.000; therefore, the data are suitable for factor analysis. Finally, the combined reliability (CR) of the seven variables is greater than 0.7, and the average variance extracted (AVE) was greater than 0.5, indicating that the variables have good convergent validity and internal consistency.

valid. Second, user expectations, product quality, interactive experience, and subjective consciousness significantly affect the perceived value of shared micro-mobility and then affect user satisfaction through the mediating variable of product perceived value; in addition, user satisfaction has a significant positive effect on continuance intention. So, hypotheses H3 ($\beta = 0.617, p < 0.001$), H4 ($\beta = 0.337, p < 0.01$), H5 ($\beta = 0.534, p < 0.01$), H6 ($\beta = 0.387, p < 0.001$), H7 ($\beta = 0.589, p < 0.01$), and H8 ($\beta = 0.326, p < 0.01$) are valid. Furthermore, as shown in the influence path coefficients, user expectation has the strongest effect on product perceived value. Third, although subjective consciousness cannot directly influence user satisfaction, it can influence user satisfaction through the mediating variable of product perceived value, so hypothesis H9 ($\beta = 0.139, p > 0.05$) is not supported but H10 ($\beta = 0.428, p < 0.001$) is valid.

5. Discussion

On the one hand, the “14th Five-Year Plan” for green transportation in China advocates for the comprehensive and in-depth promotion of green development in transportation. Understanding user evaluations and perceptions of emerging green transportation methods such as shared micro-mobility is crucial. On the other hand, in the field of shared micro-mobility research, most scholars typically assess its impact from a macro perspective, focusing on aspects such as enterprise operations and government planning. In investigating the factors influencing user satisfaction in shared micro-mobility, there has been a lack of research from the micro perspective of product value. This study employed quantitative research methods on online user comment data to explore and validate the composition of product perceived value in shared micro-mobility, as well as the critical influencing factors on user satisfaction in shared micro-mobility. The SEM results show that among the key factors, user expectation delivers the greatest influence; user expectation and product quality can positively affect the product perceived value; and interactive experience plays an important mediating effect among user expectation, product quality, and product perceived value. On the one hand, Similar to existing expectancy theory research, user expectation can provide a benchmark for interactive experience: When a product meets or exceeds such expectation, users may feel satisfied. On the other hand, product quality itself also determines users’ interactive experience; high-quality products tend to provide a better use experience, thus enhancing the product perceived value. Previous studies seem to have overlooked the comprehensive impact of product interaction experience. In contrast, we further substantiated its influencing mechanisms.

Among the four constituent factors of perceived product value, we also identified four corresponding important measurement variables. First, reliability is a key variable affecting product quality ($\beta = 0.871, p = 0.001$). This finding is supported by the research of Javadinasr et al., who discovered that a prominent factor determining users’ decisions is the perceived reliability. A point of divergence between the results of their research and this study is as follows: they maintain that the source of reliability comes primarily from the temporal and spatial accessibility of micro-mobility [56], whereas this study is focused more on users’ feedback on the vehicle condition during their riding. It can be observed that with the rapid expansion of shared micro-mobility, people’s focus on the product has shifted gradually from basic functionality to a more comprehensive experience. Second, as a measured variable, the safety standard has the greatest impact on user expectation ($\beta = 0.868, p = 0.001$). Shaaban et al. pointed out that safety plays an important role in maintaining a high level of services for any mode of transportation [57]. This finding is also supported by Pande et al., who have explored the safety of shared micro-mobility and the risk of associated liabilities from a governmental perspective [58]. We believe that users also value the safety and compliance of travel tools. Therefore, governments and businesses should take effective measures to ensure and promote the safety of travel modes to increase user adoption rates. Third, similar to the results of Javadinasr et al. [56], it is found that ease of use has a significant impact on users’ experience with shared micro-mobility ($\beta = 0.863, p = 0.001$). Ratan et al. also emphasized that mobile apps could significantly influence the

use experience of e-scooters, and media technology was a key factor impacting the usability of transportation vehicles [59]. As a form of public good, the use of shared micro-mobility necessitates the use of mobile applications. Unlike other transportation products with additional smart apps, the key lies in how to enhance universality and user-friendliness in shared micro-mobility apps. And finally, green motivation is significant in determining users' subjective consciousness for choosing shared micro-mobility ($\beta = 0.827, p = 0.001$), and this point is supported by Flores et al. [60], who demonstrated that green perceptions have a much high impact on the use of shared micro-mobility. However, Bozzi et al. pointed out that shared micro-mobility delivers a negative impact on the environment in terms of production, use, and maintenance. On the whole, the green and low-carbon slogans of shared micro-mobility companies do influence users' choices of travel modes. However, for long-term development, green and low-carbon solutions targeting the entire product lifecycle are more aligned with users' ultimate interests.

Subjective consciousness can deliver a direct positive impact on users' continuance intention. This study demonstrates the important position of subjective consciousness (such as users' green motivation, responsibility attribution, and health perceptions) in users' decision-making process [60]. This finding is consistent with current research results about the social psychology of micro-mobility users [55]. Users' intrinsic beliefs and attitudes have a profound effect on their behavioral choices; when users are convinced that a service or product is beneficial to them, they may become more inclined to use it consistently, and this willingness to use will be further enhanced when this belief is aligned with the perceived value of the product. In contrast to previous research results, we found that subjective consciousness cannot directly influence users' satisfaction; it indirectly influences their satisfaction through the product's perceived value. A possible explanation is that although users' positive awareness can boost their use of a product, users have their own psychological evaluation of the goodness of the product. This point is embodied in the integrated perceived value of products, and satisfaction is the consequence following the psychological evaluation of products. We believe that the prerequisite for the government or companies advocating for shared micro-mobility is whether users can perceive the value of the product. In other words, the green motivation and similar motivations of users can only be effective when a product achieves high user satisfaction. In addition, user satisfaction and subjective consciousness delivers a significant direct effect on continuance intention, and this finding is consistent with the research results of Peng et al., who explored continuance intention in the use shared bicycle services [61].

The results of this study support the discovery of Liao and Nikiforiadis et al.; that is, shared micro-mobility modes can attract people with similar sociodemographic characteristics [62]. As shown in the basic statistical information acquired from the questionnaire survey, the majority of shared micro-mobility users are students, and they have a relatively high level of education. College students account for a large share of the shared micro-mobility market, possibly because the transportation modes currently adopted by students influence their choices [63]. Additionally, in general, students with a high education level tend to be able to understand and utilize new technologies and apps more easily, so they are more likely to adopt and promote shared micro-mobility. For providers of shared micro-mobility services, this study can help them to better understand their target audiences so that they may develop targeted marketing strategies and service improvement plans. Moreover, the results of this study support the hypotheses of the ACSI framework, confirming the mediating effect of product perceived value between the influencing factors and user satisfaction.

In summary, the findings of this study offer a new perspective from which to understand the behavior and psychology of the users of shared micro-mobility services. This study emphasizes the key role of product perceived value in connecting the influencing factors with user satisfaction, underlines the dominance of user expectation among all influencing factors, and stresses the significant direct function of subjective consciousness in shaping users' continuance intention to use the services. Future research could further

planning in harmony with transport planning. The economic transformation involves incrementing industries with high-added value and improving freight transport network distribution and urban logistics. Vehicle transformation relates to developing and using new and more efficient transport technologies in terms of the potential impact on the environment and fuel consumption. The modal-split strategy focuses on promoting public transport and non-motorized mobility to reduce the negative impacts of extensive automobile use. The lifestyle strategy deals with changing behavior towards a more sustainable mobility pattern. For Loo and Tsoi [34], understanding the practical applications of these strategies may support the generation of more holistic policies toward promoting and increasing sustainable mobility patterns in urban areas.

Based on a case study, Smith et al. [35] analyze the implementation of sustainable travel strategies in a rural tourism context through visitor surveys, interviews, and observations, with particular attention to the New Forest National Park in the UK. This study identifies that the implemented strategies meet the needs of some visitors because there is still a lack of understanding of the visitors' practices in rural tourism [35].

Through a literature review, Holden et al. [36] seek to understand the evolution of the concept of sustainable mobility under six dimensions: research and policy, transport impacts and categories, scientific disciplines, methodological approach, and research questions. The results show that there are four generations of studies [36]: (1) techno-centric and environmental perspective, from 1992 to 1993; (2) increasing concern with the quality of life and integration of a sociological perspective, from 1993 to 2000; (3) increasing concerns with equity, accessibility, economic impacts with more qualitative approaches, from 2000 to 2010; (4) studies with an integrative view of sustainable mobility looking at all its dimensions and concerns with decarbonization and innovation, from 2010 to 2018.

4.3.3. Latin American Context (LA)

From the 24 articles initially selected through the applied search criteria, 5 were discarded for being considered out of the Latin America-specific context. These were: Chatzioannou, et al. [37] and Paula & Marins [38], who considered sustainable mobility just in general without conducting any case study in Latin America; García-Melero et al. [39], who conducted their case study in Santander (Spain); González, et al. [40], who conducted their case study in Tenerife (Spain); and Lönnqvist et al. [41], who conducted their case study in Stockholm (Sweden). Below, we start the in-depth analysis of the other 19 articles chronologically.

Campos et al. [42] apply a Sustainable Mobility Index (SMI) in the Belo Horizonte—MG, Brazil case study by combining urban transport and land-use planning aspects. They believe that these two aspects can contribute to the improvement of accessibility and the use of space, the increase in the contribution of environment-friendly modes (public transport, cycling, walking), traffic congestion reduction, safety improvement, and air pollution, noise, and visual nuisance reduction while maintaining a wealthy and healthy urban economy and ensuring social equity and transport opportunities for all community sectors. They conclude that the region with lower income has a higher frequency of better SMI per Census area, mainly due to more public transport options (subway and buses) and fewer car trips to the center.

Sagaris [43] explores the functioning of the Living City institution, presenting how it works over its “circles of participation” [43] and focusing on the pro-cycling initiatives carried out by the group together with the Dutch NGO Interface for Cycling Expertise (I-CE), the Metropolitan Santiago Regional's Government (GORE), and other autonomous citizens' actors. This initiative, which first generated a manual for cycling policies in Chile, later evolved into the Government-Citizens Roundtable for a Cycling-Friendly Culture, the central result of this three-year process for the author. The primary outcomes from the Living City project are related to the main achievements of the civil organization: the co-published report about the participatory process's proposals that were integrated into the Santiago Master Plan, the four chapters contribution by the Urban Design Manual

Working Group to the Revision of the Chilean road design manual (REDEVU); and the beginners' course for women who had never cycled. The above-mentioned participatory process in the Santiago Master Plan included an "emblematic" participatory mapping and evaluation process carried out by cyclists, although the Santiago Master Plan Commission undertook it.

Meanwhile, Sagaris [44] resulted in a more general presentation, emphasizing how small groups, more participatory and deliberative forums, and informal spaces could promote better engagement and new consensuses favoring cycling-inclusive urban planning and achieving more sustainable transport systems. Therefore, the "sustainable" term in the article refers mainly to social sustainability, focusing on its importance to social justice, human flourishing, and liveability rather than its environmental dimension.

Mercier et al. [45] studied the successful case city of Curitiba—PR (Brazil), which achieved international recognition by undertaking a series of more centralized/direct policy tools in public transport initiated by the urbanist Mayor Jaime Lerner in the 1970s. The study investigates whether Curitiba has advanced toward a participative approach through qualitative methods, such as interviews. As a result, they concluded that Curitiba policies are still very proactive and direct, even more so than those of other American cities such as Toronto, Seattle, Chicago, or Montréal, although it is possible to notice a slight rise of more indirect policy tools: a process that may be incipient at the time.

Warren et al. [46] present research relative to the unique case of Havana, Cuba. As the main objective, the authors seek to identify the possibilities and priorities for a long-term strategy for reaching equitable and sustainable mobility through workshops, which resulted in a SWOT matrix about the status of the transport system in Havana. As a result, they conclude that there is a strong consensus that public transport should be prioritized—despite explicit social acclaim for the car market deregulation. As strengths, they point out the actual low levels of motorization and the high coherence of the ongoing transport policies with the emerging sustainable necessities, and as main threats, a change in the policy-making framework and economic shocks (both recession and rapid growth).

Mercier et al. [47] present a comparative analysis between Seattle, Montreal, and Curitiba and how they deal with the challenges of achieving sustainable mobility through public policy tools in the face of metropolization and the rise of motorization, evaluated through qualitative methods. The study results show that Seattle has higher levels of interactive/governance instruments. On the other hand, Curitiba presents the oldest tradition in sustainable urban transport projects between the three cities, conjugating land use planning with infrastructure projects, such as the BRT, but also presenting higher levels of proactive participatory instruments. Finally, Montreal is the more balanced in terms of policy mix tools. However, its number of institutional players with competing mandates led the respondents to classify it as "chaotic" or "messy" in planning sustainable mobility.

Steurer and Bonilla [48] address the main issues in the Mexico City Metropolitan Area (MCMA) mobility: high CO₂ emissions, local air pollution, rising car ownership, laissez-faire urban planning and growth, and a fragmented public transport system. In order to build the paths to a more sustainable mobility future in MCMA, they apply semi-structured interviews to make four plausible exploratory scenarios based on stakeholders' perspectives on MCMA transport. They conclude that the major concerns of the stakeholders (even governmental and private ones) are the political integration between the Federal District of Mexico City and the State of Mexico (SoM) and the success of the negotiations among local stakeholders, such as mini-bus autonomous drivers.

In this article from Sagaris and Arora [49], the sustainability concept is rediscussed from more socially and equitable perspectives. They advocate for intermodal sustainable transport planning, prioritizing specific modes according to trip lengths and purposes and even adapting land use to them. Particular emphasis is given to walking and cycling and its possible arrangements with public transport, such as buses with cycle racks, cycles on trains, bike-sharing, and cycle parks near public transport stations. The authors define their study as a conceptual exploration using practical examples from many cities, mainly

Delhi (India) and Santiago (Chile). They also use literature review, field observation, and hands-on experience. The outcomes of this study are related to the proposal of criteria to integrate and promote sustainable modes of transport, such as adequate cycling distance, land use planning, equity, and safety, among others.

Stein and Silva [50] undertook a survey applying 2260 questionnaires out of 8857 estimated regular users in the University of São Paulo (USP) campus in São Carlos (Brazil) to identify barriers, motivators, and strategies to promote sustainable mobility locally. The survey confirms that one of the most significant barriers to promoting behavior change to more active and sustainable modes of transport is the ownership of cars. Furthermore, 13.6% of users of other modes of transport do want to move to cars, which is concerning. One of the appointed motivators for car use is the presence of parking places reserved for faculty employees, data that could ensure the development of strategies to limit its use and promote more sustainable modes of transport among USP campus regular users.

Sosa-López & Montero [51] discuss the tensions around sustainable mobility policy-making in Latin America, mainly from participant observation during planning forums, meetings, and public events and leading semi-structured interviews with policy actors in Mexico City and Guadalajara from 2012 to 2015. The authors conclude that active stakeholders have reassembled the politics of urban transport in Mexico, aligning contingent interests from multiple scales and orienting solutions in sustainable mobility policy among multiple actors, discourses, and technologies.

Sagaris [52] uses the participatory action research method to analyze the outcomes from two participatory planning experiences conducted by The Laboratory for Social Change in Chile within the context of transport projects. Despite the differences between both experiences, regarding their time duration, the author concludes that both initiatives present innovative aspects regarding participatory methods and strategies to enhance shifts toward greater sustainability of urban and transport systems and reveal barriers and opportunities to break with the distrust between institutional actors and citizens.

Defining as reference the principles and strategies from the TOD (Transport Oriented Development) planning approaches and the issue of sustainable urban mobility, Barbosa and Galves [53] perform a qualitative analysis of the Master Plans of three Brazilian cities in the State of São Paulo. As a result, they conclude that besides all the plans incorporate strategies following many TOD planning principles, such as prioritizing non-motorized and public transport over motorized individual ones, mixing land use, and reappropriating empty public spaces to leisure activities, their guidelines are too general and do not advance on "how" to implement them. None of the plans proposed citizen participation in transport policy planning specifically, despite it being a core principle presented in all of them.

Scheffer et al. [54] take the University of Passo Fundo (UPF) Campus I as a case study elaborating and implementing a Sustainable Mobility Plan. They focus on the initial steps of the plan elaboration: qualitative survey, questionnaire application, bibliographical review, and traffic counting. As a result, they recognize the users' preference for cars and the need to build crosswalks in the Campus area.

Alba-Martínez et al. [55] start from the premise that equitable accessibility to higher education favors social fairness in economic opportunities. From this perspective, they perform an empirical study in the Guadalajara Metropolitan Area (GMA) based on statistical and spatial analysis. Finally, the authors conclude that university students are under-represented in transport planning and that transport-related social exclusion persists. Moreover, they point out that conventional buses offer low-quality service.

Meira et al. [56] bring an innovative approach to the sustainable mobility transport policy evaluation applied to the Metropolitan Region of Recife—PE (Brazil). They introduce the concepts of effective speed and socially effective speed per mode of transport as an alternative to cost-benefit and multicriterial analysis. The authors conclude that motorized modes had a lower effective speed than non-motorized ones, confirming the initial hypothesis. The socially effective speed costs represented 50% of the total costs for cycling users and only 7% for public transport users. In comparison, 23% of the total

socially effective speed costs came from private cars alone. Surprisingly, public transport's socially effective speed was the lowest, which could be attributed to the low value of the "average daily distance" traveled by the population and the lack of public transport offered in the metropolitan region studied.

Guzmán et al. [57] studied, through survey data and statistical modeling, the implementation of mobility plans in public and private organizations since 43% of the trips generated in the city are work trips. The results show that private transport is preferred, and walking is the last option. The statistical model indicates, for example, that parking management measures could promote modal choice change towards sustainable modes. Additionally, a case study in Bogotá, Oviedo, and Guzmán [58] explores the dimension of non-mandatory trips, which are also essential for an individual, to measure inequalities in accessibility and their implications for sustainability. The authors calculate a potential accessibility index that estimates the opportunities in a zone compared to all the others. As a result, they find, for example, that non-motorized trips are relevant to non-work activities, while slow modes such as walking and bicycling are particularly relevant to "take/pick up someone" and "shopping" activities, and they also point out the differences in accessibility between socioeconomic groups.

Sagaris et al. [59] conducted their research in Santiago and Temuco-Padre las Casas, having as the main objective to create a community-oriented evidence-based periodical report on Transport Justice, called Balance de Transporte Justo (BTJ), grounded in the hypothesis that providing citizens and advocacy planners with easy-to-use evidence to better frame demands could make more effective action possible on promoting more car-free living neighborhoods and cities. The research concludes that the residents of the 2 Chilean cities perceive their transport system as extremely unjust and that citizen participation must contemplate diversity in age, gender, income, ethnic origins, and capabilities.

The last paper selected for this review is from Valenzuela-Levi et al. [60], which addresses the context of "post-COVID-19" mobility and the learnings that came from the pandemic experience. As major concerns, they point out the higher vulnerability suffered by the citizens within the low socioeconomic levels during the pandemic, due to inadequate overcrowded housing and public motorized transport dependence. For them, an integrated housing and transport policy to locate subsidized housing within cycling distance (7 km for Santiago) from areas that concentrate jobs for the poor could contribute simultaneously to disaster resilience, reduction of carbon emissions, and social equity. In order to prove so, they take as a case study the metropolis of Santiago (Chile) and undertake a household and trip distribution gravitation model with measures of impedance and generalized travel cost for each zone. They conclude that low-income people prefer to live in overcrowded areas but closer to their jobs. This leads to the implication that a short-term bike lane investment program could have a direct and immediate impact on the mobility patterns of the population since the most relevant factors that enable new cyclists are shortening trip distances together with an adequate cycling infrastructure network.

5. Comparison and Discussion: Sustainable Mobility Challenges in the Latin American Context

It is always a huge challenge to compare Latin America with the rest of the world in all aspects. The geohistorical differences that led to their differential development, their colonized past, the culture of its people, and their relative position among the hegemonized world in the actual framework of global financial capitalism are specific processes that cause not only inequality but also led to different challenges in sustainable transport and mobility. Notwithstanding, all these differences are reflected in the interests and focuses of the articles brought to analysis.

Within the Latin American context, one focus has been sustainable mobility indexes, modeling, and spatial indicators. In this direction, there are some similarities among the approaches of Campos et al. [42], Alba-Martínez et al. [55], Meira et al. [56], Oviedo and Guzmán [58] and Valenzuela-Levi et al. [60]. They ground their research on quantitative

EXPLORING THE POTENTIAL OF LARGE LANGUAGE MODELS FOR AUTOMATION IN TECHNICAL CUSTOMER SERVICE

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ABSTRACT

Purpose: The purpose of this study is to investigate the potential of Large Language Models (LLMs) in transforming technical customer service (TCS) through the automation of cognitive tasks.

Design/Methodology/Approach: Using a prototyping approach, the research assesses the feasibility of automating cognitive tasks in TCS with LLMs, employing real-world technical incident data from a Swiss telecommunications operator.

Findings: Lower-level cognitive tasks such as translation, summarization, and content generation can be effectively automated with LLMs like GPT-4, while higher-level tasks such as reasoning require more advanced technological approaches such as Retrieval-Augmented Generation (RAG) or finetuning ; furthermore, the study underscores the significance of data ecosystems in enabling more complex cognitive tasks by fostering data sharing among various actors involved.

Originality/Value: This study contributes to the emerging theory on LLM potential and technical feasibility in service management, providing concrete insights for operators of TCS units and highlighting the need for further research to address limitations and validate the applicability of LLMs across different domains.

KEYWORDS: Technical Customer Service, Automation, LLM, AI

1. INTRODUCTION

Many firms struggle to provide a reliable technical customer service (TCS) with fast response times due to several challenges such as skilled labor shortage and information overload (Özcan et al., 2014). Large Language Models (LLMs) like OpenAI's GPT-4 are set to revolutionize TCS by providing efficient, and personalized support (Kanbach et al., 2023; Wulf & Meierhofer, 2023). They potentially handle high volumes of customer interactions, reducing the need for extensive human resources, and offer significant cost savings (Liu et al., 2023).

Non-generative AI has transformed contact centers, with AI-based tools automating customer service and sales, performing back-office tasks, and enabling remote monitoring, coaching, training, and scheduling (Doellgast et al., 2023). Practical evidence suggests that machine learning plays a crucial role by automating the resolution of TCS issues and requests, thereby minimizing business interruptions. It enhances the efficiency of TCS processes, such as incident and service request management, by automating manual tasks like ticket categorization and prioritization, thus reducing errors and improving overall process efficiency (Mönning et al., 2018).

While first academic studies gather evidence of the business impact of LLMs, the full potential of LLMs in transforming customer service is yet to be fully understood (Brynjolfsson et al., 2023). The purpose of this research is to identify cognitive tasks in TCS that may be automated. Furthermore, this research assesses feasibility in a real-world setting via a proof of concept.

2. THEORETICAL BACKGROUND

2.1 Automation of Cognitive Tasks with Large Language Models

An analysis of the academic literature on language modelling (Dasgupta et al., 2023; Liu et al., 2023; Radford et al., 2019; Wei et al., 2022; Zhao et al., 2023) yields five cognitive tasks that may be automated with LLMs in customer service contexts.

- 1) Translation and Correction: LLMs can translate text between languages or language modes by learning the underlying patterns and structures of different languages from the training data.
- 2) Summarization: LLMs can understand the relationships between different parts of the text and can generate a summary that accurately reflects the overall meaning of the original text.
- 3) Content Generation: LLMs can generate a wide range of content, from emails and social media posts to blog articles and stories.
- 4) Question Answering: In question answering the LLM either searches and uses the internal factual knowledge provided in the pre-training corpus or the external contextual data provided in the prompt to generate common sense answers to questions or instructions.
- 5) Reasoning: Complex reasoning, unlike common sense question answering, necessitates the comprehension and application of evidence and logic to reach conclusions. Typically, it involves a sequential reasoning process grounded in factual knowledge, culminating in the answer to a posed question.

2.2 Role of AI in Technical Customer Service

Prior research has shown that well-designed customer service practices enhance the cocreation of customer value (Winkler & Wulf, 2019). Setting up an efficient TCS is not a trivial task. It demands considerable expertise in designing and implementing operational processes, as well as in adopting the necessary technologies (Wulf & Winkler, 2020).

Several authors discuss the role of non-generative AI for TCS. Iparraguirre-Villanueva et al. (2023) review the literature on conversational bots and propose a technical architecture for bots in incident management. Chaturvedi and Verma (2023) discuss the transformative potential of AI in customer service, highlighting both its value-creating aspects like personalization and convenience, and its challenges such as privacy concerns and technology anxiety. Reinhard, Wischer et al. (2023) propose an AI-based conversational co-agent to assist in the onboarding of novice IT support agents, aiming to reduce job demand, augment problem-solving capabilities, and improve time-to-performance by considering cognitive load. Reinhard, Li et al. (2023) address the use of recommender systems in customer service. They present an analytics pipeline designed to improve data quality in service management. Using this pipeline, high-quality support tickets are extracted from a dataset of 60,000 real-life tickets, leading to better prediction performance in the instantiated recommender system compared to traditional methods.

The academic literature on the application of LLMs for customer service reflects a growing interest across various domains. Carvalho and Ivanov (2023) outline the profound impact likely on tourism through the integration of ChatGPT and other LLMs, such as improving front-of-house customer service and back-of-house operations efficiency. Potential risks are also addressed, suggesting that technological shifts often affect human resource roles, but may ultimately enhance the capabilities of tourism employees. Research on customer satisfaction in public services suggests the value of LLMs in analyzing online user feedback. Topic models, which can convert user opinions into actionable insights, have been proposed to help improve public service provision, with studies showing that the quality of staff interactions correlates strongly with user satisfaction (Kowalski et al., 2017). LLMs are recognized for their significance in question-answering and chatbot capabilities applied to healthcare, education, and customer service. The development of scalable clustering pipelines that fine-tune LLMs has been pivotal in surfacing user intentions from large volumes of conversational texts, enhancing the performance of data analysts and ultimately reducing the time needed to deploy chatbots (Chen & Beaver, 2022).

Reinhard et al. (2024) discuss how generative AI can lead to more efficient and higher-quality customer support. They identify five support activities that can be augmented with LLMs: assigning, referring & transferring, escalating, locating, adapting, generating, and retaining.

Brynjolfsson et al. (2023) empirically study the introduction of an LLM-based conversational assistant to 5,179 customer support agents and show a productivity increase of 14%, particularly benefiting novice and low-skilled workers. The AI tool also improved customer sentiment, reduced managerial intervention requests, and enhanced employee retention.

To summarize, existing studies indicate a significant potential for employing LLMs in TCS. However, these discussions are largely theoretical. The limited number of prototype and implementation studies only showcase a fraction of the potential benefits discussed. The analysis of the literature reveals a research gap in demonstrating the practicality and outlining the necessary conditions for automating cognitive tasks with LLMs in TCS.

3. RESEARCH METHODOLOGY

We use prototyping as research methodology, because prototyping in design research serves to transition abstract concepts into concrete forms, fostering clarity from vagueness (Barzilai & Ferraris, 2023; Camburn et al., 2017). Thus prototyping is well qualified to study the feasibility of theoretical approaches for the application of LLMs in TCS discussed in prior literature.

We implement proofs of concepts using data on technical incidents of a large telecommunications operator. The data consists of 1) a description of the customer incident, 2) a flow of messages discussing the problem and 3) a description of the solution. An example is shown in Table 1.

Table 1: Customer incident example

Incident Description	<i>"I want to upgrade from [router old] to [router new]. Is it possible to upload the backup from the [router old] to the [router new], so that I don't have to manually transfer all configuration settings? Or is there another trick / migration procedure?"</i>
Problem Discussion (selection)	<i>"If you haven't made any special settings like port forwarding, then you don't need to do anything. When you connect the router (whether reset or not), you will be asked for your information on the login page. Once logged in, it will then load the previous data for WLAN and SIP (DECT or wired telephone) from the server onto [router new]. Thus, everything is as with the standard. Only then can you adjust the special parts or reload them via the locally stored file."</i>
Solution Description	<i>"I turned on and reset the [router new]. Then I connected the telephone line and waited until all data was received from [telco] and the LED was constantly white. Then I uploaded the previously performed backup of the [router old] from the local storage. Everything works perfectly as before (fixed IPs, Ports)."</i>

For each cognitive task, we design dedicated prompts and issue these to the transformer-based GPT-4 chatbot provided by OpenAI (OpenAI et al., 2023). We use prompting good practices, such as Persona and Chain-of-Thought (White et al., 2023; Zhao et al., 2023). For validation, we manually compare the LLM output to the messages and solutions generated by the human support staff.

4. RESULTS

4.1 Text Correction and Translation

Language Models (LLMs) have the ability to convert text from one language or mode to another. They achieve this by understanding the patterns and structures of various languages, which they learn from the data they are trained on. The translation procedure requires the model to be given a prompt in the original language and then asked to generate a response in the desired language. The model's

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4.3 Content Generation

LLMs have the ability to produce diverse types of content, ranging from emails and posts on social media to blog entries and narratives. They can start with a cue or an initial idea, and then build the remaining content based on the patterns they've been trained on. This feature is beneficial in numerous fields, such as content marketing, creative writing, and beyond. The following example (Figure 3) illustrates how GPT-4 can craft an email for a customer, drawing from a previous sequence of messages related to a customer question.

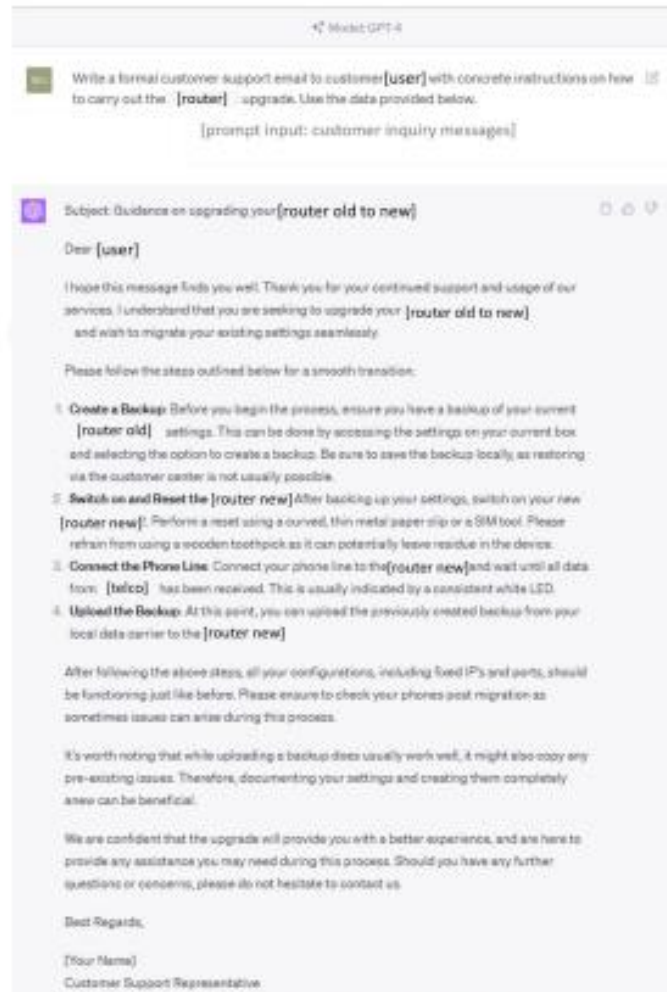


Figure 3: Example content generation

4.4 Question Answering

In question answering the LLM either searches and uses the internal factual knowledge provided in the pre-training corpus or the external contextual data provided in the prompt to generate commonsense answers to questions or instructions. In contrast to more complex reasoning tasks, question answering is limited to retrieving required and preexisting information from a large data set. The following example demonstrates the ability of GPT-4 to retrieve the solution for a customer problem from a larger problem-solution dataset (Figure 4). In this example, we handed over six different customer inquiry message flows, from which only one was relevant for the task at hand.

Retrieve the steps to migrate settings from [router old] to [router new]. Only use the data provided below for generating solutions. Only produce answers that are 100% correct, if you are insecure just state "I do not know".

[prompt input: problem-solution dataset]

Based on the information retrieved from the provided links, here are the steps to migrate settings from [router old] to [router new]

1. **Backup Settings:** Before starting the migration process, it's crucial to back up the settings of your [router old]. This can be done through the router's interface, usually accessible via a web browser. Look for an option to save or backup the current settings.
2. **Setup the New Router:** Unbox [router new] and connect it to your network. You should be able to access its interface via a web browser, similar to the [router old].
3. **Restore Settings:** In the [router new] interface, look for an option to restore or import settings. Use the backup file you created from the [router old]. This should apply all the settings from your old router to the new one.
4. **Check Connectivity:** After the settings have been imported, check your network connectivity. Ensure that all devices that were connected to the old router can connect to the new one and that they have internet access.
5. **Reconfigure if Necessary:** If any settings were not successfully imported or if any devices are having trouble connecting, you may need to manually reconfigure these settings on the [router new].

Please note that the exact steps may vary depending on the specific models of your routers and their firmware versions. Always refer to the user manuals or contact [telco] support for the most accurate information.

Unfortunately, the provided links do not contain specific instructions for migrating settings between these two models. The steps above are general guidelines for migrating settings between routers. If you need more specific instructions, I recommend contacting [telco] directly or consulting the user manuals for your specific devices.

Figure 4: Example question answering

4.5 Reasoning

In the process of answering queries, the LLM either employs the inherent factual knowledge from the pre-training dataset or the external data from the given prompt to generate sensible responses to questions or directives. Unlike more intricate reasoning tasks, the scope of question answering is confined to extracting necessary and already available information from a vast dataset.

The subsequent example illustrates GPT-4's capability to extract a solution for a customer issue from a single problem-solution dataset (Figure 5).

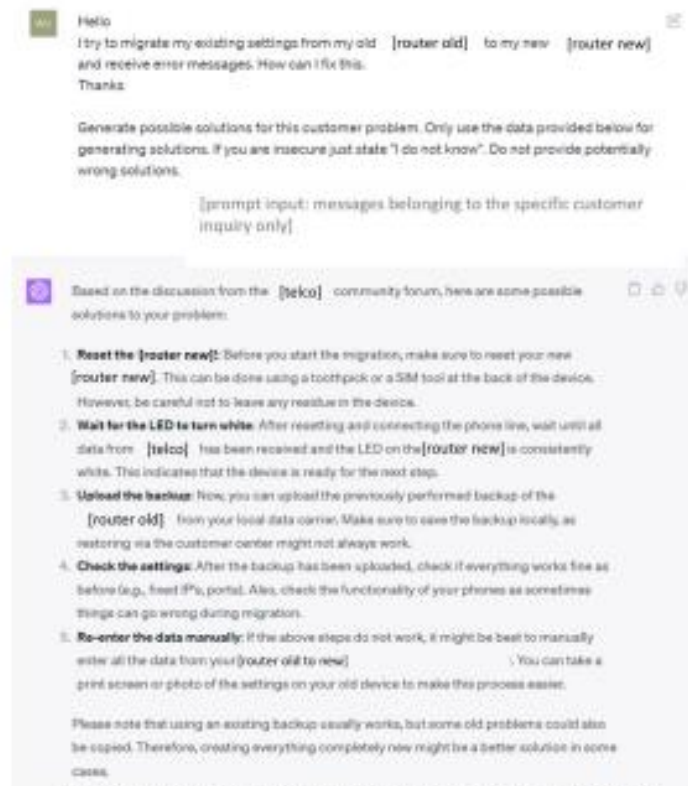


Figure 5: Example reasoning (with focused contextual data input)

In another instance (Figure 6), we employed the identical prompt as in Figure 5 but this time, we included six distinct customer query message flows. Out of these, only one was pertinent to the customer's issue. This situation is more akin to real-world cases where solutions need to be extracted from an extensive database of problems and their corresponding solutions. On this occasion, GPT-4 offered vague solution suggestions that wouldn't address the customer's issue. GPT-4 failed to pinpoint the exact problem and fetch the appropriate solution from the wider dataset. More complex reasoning tasks thus tend to produce hallucinations and require more complex and customized technological solution architectures.

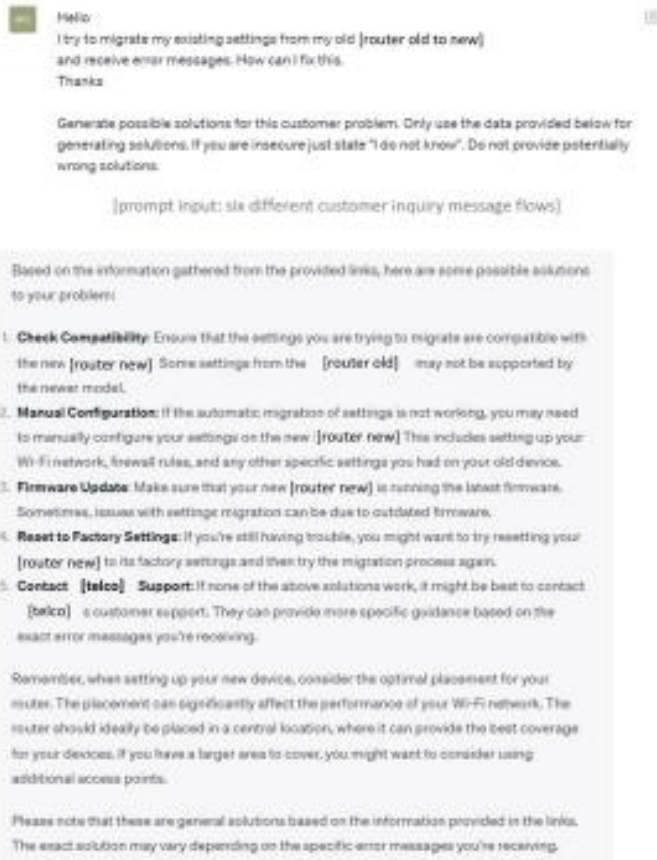


Figure 6: Example reasoning (with broad contextual data input)

5. DISCUSSION

In summary our results show that lower-level cognitive tasks such as translation, summarization and content generation can be well automated with general purpose LLMs such as GPT-4. Higher level tasks such as reasoning, however, require more advanced technological approaches, such as Retrieval-Augmented Generation (RAG) or finetuning. RAG is a method that enhances the accuracy and credibility of large language models, particularly for knowledge-intensive tasks, by incorporating knowledge from external databases, allowing for continuous knowledge updates and integration of domain-specific information (Gao et al., 2023). LLM fine-tuning is the process of further training a pre-trained base LLM, or foundational model, for a specific task or knowledge domain (Lin et al., 2024). Depending on type and complexity of serviced equipment, task automation can be applied to and create value for onsite, front or back office TCS or even for customer self-service.

Apart from technological, there are also organizational challenges when it comes to realizing more complex cognitive tasks such as question answering and reasoning. These applications heavily rely on data sharing among the different actors involved in TCS, which must cooperate in a data ecosystem. Data Ecosystems can be described as intricate socio-technical systems where various participants engage and cooperate to discover, store, share, utilize, or repurpose data. These interactions not only stimulate innovation and generate value, but also pave the way for the emergence of new business

models (S. Oliveira et al., 2019). Most often, TCS requires cooperation in an ecosystem of the following actors (Herterich et al., 2023):

- **Fellow customers:** The sharing of data about historic incidents and solutions among fellow customers of a technical service increases the overall incident-solution database on which an LLM operates. All customers would benefit from an improved question answering or reasoning in a self-service chatbot..
- **Technical product company:** It is the primary entity that produces technical goods or services. It is at the center of the data ecosystem and directly interacts with customers, providing technical support and services. It must share a rich set of data including product documentation, technical specifications, customer communication data, log data of technical events, and solution documentation. The manufacturing company benefits via a higher level of internal or customer-side automation of TCS with LLMs.
- **Service Desk Providers:** These entities handle customer inquiries and complaints. They share data about customer interactions, problem descriptions, and resolutions. This data can be used to train the LLM to handle similar issues in the future, reducing the workload on the service desk and improving customer satisfaction.
- **Field Service Providers:** These are the technicians who visit customer sites to resolve issues. They share data about the technical problems they encounter and their solutions. This data is invaluable for improving the LLM's ability to guide customers through troubleshooting steps, potentially avoiding the need for a site visit.
- **Suppliers of Technical Components:** These entities provide the parts used in the manufacturing process. They share data about component specifications, failure rates, and maintenance procedures. This data can help the LLM identify customer issues relating to component errors and facilitate the problem management for incidents at the second and third level.
- **IT Providers Enabling Industry 4.0 Solutions:** These entities provide the sensors, telecommunication networks, and software that form the basis for Industry 4.0 solutions. They share data about sensor readings, network performance, and software functionality. This data is crucial for the LLM to understand the real-time status of the product, predict potential issues, and suggest optimal operating conditions. By sharing this data, IT providers enable the LLM to provide more accurate and timely TCS.
- **Providers of Manufacturing Solutions:** These entities provide the machinery and processes used in manufacturing of a product. They share data about the production process and product components. This data can be used by the LLM to pinpoint customer issues relating to production errors or defective components. By sharing data, manufacturing solutions providers improve operational support for the products.

In conclusion, each actor in the ecosystem not only benefits individually from the data sharing but also contributes to the overall improvement of the LLM-based TCS.

6. CONCLUSION

With our results we contribute to the emerging theory on LLM potential and technical feasibility in service management. Further, we provide concrete insights for operators of TCS units. We demonstrate the automation of cognitive tasks with real-world examples.

However, it is important to acknowledge the limitations of this study to fully understand the scope and potential future directions of this research. The first limitation of this study is that it is based on technological prototypes developed using limited data. While these prototypes provide a proof of concept, they may not fully represent the complexities and variations of real-world scenarios. The study calls for further research involving large scale validation of technological feasibility. The prototypes need to be tested on a larger scale to ensure they can handle the volume and variety of data in a real-world setting. This would provide a more robust validation of LLM capabilities and its readiness for deployment.

Another limitation is the need for the usefulness of the technology in a technical customer service context to be empirically studied. While the technology may show promise in a controlled environment, its effectiveness in a practical setting, such as a TCS department, needs to be evaluated. This involves studying factors such as user acceptance, ease of integration with existing systems, and impact on service quality and efficiency.

The study is domain-specific, focusing on the telecommunications sector. Therefore, the results may not be generalized to other customer service domains without further research. Each domain has its unique characteristics and challenges, and a solution effective in one domain may not necessarily translate to success in another. Cross-domain studies are needed to explore the applicability and adaptability of LLMs for TCS across different sectors.

In conclusion, while the study has made significant strides in demonstrating LLM potential for TCS, these limitations highlight the need for further research. Addressing these limitations in future studies would provide a more comprehensive understanding of LLM potential and pave the way for its successful implementation in various domains.

REFERENCES

- Barzilai, G., & Ferraris, S. D. (2023). Developing a Data Classification Framework. In S. D. Ferraris (Ed.), *The Role of Prototypes in Design Research: Overview and Case Studies* (pp. 9–37). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-24549-7_2
- Brynjolfsson, E., Li, D., & Raymond, L. R. (2023). *Generative AI at work*. National Bureau of Economic Research.
- Camburn, B., Viswanathan, V., Linsey, J., Anderson, D., Jensen, D., Crawford, R., Otto, K., & Wood, K. (2017). Design prototyping methods: State of the art in strategies, techniques, and guidelines. *Design Science*, 3, e13. <https://doi.org/10.1017/dsj.2017.10>
- Carvalho, I., & Ivanov, S. (2023). ChatGPT for tourism: Applications, benefits and risks. *Tourism Review*, 79(2), 290–303. <https://doi.org/10.1108/TR-02-2023-0088>
- Chaturvedi, R., & Verma, S. (2023). Opportunities and Challenges of AI-Driven Customer Service. In J. N. Sheth, V. Jain, E. Mogaji, & A. Ambika (Eds.), *Artificial Intelligence in Customer Service: The Next Frontier for Personalized Engagement* (pp. 33–71). Springer International Publishing. https://doi.org/10.1007/978-3-031-33898-4_3
- Chen, X., & Beaver, I. (2022). An Adaptive Deep Clustering Pipeline to Inform Text Labeling at Scale (arXiv:2202.01211). arXiv. <https://doi.org/10.48550/arXiv.2202.01211>
- Dasgupta, I., Lampinen, A. K., Chan, S. C. Y., Sheahan, H. R., Creswell, A., Kumaran, D., McClelland, J. L., & Hill, F. (2023). Language models show human-like content effects on reasoning tasks (arXiv:2207.07051). arXiv. <http://arxiv.org/abs/2207.07051>
- Doellgast, V., O'Brady, S., Kim, J., & Walters, D. (2023). AI in Contact Centers: Artificial Intelligence and Algorithmic Management in Frontline Service Workplaces. <https://ecommons.cornell.edu/items/2c04c957-d672-400e-9aed-adb5f6ace640>
- Gao, Y., Xiong, Y., Gao, X., Jia, K., Pan, J., Bi, Y., Dai, Y., Sun, J., Guo, Q., Wang, M., & Wang, H. (2023). Retrieval-Augmented Generation for Large Language Models: A Survey (arXiv:2312.10997; Version 1). arXiv. <http://arxiv.org/abs/2312.10997>
- Herterich, M. M., Dremel, C., Wulf, J., & Vom Brocke, J. (2023). The emergence of smart service ecosystems—The role of socio-technical antecedents and affordances. *Information Systems Journal*, 33(3), 524–566. <https://doi.org/10.1111/isj.12412>
- Iparraguirre-Villanueva, O., Obregon-Palomino, L., Pujay-Iglesias, W., Sierra-Liñan, F., & Cabanillas-Carbonell, M. (2023). Productivity of incident management with conversational bots-a review. <https://repositorio.uwienr.edu.pe/handle/20.500.13053/9592>
- Kanbach, D. K., Heiduk, L., Blueher, G., Schreiter, M., & Lahmann, A. (2023). The GenAI is out of the bottle: Generative artificial intelligence from a business model innovation perspective. *Review of Managerial Science*. <https://doi.org/10.1007/s11846-023-00696-z>

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Using SMART Method for Multi-Criteria Decision Making: Applications, Advantages and Limitations



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Abstract: The applications of multi-criteria decision-making (MCDM) techniques are numerous. Simple Multi-Attribute Rating Technique (SMART) is a popular method for addressing MCDM problems with several criteria. The research investigates the SMART approach discussing how it is used, and its benefits and drawbacks, in decision-making situations. It looks at how it can be applied in choosing technology, improving healthcare systems, and managing the environment. SMART simplifies decision-making by comparing options based on factors. Yet it also has drawbacks such as biases in assigning weights and may not fully address the intricacies of certain decisions. The goal of the study is to enhance comprehension of SMART advocate for its use and propose combining it with intricate decision frameworks. Even though the SMART method is now widely used there is a lack of a thorough understanding of the method to identify its various applications. This paper aims to provide a comprehensive guide and a thorough overview of the SMART method to aid in decision-making and ranking in multi-attribute scenarios.

Keywords: multi-criteria decision making, SMART, decision-making, simple multi-attribute rating technique, multi-attribute decision-making

1. Introduction

Multiple criteria decision-making (MCDM) can be generally described as the process of selecting one from among a finite set of alternatives or ranking alternatives, based on a set of multiple usually conflicting and different unit criteria. In these cases, we use normalization to transform the various criterion dimensions into nondimensional criteria [1]. MCDM methods have been used recently by researchers in different fields of study such as finance, business, science, and engineering. These methods are utilized to evaluate, sort, rank, and select between different alternatives [2]. Numerous MCDM methods have been developed, and even small variations compared to existing methods have made the application of MCDM in different areas possible [3]. One of the main goals of an MCDM method is to help the decision-maker understand and handle the several criteria that are involved in the decision-making process so that a workable option may be chosen. The calculation of priorities and weights based on a set of criteria is an essential component of

MCDM procedures, which mostly rely on subjective judgment. This characteristic has a significant impact on choosing workable substitutes [4]. The general steps in Decision-making are as follows:

- **Objective:** This describes the objective for which the artifact evaluation is conducted; thus, the outcome should closely align with the predetermined aim.
- **Decision-maker (DM):** This is the individual responsible for determining the selection criteria and the evaluation technique for alternatives. Typically, a group of people, rather than an individual, is involved in most cases.
- **Alternatives:** The alternatives refer to the range of possible solutions.
- **Criteria:** They are the characteristics used to evaluate and assess.
- **Assessment:** The assessment process involves calculating a ranked list of options that align with the value judgments of the decision maker.

- **Solution:** A solution is an alternative that effectively achieves the optimal compromise concerning the objective.

Numerous methods have been developed throughout time to deal with MCDM research. Solving challenges involving numerous elements in decision-making may be accomplished effectively with the help of the SMART technique. Edward developed this method of decision-making in 1997 [5]. Multi-criteria analysis is a decision-making approach that is based on the idea that each alternative is made up of several criteria, each of which has a weight and value ascribed to it based on its relative relevance [6]. To identify the best option, each alternative is assessed using weighting, as stated by Kahar [6]. Moreover, SMART is seen as a reduced version of Multi Attribute Utility Theory (MAUT), having evolved from it in essence [7]. Using an appropriate numerical scale, the SMART technique provides performance ratings to the alternatives in order of subjective importance. Furthermore, SMART assigns particular grade levels to each function to assess how well it is executed [8]. The method is based on an additive linear model such as Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH). It contains direct weighing methods, which are deemed inadequate due to their fundamental characteristics. For these reasons, SMART has been extensively adopted as a suitable MCDM approach in decision-making because of its ease of use, simple calculations, and other features [9].

The use of MCDM plays a role in industries by helping to compare options based on different sometimes conflicting factors. One notable method within MCDM is the SMART, known for its versatility in decision-making situations. Despite being used there is still a lack of knowledge about its practical uses, benefits, and drawbacks. This research aims to address this gap and improve the implementation of techniques in decision-making contexts. To address these challenges, our study sets out with the following key objectives:

- What is the application of the SMART technique across different fields and focus on challenges and efficacy in problem-solving?
- What are the advantages and disadvantages of SMART in various situations and what are the solutions?
- What is the step-by-step process for the SMART technique to be an effective guide for researchers?

The objective of this research is to conduct a thorough examination of the SMART which is a vital instrument in MCDM. Although we acknowledge the wide range of applications of SMART, we do not restrict our analysis to its use in particular domains or case studies, instead, we concentrate on the theoretical underpinnings and overall methodological approach of SMART. To help readers better understand the SMART method and its application in decision-making processes this extensive guide tries to clarify the method's fundamental benefits and possible drawbacks.

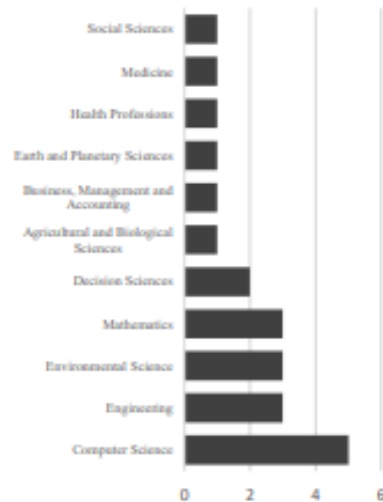
As stated in Section 2, the primary objective of this study is to investigate the use of the SMART method in

decision-making challenges in a variety of disciplines. In Section 3, we will examine SMART's merits and demerits as well as methods for minimizing the latter. A thorough explanation of the SMART technique and its phases will be given in Section 4. This study will ultimately offer a result.

2. Application of the SMART Method

A key framework in MCDM, the SMART demonstrates its applicability and adaptability in several scholarly and real-world domains. This approach is utilized in computer science, social sciences, engineering, and business sectors for both theoretical and practical purposes. It is centered on assessing alternatives according to predetermined criteria. The studies that used the SMART approach, as shown in Figure 1, were found via a thorough search of the Scopus database that 13 articles in English from 2014 to 2024 were found. Using keywords like "SMART," "MCDM," and "Simple Multi-Attribute Rating Technique" this search was done with great care to find that specifically reference these ideas in their title, abstract, or keywords. Based on findings from Scopus, the SMART technique is comprehensively used across several topic areas, demonstrating its importance and adaptability in tackling difficult decision-making issues. The domains of computer science, mathematics, and decision science are where SMART is most frequently used.

Figure 1
Distribution of SMART technique in various areas



A thorough search of the Scopus database produced insightful data on the distribution of research papers that combined the MCDM and SMART approaches. The data in Figure 1. demonstrates that SMART is strongly preferred in several significant academic subjects. The field with the

highest percentage of published publications is computer science, highlighting the importance of SMART approaches in this rapidly evolving discipline. Environmental science emphasizes ecological assessments and sustainability. It has a close relationship with SMART and shows how useful it is while making complex environmental choices. Because engineering is a problem-solving and optimization-focused discipline, decision-making procedures often use SMART because of its applicability. Additional fields like agricultural and biological sciences, business, management, accounting earth and planetary sciences, health professions, medicine, and social sciences, although less prominent, also showcase the interdisciplinary scope of the SMART approach. This emphasizes the versatility of the method and its capacity to address a wide range of research inquiries and real-world obstacles.

Following our analysis this study pinpoints specific articles from the Scopus database that use the SMART approach in a variety of fields. The study will thoroughly review all research papers that are accessible in the Scopus database with a particular focus on the topics covered by the participants and the methods employed. To provide a thorough grasp of the topics addressed by the particular research team and the variety of strategies used in conjunction with the SMART process, each article will go through a thorough analysis. To produce meaningful results this analysis will examine the various fields in which the SMART approach is employed and how well it complements other research techniques. To enhance scholarly understanding of the flexibility and efficacy of the SMART technique in decision-making research it is intended to illustrate the wide range of applications of this approach. Especially SMART has facilitate decision-making in the following areas:

- Educational Resource Management
- Healthcare Policy and Drug Procurement
- Engineering and Public Sector Construction
- Environmental Decision-Making and Management
- Architecture, Engineering, and Construction (AEC) for Sustainable Development
- Retail and Consumer Behavior Analysis
- Risk Management in Urban Planning
- Telecommunications Network Services
- Environmental Science for Microcontaminant Assessment
- Decision Making Under Ambiguity with Fuzzy Sets

The following part will discuss the mentioned applications of SMART and will illustrate how the researcher could apply SMART on the Decision-Making Problems.

One practical use of the SMART technique is how it's applied in primary research. By comparing alternatives to a set of criteria MCDM techniques like the Analytic Hierarchy Process (AHP) and MACBETH play a crucial role in supporting comprehensive decision-making processes. Students and university employees participate in [10] study to test the efficacy of these MCDM tools. The effectiveness

of these MCDM technologies was assessed by university staff and students through experimental research. AHP, SMART and MACBETH techniques were evaluated by study participants using vouchers to rate five coffee shops on a college campus. This useful strategy gives insights into the relative efficacy of these techniques in supporting decision-making processes in addition to demonstrating how applicable they are in practical contexts. The assessment is predicated on how the techniques affect the participant's processes of ranking and decision-making. The study recorded participants' initial tool-influenced and final assessments of the coffee shops using a unique incentive-driven methodology. The purpose of this study is to investigate how well MCDM tools work in practical situations with an emphasis on college students.

Implementing MCDM techniques in a support system delivers many advantages. This study has broad applications in support systems. Roszkowska and Wachowicz [11] Examine whether the subjective perceptions of decision-makers will influence the future use of MCDM approaches in negotiation support systems. In choosing between three MCDM approaches—Analytic Hierarchy Process (AHP), SMART and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)—this study examines the impact of interface preference time constraints efficiency and usability. To analyze the data from online decision-making studies a multinomial logistic regression model was employed. Students and staff members from the university participated in the studies to determine how well specific MCDM processes performed in decision-making situations. To select MCDM tools that offer insights into the behavioral aspects of decision support system utilization, this study emphasizes the importance of user satisfaction and method efficiency.

Moreover, Abdullah et al. [12] illustrate the collaborative effort to develop a decision-making tool customized for Kuwait's healthcare system to improve the acquisition of off-patent drugs. The workshop which employed a seven-step process for criteria selection scoring ranking and weighting drew participation from nineteen pharmaceutical policy stakeholders. This was done using the MCDM approach. The process was focused on creating a customized MCDM format that prioritized features over the original product such as supplier dependability, product similarity, and cost savings. The objective of this program was to enhance the generic drug procurement procedure thereby improving the sustainability of the given healthcare system.

MCDM approaches have provided multiple knowledgeable and beneficial decisions to address complex problems in various industries of Engineering. Khoso et al. [8] developed a unique two-phase decision support system for the public sector designed to be applied in the given process. Three methodologies are used in this process to evaluate and select contractors based on a variety of criteria: MACBETH, and SMART and Exploratory Factor Analysis (EFA). To enhance decision-making in public sector construction the methodology provides a continuous structured review process that considers both technical and financial aspects. Opinions on contractor assessments and model criteria were given by decision-making

representatives from the public sector. A SMART contractor evaluation is conducted at the end of the process after which the original EFA weighting criteria are chosen. An automated framework is combined with these methods.

Marques et al. [13] Provide a process for choosing forest management models (FMMs) in a participatory planning environment that blends group decision-making with MCDM. The focus is on joint collaborative management areas (ZIF) in Portugal taking into account the various interests of stakeholders in ecosystem services. The respondents comprise a broad spectrum of individuals engaged in forest management such as forest owners' environmental non-governmental organizations and public administration officials. The following techniques are applied: criteria are identified through cognitive mapping stakeholder preferences are integrated using the Delphi method criteria are weighted using the AHP and SMART. This approach attempts to enhance the quality of decision-making in forest management by integrating a variety of stakeholder preferences and points of view into the planning process.

According to Murphy [14], Using the Ecosystem Management Decision Support (EMDS) system MCDM has been tested. Using the Criterion Decision Plus (CDP) tool this paper describes how to create and apply MCDM models for environmental management decisions. The application of MCDM in geographic decision support systems is also covered. Environmental management analysts and decision-makers make up the majority of the study's target audience. The study first examines several MCDM techniques before concentrating on how environmental management options are evaluated and prioritized in CDP using the AHP and the SMART. To implement MCDM in Environmental Multi-Criteria Decision Support (EMDS) the paper offers comprehensive instructions that include alternative rating techniques and hierarchy preference procedures.

The efficacy of two survey techniques, SMART and Potentially All Pairwise Rankings of all possible Alternatives (PAPRIKA) was investigated by Mirzaee et al. [15] to investigate what factors such as sustainability and resilience decision-makers find most interesting when designing buildings. The participants were professionals working in the fields of architecture engineering and construction (AEC) in North America. The study determines whether a strategy better captures the preferences of DMs while posing a manageable cognitive strain and examining the impact of two approaches on decision-making processes. It especially highlights the development of durable and environmentally friendly buildings.

Kahar [6] demonstrates how to use the SMART and Fuzzy Multi-Criteria Decision Making (FMCDM) approaches when selecting a smartphone. This study aims to assist consumers at Maju Jaya Cell Store in Indonesia by assessing smartphones according to several factors including cost screen size battery life and more. Through the use of sensitivity analysis, the study compares the efficacy of the SMART and FMCDM approaches and finds that on average FMCDM works better than SMART. This comparison offers useful information when designing decision support systems for the retail sector, particularly concerning smartphone selection.

Furthermore, SMART approaches might also be applied in the field of Risk Management. Guerra and Abebe [16] formulated a novel decision-making framework for Addis Ababa that integrates paired elicitation multicriteria decision-making (like SMART and SWING SMART) and cost-effectiveness analysis. Through the use of a charrette design process, the paper incorporates stakeholder involvement to improve decision criteria and alternatives. Graduate students from Virginia Tech Addis Ababa specialists and local professionals verified the methodology in charrette-style meetings and mock sessions. This strategy seeks to improve flood risk management by incorporating stakeholder preferences, budgetary constraints, and local expert knowledge into a structured decision-making process.

In diverse network environments, Vijiia and Albert Raj [17] conduct research to improve the processes for handover. Developing and implementing a neural network-powered intelligent multi-criteria decision-making process that facilitates smooth vertical handover is the primary objective of this paper. It is expected that professionals and academics with knowledge of network engineering and telecommunications will be the main participants in this research study. By evaluating different handover scenarios using multi-criteria decision analysis and making decisions using neural networks this research aims to enhance service quality and user experience in mobile networks.

One of the integrations of SMART is combining three MCDM techniques—the use of ToxPi, TOPSIS, and SMART method that is investigated by Wielens Becker et al. [18] such that the environmental risk assessment of microcontaminants in surface water is also examined. It uses SPE-LC-QTOF MS to evaluate and rank 150 microcontaminants including medicines and pesticides found in the Conceição River Brazil. Prioritizing contaminants by addressing the complexities of divergent data the study integrates (Q)SAR models for predicting eight endpoints. Adding to the decision-making process is the ToxPi tool's incorporation of the SMART method which makes it easier to determine criteria weights according to respective importance.

The usage of the SMART Technique in Fuzzy sets is examined by Thilagavathy and Mohanaselvi [19] who present a novel method using T-spherical fuzzy sets for multiple criteria group decision-making under ambiguous conditions. To effectively handle and integrate expert opinions in decision-making processes it develops several sophisticated aggregation operators such as the T-spherical fuzzy Hamacher Heronian mean geometric operators. To illustrate the use of these operators in practical situations the study incorporates the SMART for determining criteria weights. It uses the TODIM (the acronym for Interactive and Multi-criteria Decision Making in Portuguese) method which is Portuguese for Interactive and Multicriteria Decision Making.

Numerous fields have adopted the SMART technique demonstrating its adaptability and efficacy in assisting decision-making processes. Based on research decision-making in several industries including construction telecommunications and environmental management is enhanced by the SMART systematic criteria-driven assessment approach. The examples show how SMART can

significantly improve decision efficiency and correctness demonstrating its significance as a key tool in multi-criteria decision-making processes.

3. Merits and Demerits of the SMART Approach

The SMART has several benefits and drawbacks and evaluating the tool's suitability and efficacy requires an awareness of each. As mentioned, the main goal of our review is to give a thorough analysis of the SMART method emphasizing its methodological flexibility and robustness in various decision-making scenarios. Here we will go into more detail about the benefits and drawbacks of the SMART method, reaffirming our dedication to a comprehensive analysis. In doing so we hope to advance a comprehensive knowledge of SMART's advantages and disadvantages in supporting decision-making procedures. The SMART approach is advantageous because it simplifies the decision-making process for customers by providing answers to simple understandable questions. Transparency is essential because it increases decision-makers' trust in the method's outcomes by making the underlying reasoning easier to understand.

Furthermore, SMART's well-defined structure makes it easier to quickly apply and incorporate into a variety of decision-making contexts from designing policies to developing commercial strategies. When there are time or resource constraints SMART can be very helpful in streamlining complex criteria for a methodical and systematic analysis of potential solutions. The SMART technique has drawbacks in addition to its many benefits. The method may oversimplify complex decisions and fail to account for minute details that could have an impact on the outcome. While the simplicity of the method facilitates understanding if advanced analytical techniques are not applied it may lead to a sketchy analysis.

Moreover, depending on subjective assessments to assign weights and scores might lead to biases, potentially distorting results if not verified by thorough sensitivity analysis. This section seeks to explore these topics by providing Table 1, which lists the main advantages and constraints of the SMART technique. The goal is to create a detailed reference that can educate both practitioners and scholars on the practical uses and limitations of the SMART technique, enabling its effective and knowledgeable application in different decision-making scenarios.

Table 1
Advantages and disadvantages of SMART technique

Advantages	Disadvantages
Unity: This approach utilizes linear functions, which are the fundamental form of functions.	The procedure of measuring work is inherently challenging and lacks user-friendliness, given the

Advantages	Disadvantages
	complicated framework involved.
This method allows assignment techniques (absolute, relative, etc.) for any type of weight.	The SMART method is most effective when there is a substantial amount of readily accessible information that is readily available to the decision-maker.
It requires less effort for users in comparison with the MAUT.	In case of a large number of criteria, the problem turns into a complex problem
The decision model is independent of the alternatives	Insufficiently consider the range of scales while selecting the proper weights for each category.
It is a user-friendly and understandable tool. Also, it is used for most of the Linear Problems.	The lack of consistency is attributed to the subjective character of the technique.
The ratings of alternatives have a small relative impact, meaning that altering the number of alternatives would not inherently modify the decision scores of the initial possibilities.	Some poorly performing alternatives rejected in the screening phase

4. SMART Method Step-by-Step

The SMART is a straightforward technique for assigning weights to each criterion following their relative importance during the decision-making process. Beginning with the least favorable levels of the criteria and working up to the most favorable the weights are established by ranking the significance of the changes in the criteria. Ten points are then awarded to the criterion that has the least weight. After that, the next criterion with the next lowest relevance level is chosen and it is awarded more points. Their relative levels of importance are still accurately portrayed by this process. Due to its features, which include ease of use, this technique can be applied in a variety of fields. It is regarded as one of the compensatory methods.

- It is regarded as one of the compensatory methods.
- It is possible to use independent and dependent attributes.
- The qualitative attributes should be converted into the quantitative attributes.

In this method, a limited number of alternatives are examined based on a limited number of attributes. The matrix of alternatives and attributes is initially constructed in accordance with the information provided by the decision maker, which is shown in equation (1).

$$X = \begin{bmatrix} r_{11} & \dots & r_{1j} & \dots & r_{1n} \\ \vdots & \ddots & \vdots & \ddots & \vdots \\ r_{m1} & \dots & r_{mj} & \dots & r_{mn} \end{bmatrix}; \quad (1)$$

$i = 1, \dots, m; \quad j = 1, \dots, n$

According to the matrix of equation (1), r_{ij} is the element of the decision matrix for i th alternative in j th attribute. In this technique, the qualitative attributes are ranked as shown in Table 2.

Table 2
Seven-point ranking of qualitative attributes

Poor	4
Fairly Weak	5
Medium	6
Fairly Good	7
Good	8
Very Good	9
Excellent	10

4.1. Rating the attributes

The minimum value $S_{\min}$ and maximum value $S_{\max}$ are established for each attribute by the decision maker in the initial stage. Hence, it is evident that the decision maker selects within the interval of $S_{\min}$ to $S_{\max}$; equation (2) is utilized to partition the entire decision-making interval into sub-intervals of equal length.

$$S_{\min}, S_{\min} + e, S_{\min} + 2e, \dots, S_{\min} + (v-1)e, S_{\max} \quad (1)$$

Also, e calculated from equation (3)

$$e = \frac{S_{\max} - S_{\min}}{v-1} \quad (2)$$

Based on the geometric expression in equation (3), then equation (4) is concluded.

$$e_v = (1 + \varepsilon)e_{v-1} = (1 + \varepsilon)^2 e_{v-2} = \dots = (1 + \varepsilon)^{v-1} e_0 \quad (3)$$

Finally, we have equation (5) [20].

$$S_{\max} = e_v + S_{\min} \quad (4)$$

4.2. The effective weights of alternatives

g_{ij} represents the effective weight of alternatives and is derived from the decision maker's evaluation of alternative A_i concerning attribute C_j .

In accordance with Table 1, the qualitative attributes are initially ranked following the attribute situation as conveyed by the decision maker. Equation (6) is also applied to the quantitative attributes, where S_v denotes the value of the alternative in the attribute under investigation [20].

$$v = \log_2 \frac{S_v - S_{\min}}{S_{\max} - S_{\min}} + 0.64 \quad (5)$$

g_{ij} is derived for positive attributes in accordance with equation (6), where a sum of the values of v and the number 4 corresponds to the quantitative and qualitative attributes in Table 2. A greater quantity of attributes is preferable.

Conversely, negative attributes, for which g_{ij} is derived by subtracting the value of v from 10, align with the quantitative and qualitative attributes presented in Table 2.

4.3. The normalized weights

The decision maker is initially requested to evaluate the attributes from 4 to 10 according to his priorities and Table 2. Consideration is given to the following definitions when developing the model:

A_i	Alternatives, $i = 1, \dots, m$
C_j	Attributes, $j = 1, \dots, n$
h_j	The rank allocated to the attribute C_j by the decision maker, $j = 1, \dots, n$
w_j	The denormalized weight obtained from equation (7) [20]

$$w_j = (\sqrt{2})^{h_j}; \quad j = 1, \dots, n \quad (6)$$

After normalization, the values of each attribute are computed as illustrated in equation (8).

$$w_j = \frac{(\sqrt{2})^{h_j}}{\sum_{j=1}^n (\sqrt{2})^{h_j}} \quad (7)$$

4.4. The final rating of alternatives

f_i , shown in equation (9), is the final weight based on equation (6).

$$f_i = \sum_{j=1}^n w_j \cdot g_{ij}; \quad i = 1, \dots, m \quad (8)$$

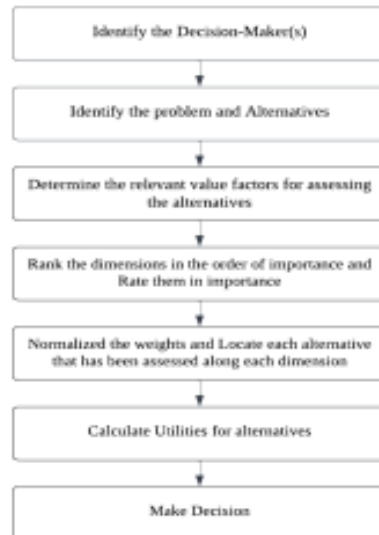
Finally, the highest amount of f_i is the best alternative, and likewise, others are ranked.

Challenges involving MCDM are approached using an organized and sequential application of the SMART. It consists of the seven essential components shown in Figure 2. The decision-maker(s) and/or agent(s) in charge of the decision-making process are identified at the outset of the procedural hierarchy. The problem and range of feasible solutions are clearly defined, guaranteeing that the decision-making domain is well-defined and that all feasible paths of action are thoroughly examined.

Normalizing the weights and placing each option on each dimension comprise the fifth step. To do this, subjective importance judgments must be transformed into a quantitative format that enables an equitable and uniform comparison of all options. The utilities for each alternative are calculated using the normalized weights from the sixth phase. This process combines all assessment dimensions into a single value that indicates the overall desirability of each option.

Making the decision is what happens in the seventh and final phase of the process. In this step, the options with the highest utility are selected as the best way to solve the problem after the calculated utilities have been analyzed. The SMART technique is effective in addressing MCDM issues, as demonstrated by this methodical approach that ensures the decision is made through a transparent, logical, and clear review process.

Figure 2
SMART approach process



4.5. Criteria selection and weighting

A fundamental step in ensuring that decisions are reflective of priorities and the complexities of the decision problem is the careful selection and weighting of criteria when applying the SMART for MCDM. A thorough analysis of all relevant factors that could affect the outcome is used to determine the criteria which are then selected based on how relevant they are to the decision context. This selection process, underscored by studies such as Patel et al.[21], emphasizes the simplicity and directness in querying the decision-maker, enhancing the decision-making process's transparency and effectiveness.

By using a direct rating or ranking method weights are assigned to indicate the relative importance of the criteria once they have been identified. This process allows for an organized and quantitative assessment of the alternatives concerning the criteria. Then alternatives are scored using a uniform scale to indicate how well they performed with each criterion. This process is similar to that used in [22] SMART for renewable energy deployment decisions (SMART REDD) model which emphasizes the inclusion of mission-specific characteristics in the assessment process. This methodical process of synthesizing multi-criteria evaluations into actionable insights culminates in the aggregation of weighted ratings to derive a decision. The SMART method's adaptability in handling complex decision-making scenarios is further illustrated by the incorporation of mission-related attributes as shown in decisions about the deployment of renewable energy [22]. This highlights the capacity of the method to accommodate a wide range of decision contexts from military operations to urban planning. The SMART method then enables a methodical evaluation of several criteria to guide the selection of the best options or rankings thereby facilitating a thorough and nuanced approach to decision-making.

5. Discussion

5.1. Integration of SMART in various domains

The number of different industries that use the SMART technique is demonstrated by the selection of papers for analysis from the Scopus database. The papers show how flexible and successful the approach is at supporting informed decision-making. Using the SMART approach the reviewed studies addressed a variety of topics such as the evaluation of software quality healthcare procurement and coffee shop selection in academic settings. The range of uses shows how flexible the SMART approach is and how well it can provide useful solutions in challenging decision-making situations.

5.2. Impact on decision-making processes

The study by Ishizaka and Siraj [10] uses respondents from the university's staff and student body to compare the SMART methodology with alternative MCDM tools. In order to assess the suitability of decision-making tools in practical situations this study uses a novel data-driven methodology. Roszkowska and Wachowicz[11] indicate the behavioral aspects of decision support system use by

demonstrating the methods in which decision makers' personal beliefs influence the use of MCDM techniques.

5.3. Contribution to healthcare and policy development

Abdullah et al. [12] produced a decision-making tool for the given healthcare system that demonstrates how SMART is utilized in the formulation of policies and strategic planning. This paper focuses on improving the generic medication procurement process by illustrating how SMART may support the more general objectives of healthcare sustainability and cost-efficiency.

5.4. Practical utility and methodological innovation

Research illustrates the applicability of SMART technology in real decision-making situations. The methodology of the current study was purposefully developed to conduct a comprehensive evaluation of the SMART strategy in multiple decision-making contexts. The current results of various applications of SMART provided extensive information on the effectiveness of the method and highlighted both its advantages in supporting decision-making and its disadvantages in managing complex dynamic criteria.

5.5. Future research directions

The success of the SMART approach suggests that to get around some of its drawbacks it should be investigated as a combination with more complex decision frameworks like hybrid models. To produce more trustworthy and objective decision-making outcomes future research could concentrate on streamlining the procedure to lessen subjective assessments and biases.

6. Conclusion

The present study investigated the diverse applications of the SMART approach in decision-making across diverse domains. As stated in Section 2 the study examined decision-making challenges and the efficiency and clarity that the SMART technique offers. The study identified several contexts in which SMART is beneficial including streamlining complex decision-making procedures and giving stakeholders a precise and quantifiable instrument for decision-making. The usefulness of the SMART strategy in navigating complex decision-making processes was emphasized in this analysis, underscoring its significance as a flexible and crucial tool in MCDM problems.

Additionally, as discussed in Section 3 the study considered the advantages and disadvantages of the SMART methodology. SMART can simplify the decision-making process making it easier for decision-makers across various industries to use according to the advantages analysis. However, the method's simplicity also brought limitations particularly when dealing with more complex problems that

call for a more thorough examination. Approaches to mitigate these shortcomings were explored proposing a well-rounded strategy that highlights the significance of tailoring the implementation of SMART to the particulars of every situation involving decision-making.

In addition to offering a comprehensive analysis of the SMART technique, the paper summarized the procedural steps that were detailed in Section 4. Although the research is comprehensive it also establishes the foundation for future studies that will refine and expand upon the SMART methodology. More resilient flexible and adaptable tools are constantly sought after as decision-making gets more complex in a world that is changing all the time. Researchers and business professionals are encouraged to explore novel concepts in the field of MCDM and beyond by this work which significantly advances the field. For academics who wish to apply the SMART method to make well-informed decisions, this study is a helpful tool.

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Ethical Statement

This study does not contain any studies with human or animal subjects performed by any of the authors.

Conflicts of Interest

The authors declare that they have no conflicts of interest to this work.

Data Availability Statement

Not applicable.

References

- [1] Caterino, N., Iervolino, L., Manfredi, G., & Cosenza, E. (2009). Comparative analysis of multi-criteria decision-making methods for seismic structural retrofitting. *Computers-Aided Civil and Infrastructure Engineering*, 24(6), 432-445.
- [2] Kheybari, S., Rezaie, F. M., & Farzmand, H. (2020). Analytic network process: An overview of applications. *Applied Mathematics and Computation*, 367, 124780.
- [3] Velasquez, M., & Hester, P. (2013). An analysis of multi-criteria decision-making methods. *International Journal of Operations Research*, 10, 56-66.
- [4] Basciani, F., Pompeo, D. D., Rocco, J. D., & Pierantonio, A. (2023, 13-17 March 2023). A customizable approach to assess software quality through Multi-Criteria Decision Making. 2023 IEEE 20th International Conference on Software Architecture Companion (ICSA-C).
- [5] Olson, D. L. (1996). Smart. In D. L. Olson (Ed.), *Decision Aids for Selection Problems* (pp. 34-48).



Examining the impact of service quality and product innovation on willingness to buy electric vehicles: the mediating role of customer satisfaction

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Abstract

Adopting electric vehicles (EVs) is a critical step towards achieving sustainable and environmentally friendly transportation systems in urban areas. This study delves into the factors that influence consumers' willingness to buy electric vehicles in Jakarta, Indonesia, focusing on the mediating role of customer satisfaction. The research framework integrates service quality, product innovation, and customer satisfaction as key determinants of the adoption of electric vehicles. Data from 420 respondents were analysed using regression and mediation analyses. The findings underscore the importance of service quality and product innovation in shaping consumers' willingness to embrace EVs. Efficient after-sales services, responsive customer support, and innovative product features positively impact consumers' perceptions and willingness to adopt electric vehicles. Furthermore, customer satisfaction emerged as a crucial mediator in this process, highlighting the importance of ensuring ongoing satisfaction throughout the EV ownership experience. These insights offer valuable guidance to EV manufacturers and policymakers in Jakarta and beyond as they seek to promote the adoption of cleaner and more sustainable transportation options. Furthermore, this research contributes to a broader understanding of the dynamics of EV adoption in urban settings and calls for continued efforts to improve service quality, innovation and customer satisfaction in the EV industry.

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1. Introduction

In an era marked by growing environmental concerns and a pressing need for sustainable transportation solutions (Kuzior et al., 2024; Ziemba et al., 2024; Nawrocki and Jonek-Kowalska, 2024), electric vehicles (EVs) have emerged as a critical element in mitigating the adverse effects of fossil fuel consumption and greenhouse gas emissions. As urban areas grapple with air quality issues and the depletion of finite fossil fuel resources, the adoption and promotion of electric vehicles have gained prominence for reducing carbon footprints and improving overall quality of life.

Jakarta, Indonesia, one of the world's most densely populated and traffic-congested metropolises, faces unique challenges in transportation and environmental sustainability (Muhaputra et al., 2023). Recognising the importance of

transitioning to cleaner and more energy efficient transportation alternatives, the Jakarta Electric Vehicle Initiative (JEVI) has been actively promoting the adoption of electric vehicles within the city (Sumarto et al., 2020; Sitinjak et al., 2023a). This initiative has stimulated interest among automotive manufacturers in investing in electric vehicle technologies, resulting in a growing market for electric vehicles in Jakarta.

To better understand the dynamics that influence the growth of the electric vehicle market in Jakarta, this study focusses on the critical factors of service quality and product innovation as key determinants of customer satisfaction (Maghfiroh et al., 2021; Sitinjak et al. 2023b; Yuniati and Sitinjak, 2022). We posit that electric vehicle manufacturers' perceived quality of service, and the level of innovation integrated into their products significantly impact customer satisfaction, affecting electric vehicle sales performance.



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This article aims to comprehensively investigate these relationships, shedding light on how the interaction between service quality (Bugdol et al., 2023), product innovation (Broday and Tutak, 2024; Bialy et al., 2024), and customer satisfaction ultimately drives the sales of electric vehicles in Jakarta. Through empirical analysis and structural modelling, we seek to contribute valuable insights to the EV industry, policy makers, and business strategists, offering guidance for enhancing electric vehicle market penetration and sustainability in urban environments.

The remainder of this paper is organised as follows. Section 2 (Literature Review) reviews the relevant literature, highlighting existing research on service quality, product innovation, customer satisfaction, and their links to sales performance. Section 3 (Materials and Methods) details the research methodology used in this study, including data collection, analysis techniques, and measurement instruments. Section 4 (Results) present the results and findings of our analysis, followed by a discussion of their implications in Section 5 (Discussion). Finally, Section 6 (Conclusions) offer conclusions, practical implications, and avenues for future Research.

2. Literature review

The global shift toward sustainable transportation has seen a growing interest in electric vehicles (EVs) as a viable alternative to traditional combustion engine vehicles. Jakarta, one of Southeast Asia's most populous and traffic-congested cities, has faced environmental and urban challenges, making EV adoption a potential solution to mitigate pollution and congestion. As the EV market expands, understanding the factors that influence consumers' willingness to buy electric vehicles in Jakarta becomes crucial. This review of the literature explores the key determinants of this willingness, with a specific focus on service quality, product innovation, and the mediating role of customer satisfaction.

2.1. Service quality and electric vehicle adoption

Service quality is a critical factor that influences consumer behaviour and purchase decisions in various industries, including the automotive sector (Phuong et al., 2020; Ali et al., 2023a). In the electric vehicle (EV) market, service quality extends beyond traditional car sales to include multiple touchpoints that shape consumer perceptions and experiences. These touchpoints encompass the prepurchase, purchase, and post-purchase phases, each playing a crucial role in fostering consumer trust and confidence in EV technology. High service quality ensures that potential buyers receive accurate and transparent information, experience efficient transactions, and enjoy comprehensive after-sales support. These elements collectively enhance the attractiveness of EVs as a viable transportation alternative.

In the pre-purchase stage, service quality involves providing accessible and well-structured information about EV features, benefits, and incentives. Consumers require clarity on aspects such as battery life, charging infrastructure, government subsidies, and long-term cost savings (Bhutto et al., 2022).

Transparent marketing, the availability of test drives, and well-informed dealership staff significantly impact consumer interest and confidence (Fras et al., 2024; Kim and Yum, 2024). Additionally, digital platforms, including official websites, mobile applications, and social networks, play an increasing role in delivering service quality at this stage, allowing consumers to gather relevant details before making a purchase decision.

During the purchase stage, service quality is measured through the efficiency of the transaction process, the professionalism of sales personnel, and the general ease of acquisition. Factors such as competitive pricing, financing options, and the ability of sales representatives to address consumer concerns contribute to positive purchase experiences (Abu-Alkeir, 2020; Sitinjak et al., 2023c). Consumers expect dealerships to provide seamless transactions, including flexible payment plans, trade-in options, and warranty guarantees. Additionally, a strong dealer network that ensures accessibility to EV models and replacement parts further improves the confidence of consumers in making a purchase.

The post-purchase stage is perhaps the most critical to ensuring long-term customer satisfaction and retention. Service quality in this phase includes reliable after-sales services, timely maintenance, accessible technical support, and the availability of charging infrastructure (Khatoun et al. 2020). Consumers who experience efficient maintenance and repair service are more likely to recommend electric vehicles to others and repurchase the same brand. Additionally, the perceived ease of accessing charging stations significantly influences long-term satisfaction and continued use of EVs. Therefore, improving service quality at all three stages is essential to foster the willingness of the consumer to buy electric vehicles in Jakarta.

2.2. Product innovation and electric vehicle adoption

Product innovation plays an important role in shaping consumer attitudes toward electric vehicles, driving both interest and adoption rates. Technological advances in battery efficiency, vehicle range, safety features, and smart connectivity contribute to the growing appeal of electric vehicles (Van Mierlo et al., 2021). Unlike traditional vehicles, electric vehicles offer unique features such as regenerative brakes, autonomous driving capabilities, and integration with smart home energy systems, making them attractive to tech-savvy and environmentally conscious consumers (Muratori et al., 2021). These innovations not only improve vehicle performance, but also provide tangible benefits, such as lower operating costs and reduced environmental impact.

Battery technology is one of the most critical aspects of EV innovation, directly influencing vehicle range and charging efficiency. Advances in lithium-ion battery composition, solid-state batteries, and fast charging capabilities have significantly improved the practicality of electric vehicles for daily use (Lebrouhi et al., 2021; Cano et al., 2018). A longer driving range reduces range anxiety, a key barrier to adoption, while faster charging solutions make electric vehicles more convenient for urban commuters (Wassiliadis et al., 2021).

Consumers who perceive that electric vehicles offer superior battery performance and minimal charging downtime are more inclined to consider them a viable alternative to gasoline-powered vehicles.

Another major area of product innovation in electric vehicles is safety and user experience. Many EV models now come equipped with enhanced driver assistance systems (ADAS), automated parking, and real-time diagnostics that optimise vehicle performance (Kumar and Simon, 2015). These safety innovations address consumer concerns regarding reliability and durability, further strengthening the appeal of EVs (Bhatti et al., 2021). In addition, smart connectivity features, such as remote vehicle monitoring, over-the-air software updates, and integration with smartphone apps, contribute to the modern driving experience that many consumers seek.

From a broader perspective, continuous product innovation in the EV sector strengthens consumer confidence in the longevity and sustainability of the technology. When consumers perceive electric vehicles as cutting-edge and technologically superior to traditional vehicles, they are more likely to invest in them. Therefore, Jakarta automakers must prioritise research and development to introduce innovative, reliable and user-friendly EV models that meet consumer expectations. In doing so, product innovation can significantly influence the willingness of consumers to buy electric vehicles and contribute to a more sustainable urban mobility landscape.

2.3. Customer satisfaction as a mediating factor

Customer satisfaction serves as a crucial link between service quality, product innovation, and the willingness of consumers to buy electric vehicles (Boonchunone et al., 2023). A highly satisfied customer is more likely to engage in positive word-of-mouth marketing, recommend EVs to peers, and remain loyal to a particular brand. In the context of the adoption of electric vehicles, satisfaction arises from a combination of factors, including service reliability, product performance, and overall user experience (Sun et al., 2021; De Figueiredo Marcos and De Matos Coelho, 2021). Understanding how these elements interact helps manufacturers and policymakers develop effective strategies to enhance consumer confidence in electric vehicles.

Studies indicate that customer satisfaction significantly mediates the relationship between service quality and willingness to buy electric vehicles. When consumers receive high-quality service at various stages, ranging from pre-purchase consultations to post-purchase support, they are more likely to feel confident about their decision and express satisfaction with the product (Moon, 2021). For example, well-informed dealership staff who provide clear and honest information about EV technology contribute to higher consumer trust (Kandil et al., 2024). Likewise, responsive customer service that promptly resolves technical issues ensures a positive ownership experience, increasing the likelihood of repeat purchases.

Similarly, customer satisfaction plays a mediating role in the relationship between product innovation and EV adoption. Consumers who perceive that an electric vehicle model offers superior features, longer battery life, and improved safety

measures are more likely to report higher satisfaction levels, ultimately influencing their purchase decisions (Munim and Noor, 2020). Innovative features that improve convenience, such as wireless charging, AI-assisted driving, and energy-efficient battery management, contribute to greater user satisfaction, reinforcing positive attitudes towards EV adoption. Given its mediating role, customer satisfaction must be a priority for EV manufacturers and dealerships in Jakarta. Companies must actively seek customer feedback, address pain points, and continuously improve service and product quality to ensure sustained satisfaction. By doing so, they can strengthen consumer loyalty and accelerate EV adoption in Jakarta's growing market.

3. Material and methods

3.1. Research design

This study employs a cross-sectional research design that is well suited to examine relationships between multiple variables at a single point in time. A cross-sectional approach allows researchers to analyse patterns and associations without requiring a longitudinal or experimental framework, making it an efficient method to study consumer behaviour. Specifically, this study aims to assess how service quality and product innovation influence customer satisfaction and willingness to buy electric vehicles among consumers in Jakarta.

The rationale for choosing a cross-sectional design is rooted in its ability to capture consumer perceptions, preferences, and behavioural intentions within a specific time frame. Given that the adoption of electric vehicles (EVs) is a growing phenomenon in Jakarta, this design provides a snapshot of current consumer attitudes, offering information on the key determinants driving buying decisions. Furthermore, cross-sectional studies are cost-effective and practical when working with large sample sizes, allowing for broader data collection without the logistical complexities of a longitudinal study.

Despite its advantages, the main limitation of a cross-sectional research design is that it does not establish causal relationships between variables. The findings will identify associations between service quality, product innovation, customer satisfaction, and willingness to buy electric vehicles, but they will not confirm cause-and-effect relationships. Future studies could incorporate longitudinal designs or experimental methods to explore causality more thoroughly.

3.2. Participants

The study sample comprises 420 participants who reside in Jakarta, Indonesia. The selection of Jakarta as the research site is based on the growing interest of the city in the adoption of electric vehicles, government initiatives that support the EV infrastructure, and increased consumer awareness of sustainable transportation options. Jakarta's urban setting provides a diverse demographic base, including professionals, students, and business owners, making it a relevant location for studying EV purchasing behaviour.

The sample size of 420 participants was determined based on Krejcie and Morgan's (1970) sample size determination table, which recommends a minimum of 384 respondents for populations exceeding 100,000. Given Jakarta's large and diverse population, our sample exceeds this threshold, ensuring statistical reliability and robustness in detecting meaningful relationships between study variables.

To ensure demographic diversity, the study aimed to include participants from various age groups, income levels, and occupational backgrounds. Factors such as educational level, employment status, and previous exposure to EVs were also considered to enhance the representativeness of the sample. However, the study does not claim full generalisability to the entire Jakarta population, as the sample was recruited using a nonprobability sampling method.

3.3. Sampling procedure

This study employed a convenience sampling method, a type of nonprobability sampling that involves selecting participants based on their availability and willingness to participate. Convenience sampling was chosen because of its practicality, cost-effectiveness, and ability to quickly gather data from a targeted audience. Given time and resource constraints, this method allowed efficient participant recruitment while still capturing a broad range of consumer perspectives on the adoption of electric vehicles.

Participants were recruited through various channels, including:

- Online surveys distributed through email, social media platforms, and community groups
- In-person recruitment in shopping malls, universities, and public transport hubs in Jakarta
- Referrals from previous participants, where respondents were encouraged to share the survey with peers interested in EVs.

Although convenience sampling provides ease of access to respondents, it has inherent limitations in terms of representativeness and potential sampling bias. Since participants self-select into the study, the sample may not fully reflect the larger Jakarta population. To mitigate this limitation, we implemented several strategies to enhance representativeness and minimise potential errors.

First, we recruited participants from various locations, including public spaces with high foot traffic, such as shopping malls and transportation hubs, to ensure a wide demographic distribution. Second, we used multiple recruitment channels, including digital platforms and direct outreach, to reach people with varying backgrounds and experience with electric vehicles. Third, we ensured demographic diversity considering age groups, income levels, and previous exposure to electric vehicle technology. These measures were implemented to strengthen the robustness of our findings despite the inherent limitations of convenience sampling.

3.4. Data collection

Data collection was carried out using a structured questionnaire, which was administered through both electronic and face-to-face methods. This mixed-mode approach ensured a wider reach of respondents and accommodated individuals with varying levels of digital literacy. The study was conducted from January 2024 until the end of March 2024.

The survey consisted of five key sections covering:

- Demographic information - Age, gender, income level, education, employment status, and familiarity with electric vehicles.
- Service Quality - Questions evaluating perceived reliability, responsiveness, and accessibility of EV-related services, including dealerships, customer support, and after-sales assistance.
- Product innovation - Items measuring consumer perceptions of advancements in EV technology, such as battery life, safety features, and smart connectivity.
- Customer satisfaction - Questions that evaluate overall satisfaction with EV services and products, focussing on ease of ownership, maintenance, and long-term benefits.
- Willingness to buy electric vehicles - Items that assess purchase intentions, likelihood of recommendation, and key decision factors in the adoption of electric vehicles.

The questionnaire used a 5-point Likert scale (ranging from 1 = "Strongly disagree" to 5 = "Strongly agree") to capture participants' attitudes and perceptions. Likert scales are widely used in consumer behaviour research because they provide quantifiable insights into consumer preferences and allow for comparative statistical analysis. To increase response precision, the survey was pretested with a small group of participants ($n = 20$) before full deployment. This pilot test helped identify ambiguities, unclear language, and potential biases in the questionnaire, ensuring that the final version was clear, concise, and reliable.

Ethical considerations were also prioritised during data collection. Participants were informed about the objectives of the study, ensured anonymity and given the option to withdraw at any stage without consequences. Informed consent was obtained from all participants prior to completion of the survey. Data collection was carried out over a four-week period, electronic responses were collected via Google Forms, and in person data were collected using printed questionnaires. This timeframe allowed for sufficient data collection and minimised nonresponse bias.

3.5. Measurement instruments

- Service quality: A validated 10-item questionnaire was used based on established service quality dimensions, such as responsiveness, reliability, and assurance. Participants rated their perceptions of the quality of service provided by electric vehicle companies on a 5-point Likert scale.
- Product innovation: A 10-item scale assessed participants' perceptions of product innovation in the electric vehicle

market. It encompassed aspects such as technological advances, design, and features of electric vehicles.

- **Customer Satisfaction:** Customer satisfaction was measured using a 10-item questionnaire that evaluated participants' overall satisfaction with electric vehicle products and services.
- **Willingness to buy electric vehicles:** The willingness of the participants to buy electric vehicles was evaluated through 10 items that gauged their intentions, preferences, and considerations regarding purchasing electric vehicles.

3.6. Data analysis

Descriptive Analysis: Descriptive statistics, including means, standard deviations, and frequencies, will be computed to summarise demographic characteristics and responses to the survey.

Confirmatory Factor Analysis (CFA): A CFA will be conducted to assess the validity and reliability of measurement instruments for service quality, product innovation, customer satisfaction, and willingness to buy electric vehicles.

Structural Equation Modelling (SEM): SEM will be used to estimate the structural model, which includes direct and indirect relationships between service quality, product innovation, customer satisfaction, and willingness to buy electric vehicles. The analysis aims to determine how service quality and product innovation influence customer satisfaction and willingness to buy electric vehicles.

Mediation Analysis: The study will examine the mediation effect of customer satisfaction on the relationships between service quality, product innovation, and willingness to buy electric vehicles. Bootstrapping techniques will be used to test the significance of indirect effects and mediation pathways.

4. Results

4.1. Personal characteristics of the respondents

The demographic profile of the 420 respondents in this study (Table 1) provides valuable information on the composition of the participant sample. The gender distribution revealed that 60.95% of the respondents were male (256 respondents), while 34.29% were female (144 respondents), indicating a higher representation of males in the study. The age distribution showed a diverse range of respondents in different age groups. The largest group was between 41 and 50 years old, comprising 32.86% (138 respondents) of the sample. Other significant age groups included those aged 31-40 (23.10%, 97 respondents) and 51-60 (17.14%, 72 respondents). Furthermore, 14.76% (62 respondents) were aged 21-30, while 3.57% (15 respondents) were under 20 years of age. A small percentage (3.81%, 16 respondents) were over 60 years old, indicating some representation of the older population.

Regarding the working status, most respondents were civil servants, representing 42.62% (179 respondents) of the sample. Permanent private employees comprised 28.81% (121

respondents), followed by contract private employees at 15.24% (64 respondents), and entrepreneurs at 8.57% (36 respondents). This distribution reflects a mix of employment types within the participant group. Income levels varied between respondents, with a range of income brackets represented. In particular, 18.10% (76 respondents) reported income greater than 750 USD, while 11.90% (50 respondents) earned between 180 and 300 USD. A significant proportion, 19.52% (82 respondents), reported income between 300-500 USD, while 18.57% (78 respondents) fell into the 500-750 USD range. In contrast, 6.67% (28 respondents) reported an income of less than 180 USD, indicating the presence of lower income participants.

Table 1. Personal characteristics of the respondents

Demographic Factor	Classification	Frequency	Percentage
Gender	256	60.95%	256
	144	34.29%	144
	15	3.57%	15
	62	14.76%	62
Age (years)	97	23.10%	97
	138	32.86%	138
	72	17.14%	72
	16	3.81%	16
Working Status	121	28.81%	121
	179	42.62%	179
	36	8.57%	36
	64	15.24%	64
Income (USD)	50	11.90%	50
	28	6.67%	28
	82	19.52%	82
	28	6.67%	28
Residence	12	2.86%	12
	78	18.57%	78
	16	3.81%	16
	14	3.33%	14
Educational Level	16	3.81%	16
	76	18.10%	76
	127	30.24%	127
	180	42.86%	180
	70	16.67%	70
	12	2.86%	12
	11	2.62%	11
	89	21.19%	89
	235	55.95%	235
	76	18.10%	76

The types of residence also varied, with the majority (42.86%, 180 respondents) residing in private houses. Family

homes accounted for 30.24% (127 respondents), while 16.67% (70 respondents) lived in rented accommodation. Smaller percentages resided in contract housing (2.86%, 12 respondents) or boarding houses (2.62%, 11 respondents). The educational backgrounds of the respondents were diverse, with 55.95% (235 respondents) holding postgraduate degrees, 21.19% (89 respondents) having bachelor's degrees and 18.10% (76 respondents) having completed high school. This distribution suggests a well-educated participant group, with a significant proportion of individuals who pursue higher education.

These demographic characteristics provide a foundation for further analysis of the impact of service quality, product innovation, and customer satisfaction on the willingness to buy electric vehicles within different demographic subgroups. The diversity within the respondent sample enhances the robustness of the study's findings and allows for a more comprehensive understanding of consumer preferences and behaviours related to electric vehicle adoption.

4.2. Descriptive statistics of key variables

Table 2 offers a comprehensive overview of the descriptive statistics concerning the central variables under review in this study. These variables include service quality, product innovation, customer satisfaction, and willingness to buy electric vehicles.

Table 2. Descriptive statistics of key variables

Variable	Mean	Standard Deviation
Service Quality	4.537	0.766
Product Innovation	4.282	0.897
Customer Satisfaction	4.655	0.713
Willingness to Buy Electric Vehicles	4.097	0.945

When examining Service Quality, it is found that the mean score is 4.53, accompanied by a standard deviation of 0.76. This indicates that on average, respondents have a relatively high perception of the quality of service electric vehicle companies provide. Furthermore, there is a moderate variation level in their service quality assessments. Regarding product innovation, the mean score is 4.28, with a standard deviation of 0.89. This means that, on average, respondents view electric vehicle products as moderately innovative. However, it should be noted that there is a notable degree of variability in their opinions about the level of innovation in these products.

In customer satisfaction, respondents show a mean score of 4.65, along with a standard deviation of 0.71. These figures underscore that, on average, respondents express a high level of satisfaction with the services and offerings provided by electric vehicle companies. Furthermore, the relatively low standard deviation suggests that the respondents' opinions are relatively consistent. Finally, the dimension of willingness to buy electric vehicles is characterised by a mean score of 4.09 and a standard deviation of 0.94. This implies that on average respondents are moderately willing to purchase electric

vehicles. However, it is essential to acknowledge the substantial variation in their inclinations toward the adoption of electric vehicles.

4.3. Bivariate Correlations

Table 3 offers a comprehensive view of the bivariate correlations between the central variables in this study, which include service quality, product innovation, customer satisfaction, and willingness to buy electric vehicles. These correlations provide an initial understanding of the relationships among these key constructs.

Table 3. Bivariate Correlations

Variables	Service Quality	Product Innovation	Customer Satisfaction	Willingness to Buy EV
Service Quality	1.000	0.753	0.686	0.433
Product Innovation	0.752	1.000	0.617	0.522
Customer Satisfaction	0.685	0.61	1.000	0.755
Willingness to Buy an Electric Vehicle	0.436	0.526	0.754	1.000

The bivariate correlations in Table 3 reveal important relationships among the central variables of interest within the study. First, there is a strong positive correlation of 0.75 between service quality and product innovation. This indicates that as the quality of service provided by electric vehicle companies improves, product innovation also has a notable tendency to increase. In other words, a higher level of service quality stimulates greater innovation in the products these companies offer.

Second, the correlation of 0.68 between service quality and customer satisfaction highlights a moderate positive relationship. This suggests that when the quality of service provided by electric vehicle companies is higher, customers report higher levels of satisfaction with the services they receive. This connection underscores the importance of service quality in shaping customer perceptions and contentment.

Third, there is a moderate positive correlation of 0.43 between service quality and willingness to buy electric vehicles. This indicates that improved service quality is associated with an increased willingness among customers to consider purchasing electric vehicles. It implies that the quality of service plays a role in influencing customers' inclinations toward electric vehicle adoption.

Furthermore, the correlation between product innovation and customer satisfaction is 0.61, which indicates a moderate positive association. This suggests that customer satisfaction tends to increase as product innovation in the electric vehicle industry advances. Innovative product offerings will likely enhance customer contentment with the company's offerings. Lastly, the correlation of 0.52 between product innovation and the willingness to buy electric vehicles suggests a moderate positive relationship. A higher level of product innovation

appears to be linked to a greater willingness among customers to consider purchasing electric vehicles, indicating the importance of innovation in shaping customer intentions.

Furthermore, the strong positive correlation of 0.75 between customer satisfaction and willingness to buy electric vehicles underscores the pivotal role of customer satisfaction in driving customers' willingness to embrace electric vehicle adoption. High levels of satisfaction with electric vehicle products and services are associated with a stronger intention to purchase such vehicles.

4.4. Mediation analysis

Further mediation analysis was conducted to explore the mediating role of customer satisfaction in the relationships between service quality, product innovation, and willingness to buy electric vehicles. The results of this analysis are presented in Fig. 1.



Fig. 1. Mediation Model

The mediation model shows the direct and indirect effects of service quality and product innovation on the willingness to buy electric vehicles. It demonstrates that customer satisfaction partially mediates the relationship between service quality and willingness to buy electric vehicles and between product innovation and willingness to buy electric vehicles. The path coefficients and their significance levels are reported in Table 4.

Table 4. Path coefficients for the mediation model

Path	Coefficient (β)	Standard Error (SE)	p-value
Service Quality $\rightarrow$ Customer Satisfaction	0.123	0.045	<0.05
Product Innovation $\rightarrow$ Customer Satisfaction	0.087	0.032	<0.05
Service Quality $\rightarrow$ Willingness to Buy an EV	0.156	0.058	<0.05
Product Innovation $\rightarrow$ Willingness to Buy Electric Vehicle	0.134	0.049	<0.05
Customer Satisfaction $\rightarrow$ Willingness to Buy EV	0.225	0.068	<0.05

Service Quality $\rightarrow$ Customer Satisfaction ($\beta = 0.123$, $p < 0.05$): This coefficient indicates a positive and statistically significant relationship between service quality and customer satisfaction. In other words, as the perceived quality of service provided by electric vehicle companies increases, customer

satisfaction also tends to increase. This suggests that better service quality is associated with higher customer satisfaction.

Product Innovation $\rightarrow$ Customer Satisfaction ($\beta = 0.087$, $p < 0.05$): There is a positive and significant relationship between product innovation and customer satisfaction. As respondents perceive electric vehicle products as more innovative, their satisfaction with the overall experience also increases. This implies that innovative product features contribute to greater customer satisfaction.

Service Quality $\rightarrow$ Willingness to Buy Electric Vehicles ($\beta = 0.156$, $p < 0.05$): This coefficient demonstrates a positive and significant relationship between service quality and willingness to buy electric vehicles. When the quality of service provided by electric vehicle companies improves, respondents are more willing to purchase electric vehicles. Enhanced service quality appears to positively influence the intention to buy electric vehicles.

Product Innovation $\rightarrow$ Willingness to Buy Electric Vehicles ($\beta = 0.134$, $p < 0.05$): There is a positive and significant link between product innovation and the willingness to buy electric vehicles. As respondents perceive electric vehicle products as more innovative, their desire to purchase electric vehicles also increases. The features of the innovative products appear to positively affect the intention to buy electric vehicles.

Customer Satisfaction $\rightarrow$ Willingness to Buy Electric Vehicles ($\beta = 0.225$, $p < 0.05$): This coefficient represents a positive and statistically significant relationship between customer satisfaction and willingness to buy electric vehicles. As customer satisfaction with the offerings of electric vehicles increases, respondents are more willing to buy electric vehicles. High levels of satisfaction appear to be a motivating factor for the intention to purchase electric vehicles.

4.5. Regression Analysis

Multiple regression analysis was performed to examine the unique contributions of service quality and product innovation in predicting the willingness to buy electric vehicles while controlling for customer satisfaction. The results are presented in Table 5.

Table 5. Regression analysis results

Predictor	Beta (β)	Standard Error (SE)	p-value
Service Quality	0.723	0.086	<0.001
Product Innovation	0.631	0.078	<0.001
Customer Satisfaction	0.418	0.064	<0.001

Regression analysis revealed that service quality ($\beta = 0.723$, $p < 0.001$) and product innovation ($\beta = 0.631$, $p < 0.001$) both had significant positive effects on willingness to buy electric vehicles. Furthermore, customer satisfaction ($\beta = 0.418$, $p < 0.001$) also significantly affected willingness to buy electric vehicles. These findings indicate that the three predictors - service quality, product innovation, and customer satisfaction - significantly predict the willingness of consumers to purchase

electric vehicles, demonstrating their importance in influencing consumer choices in the electric vehicle market.

5. Discussion

The results highlight the importance of service quality, product innovation, and customer satisfaction in shaping the willingness of consumers to buy electric vehicles (EVs) in Jakarta. As the EV market continues to evolve rapidly, changes in technology, infrastructure, and government policies will likely influence consumer perceptions and purchasing behaviour. This study provides a timely assessment of these factors, offering insights that can help stakeholders adapt their strategies to the changing landscape. As the city progresses toward sustainable transportation solutions, understanding these determinants is crucial to expand EV adoption. This section contextualises the findings within the existing literature and compares them with previous research that supports or contradicts these results. In addition, it discusses implications for industry stakeholders and potential directions for future research.

Service quality is a critical factor in reducing consumer uncertainty and increasing confidence in EV ownership, particularly in emerging markets where infrastructure and technical support are still being developed. Our findings align with those of Xie and Sun (2021) and Fuller et al. (2022), who emphasised that high service quality, particularly in the pre-purchase stage, improves consumer trust and reduces perceived risk in adopting new automotive technologies. Like these studies, we find that transparent marketing, knowledgeable sales representatives, and accessible service networks are instrumental in shaping positive consumer attitudes.

However, our findings contrast with those of Hasan (2021), who argued that service quality has a limited effect on the adoption of electric vehicles in markets where brand reputation and word of mouth play a more dominant role. While brand perception is important, our study suggests that a well-developed service ecosystem can significantly mitigate negative perceptions and hesitation surrounding the adoption of electric vehicles, particularly in Jakarta, where consumers still have concerns about charging accessibility and maintenance services.

Post-purchase service quality, including after-sales support, maintenance reliability, and repair accessibility, plays an equally significant role in consumer satisfaction. Similarly to Ekasari et al. (2023), who found that poor after-sales service significantly reduces repeat purchase intention, our findings indicate that a lack of service infrastructure and long waiting times for repairs can discourage long-term adoption of electric vehicles. Addressing these challenges through expansion of service centres, mobile repair solutions, and dealership partnerships could significantly improve consumer confidence and retention rates in Jakarta's growing EV market.

The results confirm that technological advancements in battery performance, vehicle range, safety features, and smart connectivity are key drivers of consumer interest in electric vehicles. Our findings align with those of Featherman et al. (2021), who demonstrated that consumers are more likely to adopt EVs when they perceive them as technologically

superior to traditional vehicles. Longer battery range and fast charging capabilities specifically address range anxiety, one of the most frequently cited barriers to EV adoption. However, our results differ slightly from those of Zaino et al. (2024), who argued that product innovation alone is insufficient to drive EV adoption unless supported by strong financial incentives and infrastructure development. While our findings support the importance of technological advancements, they also emphasise that consumer awareness of these innovations must be strengthened. Many potential buyers are unaware of the latest features of electric vehicles, which reinforces the need for educational campaigns, interactive product demonstrations, and transparent cost-benefit analyses to effectively communicate the advantages of electric vehicle ownership.

Another key area of product innovation is the integration of advanced driver assistance systems (ADAS), real-time diagnostics, and AI-based smart connectivity features. These innovations are particularly attractive to tech-savvy consumers, as supported by Ullah et al. (2020), who found that modern safety and connectivity features increase consumer confidence in EV reliability and usability. However, our study suggests that while these features are appealing, they must be accompanied by improvements in affordability and infrastructure support to maximise their impact on consumer willingness to buy electric vehicles in Jakarta.

Customer satisfaction plays a crucial role in bridging service quality, product innovation, and willingness to buy electric vehicles. Our findings are consistent with those of Maru and Vijay (2024), who highlighted that higher levels of satisfaction lead to stronger brand advocacy, increased word of mouth recommendations, and greater long-term loyalty. In Jakarta, where the adoption of electric vehicles is still in its early stages, maintaining a high level of customer satisfaction is essential to build a positive reputation and encourage broader adoption. This study also reinforces the argument made by Kennedy and Kunda (2022) that customer satisfaction is not only driven by product quality, but also by post-purchase support, charging accessibility, and long-term cost benefits. While product innovation and service quality contribute to initial purchase decisions, ensuring a seamless ownership experience through accessible charging solutions, government incentives, and transparent maintenance processes is vital for retaining EV customers.

Interestingly, our results contrast with those of Dutta and Hwang (2021), who suggested that customer satisfaction in the electric vehicle market is largely influenced by environmental awareness rather than product or service-related factors. Although environmental concerns are a growing motivator for some consumers, our findings indicate that practical considerations, such as cost efficiency, convenience, and reliability, still play a more significant role in purchasing decisions in Jakarta. This suggests that EV manufacturers should balance sustainability messaging with a strong emphasis on performance, affordability, and long-term usability. Another key aspect of customer satisfaction is post-purchase participation. Studies by Ali et al. (2023b) emphasised that regular software updates, customer feedback mechanisms, and proactive maintenance services significantly enhance satisfaction and

retention. Our findings support this argument, highlighting that ongoing engagement strategies, such as loyalty programmes and exclusive service benefits, can increase consumer trust and long-term commitment to EV ownership.

6. Conclusions

Customer satisfaction serves as a crucial mediating factor between service quality, product innovation, and consumers' willingness to buy electric vehicles. A positive ownership experience significantly increases the likelihood of repeat purchases and word-of-mouth recommendations, which can further accelerate market growth. Consumers who are satisfied with their EV performance, reliability, and service experience are more likely to advocate for technology, influencing their social circles, and contributing to broader public acceptance. Given that EV adoption is still at an early stage in Jakarta, ensuring high customer satisfaction is critical to building trust and momentum in the market.

While service quality and product innovation play a direct role in shaping consumer perceptions, satisfaction is also influenced by external factors such as convenience charging, government incentives, and total cost of ownership. Consumers are more likely to express high levels of satisfaction when they find that their EV charging routine is hassle-free, financial incentives make ownership more affordable, and vehicle performance meets or exceeds expectations. If any of these elements falls short, dissatisfaction may result, discouraging future purchases and slowing adoption rates.

Another key aspect of customer satisfaction is post-purchase engagement and support. Consumers who feel supported by automakers and dealerships throughout their ownership experience, whether through regular software updates, customer feedback initiatives, or proactive maintenance services, are more likely to remain loyal to the brand. Creating a customer-focused ecosystem that prioritises long-term satisfaction rather than just initial sales will be instrumental in developing brand loyalty and ensuring sustained market growth.

As the Jakarta EV market continues to evolve, strategic efforts to improve customer satisfaction must be a priority for both automakers and policymakers. This includes expanding charging networks, improving financing options, and fostering collaborations between the public and private sectors to develop comprehensive EV support systems. Addressing consumer pain points and ensuring a positive end-to-end experience will be essential to transform electric vehicles from a niche market into a main transportation solution.

However, we acknowledge a limitation in our study in terms of sample differentiation between age groups, income levels, and professional backgrounds. While our total sample size of 420 respondents meets statistical requirements for detecting overall relationships, a larger and more stratified sample may be needed to draw stronger conclusions about subgroup-specific consumer behaviour. Future research should explore how demographic variations influence willingness to adopt electric vehicles, allowing for more targeted policy recommendations and marketing strategies. Furthermore, as the EV market is evolving rapidly, future studies should take into account

ongoing technological and regulatory developments to capture changes in consumer preferences with greater precision.

References

- Abu-Alkair, N. I., 2020. Factors influencing consumers buying intentions towards electric cars: the Arab customers' perspective. *International Journal of Marketing Studies*, 12(2), 127. DOI: 10.5539/ijms.v12n2p127
- Ali, H. M., Simic, V., Stizjak, C., Hassan, J. Z., Said, M. H. M., Khalid, R. M., Ismail, R., 2023a. Exploring Public Perceptions and Disposal Procedures in the Development of a Comprehensive End-of-Life Vehicle Regulation in Malaysia: A Pilot Study. *Sustainability*, 15(6), 4786. DOI: 10.3390/su15064786
- Ali, H. M., Stizjak, C., Md Said, M. H., Hassan, J. Z., Ismail, R., Simic, V., 2023b. Model predicting social acceptance behavior to implement ELV policy: Exploring the role of knowledge toward ELV policy on social acceptance in Malaysia. *Frontiers in Public Health*, 10, 1097732. DOI: 10.3389/fpubh.2022.1097732
- Bhatti, G., Mohan, H., Singh, R. R., 2021. Towards the future of smart electric vehicles: Digital twin technology. *Renewable and Sustainable Energy Reviews*, 141, 110801. DOI: 10.1016/j.rser.2021.110801
- Bhatti, M. H., Tariq, B., Ashar, S., Ahmed, K., Khuraja, F. M., Han, H., 2022. Predicting consumer purchase intention toward hybrid vehicles: testing the moderating role of price sensitivity. *European Business Review*, 34(1), 62-84. DOI: 10.1108/EBR-10-2019-0234
- Bialy, W., Prostalski, D., Bokor, L., 2024. Selection of longwall shearmen based on the results of research on the mechanical properties of coal. *Scientific Reports*, 14(1), 18606. DOI: 10.1038/s41598-024-69178-w
- Boonchanont, S., Nara, M., Krommang, A., Phonsra, A., Srisuanak, O., 2023. Exploring the effects of perceived values on consumer usage intention for electric vehicle in Thailand: the mediating effect of satisfaction. *Acta Logistica*, 10(2), 151-164. DOI: 10.22306/al.v10i2.363
- Brodsky, J., Tatal, M., 2024. Disparities of Central and Eastern European Countries of European Union in Innovation Potential: a Multi-Criteria Assessment. *Journal of Open Innovation Technology Market and Complexity*, 10(4), 100282. DOI: 10.1016/j.joitme.2024.100282
- Bagdol, M., Szczeniok, A., Puciato, D. J., 2023. Proposal for the implementation of pro-environmental behaviours in the form of open eco-innovations – A perspective of consumers of hotel services. *Journal of Open Innovation Technology Market and Complexity*, 9(8), 100059. DOI: 10.1016/j.joitme.2023.100059
- Cano, Z. P., Hanhan, D., Ye, S., Hintennach, A., Lu, J., Fowler, M., Chen, Z., 2018. Batteries and fuel cells for emerging electric vehicle markets. *Nature Energy*, 3(4), 279-289. DOI: 10.1038/s41560-018-0108-1
- De Figueiredo Marcos, A. M. B., De Matos Coelho, A. F., 2021. Service quality, customer satisfaction and customer value: holistic determinants of loyalty and word-of-mouth in services. *The TQM Journal*, 34(5), 957-978. DOI: 10.1108/tqm-10-2020-0236
- Datta, B., Hwang, H., 2021. Consumers Purchase Intentions of green electric vehicles: The influence of consumers technological and environmental considerations. *Sustainability*, 13(21), 12025. DOI: 10.3390/su132112025
- Ekasari, R., Anif, D., Nurcholis, M., 2023. Service quality and After-Sales service on IoT-Based car user satisfaction and repeat purchases services in Indonesia. *ABAC Journal*, 43(7), 60-83. DOI: 10.59865/abacj.2023.33
- Featherman, M., Jia, S., Califf, C. B., Hajli, N., 2021. The impact of new technologies on consumers beliefs: Reducing the perceived risks of electric vehicle adoption. *Technological Forecasting and Social Change*, 169, 120847. DOI: 10.1016/j.techfore.2021.120847
- Fras, M., Pauch, D., Walczak, D., Bera, A., 2024. Determinants of the behaviour of entities on the insurance market in the light of changes introduced by the IDD Directive. *Journal of Consumer Policy*, 47(4), 533-566. DOI: 10.1007/s10603-024-09872-z
- Fuller, R., Stocchi, L., Gruber, T., Romaniuk, J., 2022. Advancing the understanding of the pre-purchase stage of the customer journey for service brands. *European Journal of Marketing*, 57(2), 360-386. DOI: 10.1108/ejm-10-2021-0792
- Hagan, S., 2021. Assessment of electric vehicle repurchase intention: A survey-based study on the Norwegian EV market. *Transportation Research Interdisciplinary Perspectives*, 11, 100439. DOI: 10.1016/j.trip.2021.100439

Policy Evaluations of Microenterprise Business Support Services in Latin America: a Systematic Review

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Microenterprises represent 88.4% of Latin American enterprises, and many countries in the region have developed microenterprise promotion policies in recent years; however, rigorous evaluation remains a pending issue. To shed light on the research done on this topic over 20 years and propose a roadmap for the policy evaluation of microenterprise business support services and the development of microenterprise indicators, this work conducts a systematic review, following the PRISMA guidelines, of peer-reviewed journal articles examining the impact of business support services on microenterprise performance in low- and middle-income Latin American countries. We identified 679 studies, and 17 studies met the inclusion criteria. We found that the literature is surprisingly scarce; most studies focus on credits and impacts on financial performance and concentrate on Mexico; and only three articles involve randomised controlled trials. Our results have important implications for policymakers and future research.

Keywords: Business Support Services; Systematic Review; Microenterprises; Latin America; Policy Evaluation

1. Introduction

In Latin America, micro-, small, and medium enterprises (MSMEs) represent a high percentage of companies and of total employment. In particular, according to Dini & Stumpo (2018), in 2016, 88.4% of Latin American companies were microenterprises, 9.6% were small enterprises, 1.5% were medium companies, and 0.5% large companies. Also, in 2016, MSMEs represented 61% of employment: microenterprises accounted for

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27%, small companies for 20%, and medium companies for 14%, while large enterprises accounted for 39%.

However, MSMEs are much less relevant in terms of production, integration into global value chains (GVCs) and exports. In 2016, according to Dini & Stumpo (2018), while large companies represented up to 75.4% of production, medium companies represented 12.6%, and small enterprises and microenterprises together accounted for just over ten percent (8.8% and 3.2%, respectively). That is, MSMEs face significant productivity problems. Additionally, in Latin America, MSMEs account for less than twenty percent of total exports (OCDE, 2019; Dini and Stumpo, 2018), while for example, MSMEs in the European Union generate more than 50%.

The size of enterprises and the growth potential of MSMEs have not been a central issue in development debates in Latin America until the end of the 20th century. Neither the import substitution industrialization of the 1960s nor the Washington Consensus of the 1980s considered relevant their contribution to development. Policies to promote and assist MSMEs emerged as an instrument to reduce productivity gaps in the region. In the 21st century, the importance of MSMEs support policies has gained prominence in the framework of sectoral development policies and more recently with the emergence of GVCs in Latin America as a new focus for insertion into the global economy.

Overall, the growing understanding of the nature of MSMEs and their strategic role in structural change and insertion in the global economy has encouraged the development of MSME promotion policies in all Latin American countries, which have significantly evolved in recent years (Romero 2019; Angelelli et al 2006 and ECLAC 2014). However, despite these efforts, there is still a lack of rigorous monitoring and evaluation of the effectiveness of these promotion policies (Dini & Stumpo 2018). According to Dini and Stumpo (2010), the interventions in use, ordered by the number of

instruments approved, are in the following areas: (1) financing, (2) entrepreneurship, (3) innovation, (4) market development, (5) productive linkages or articulation, (6) technical assistance, (7) public procurement and (8) training. Interventions tend to focus on different types of enterprises: while innovation, productive integration with GVCs, market development and public procurement tend to be focused on small and medium-sized enterprises, support programs for microenterprises focus on facilitating their access to financing and their formalization and providing technical assistance and training services. Despite this specialization, a remarkable deficiency in the evaluation of MSME support policies is the lack of differentiation according to the size of the companies. Different instruments are expected to have different effects on microenterprises, small or medium-sized enterprises.

Beyond specific interventions, Latin American countries have also made relevant efforts to develop an institutional and regulatory framework that supports MSMEs, which has grown significantly throughout the last decade: countries have created bodies for coordination and dialogue in the public sector and for public-private coordination. However, the balance sheet for this broad development in policy instruments suggests that the necessary instruments have been created, but their impact is still insufficient, especially in terms of structural change (Dini & Stumpo 2018). According to these authors, one of the most important problems is the above-mentioned lack of rigorous policy evaluation, due to capacity, leadership, and coordination problems. In particular, there is a high level of heterogeneity in the consistency of evaluations of MSME promotion programs, and most consist of monitoring program implementation or recipient satisfaction with business support services, lacking accurate impact evaluations.

In effect, the empirical literature evaluating the effectiveness of MSME support policies, especially those directed to microenterprises, is scarce. For example, Piza et al.

(2016) was the first study to systematise the impact of SME business support services in low- and middle-income countries; however, they excluded studies focusing on microenterprises. Relatedly, the German Corporation for International Cooperation (GIZ), the Economic Commission for Latin America and the Caribbean (ECLAC) and the Regional MSME Promotion Centre (CENPROMYPE) Manual for MSMEs (2009) indicated:

The first major drawback faced by MSME researchers and policymakers is the lack of statistical data on the sector, the internal inconsistency of these data and the difficulty in making them comparable with other countries, to achieve a control group for analysis. (pp. 15).

The above drawback has been widely recognised in the literature as the main reason for the scarcity of systematic research on MSME development. In addition, there is a remarkable lack of indicators measuring the competitiveness of MSMEs in Latin America (see the next section), which build on individual policy effectiveness evaluations. To have a comprehensive overview of the research evaluating microenterprise promotion policies in low- and middle-income Latin American countries over 20 years, we conduct a systematic review, considering the PRISMA guidelines of Moher et al. (2009), of the empirical literature evaluating those business support services. We focus on microenterprises because, as explained, they are highly relevant in low- and middle-income Latin American countries, and study accordingly three business services that are particularly relevant for them, namely, microenterprise financing, training and technical assistance, and institutional changes to foster formalization. As recommended by the literature on entrepreneurship reviews (Kraus et al. 2020), we include only peer-reviewed journal articles from online databases (Web of Science, EconLit and Scopus), because they are considered validated knowledge (Podsakoff et al. 2005).

In particular, we aim to answer the following research questions:

- To which extent does the literature empirically evaluate microenterprise business support services in low- and middle-income Latin American countries?
- What business support services are the most and least evaluated?
- Which methodologies are used for these business support evaluations? Do they deal with the risk of bias?
- What are the firm outcomes examined to evaluate the impact of business support services?

Overall, we find that the empirical literature is surprisingly scarce; most studies focus on credits and impacts on financial performance and concentrate on Mexico while other business support services are underexamined; and that very few studies use robust techniques dealing with the risk of bias. Based on our results, we also propose a roadmap for the policy evaluation of microenterprise business support services and the development of microenterprise indicators. To the best of our knowledge, this is the first study to perform such an analysis.

Finally, it should be noted that the analysis of microenterprises statistics for Latin America (and developing countries) is limited by their intense structural heterogeneity and the limited reliability of national statistics on MSMEs. Although several countries have registration offices and others have developed recent initiatives to create such offices, official data are not collected systematically or in a comprehensive manner (the informality of microenterprises and small enterprises in many Latin American countries is a major obstacle to obtaining comprehensive information).

The rest of the paper is organized as follows: section 2 argues the need to develop more indicators specific for micro- and SMES in Latin America; section 3 presents the

methodology that we follow to perform the systematic analysis; section 4 presents the results, describing our selected articles organized by business service evaluated; section 5 discusses overall results, and section 6 concludes and includes practical implications.

2. Indicators for MSMEs in Latin America

While there are very useful global indicators to measure the competitiveness of the business system in middle-income countries, such as the World Bank's Doing Business system or the World Economic Forum's Global Competitiveness Index, none of these indicators are focused on the specifics of MSMEs. This absence of indicators is one of the main obstacles for the promotion of MSMEs in Latin America. In particular, while several organizations such as ECLAC and the Inter-American Development Bank have generated indicators to measure the competitiveness of Latin American companies, and some of these may be useful for some small and medium-sized enterprises, these indicators are not designed specifically for SMEs, and much less so for microenterprises. Relatedly, Lara et al. (2017) gather some evidence from recent studies in various Latin American countries to determine and explain the features that affect a country's competitiveness from the perspective of SMEs. However, they also conclude that there are few studies considering the specificities of microenterprises.

The proposal best adapted to MSMEs in Latin America so far is the Public Policy Index for SMEs in Latin America and the Caribbean (IPPALC) by SELA (the Spanish acronym for the Latin American and Caribbean Economic System). This index aims to assess the performance of MSMEs in Latin America and the Caribbean, in a context of scarcity of information not allowing for the diagnosis and measurement of the obstacles faced by MSMEs. In particular, there is hardly any data on issues such as access to financing, the incorporation of new technologies and the promotion of innovative

production processes, the insertion of SMEs into international markets, or the nature of the simplification of administrative procedures for the operation of companies.

The IPPALC is in fact an adaptation of the Public Policy Index created by the OECD. The OECD indicator aims to optimise the promotion of MSMEs in Latin America through the evaluation of key thematic areas of operation. The design and application of the OECD Public Policy Index are based on the 10 principles of the Small Business Act for Europe but has been adapted for use in several regions of the world. Since its first application in 2007, the OECD Index has been used in 32 economies and four regions around the world, including the Western Balkans, Association of Southeast Asian Nations (ASEAN) countries, North Africa, and the Middle East. The OECD, CAF—the Latin American Development Bank—and SELA adapted their index to Latin America for the first time in 2016-2019, analysing the member countries of the Pacific Alliance (Chile, Colombia, Mexico, and Peru) plus Argentina, Ecuador, and Uruguay.

The IPPALC indicator includes 9 dimensions, 25 subdimensions and 120 indicators that address the areas of the greatest importance for SME performance. The nine dimensions provide a very advanced idea of the problems faced by MSMEs in Latin America (the institutional and regulatory framework, access to financing, simplification of procedures, business education, training and capacity building, innovation and technology transfer, business development services, associativity and productive coordination, and internationalization).

Overall, IPPALC initiative specifically addresses the lack of data and indicators for MSMEs while facing the enormous complexity of collecting data on 120 indicators. Undoubtedly, an effort to refine indicators is necessary to provide an index applicable to the whole region that is simpler to build and is more compact and consistent.

3. Method

3.1. Protocol and Eligibility Criteria

We conducted a systematic literature review considering the PRISMA guidelines of Moher et al. (2009). The original articles had to evaluate the impact of business support services on microenterprise performance in low- and middle-income Latin American countries. While some authors encourage to search for all available literature including books, conference and working papers and grey literature when doing literature reviews (Briner & Denyer 2012), other authors, in particular for entrepreneurship literature reviews, encourage to use journal articles only via online databases because it gives transparency to the process and allows it to be applied globally (Kraus et al. 2020). Articles in peer-reviewed journals are scrutinized through the academic process (see Kraus et al. 2020 for a complete discussion on the advantage of including peer-reviewed articles only in systematic reviews and an overview of other systematic reviews using the same strategy). In line with this reasoning, we include only peer-reviewed journal articles in this study because they are considered validated knowledge (Podsakoff et al. 2005). Due to variability in their peer review process and their limited availability, we exclude books, chapters, and conference papers (Jones et al. 2011). Table 1 presents our specific inclusion and exclusion criteria.

Most countries define MSMEs in terms of not only the number of employees but also other variables, particularly annual sales, and net assets. While the other variables help define subsidies and access to fiscal benefits, the number of workers is the variable that best defines microenterprises. In general, Latin America understands microenterprises to be those with between one and ten employees, but there is still some heterogeneity in this criterion. For this reason, we select papers that study enterprises with

up to ten employees or, if that fails, papers that use the term 'microenterprise/entrepreneur' to refer to their sample subjects.

Table 1
Definition of Inclusion and Exclusion Criteria Used in the Literature Review

Criteria	Inclusion Criteria	Exclusion Criteria
(1) Population	Microenterprises in low- and middle-income Latin American countries	Other than microenterprises, other than low- and middle- income Latin American countries
(2) Period	From 2000 until now	Earlier publication date
(3) Business support service	Institutional changes to foster formalization; training and technical assistance; microenterprise financing	Not analysing business support services
(4) Study design	Quantitative studies evaluating the impact of business services, preferably randomised controlled trials, quasi-experiments and group comparison without before data.	Nonquantitative analysis
(5) Outcomes	Different measures of firm financial performance, longevity, employment, entry into entrepreneurship investment and formalization	Not analysing, at least, one final outcome of the business service, and if small and medium-sized enterprises are integrated, then not analysing disaggregated outcomes for microenterprises
(6) Publication type	Journal articles	Other than journal articles
(7) Language	English, Spanish, French and Portuguese with an English abstract	Other languages

Source. Own elaboration

3.2. Information Sources

Two authors from the research team separately checked three electronic bibliographic databases: Web of Science, EconLit and Scopus. The selection of these databases was due to their wider coverage of economic and management journals and following previous literature in the field of entrepreneurship (Bramer et al., 2017; Kraus et al., 2020). To review the latest scientific evidence, the research was restricted to the period January 1st, 2000, through January 31st, 2020. The search was performed in January 2020.

3.3. Search Strategy

Table 2 lists the types of microenterprise business services analysed and their related search terms (please find the complete search string in Appendix I). The search strategy was first developed and tested using Web of Science and then adapted and refined for EconLit and Scopus.

Table 2
Types of Microenterprises Business Support Services and Related Search Terms

Types of microenterprises business support services	Related search terms
Microenterprise Financing	Microenterprises and (finance, credit, lending, business support)
Training and technical assistance	Microenterprises and (training, technical assistance) (entrepreneurship, entrepreneurial initiative, skills, abilities, development center)
Institutional changes to foster formalization	Microenterprises and (formalization, business environment, institutions, property registration, regulatory frameworks)

Source: Own elaboration

3.4. Selected Research Papers

To select studies, we followed four steps: 1) we searched the electronic databases, integrating the results of the search strategy and eliminating duplicates; 2) we examined the titles and abstracts of the articles, implementing the criteria for inclusion and exclusion; and 3) if a doubt arose, we read the whole article to decide whether the article met the research criteria.

3.5. Information Analysis

The main characteristics of the selected studies and the results were summarised in a data extraction sheet that included the author names, year of publication, country of study, whether the abstract was in English, the main topic and the summary, methods and aims. Two authors from the research team separately examined the search results

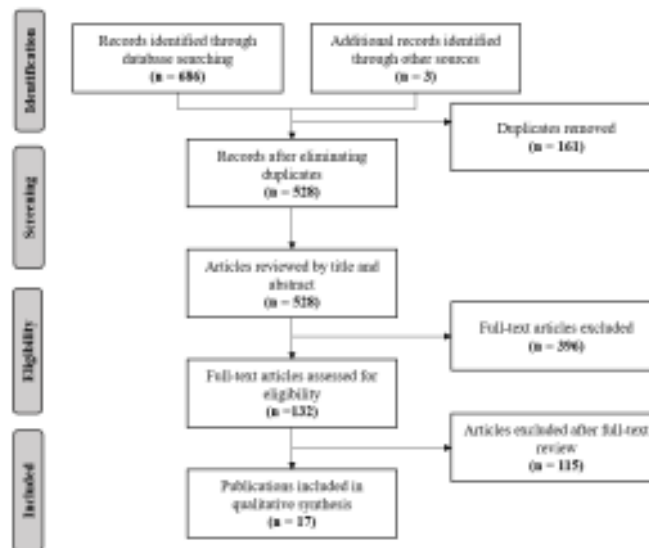
according to the inclusion and exclusion criteria. Any questions or disagreements were resolved through consultation with the third member of the team.

4. Results

4.1. Study Selection

The search strategy produced 686 potentially relevant studies, and three additional references were identified through other sources. After eliminating duplicates, 528 articles remained and were examined by title and abstract. A total of 396 articles were excluded because they did not meet the inclusion criteria, and the remaining 132 articles were full-text assessed. After the full-text review, we removed 115 articles according to our exclusion criteria. Finally, we selected seventeen studies. Figure 1 shows the scoping review process.

Figure 1
Flow Diagram of Articles Included and Excluded in the Literature Review



Source: own elaboration.

4.2. Description of Selected Articles

Table 3 summarises the main characteristics of the seventeen articles selected (Table A1 in the appendix provides the detailed characteristics and main results of the articles). Figure 2 shows the geographical distribution of the identified studies. The majority of articles were conducted in México (6), followed by Brazil (3) and Peru (3). The remaining five articles focused on Chile (2), Nicaragua (1), Honduras (1), and Costa Rica (1).

The evaluation of microenterprise business support services has received increasing attention since 2007 (see Figure 3); prior to that year, there was only one related study, that of Dunn and Arbuckle (2001). Most studies were published between 2007 and 2013 (12), and the remaining studies (4) were published from 2017 onwards.

Table 3
Main Characteristics of the Selected Studies

Authors	Country	Business Support Service	Study Design	Evaluated Outcome
Dunn and Arbuckle (2001)	Peru	Financing	Quasi-experimental	Revenues, fixed assets, employment and transactions
Vander Weele and Vander Weele (2007)	Honduras	Financing	Quasi-experimental	Revenue, value added, adjusted net income productivity and employment creation.
Cotler, Pablo; Woodruff, Christopher	Mexico	Financing	Quasi-experimental	Profits reported, Gross Sales, Investment in Inventories and Fixed Assets.
Ledesma, David; Mungaray, Alejandro; Ocegueda, Juan Manuel	México	Training technical assistance	and Before-and-after study without control group	Income
Tedeschi, Gwendolyn Alexander	Peru	Financing	Quasi-experimental	Weekly and Monthly profits
Fajnzylber et al (2009)	Mexico	Training technical assistance	and Quasi-experimental	Profits, firm growth and survival.
McPherson, Michael A.; Molina, David J.; Jewell, R. Todd	Mexico	Financing	Simple comparison between groups	Employment Growth since the microenterprise began operating
Pisani and Yoskowitz	Nicaragua	Financing	Simple comparison between groups	Weekly income
Fajnzylber et al (2011)	Brazil	Institutional changes to foster formalization	Quasi-experimental	Formality, and its influence on income, profits and employment
Karlan and Valdivia (2011) OK	Peru	Training technical assistance	and Randomised controlled trial	Business results (sales, employment, profits) business skills and practices (tax formality, keeping record of sales...)
Monteiro, J.C.M., and Assunção, J. J.	Brazil	Institutional changes to foster formalization	Quasi-experimental	Formal licensing
Bianchi, Milo; Bobba, Matteo	Mexico	Financing	Randomised controlled trial	Entry into entrepreneurship
Fuentes and Dresdner	Chile	Financing	Before-and-after study without control group	Probability of closure
Canozzi et al.	Brazil	Institutional changes to foster formalization	Quasi-experimental	Survival rate
Ramírez Angulo, Natanael; Mungaray Lagarda, Alejandro; Aguilar Barceló, José Gabriel; Flores Anaya, Yadir Zulith	Mexico	Training technical assistance, Financing	and Before-and-after study without control group	Social net present value and percentage of microenterprises increasing economic returns after the intervention.
Martínez et al.	Chile	Entrepreneurial education	Randomised controlled trial	Business practices, employment and labour income
Sanchez-Retana, C.	Costa Rica	Financing	Quasi-experimental	Profits

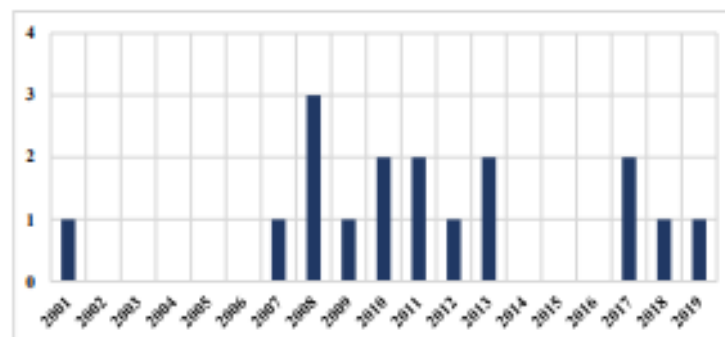
Source: Own elaboration

Figure 2
Geographical Distribution of the Selected Studies



Source: Own elaboration

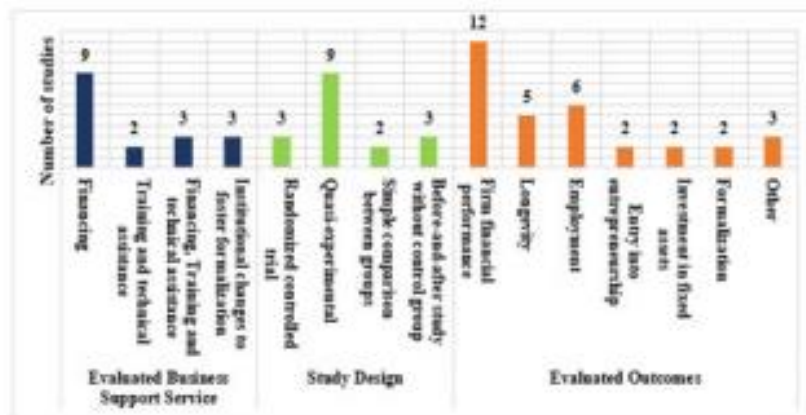
Figure 3
Temporal Distribution of the Selected Studies



Source: Own elaboration

Figure 4 summarises the characteristics of the selected studies according to the business support services evaluated, the study design and the firm outcomes evaluated. Among the seventeen selected studies, nine analysed the impact of microenterprise financing (alone), two evaluated the impact of the combination of training and technical assistance, and three evaluated the impact of both types of interventions simultaneously. There were also three other studies that evaluated the impact of institutional changes to foster formalization. Overall, the outcome most frequently analysed by evaluation studies was the financial performance of microenterprises (12).

Figure 4
Characteristics of Selected Articles



Source: Own elaboration

With respect to the study design, three studies were randomised controlled trials (RCTs; consist of prospective studies with a random allocation of observations to intervention and comparison groups that include before-and-after data for both groups) that, while having some limitations (see for instance Deaton & Cartwright, 2018 for a discussion), are helpful to obtain unbiased estimates and hence are appropriate for impact evaluations; nine were quasi-experimental (comparing groups with and without the

Servicio posventa y capacidad de repuesta como factores de satisfacción del cliente de productos tecnológicos

Post-sale service and answer capacity as satisfaction factors of technology products' clients

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Palabras

claves:

capacidad de
respuesta,
gestión de
recursos,
satisfacción del
usuario,
tecnología,
Ecuador.

Resumen

Introducción. La presente investigación nace frente a la necesidad de incrementar la satisfacción del cliente del servicio de mantenimiento de productos tecnológicos en la ciudad de Cuenca.

Objetivo. Determinar los factores que impactan en la percepción de los consumidores del servicio de mantenimiento de productos tecnológicos, en la ciudad de Cuenca, Ecuador. **Metodología.** El estudio es de tipo cuantitativo, exploratorio, descriptivo y correlacional. Se parte de una población finita de 2793 clientes de productos tecnológicos. Se estudia a 114 sujetos de investigación mediante un instrumento validado por juicio de expertos y con un Alpha de Cronbach de 0.856. La investigación es no probabilística e intencional. **Resultados.** Se estudia 2 factores externos de incidencia: servicio de posventa y capacidad de respuesta. Se evidencia que el servicio de postventa y la capacidad de respuesta están fuertemente correlacionadas con la satisfacción del cliente. **Conclusión.** Se concluye que las empresas que prestan el servicio de mantenimiento en productos tecnológicos tienen que aplicar estrategias de fidelización utilizando las variables correlacionales que están asociadas significativamente en la satisfacción del cliente como estrategia de mejora continua.

Keywords:

Answer
capacity,
management of
resources,
users'
satisfaction,
technology,
Ecuador

Abstract

Introduction. This research is the result of the need to increase customers' satisfaction related to the maintenance of technology products in Cuenca. **Objective.** Determine the factors that impact the perception of clients of the maintenance service of technological products, in the city of Cuenca, Ecuador. **Methodology.** This research is a quantitative, explorational, descriptive, and correlational type. To achieve it, a group of 2,793 clients was used, from which, 114 customers were the target of the study by using a 0.856 Alpha de Cronbach index and the validation of a group of experts. This research is not probabilistic or intentional. **Results.** Two external factors of incidence are studied: post-sale service and

answer capacity. It was observed. These two factors are strongly related to customers' satisfaction. **Conclusion.** Eventually, companies that give technology products maintenance services will have to apply fidelity strategies using correlational variables significantly associated with customer satisfaction as a strategy to improve and grow.

Introducción

El COVID-19 afectó a todo el mundo en su economía y su repercusión continúa desarrollándose a medida que va extinguiéndose. Si bien las consecuencias de la crisis amplifican los riesgos que ya existían y crean otros nuevos, también permite nuevas oportunidades como el incremento del uso de la tecnología.

El teletrabajo por ejemplo es una tendencia fruto de la pandemia. En España en el año 2019 el porcentaje de personas que realizaban actividades de teletrabajo fue apenas del 4.8%, para el año 2020 el porcentaje creció hasta el 34% según datos publicados en la revista Tech Magazine el año 2020.

Según la Consultora *International Data Corporation* (IDC, 2021), en el 2020 se comercializó cerca de 302.6 millones de computadoras de diferentes marcas en todo el mundo comparado con el año 2019 el incremento fue del 13.04%.

En América Latina en el contexto colombiano de acuerdo con la publicación de la revista *Forbes* (2020), en la edición de agosto consigna que las computadoras portátiles fueron las más vendidas lo que representa un 62% de las ventas a diferencia del 2019.

Según cifras del Servicio Nacional de Aduana (2021), la importación de computadoras en Ecuador creció en un 62.3% en el año 2020. En la ciudad de Cuenca, Ecuador las ventas de tecnología fueron exponenciales. Tal es el caso que, en comparación con el mismo periodo del año 2019 el incremento fue del 200% de acuerdo con el informe interno de ventas de la empresa Office Soluciones (2020), lo que obligó a las empresas ya existentes a ser más competitivas y generar una mejor oferta en el servicio de mantenimiento y postventa, procurando fidelizar al cliente mediante la atención permanente y eficaz de este departamento.

Se puede inferir según estudios realizados por Macías (2017), para las empresas del sector tecnológico el principal problema que experimentan es la insatisfacción del cliente y la falta de seguimiento del departamento de soporte técnico, elementos que influyen en gran manera para que los consumidores decidan irse con la competencia.

En función del problema de investigación y el tema planteado, factores que inciden en la satisfacción de clientes del servicio de mantenimiento de productos tecnológicos y de acuerdo a los estudios realizados por varios años de algunos autores, se centran en dos

dimensiones fundamentales: servicio de postventa y capacidad de respuesta (Mejías et al., 2011; Arancibia et al., 2013; Romero, 2015; Santamaria, 2016; Sánchez, 2016; Becerra, 2020), como variables que inciden en la satisfacción de los clientes.

Bajo las consideraciones antes expuestas, el objetivo del presente trabajo de investigación es determinar los factores que impactan en la percepción de los consumidores del servicio de mantenimiento de productos tecnológicos, en la ciudad de Cuenca, Ecuador, con el propósito de realizar una propuesta enfocada en el mejoramiento de la satisfacción del cliente de este tipo de productos.

Lo que se busca es dar contestación a la pregunta de investigación ¿Qué factores inciden en la satisfacción de clientes del servicio de mantenimiento de productos tecnológicos, en la ciudad de Cuenca, Ecuador? Para ello mediante la investigación aplicada se va a realizar un estudio para tratar de determinar estos factores.

Fundamentación Teórica

Una mirada de las principales teorías de la satisfacción de los clientes

En esta sección se presenta el marco teórico. Se realiza una revisión sistemática de la literatura partiendo de las definiciones de los conceptos de las variables de estudio y las teorías.

Definición del concepto, teorías y estudios aplicados sobre la satisfacción al cliente (T)

La satisfacción de cliente se puede constituir en un estado mental que se expone por medio de algunos tipos de repuestas intelectuales, materiales y emocionales de diversos indoles para la satisfacción de una necesidad o deseo de información. Tiende a ser contractivo y de tipo evaluativo ya que permite la comparación de los objetivos y expectativas del usuario (Hernández, 2011).

Para Kotler & Armstrong (2017), la satisfacción de los clientes está en relación con las expectativas generadas por el funcionamiento del producto o servicio que se ofrece. Cuando un cliente se encuentra satisfecho además de volver a comprar comunican a otros sus buenos hábitos.

Al respecto a Bonyadi et al. (2020), la satisfacción de cliente comprende un conjunto de objetivos que afectan en la percepción del cliente. Se puede indicar que la satisfacción representa un estado consciente, involucra respuestas emocionales y depende del estado de ánimo que los clientes observen ante un determinado bien o servicio ofrecido por una empresa.

Teorías de la satisfacción del cliente

Para fortalecer la línea de estudio de la satisfacción del cliente se recurre a teorías relacionadas tal como propone Kano (1980), desarrolla una teoría en la satisfacción del cliente, consiste en evaluar las propiedades de los productos y servicios y así obtener una vista panorámica sobre aspectos que se pueden mejorar para cumplir con las expectativas de los clientes. Este modelo hace una categorización según el tipo de calidad percibida por los consumidores: calidad esperada, deseada, motivadora, indiferente y rechazo. La teoría de la satisfacción del cliente se fundamenta en la percepción del consumidor sobre bienes y servicios ofertados, con influencia en los resultados empresariales.

Para Brooks (1995), en concordancia con la teoría de la equidad, la satisfacción se origina cuando una explícita parte concibe que los resultados están equánimes al costo, tiempo y esfuerzo. Por otro lado, expone que en la teoría de la atribución causal los resultados se ven en términos de éxito o fracaso. Atribuye la satisfacción a factores internos y externos.

Del mismo modo Carmona (1997), en su estudio bibliográfico fundamenta que la teoría de los dos factores sobre productos o servicios se relaciona con la satisfacción de insatisfacción del cliente.

Estudios aplicados a la satisfacción del cliente en contextos distintos

El estudio realizado por Santamaria (2016), presenta un análisis de la percepción de la calidad del servicio de los concesionarios automotrices en el contexto colombiano. La investigación es en base de un muestreo no probabilístico, utilizando encuestas individuales y complementando con entrevistas a profundidad. Los resultados arrojaron que los clientes prefieren ir directamente a los concesionarios debido al tiempo de espera en el agendamiento de citas, al igual es importante una comunicación efectiva con los clientes mediante información precisa. Se concluye que la competencia no es de precios sino de valor agregado en la calidad del servicio, mejorando los tiempos de respuesta.

Álvarez & Rivera (2019), realizaron una investigación para establecer el vínculo entre la calidad del servicio y la satisfacción de los clientes en la ciudad de Arequipa en el entorno financiero. La investigación es no experimental, correlacional; se tomó una muestra a 339 clientes. Se concluye que la satisfacción de los clientes está estrechamente relacionada con la gestión de la calidad,

Por otro lado, Tóala & Hinojosa (2021), en la ciudad de Guayaquil, presenta un estudio en el contexto hotelero, refiriendo que la competitividad del sector ha aumentado y la industria debe orientar en ofrecer servicios de calidad y cumplimiento de estándares, para ello, utiliza encuestas para medir la satisfacción de los clientes. En donde se dieron resultados como que los huéspedes se encuentran muy satisfechos en cuanto a la visión general del hotel, el componente de menor satisfacción es el servicio de restaurante,

concluyendo que el reto de la administración es grande y tienen que dedicar mayor cuidado para menorar este servicio.

Definición del concepto y estudios aplicados sobre la variable independiente (X)

Para una mayor comprensión en la tabla 1: factores que inciden en la satisfacción de los clientes, se procede a desagregar variables tomadas de investigaciones realizadas, apreciando una correlación en cuanto el número de componentes y una diferencia en cuanto a la terminología utilizada.

Para ello se ha utilizado las siguientes nomenclaturas: I: Infraestructura; T: Tecnología; SC: Servicio al Cliente; P: Precio; SP: Servicio de Posventa; EC: Experiencia del Consumidor; CR: Capacidad de Respuesta; E: Empatía; EX: Expectativas; C: Confianza

Tabla 1

Factores que inciden en la satisfacción de los clientes

Autor/es	AÑO	I	T	SC	P	SP	EC	CR	E	EX	C
Mejías, Agustín y Manrique	2011		x			x	x			x	x
Arancibia, Leguina y Espinoza	2013			x		x		x			
Romero	2015	x	x	x	x	x		x			
Santamaria	2016			x			x				
Sánchez	2016							x	x		
Becerra	2020					x		x	x		x

Nota. Factores que inciden en la satisfacción de los clientes. Adaptado desde la revisión de la literatura.

Como se puede visualizar en la tabla, a lo largo de los años se han presentado componentes que inciden en la satisfacción de los clientes, se tomó en consideración a seis autores, ya que se centran en dos dimensiones fundamentales: servicio de postventa y capacidad de respuesta (Mejías et al., 2011; Arancibia et al., 2013; Romero, 2015; Santamaria, 2016; Sánchez, 2016; Becerra, 2020).

Si bien son varios los factores que inciden en la satisfacción de los clientes, en este trabajo de investigación se va a centrar en dos dimensiones principales: servicio de posventa y capacidad de respuesta;

A continuación, se procede analizar los dos factores fundamentales.

Servicio de posventa

La postventa es un servicio que se da después de la venta y este va desde los mantenimientos en general, venta de repuestos, atención técnica, entre otros; también es una estrategia para fidelizar al cliente ofreciéndoles servicios extras adicionales al producto o servicio obtenido (Kotler, 2005).

Por otro lado, Pérez (2013), señala que la prestación del servicio posventa asegura una compra regular o repetida por parte de los clientes, además resalta que la venta no concluye al finalizar la misma. El servicio postventa puede ser un punto diferenciador con respecto a la competencia, apuntando a que es el último proceso en la espiral de la calidad.

Arenal (2017), expone que, un servicio de posventa consiente a las empresas conocer lo que opinan los clientes; reconocer oportunidades de progreso, hacer un análisis de los productos y procesos y así contar con una mejor retroalimentación.

Estudios aplicados del servicio de posventa en contextos distintos

El estudio realizado por Coloma (2014), propone verificar la correlación entre la venta y posventa con la satisfacción del cliente en la empresa Innova Tecnología y Concepto S.A.C. de la ciudad de Lima. Mediante un muestreo probabilístico – aleatorio simple, con una muestra de 98 clientes y un cuestionario de 22 preguntas, se determinó que existe una estrecha relación entre los servicios que realiza el área de venta y postventa con la satisfacción al cliente.

Por su parte, Silva (2021) en el contexto inmobiliario, realizó una investigación para buscar una estrategia de gestión del servicio de posventa y la fidelización de los clientes en la empresa Remax Platinum de la ciudad de Chiclayo, con una investigación aplicada y no experimental, utilizando métodos mixtos, una encuesta, y 123 entrevistas, se pudo concluir que se debe emplear un plan de fidelización, logrando consentir que el mismo se sienta como parte de la empresa, obteniendo un mayor valor y sobre todo su aceptación.

La definición de servicio de posventa que se adopta para la presente investigación es de Arenal (2017), y que servirá para la medición con el instrumento validado.

Capacidad de Respuesta

Arellano (2000) y Bernavente & Figueroa (2012), definen la capacidad de respuesta, como la habilidad de brindar a los clientes un buen servicio; contando con personal eficiente, capaz de prestar un servicio ágil, reflejando la importancia de mantenerse notificado sobre las principales dificultades para trazar iniciativas de mejora de manera eficaz.

De acuerdo con Mirzoev & Kane (2017), para tener una buena capacidad de respuesta con los clientes, hay que cumplir siete elementos: confidencialidad, una buena elección de los proveedores, independencia, atención acertada, redes de apoyo, calidad, y dignidad.

Estudios aplicados de la capacidad de respuesta en contextos distintos

Campos (2021), en su estudio aplicado, evalúa la relación que existe entre la capacidad de respuesta con el stress del personal de salud, tomando una muestra de 50 profesionales, se obtuvo que para el 44% de los encuestados la capacidad de respuesta fue percibida como alta, para el 36% regular, confirmando que a mayor agilidad en la atención el personal se siente más estresado.

Por otro lado, en el estudio realizado por Álvarez (2022), se establece la relación entre la capacidad de respuesta y la satisfacción de los usuarios de la empresa Prestadora de Servicios y Saneamiento Moyobamba, tomando una muestra de 194 usuarios, se estableció que existe una relación moderada en la satisfacción de los usuarios y la capacidad de respuesta.

La definición de capacidad de respuesta que se adopta para la presente investigación es de Mirzoev & Kane (2017), y que servirá para la medición con el instrumento validado.

Como se muestra en la tabla 2

Tabla 2

Relación estructura del marco teórico

Referencia	X1	X2	Y
Kotler (2005)	X		
Pérez (2013)	X		
Arena (2017)	X		
Arellano (2000) y Bernavente & Figueroa (2012)		x	
Mirzoev & Kane (2017)		x	
Hernández (2011)			x
Kotler & Armstrong (2017)			x
Bonyadi et al. (2020)			x

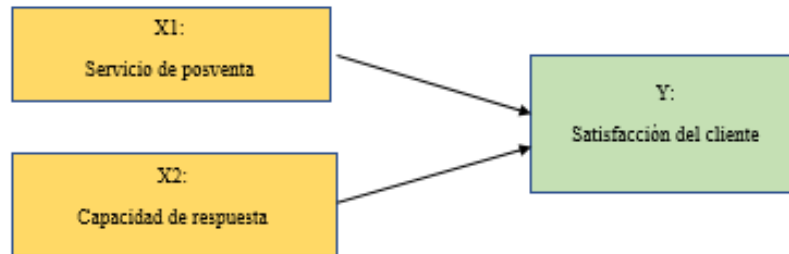
Nota. Adaptado a partir del marco teórico con las variables de investigación independientes (X1, X2) y la variable dependiente (Y)

Modelo gráfico de las variables

Véase figura 1

Figura 1

Modelo de las hipótesis correlacionales



Las hipótesis correlacionales quedan expresadas así:

H1: La variable servicio de postventa está asociada positivamente a la satisfacción del cliente.

H2: La variable capacidad de respuesta está asociada positivamente a la satisfacción del cliente.

$$\text{Satisfacción al cliente} = f(\text{servicio postventa}, \text{capacidad de respuesta}).$$

Metodología

La metodología se fundamentó en el modelo positivista y el método científico. El estudio cuantitativo estableció supuestos y midió los hallazgos desde la investigación de campo (Sáenz & Rodríguez, 2014; Lincoln & Guba, 2000). La investigación examinó las citas teóricas y determinó la causa y efecto. El muestreo aplicado fue no probabilístico e intencional porque la selección de los sujetos de estudio no fue tomados al azar (Bologna, 2018). El muestreo no probabilístico se denomina también conducente y se enfatiza en un proceso no formal de selección de datos (Hernández et al., 2010). El muestreo no probabilístico se lo ejecuta por beneficio radica en elegir intencionadamente el sitio, el objeto y al sujeto de estudio para la indagación (Baca, 2016).

La investigación fue exploratoria, descriptiva y correlacional. Exploratoria porque indaga el fenómeno de investigación en el contexto específico de análisis (Hernández et al., 2010). Descriptiva porque determinó el perfil de los sujetos de estudio (Dankhe, 1989). Correlacional porque midió la correspondencia entre las variables dependientes e independientes (Abreu, 2012). Además, transversal o transeccional porque observó el fenómeno en un solo momento. El estudio es no experimental las variables no se encuentran manipuladas de manera intencional (Briones, 2003; Creswell, 2009).

Se empleó la encuesta para la cosecha de los datos, y como instrumento el cuestionario. Se revisó artículos científicos en base de datos como Scopus, Redalyc, Scielo y Google académico (Arribas, 2004). La organización del instrumento constó de 2 partes: en la primera se midieron las dimensiones por escala de Likert de 5 opciones siendo 1 totalmente en desacuerdo, 2 en desacuerdo, 3 ni de acuerdo ni en desacuerdo, 4 de acuerdo y 5 totalmente de acuerdo. Los ítems o variables observables se obtuvieron de la experiencia del investigador; y, en la segunda se midieron las variables de control para caracterizar el perfil del sujeto de investigación (Mendoza & Garza, 2009; Dillman, 2000).

La herramienta de medición se validó mediante juicio de expertos, para ello se escogió 3 personas y se envió el formulario respectivo, los mismos tuvieron 4 opciones 1 irrelevante, 2 poco relevante, 3 relevante y, 4 muy relevante. Luego se procedió a sacar el promedio respectivo de las valoraciones. Los ítems ascendentes al promedio de 3 permanecieron en el instrumento y las variables observables iguales o menores a 3 se excluyeron con lo que se consiguió el instrumento de cálculo para prueba piloto de 30 variables observables originales a 22 ítems (Ander, 2003).

La investigación partió de una población finita de 2.793. Los sujetos de investigación son los clientes que compran productos tecnológicos en la ciudad de Cuenca. El marco muestral fue la base de datos de clientes de una organización de venta de tecnología. El tamaño de la muestra correspondió al 95% de nivel de confianza y el 5% de error con 2 desviaciones estándar (Rositas, 2014).

$$n = \frac{Npq}{(N-1)\left(\frac{Z^2}{4}\right) + pq}$$

$$n = \frac{698.25}{2.06695127}$$

$$n = 338$$

De donde:

Z= intervalo de confianza del 95% con un valor crítico de Z=1.96

p= probabilidad de éxito del 50%

q= (1-p) probabilidad de fracaso del 50%

N= Población finita

e= error del muestreo aceptable del 5%

n= 338

Fiabilidad del instrumento de medición con prueba piloto

Según la investigación de Mendoza & Garza (2009), la fiabilidad de la escala de la encuesta es el número de veces que un instrumento es aprovechado al mismo sujeto de estudio con resultados semejantes, lo que permite mejorar la encuesta en cuanto al formato, redacción y comprensión de los ítems (Fernández, 2018).

Se emplea el Alpha de Cronbach que consiste en un procedimiento de análisis de fiabilidad orientado a medir la confianza que tienen los ítems (George & Mallery, 2003); por su parte Nunnally (1967), se refiere que en la etapa inicial en estudios aplicados a ciencias sociales es suficiente un coeficiente de fiabilidad de 0.6 o 0.5. El cual mejoró en la medida en que se aplicó la encuesta general.

La prueba piloto que se aplicó a 30 sujetos de investigación, que permitió medir la seguridad del instrumento por el coeficiente de Alpha de Cronbach. De 22 ítems se llegó a considerar 15, con un Alpha de Cronbach, como se aprecia en la tabla 3:

Tabla 3

Confiabilidad del instrumento de medición por alpha de cronbach

Variables independientes	Ítems con validez de contenido	Alpha de Cronbach prueba piloto	Ítems finales	Alpha de Cronbach final
X1 Postventa	8	0.453	4	0.543
X2 Capacidad de respuesta	7	0.777	6	0.821
Variable dependiente				
Y Satisfacción al cliente	7	0.804	5	0.873
Alpha de Cronbach de la escala general	22	0.856	15	

Nota. Fiabilidad del instrumento de medición

Resultados

Caracterización del perfil de los sujetos de investigación

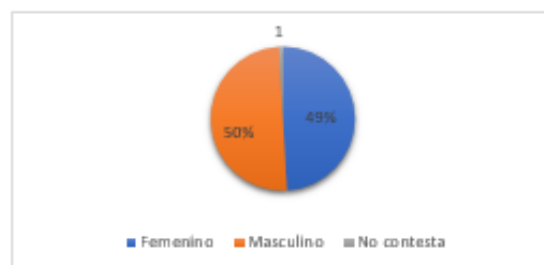
Para obtener información relevante en el estudio es necesario recopilar y analizar los datos obtenidos de las encuestas que se realizaron a las empresas que adquieren productos tecnológicos en la ciudad de Cuenca.

Las figuras expuestas a continuación resumen las principales variables de control del estudio realizado.

En la figura 1 se observa que el 50% de los encuestados pertenecen al género masculino, y el 49% al género femenino, un encuestado no contestó esta pregunta.

Figura 2

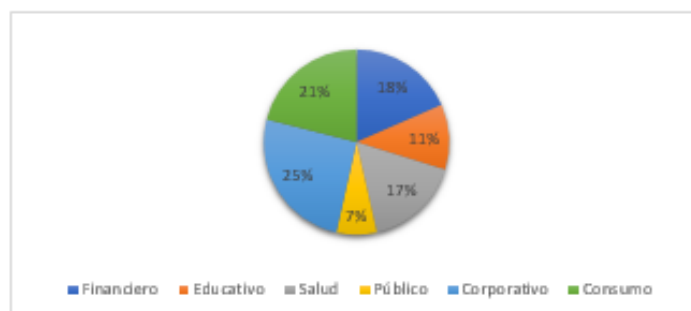
Género



De acuerdo con lo contestado por los encuestados, en la figura 2 muestra que el 25% de las empresas que compran tecnología pertenecen al sector corporativo, el 21% al sector consumo, el 18% al sector financiero, 17% al sector salud, 11% sector educativo y el 7% al sector público.

Figura 3

Sector Comercial al que pertenece la Empresa



En la figura 3 refleja que el 65% de la población encuestada tiene tercer nivel, seguido por el 25% de instrucción de cuarto nivel, un encuestado no contestó la pregunta.

Figura 4

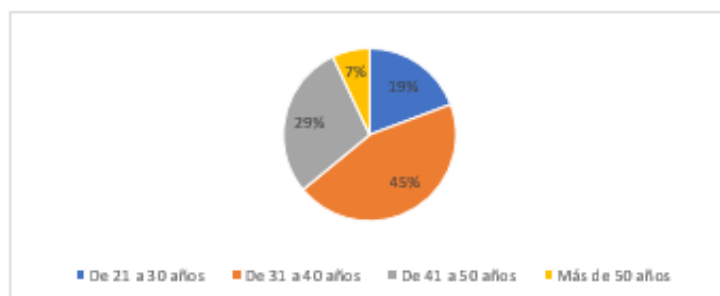
Nivel de Instrucción



En cuanto al rango de edad, el 45% representa a la población encuestada que están entre los 31 a 40 años, seguido por el 29% que representa a los de 41 a 50 años, siendo el 19% en edades comprendidas de 21 a 30 años, y la menor parte representativa es el 7% que pertenece a la población de más de 50 años. Como se muestra en la figura 4

Figura 5

Edad



Correlaciones

La presente investigación presenta los resultados de correlación bilateral de Pearson entre la variable promedio satisfacción del cliente que ha sido estudiada como dependiente y las variables promedio servicio de posventa y capacidad de respuesta. Se aplica la correlación de Pearson dando como resultado 0.282** lo que evidencia una asociación de la variable independiente servicio de posventa con la variable dependiente satisfacción de cliente y es estadísticamente significativa (Sig. Bilateral 0.002 < p-valor de 0.05). De igual manera existe una potente correlación de la variable capacidad de respuesta con la variable dependiente de 0.809** siendo estadísticamente significativa (Sig. Bilateral 0.000 < p-valor de 0.05).

Como se muestra en la tabla 4

Tabla 4

Correlaciones Bivariadas de la Satisfacción de Clientes de Servicio de Mantenimiento en Empresas de Tecnología

		Prom. Satisfacción del cliente	Prom. servicio de posventa	Prom. Capacidad de respuesta
Prom. Satisfacción del cliente	Correlación de Pearson	1	.282**	.809**
	Sig. (bilateral)		.002	.000
	N	114	114	114
Prom. servicio de posventa	Correlación de Pearson	.282**	1	.258**
	Sig. (bilateral)	.002		.006
	N	114	114	114
Prom. Capacidad de respuesta	Correlación de Pearson	.809**	.258**	1
	Sig. (bilateral)	.000	.006	
	N	114	114	114

Nota: Adaptado de las salidas del SPSS (2022)

Análisis correlación

Se muestran los resultados de la investigación con base en las salidas del SPSS, se utilizó el modelo de regresión lineal multivariada y que tienen que ver con las hipótesis correlacionales:

H1: La variable servicio de postventa influye de manera positiva en la satisfacción del cliente cumpliéndose la hipótesis

H2: La variable capacidad de respuesta está asociada positivamente a la satisfacción del cliente cumpliéndose la hipótesis.

Se procedió a aplicar la encuesta con validez de contenido y fiabilidad de Alpha de Cronbach a la población de 114 sujetos de estudio. En consecuencia, se presentó los resultados de investigación, y se procedió a la determinación del coeficiente de confiabilidad con la encuesta general que permitió de 22 ítems reducirlos a 15.

Discusión

En el estudio se evaluó los factores que inciden en la satisfacción de los clientes en las empresas que compran productos tecnológicos, con los resultados de las encuestas realizados a los diferentes clientes externos respecto al servicio de posventa y la capacidad de respuesta brindada por las empresas de tecnología.

Conforme a los resultados emanados se encontró que el servicio de posventa brindada por las empresas de tecnología tienen un servicio accesible y fue evaluada como buena por el 52.63% por parte de los clientes, un punto importante de resaltar es que el 56.14% de las personas encuestadas consideraron que es importante que las empresas de tecnología cuenten con un amplio inventario de repuestos para el arreglo de sus equipos, en cambio, un estudio de Silva (2021), en el contexto peruano el 57% de las empresas opinaron que la atención que les brindaron es alta con un adecuado servicio de posventa.

En el estudio de Coloma (2014), sobre la posventa y su relación con la satisfacción del cliente, es estadísticamente significativo en el contexto Lima-Perú y tiene una correlación positiva de 0.843**, lo que dialoga con la correlación del contexto Cuenca – Ecuador que es de 0.282**. Por lo tanto, el servicio de posventa tiene una relación positiva con la satisfacción de cliente.

En el caso de la capacidad de respuesta, un estudio en el contexto peruano realizado por Álvarez (2022), encuentra que es estadísticamente significativo y tiene una correlación positiva de 0.699** este hallazgo se empatiza con el resultado de la investigación en el contexto Cuenca-Ecuador que tiene una correlación de 0.809**, por lo que evidencia que la capacidad de respuesta tiene una relación fuerte y positiva con la satisfacción de cliente.

En consecuencia, se confirma las hipótesis en el presente trabajo de investigación.

Conclusiones

- De acuerdo a la pregunta de investigación ¿es posible definir qué factores inciden en la satisfacción de clientes de servicio de mantenimiento de productos tecnológicos en la ciudad de Cuenca? y del objetivo de investigación: determinar

los factores que impactan en la percepción de los consumidores del servicio de mantenimiento de productos tecnológicos, en la ciudad de Cuenca, Ecuador, se cumple la incógnita y el diseño con las variables independientes servicio posventa y capacidad de respuesta, pues concurre certeza estadística que sobrelleva las manifestaciones en el contexto de estudio.

- Se determina que la investigación si mueve el marco teórico del fenómeno estudiado, ya que fundamentado con los autores Arenal (2017), Arellano (2000), Benavente & Figueroa (2012). establecieron que el servicio de posventa y la capacidad de respuesta permite identificar oportunidades de mejora, conocer la opinión de los clientes, ofrecerles un buen servicio implicando al personal con disposición de prestar un servicio ágil y eficiente.
- Las variables utilizadas para la investigación son relativamente esenciales, sin embargo, se puede trabajar con un sinnúmero de variables, que mejoren la investigación, para obtener excelentes resultados e identificar habilidades y destrezas que estas empresas pueden aplicar mediante la obtención de información adicional, en un futuro, con la concurrencia de algunas áreas referentes al estudio se podría hacer nuevamente un análisis y obtener derivaciones óptimas con la variable del servicio al cliente.

Conflicto de intereses

Los autores declaran que no tienen conflicto de intereses con relación al manuscrito.

Agradecimiento

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Referencias bibliográficas

- Abreu, J.L. (2012). *La pregunta de investigación: alma del método científico*. Monterrey, México: UANL.
- Álvarez, D. & Rivera, A. (2019). *Calidad de servicio y su relación con la satisfacción de los clientes de Caja Arequipa agencia Corire 2018*. (Tesis licenciatura), Universidad Tecnológica del Perú, Arequipa, Perú
- Álvarez, A. (2022). *Capacidad de respuesta y satisfacción de los usuarios de la Empresa Prestadora de Servicios de Saneamiento Moyobamba*. (tesis maestría, Universidad Cesar Vallejo). https://repositorio.ucv.edu.pe/bitstream/handle/20.500.12692/77806/Alvarez_JA-SD.pdf?sequence=1