International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 12s, 2025
https://www.theaspd.com/ijes.php

Exploring The Impact Of Telecom Models On Customer Experience In The Digital Age

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ABSTRACT
The telecommunications sector is a key pillar of the digital economy, relying on a blend of technical systems, service models, and customer focused strategies to deliver effective and high quality communication. This paper presents a structured review of major models used in telecommunications, including technical frameworks such as OSI, TCP/IP, and Erlang, as well as advancements in network technology from 2G to 5G. It also examines business models like Mobile Virtual Network Operators and Over The Top platforms, along with modern technologies such as Network Function Virtualization and Software Defined Networking.

To connect technology with customer experience, the study introduces the Integrated Telecom Satisfaction and Retention Model (ITSORM), a conceptual framework with three layers. ITSORM links technical infrastructure, service delivery, and customer experience, showing how each layer affects customer satisfaction and loyalty. The model demonstrates that problems in any part of the system can lead to customer loss, while strong alignment across all layers helps retain customers. This approach provides telecom companies with a clear way to review and improve their services, supporting higher customer satisfaction and loyalty by synthesizing established ideas and perspectives from existing literature.

Keywords: *Telecom models, customer satisfaction, churn, NFV, SDN, 5G*

1. INTRODUCTION
The telecommunications industry stands as a foundational pillar of the modern digital economy, enabling instant communication, seamless information exchange, and the integration of societies and markets worldwide. Its evolution traces a remarkable journey from early signaling methods to today's advanced digital networks that underpin global connectivity.

The origins of telecommunications can be traced to the 19th century, beginning with the invention of the electric telegraph and the telephone. Alexander Graham Bell's pioneering work led to the introduction of commercial telephone services in the late 1870s, transforming the telephone from a simple communication tool into a networked system capable of connecting millions of users. The 20th century saw significant milestones, including the development of long-distance telephony, the installation of transatlantic cables, and the rise of global telephone monopolies, all of which laid the groundwork for a unified communications infrastructure.

The advent of the semiconductor era in the 1950s brought about a revolution in telecommunications through the introduction of transistor technology and digital signal processing. This shift from analog to digital networks reduced costs, increased capacity, and broadened access to telecommunications services. The emergence of mobile phones in the 1970s and the rollout of cellular networks in the early 1980s further accelerated the industry's expansion and reach.

Telecommunications has experienced several generational advancements, each introducing transformative capabilities. The first generation (1G) enabled analog wireless voice calls, though with limited quality and coverage. The second generation (2G) marked the transition to digital technology, improving call quality and introducing services such as SMS and MMS.

The third generation (3G) facilitated high-speed internet access and mobile applications, while the fourth generation (4G) enabled seamless video streaming, internet calling, and a surge in data-driven services. The current fifth generation (5G) is characterized by ultra-low latency, massive device connectivity, and serves as a foundation for emerging technologies such as the Internet of Things, autonomous vehicles, and smart cities.

The structure of the telecommunications industry has evolved from regulated monopolies to a more decentralized and competitive environment. The rise of Mobile Virtual Network Operators and Over The Top service providers has intensified competition, encouraging innovation and diversification of services. The adoption of Network Function Virtualization and Software Defined Networking has allowed operators to separate network functions from proprietary hardware, resulting in more agile, cost-effective, and scalable service delivery.

As technology and service options have advanced, customer expectations have also increased. Modern consumers expect not only reliable connectivity but also high-quality service, transparent pricing, and personalized experiences. Operators must balance investments in advanced infrastructure with the delivery of exceptional customer value. Even minor lapses in service can lead to dissatisfaction and increased customer turnover, making satisfaction and retention central to business success.

While significant research has explored network performance and customer behavior, there is a growing need for comprehensive frameworks that connect technical infrastructure, service delivery, and customer experience. Many existing models address these elements separately, often overlooking their complex interactions. To address this gap, this paper reviews key technical and business models in telecommunications and introduces the Integrated Telecom Satisfaction and Retention Model (ITSORM), a layered conceptual framework designed to link operational performance with customer satisfaction and loyalty.

2. LITERATURE REVIEW

The telecommunications sector has undergone rapid technological and business transformation, making customer satisfaction and churn rate two of the most critical metrics for service providers. As competition intensifies and customer expectations evolve, understanding the drivers of satisfaction and the causes of churn has become a central focus in both academic research and industry practice. Conceptual models have been developed to clarify these relationships and to guide strategies for customer retention and service improvement.

Models Used in the Telecom Sector; Early work in telecom focused on standardizing network communication, as seen in the OSI and TCP/IP models, which provide the foundational architecture for interoperability and data transfer (Tanenbaum & Wetherall, 2011). Network performance and capacity planning have been addressed through the Erlang B and Erlang C models, which help operators, predict call blocking and queuing probabilities (Cooper, 1981). The evolution from 2G to 5G networks has not only enhanced data speeds and connectivity but also increased the complexity of customer needs and service expectations (Sauter, 2021).

Business models in telecom have diversified to include infrastructure-based operators, MVNOs, and OTT providers, each presenting unique value propositions and customer engagement strategies (Gerpott, 2010). The adoption of Network Function Virtualization (NFV) and Software-Defined Networking (SDN) has further increased network agility and service customization (Mijumbi et al., 2016).

Conceptual Models of Customer Satisfaction; Customer satisfaction in telecom is recognized as a multi-dimensional construct, influenced by both tangible and intangible factors. Service quality, encompassing network quality, reliability, and customer support, is consistently identified as a primary driver of satisfaction (Aydin & Özer, 2005; Ranaweera & Neely, 2003).

Transparent pricing, accurate billing, and flexible payment options are also essential, as billing errors or unclear charges can quickly erode trust (Kim, Park, & Jeong, 2004).

Value-added services, such as entertainment features, cloud storage, and loyalty programs, have become increasingly important for differentiation and perceived value (Lai et al., 2009). The customer experience is further shaped by ease of use, personalization, and proactive engagement through digital platforms (Lemon & Verhoef, 2016). Corporate image and CSR initiatives contribute to emotional loyalty and positive brand associations (Martínez & del Bosque, 2013). Technical support and effective complaint handling complete the model, ensuring that problems are resolved promptly and customer voices are heard (Homburg & Fürst, 2005).

Customer Satisfaction, Churn, and the Need for Integration; Empirical studies confirm a strong inverse relationship between satisfaction and churn: as satisfaction rises, churn drops (Bolton, 1998; Gustafsson, Johnson, & Roos, 2005). Most models treat satisfaction as a central outcome influenced by service quality, pricing, and experience. When any of these areas fail—such as unclear billing or poor service response—it can lead to dissatisfaction and customer loss (Ahn, Han, & Lee, 2006).

Linking Customer Satisfaction and Churn Rate: A substantial body of research confirms the inverse relationship between customer satisfaction and churn rate: higher satisfaction leads to lower churn, while dissatisfaction in any key area increases the risk of customer defection (Bolton, 1998; Gustafsson, Johnson, & Roos, 2005). Conceptual models typically position satisfaction as a mediating variable between service attributes and retention outcomes. For example, the integrated model presented in this research draws on components such as service quality, pricing, value-added services, customer experience, corporate image, technical support, and feedback handling. These elements collectively shape satisfaction, which in turn influences churn and retention.

3. OBJECTIVES

1. Explore how telecom models (OSI, TCP/IP, NFV, SDN, and 2G–5G) impact customer satisfaction based on existing literature.
2. Explore the conceptual foundation of the ITSORM model for customer retention in the telecom sector.
3. Explore the relationship between customer satisfactions and churn rate in telecom service providers through existing conceptual models.

4. MODELS USED IN THE TELECOM SECTOR

4.1. OSI Model (Open Systems Interconnection Model)

The OSI model provides a seven layer structure for networking, standardizing how different hardware and software systems communicate. Each layer, from the physical connection to the application interface, has a specific function, making it easier to identify and address issues that may affect service quality and ultimately customer satisfaction.

- **Physical Layer:** Manages the physical connection between devices.
- **Data Link Layer:** Handles node-to-node data transfer and error detection.
- **Network Layer:** Manages device addressing and routes data.
- **Transport Layer:** Ensures reliable data transfer with error checking and recovery.
- **Session Layer:** Manages sessions between applications.
- **Presentation Layer:** Translates data formats for interoperability.
- **Application Layer:** Provides network services to end-user applications (e.g., email, file transfer)

Industry experts highlight the OSI model as a roadmap for troubleshooting allowing for rapid identification and resolution of faults without disrupting other parts of the network. This systematic approach minimizes service downtime and enhances reliability which is key drivers of customer satisfaction. Customization of the OSI model for specific environments such as cloud services can further optimize performance and security reducing overhead and improving efficiency for end users. The OSI model's flexibility and clear separation of duties across layers make it easier to implement tailored solutions ensuring high quality service delivery.

4.2 TCP/IP Model (Transmission Control Protocol/Internet Protocol)

The TCP/IP model while more streamlined and practical for real world network operations also contributes significantly to customer satisfaction. It's layered approach though fewer layers than OSI supports robust reliable communication across diverse platforms and devices.

The TCP/IP model's widespread adoption ensures interoperability which is crucial for seamless connectivity a major expectation of telecom customers.

TCP/IP's error correction and retransmission mechanisms provide reliability but can introduce overhead potentially affecting performance during peak times. Nonetheless the model's efficiency in managing network traffic and ensuring data integrity underpins the dependable service that customers demand. The strong focus on embedded security protocols within TCP/IP further protects user data and maintains trust.

4.3 Erlang Model

The Erlang Model is like a calculator for telecom traffic, helping companies make sure there are enough lines or resources for their customers, without having too many unused ones.

- **The Erlang B model** is used in telecommunications to estimate the probability that a call will be blocked when all available lines or channels are busy, and there is no waiting or queuing for calls. This model is commonly used in systems like traditional telephone exchanges, where if a call cannot be connected immediately, it is simply lost. The formula for the Erlang B model
- $$E_B = \frac{\frac{A^N}{N!}}{\sum_{k=0}^{N} \frac{A^k}{k!}}$$

Where:

- E_B = probability of call blocking
- A = total traffic offered (in Erlangs)
- N = number of available channels

- **The Erlang C model** is used when calls can wait in a queue if all lines are busy, such as in a call center. It calculates the probability that a call will have to wait before being served. This model helps organizations plan how many agents or lines are needed to keep waiting times low. The formula for the Erlang C model
- $$E_C = \frac{\frac{A^N}{N!} \cdot \frac{N}{N-A}}{\sum_{k=0}^{N-1} \frac{A^k}{k!} + \frac{A^N}{N!} \cdot \frac{N}{N-A}}$$

Where:

- E_C = probability that a call waits
- A = total traffic offered (in Erlangs)
- N = number of servers or agents

4.4 Mobile Network Models (2G–5G)

The evolution of mobile networks is marked by generational advances:

- **2G:** Digital signal transmission, SMS, MMS.
- **3G:** Higher data rates, mobile internet, multimedia services.
- **4G:** High-speed IP-based communication, VoIP.
- **5G:** Ultra-high-speed, low latency, massive IoT support, enhanced broadband, and ultra-reliable low latency communication.

4.5 Telecom Business Model

Telecom operators employ various business models.

- **Infrastructure-Based Model:** Operators own and maintain network infrastructure, generating revenue through subscriptions.
- **MVNO (Mobile Virtual Network Operator):** Operators lease infrastructure, targeting niche markets.
- **OTT (Over-The-Top) Services:** Deliver content over the internet, bypassing traditional networks (e.g., Skype, WhatsApp)

4.6 Network Function Virtualization (NFV)

NFV transforms traditional telecom infrastructure by virtualizing network services, allowing them to run on standard hardware. This flexibility enables telecom providers to rapidly introduce new services, scale resources on demand, and reduce operational costs. The ability to quickly adapt to changing customer needs and market trends means users benefit from timely, innovative services and fewer disruptions.

NFV also supports more efficient resource allocation, helping operators maintain high service quality even during fluctuating demand. These improvements in agility, scalability, and cost-effectiveness translate to a more satisfying customer experience, with faster issue resolution and enhanced service reliability.

4.7 Software Defined Networking (SDN)

SDN decouples the network control plane from the data forwarding plane, introducing centralized, programmable management. This architecture allows providers to respond swiftly to network issues and customer requests. Literature and industry surveys indicate that SDN deployments are associated with high customer satisfaction rates, particularly due to improved agility, efficiency, and responsiveness in network management.

Centralized control enables operators to automate troubleshooting, optimize traffic flows, and deploy customized solutions, all of which reduce service interruptions and enhance user experience. SDN's programmability also allows for rapid innovation, supporting new services that align with evolving customer expectations.

Telecom Model Insights

Together, these models form the technical and operational backbone of the telecom sector. OSI and TCP/IP provide the logical structure for communication, Erlang ensures efficient resource management, 2G to 5G generations drive service evolution, business models shape market offerings, and NFV and SDN deliver the flexibility and scalability required in today's dynamic environment. Their combined implementation enables telecom operators to deliver high performance, reliable, and innovative services that meet and exceed customer expectations.

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5. CONCEPTUAL FRAMEWORK (ITSORM) - INTEGRATED TELECOM SATISFACTION AND RETENTION MODEL

The ITSORM framework synthesizes these models into three interconnected layers to explain their collective impact on customer satisfaction and retention.

Layer 1: Technical Models: It includes the technical models like OSI, TCP/IP, and newer technologies like NFV and SDN. These help telecom companies build strong, fast, and reliable networks that can handle large amounts of data and many users.

Layer 2: Service Delivery: This includes how services are actually provided to customers, such as business approaches like MVNO, OTT platforms (e.g., WhatsApp, Netflix), 2G to 5G mobile networks, Erlang and network speed. This layer connects the technical side with what customers experience directly.

Layer 3: Customer Experience: This part focuses on how customers feel about the service. Important factors include call clarity, fair pricing, helpful technical support, extra features like entertainment or cloud storage, and how well the company listens to complaints or feedback.

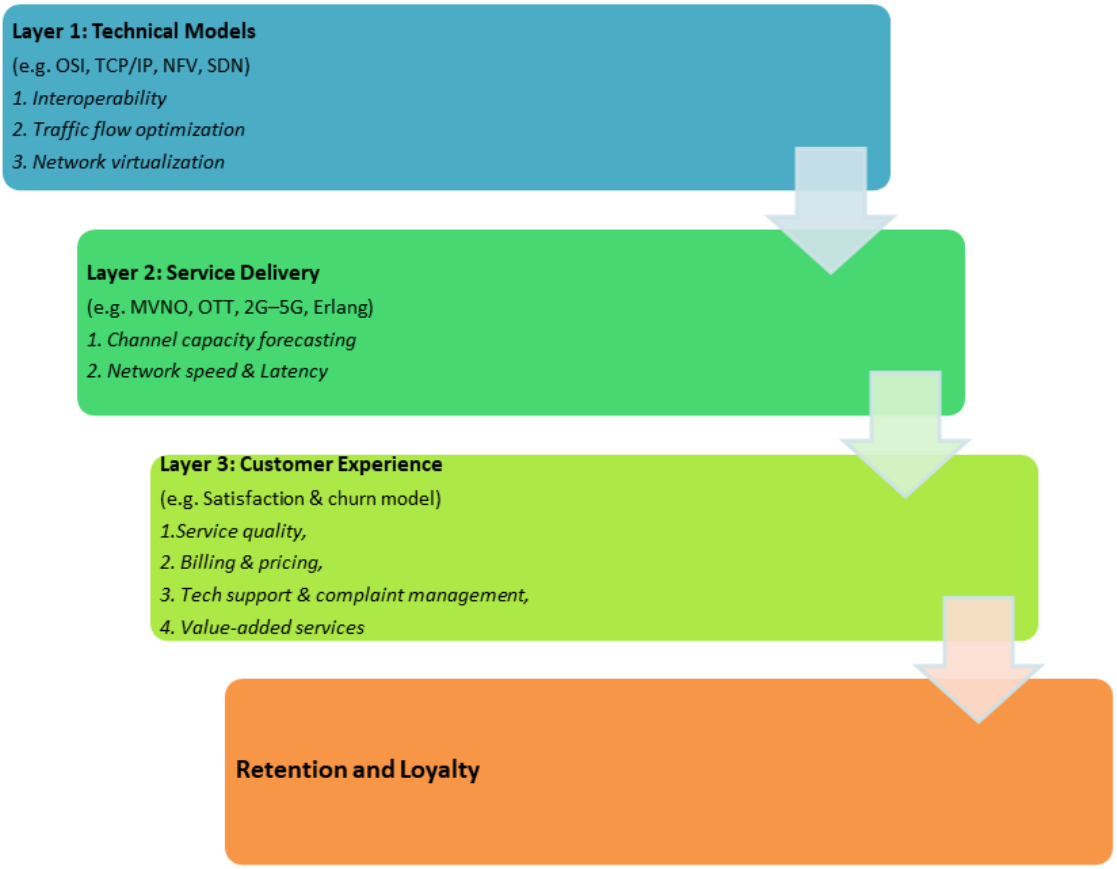

Figure 1. Integrated Telecom Satisfaction and Retention Model (ITSORM)

5.1 How the model works:

All three layers are connected. If one layer fails like weak network quality or poor customer support it can lead to customer dissatisfaction and churn. But when all layers perform well together, it leads to higher satisfaction and stronger customer loyalty.

This model helps telecom companies see where improvements are needed and shows that both good technology and quality service are essential for keeping customers happy and loyal.

6. CONCEPTUAL MODEL IN TELECOM SERVICE PROVIDERS

6.1 Conceptual Model to Understand Customer Satisfaction in Telecom

Customer satisfaction in the telecom industry is a multifaceted concept influenced by various factors. To understand and measure customer satisfaction effectively, a conceptual model can be developed. This model considers different dimensions that contribute to overall satisfaction and can help telecom companies improve their services and customer relationships.

The Customer Satisfaction Model in telecom focuses on all the main factors that make customers happy with their service provider. These factors include:

i. **Service Quality:** This covers the clarity of calls, speed of data, network coverage, and how reliable the service is Good customer support, which is quick and helpful, is also a part of service quality.

ii. **Pricing and Billing:** Customers want clear, fair pricing and accurate bills. Flexible payment options also add to their convenience.

iii. **Value-Added Services:** Extra features like entertainment, cloud storage, and special offers make the service feel more valuable.

iv. **Customer Experience:** Easy-to-use apps and websites, personalized plans, and engaging communication help customers feel connected and understood.

v. **Corporate Image:** A strong brand and positive company reputation, including social responsibility efforts, make customers feel proud to use the service.

vi. **Technical Support:** Skilled staff and 24/7 support channels ensure customers can get help whenever they need it.

vii. **Feedback and Complaint:** Handling: Easy ways to give feedback and fast, fair complaint resolution show customers that their opinions matter.

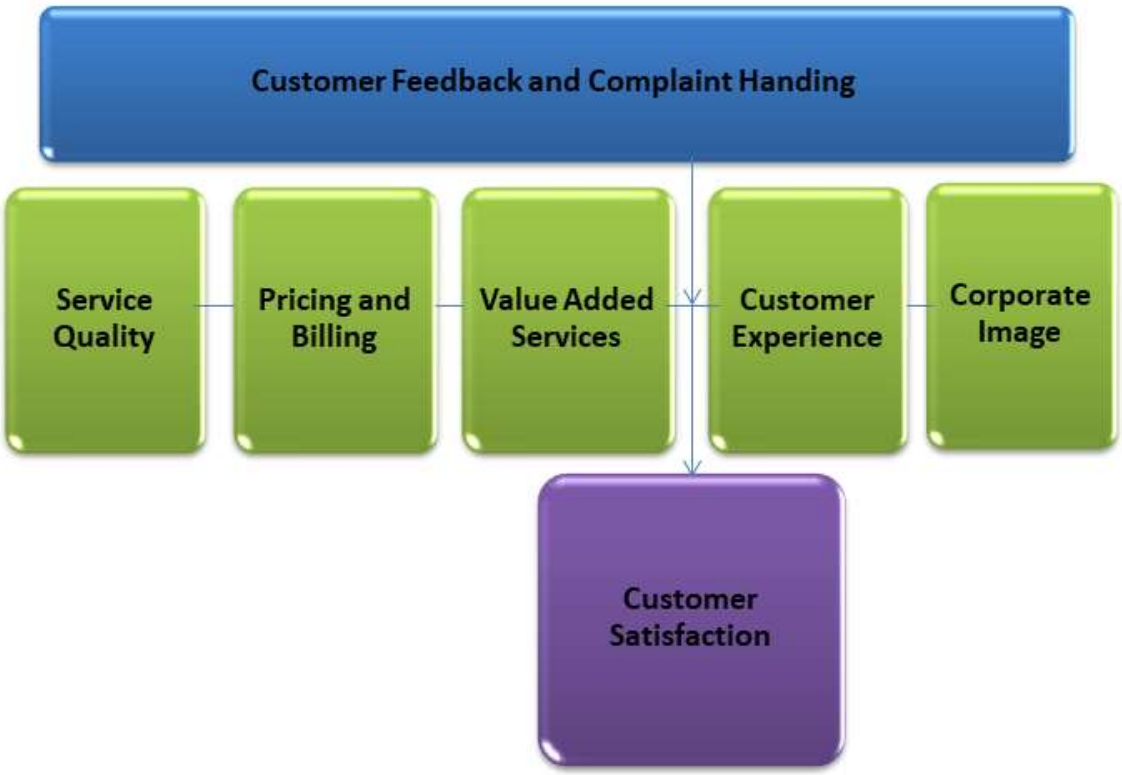

Figure 2. Conceptual Model Diagram for Customer Satisfaction in Telecom

6.1.1 Relationships between Telecom Service Factors and Customer Satisfaction

Understanding what drives customer satisfaction in the telecom sector is crucial for building loyalty and reducing churn. Below is a redesigned and well-structured explanation of how various service dimensions relate to customer satisfaction.

1. Service Quality and Customer Satisfaction

Relationship:
High network quality, reliable connectivity, and effective customer support are foundational to customer satisfaction.

Explanation:

- **Reliable Service:** Consistent call clarity, minimal dropped calls, and fast data speeds ensure users' needs are met.
- **Customer Support:** Quick, helpful responses to issues or queries build trust and satisfaction.

Impact: When service is dependable and support is responsive, customers feel valued and are more likely to remain loyal.

2. Pricing and Billing and Customer Satisfaction

Relationship:
Transparent, competitive pricing and accurate billing practices enhance customer trust and satisfaction.

Explanation:

- **Transparency:** Clear, upfront pricing with no hidden charges prevents frustration.

Impact: Customers who feel they are charged fairly and accurately are more likely to be satisfied and recommend the service.

Accuracy: Correct, timely bills reduce confusion and disputes.

3. Value-Added Services and Customer Satisfaction

Relationship:
Offering additional features, exclusive content, and attractive promotions boosts perceived value and satisfaction.

Explanation:

- **Extra Features:** Services such as entertainment bundles, cloud storage, or loyalty rewards make the offering more attractive.
- **Promotions:** Special deals or discounts create a sense of getting more for their money.

Impact: Customers appreciate added value, increasing their overall satisfaction and engagement.

4. Customer Experience and Customer Satisfaction

Relationship:
A seamless, personalized, and engaging customer experience leads to higher satisfaction levels.

Explanation:

- **Personalization:** Tailored plans and communications make customers feel understood.
- **Ease of Use:** User-friendly apps, websites, and self-service options simplify interactions.

Impact: A positive, hassle-free experience keeps customers happy and reduces the likelihood of switching providers.

5. Corporate Image and Customer Satisfaction

Relationship:
A strong brand reputation and active corporate social responsibility (CSR) efforts positively influence customer perception and satisfaction.

Explanation:

- **Brand Trust:** Well-known, respected brands are perceived as more reliable.
- **CSR Initiatives:** Community involvement and ethical practices foster goodwill.

Impact: Customers are proud to associate with brands that have a positive image, enhancing loyalty.

6. Customer Feedback & Complaint Handling and Customer Satisfaction

Relationship:
Effective feedback mechanisms and swift resolution of complaints lead to improved satisfaction and loyalty.

Explanation:

- Feedback Channels: Easy ways to provide feedback show the company values customer opinions.
- Complaint Resolution: Fast, fair handling of issues demonstrates commitment to customer care.

Impact: Customers who feel heard and see their issues resolved are more likely to remain satisfied and loyal.

6.2 Conceptual Model to Relate Churn Rate and Customer Satisfaction in Telecom Service Providers

In the telecom industry, customer satisfaction and churn rate are closely linked. Churn rate refers to the percentage of customers who leave a service provider over a certain period. The same factors that increase customer satisfaction such as good service quality, fair pricing, and strong customer support also help reduce churn. By understanding and improving these factors, telecom companies can keep more customers and build long-term loyalty.

The Churn Rate and Customer Satisfaction Model in telecom focus on all the main factors include:

i. Service Quality

ii. Pricing and Billing

iii. Value-Added Services

iv. Customer Experience

v. Corporate Image

vi. Technical Support

vii. Customer Feedback & Complaint Handling

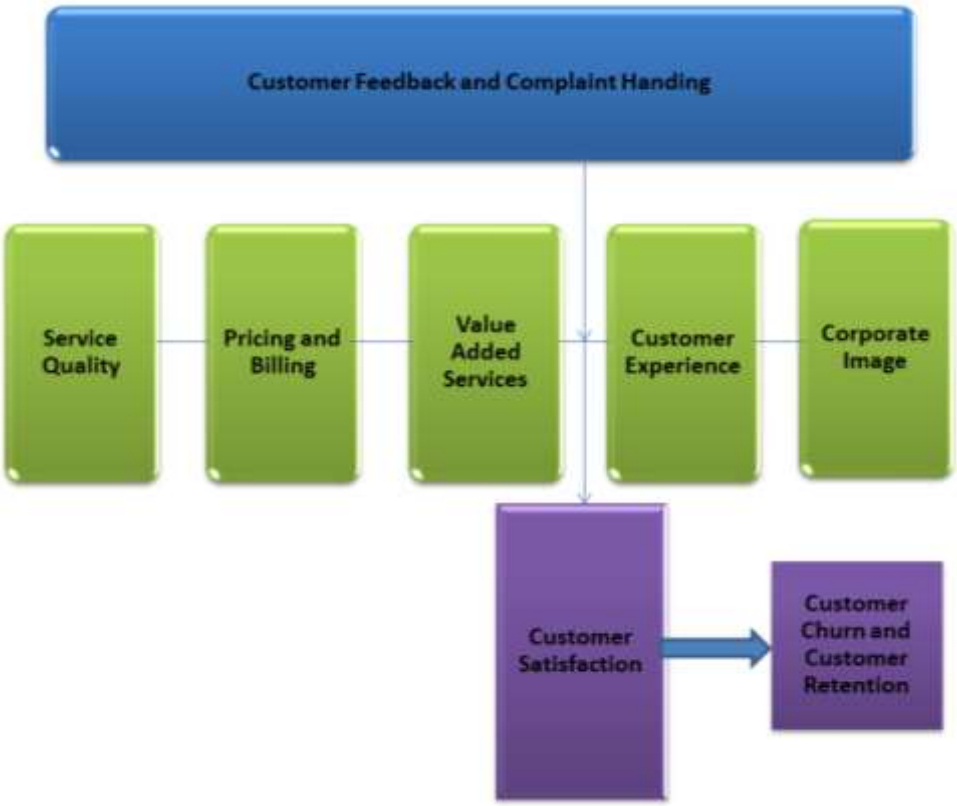

Figure 3. Conceptual Model Diagram for Customer Satisfaction and Churn Rate

6.2.1 Relationships between Service Factors, Customer Satisfaction, and Churn Rate

Understanding how various service dimensions impact both customer satisfaction and churn rate is critical for telecom operators aiming to build loyalty and minimize customer loss. Here's a clear, structured redesign of these relationships:

1. Service Quality: The Foundation of Satisfaction and Retention

Positive Impact:
High service quality characterized by reliable connectivity, clear calls, fast data, and responsive support directly increases customer satisfaction and significantly reduces churn rates.

Negative Impact:
Poor service quality leads to frustration, dissatisfaction, and a higher likelihood that customers will switch to competitors.

2. Pricing and Billing: Building Trust and Loyalty

Positive Impact:
Transparent, competitive pricing and accurate, easy to understand billing foster trust, enhance satisfaction, and lower churn.

Negative Impact:
Inaccurate billing, hidden fees, or confusing pricing structures cause dissatisfaction and drive customers away.

3. Value Added Services: Enhancing Perceived Value

Positive Impact:
Offering additional features such as entertainment bundles, cloud storage, or exclusive promotions boosts perceived value, increases satisfaction, and discourages churn.

Negative Impact:
Lack of compelling value added services can make the offering feel basic or outdated, leading to higher churn.

4. Customer Experience: The Key to Emotional Connection

Positive Impact:
A seamless, intuitive, and personalized customer experience across digital and physical touch points results in higher satisfaction and stronger retention.

Negative Impact:
Complicated processes, impersonal service, or frustrating interactions lead to dissatisfaction and increased churn.

5. Corporate Image: Reputation Matters

Positive Impact:
A strong, positive brand image and visible commitment to corporate social responsibility enhance customer pride, satisfaction, and loyalty, reducing churn.

Negative Impact:
Negative publicity or a weak corporate image erodes trust, leading to dissatisfaction and higher churn.

6. Technical Support and Assistance: Critical in Moments of Need

Positive Impact:
Fast, effective technical support reassures customers, resolves issues quickly, and boosts satisfaction while reducing the urge to leave.

Negative Impact:
Slow, unhelpful, or inaccessible support increases frustration and the likelihood of churn.

7. Customer Feedback and Complaint Handling: Listening and Acting

Positive Impact:
Easy to use feedback channels and swift, fair complaint resolution show customers they are valued, increasing satisfaction and loyalty while lowering churn.

Negative Impact:
Ignoring feedback or handling complaints poorly leads to dissatisfaction and a greater risk of customer loss.

7. FINDINGS

This review of telecom research shows several important points about customer satisfaction and churn.

1. When telecom companies focus on technology, service, and customer experience together, customers are more satisfied and less likely to leave.
2. Reliable service and clear billing are the most important factors for building customer trust.
3. Providing personal experiences and solving problems quickly helps increase customer loyalty.
4. The ITSORM model helps explain how all these factors work together to affect customer satisfaction.
5. Customer happiness and the chance of leaving are influenced by many things, such as service quality, pricing, extra services, customer experience, company image, technical support, and how feedback is handled.

In summary, understanding these ideas shows how telecom companies can keep their customers happy and loyal.

8. CONCLUSIONS

This study shows that telecom companies need more than just strong technology and good networks to be successful. They also need to deliver services well and make sure customers have a positive experience. The Integrated Telecom Satisfaction and Retention Model, or ITSORM, explains how network quality, service delivery, and customer experience all work together to shape how satisfied customers feel and whether they stay with the company or leave.

When companies pay equal attention to reliable service, clear and honest billing, and helpful customer support, they build more trust and loyalty with their customers. If any one of these areas is weak, customers are more likely to leave for another provider. By focusing on all these important parts together, telecom operators can improve their overall performance and keep more customers. This approach helps companies see the big picture and understand that every part of the customer journey matters for long-term success.

9. KEY RECOMMENDATIONS

The following recommendations are proposed to help telecom companies enhance customer satisfaction and reduce customer churn.

1. **Enhance Network Infrastructure:** Invest continuously in upgrading network coverage, speed, and reliability to meet growing customer demands.
2. **Improve Service Delivery:** Ensure transparent communication, timely issue resolution, and seamless service activation to build trust.
3. **Focus on Customer Experience:** Prioritize customer support quality and personalized engagement to foster satisfaction and loyalty.
4. **Localize Strategies:** Tailor offerings and support based on regional customer needs and preferences to address specific market gaps.
5. **Promote Brand Trust:** Build a strong brand reputation through consistent quality and ethical practices.

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