

Large Language Models and AI Agents in Telecom: Two Empirical Studies on Emerging AI Trends in the GCC Region

Asfand Ahmed Khan
PhD Candidate, Asia e University, Malaysia

Aymun Shujat
MSc Candidate in CS with Artificial Intelligence, University of Wolverhampton, UK.

Wamiq Rafi Syed
Project Management Director specializing in Artificial Intelligence projects.

Abstract – Needless to say, the telecommunications industry is experiencing a fundamental shift driven by artificial intelligence. Two AI technologies, in particular, are changing how telecom companies have been operating in last decade: Large Language Models (LLMs) and autonomous AI agents. This paper presents two separate empirical studies conducted by the authors – one for the LLM side and other for the use of AI Agents in the Telecom industry in partuclar to enhance efficiency. The first study currently under review, we surveyed 123 telecom professionals on LLM integration (Khan et al., under review). Furthermore, in a previously published study, we surveyed 93 senior telecom professionals related to the GCC telecommunication industry on AI agent adoption (Khan et al., 2024). Both studies used quantitative survey methods and drew respondents from senior telecom professionals with ten or more years of industry experience. The findings from both studies independently confirm that these AI technologies are delivering measurable business value. LLM integration showed strong positive effects on business performance improvement, while AI agents demonstrated significant impacts on operational efficiency and customer satisfaction. Together, these studies indicate that the telecom sector in the GCC is actively adopting AI technologies and realizing benefits across cost reduction, service quality, and financial performance.

Keywords - Large Language Models, AI Agents, Telecommunications, GCC, Operational Efficiency, Customer Satisfaction, Emerging Trends

INTRODUCTION

The aforementioned rapid evolution of artificial intelligence has brought new capabilities to the telecommunications industry. Among the most capable developments are Large Language Models (LLMs) and autonomous AI agents. These technologies characterize a departure from traditional rule-based automation and are shifting how telecom companies handle customer interactions, manage networks, and make business decisions.

LLMs use advanced natural language processing to understand and produce human-like text. In telecommunications, they are being deployed for customer support automation, technical documentation analysis, and data-driven decision-making (Maatouk et al., 2024; Xiaoliang et al., 2024). AI agents, on the other hand, are autonomous software systems that can perceive their environment, make independent decisions, and take action with minimal human

intervention (Russell & Norvig, 2021). In telecom, AI agents are used for network optimization, fraud detection, predictive maintenance, and resource allocation (Cao et al., 2019; Phua et al., 2010).

The Gulf Cooperation Council (GCC) region provides an interesting context for studying these trends. The region has high mobile penetration rates, significant investment in network infrastructure. Undoubtedly, there is a huge role of the government support for such massive digital transformation through initiatives such as Saudi Vision 2030 and the UAE Strategy for the Fourth Industrial Revolution (Arab Advisors Group, 2021). Telecom companies in the GCC also benefit from high Average Revenue Per User (ARPU) compared to global averages, which creates financial capacity to invest in new technologies (ITU, 2024).

This paper presents findings from two independent quantitative studies conducted among telecom professionals in the GCC region. The first study focused on LLM integration. The second study focused on AI agent adoption. Both studies were conducted separately, but together they provide a picture of how these emerging AI technologies are being adopted and what value they are delivering to telecom operators in the region.

LITERATURE REVIEW

AI in Telecommunications

Artificial intelligence has been applied in telecommunications for several years, but recent advances have expanded its capabilities significantly. Research has shown that AI can optimize network performance, predict and prevent outages, and improve customer service through chatbots and virtual assistants (Mischia et al., 2022; Yousef et al., 2017). AI also helps telecom companies detect fraudulent activities, personalize marketing campaigns, and plan predictive maintenance to reduce network disruptions (Phua et al., 2010; Ericsson, 2021).

Large Language Models in Telecom

LLMs represent a more recent advancement. These models are trained on vast amounts of text data and can understand, summarize, and generate human-like responses. In telecommunications, LLMs are being used to automate

customer service interactions, analyze technical documentation such as 3GPP standards, and support network fault prediction (Maatouk et al., 2024; Yilma et al., 2024). Studies have shown that LLMs can improve first-call resolution rates, reduce network downtime, and help engineers navigate complex technical specifications (Byra, 2024; Karapantelakis et al., 2024).

AI Agents in Telecom

AI agents take automation a step further. Unlike LLMs, which primarily process language, AI agents can take autonomous action. They operate using machine learning, natural language processing, and predictive analytics to automate complex processes, provide personalized recommendations, and offer intelligent support (Russell & Norvig, 2021). In telecom, AI agents are being deployed for network resource allocation, real-time anomaly detection, fraud prevention, and automated customer service (Cao et al., 2019; Lin et al., 2024).

GCC Telecom Market

The GCC telecom market is characterized by high competition, rapid technological adoption, and strong government support for digital initiatives (Arab Advisors Group, 2021). Telecom operators in Saudi Arabia, UAE, Qatar, Kuwait, Oman, and Bahrain are investing heavily in 5G networks and digital services. This environment creates opportunities for AI adoption, though challenges related to data privacy, workforce readiness, and implementation costs remain (Hazaa & Mubarak, 2024).

RESEARCH OBJECTIVES

- Study One (LLM Integration):
 - To assess the impact of LLM-driven AI decision-making on operational efficiency and cost-effectiveness of telecom businesses.
 - To analyze how LLM-based automation enhances customer service, personalization, and overall telecom business performance.
 - To evaluate the effectiveness of AI-powered predictive maintenance and fault management in optimizing telecom networks.
 - To identify challenges, ethical concerns, and strategic solutions for maximizing LLM integration benefits in telecom operations.
- Study Two (AI Agent Adoption):
 - To understand the perceived impact of AI agent adoption on employee efficiency.
 - To understand the relationship between AI agent incorporation and operational efficiency.
 - To quantify the outcome of AI agent deployment on customer satisfaction.
 - To understand the moderating role of organizational capabilities in the association between AI agent adoption and business performance.

RESEARCH QUESTIONS

Study One:

1. How does AI-powered decision-making through LLMs contribute to operational efficiency and cost savings in telecom?
2. In what ways do LLMs enhance customer experience, service automation, and business performance in the telecom industry?
3. What role do LLMs play in predictive maintenance, network optimization, and fault mitigation within telecom businesses?
4. What are the key challenges and risks of LLM integration in telecom, and how can businesses address them?

Study Two:

1. How does the perceived adoption of AI agents influence employee efficiency – on the Human Resource side?
2. What is the relationship between AI agent integration and operational efficiency – purely on the business process die?
3. How does the placement of AI agents influence customer satisfaction levels – managing customer satisfaction side of the business?
4. Does organizational capability moderate the connection between AI agent adoption and business performance in the telecom sector?

THEORITICAL FRAMEWORK

This paper draws on four theoretical frameworks that are well established in technology adoption and business strategy research.

The Resource-Based View (RBV) argues that a firm's unique resources and capabilities can provide sustained competitive advantage (Barney, 1991). Both LLMs and AI agents, when effectively implemented, can serve as valuable organizational resources that differentiate telecom companies from competitors.

The Technology-Organization-Environment (TOE) Framework explains how does the factors like technology, organizations environment, and other environmental factors influence technology adoption (Tornatzky & Fleischer, 1990). This framework helps understand why some telecom companies adopt AI faster than others based on their technological readiness, organizational support, and market pressures.

The Technology Acceptance Model (TAM) focuses on perceived usefulness and perceived ease of use as key drivers of technology acceptance (Davis, 1989). This framework is particularly relevant for understanding how employees accept and use AI agents in their daily work.

The Dynamic Capabilities Theory (DCT) sheds light on the the ability of firms sensing, seizing, and transform resources to maintain competitiveness in changing environments (Teece et al., 2003). This theory helps explain how telecom companies develop the organizational capabilities needed to successfully adopt and integrate AI technologies.

METHODOLOGY

Research Sample

This paper combines data from two independent quantitative surveys conducted among telecom and ICT professionals across GCC countries.

Study One (LLM Integration): A structured questionnaire was distributed to over 150 senior professionals with ten or more years of industry experience. A total of 123 valid responses were received, representing a response rate of 82 percent. The survey ensured anonymity and confidentiality. Responses were collected digitally to facilitate systematic data management and analysis.

Study Two (AI Agent Adoption): The sample comprised 93 senior officials from top telecom companies, including operators, vendors, distributors, system integrators, and C-level executives functioning in the Gulf region. A purposive sampling technique was used to select individuals with relevant knowledge and experience in AI and the telecom sector. Respondents were selected based on their current job responsibilities and roles, ensuring representation from different functions including and primarily IT, operations, customer service, and strategy functions.

Note on Original Studies: The data presented in this paper come from two independent studies conducted by the same authors. The AI agent study has been published previously (Khan et al., 2024). The LLM study is currently under review for publication (Khan et al., under review). This paper synthesizes the findings from both studies to present a broader picture of emerging AI trends in the GCC telecom sector. No new data were collected for this synthesis.

DATA COLLECTION

Both studies used structured questionnaires based on their respective research objectives and theoretical frameworks. All items were measured using five-point Likert scales ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The questionnaires were pre-tested with small groups of experts in the field, including academic and industry professionals, to ensure clarity, content validity, and face validity. Minor revisions were made based on feedback received. Surveys were administered online using secure platforms to ensure confidentiality.

DATA ANALYSIS

Statistical software (SPSS) was used to analyze the data collected from both studies. Reliability testing was conducted using Cronbach's Alpha. ANOVA analysis was performed to examine differences across variable groups. Multiple regression analysis was employed to assess the relationships between independent and dependent variables.

RESULTS

Study One: LLM Integration

The reliability analysis for the LLM study demonstrated strong internal consistency across all constructs. Cronbach's

alpha values ranged from 0.76 (Technology Adoption Readiness) to 0.92 (Overall). LLM Integration achieved alpha of 0.89, and Business Performance Improvement achieved alpha of 0.91.

The ANOVA results revealed statistically significant differences ($p < 0.05$) across all operational domains. LLM Integration showed $F = 12.45$ ($p < 0.001$), AI-Driven Automation showed $F = 9.87$ ($p < 0.001$), and Customer Service Enhancement showed $F = 11.34$ ($p < 0.001$).

The RBV regression model accounted for 68 percent of variance in Business Performance Improvement ($R^2 = 0.68$). LLM Integration emerged as the strongest predictor ($\beta = 0.32$, $p < 0.001$), followed by AI-Driven Automation ($\beta = 0.28$, $p = 0.002$) and Data Analytics ($\beta = 0.25$, $p = 0.004$).

The survey responses showed that 78.9 percent of respondents reported their organizations are using AI-driven solutions in at least some business domains, either fully or partially, while 21.1 percent stated their companies have not yet implemented AI. Approximately 72 percent of AI-adopting companies reported measurable improvements in financial performance. Nearly 68 percent of respondents reported that AI-powered customer service solutions have led to reduced response times and improved customer satisfaction scores. Around 65 percent of respondents agreed that AI-driven insights allow for more tailored telecom offerings based on customer behavior and preferences.

Study Two: AI Agent Adoption

The reliability analysis for the AI agent study showed strong internal consistency. AI Adoption achieved Cronbach's alpha of 0.85, Customer Satisfaction at 0.82, and Financial Performance at 0.88. All values exceeded the 0.70 threshold.

The ANOVA results indicated that AI Adoption ($F = 4.32$, $p = 0.002$), Customer Satisfaction ($F = 3.89$, $p = 0.004$), and Financial Performance ($F = 5.12$, $p = 0.001$) all had statistically significant impacts.

Three regression models were developed for the AI agent study. For Operational Efficiency, the regression equation was $OE = 0.32(ANO) + 0.41(ACS) + 0.28(APM) + 0.30(AFA) + 0.35(AAI) + 0.29(ASI)$. AI-powered customer service automation demonstrated the highest impact on operational efficiency ($\beta = 0.41$, $p < 0.05$). For Customer Satisfaction, AI-powered customer service automation again showed the strongest effect ($\beta = 0.45$, $p < 0.05$). For Financial Performance, AI-driven financial analytics had the highest impact ($\beta = 0.38$, $p < 0.05$).

The survey responses indicated that AI-driven automation significantly improves operational efficiency by reducing response times, improving network optimization, and minimizing human errors. AI adoption directly correlates with higher customer satisfaction levels, with AI powered chatbots, generative and predictive analytics personalizing customer interactions and resolving – at a speed of millions per second. Financial performance metrics demonstrated positive impact from AI adoption through AI-driven pricing calculations and models, detecting anomalies and frauds, and on the other hand performing personalized marketing campaigns.

DISCUSSION

The findings from both studies independently confirm that AI technologies are delivering measurable value to telecom operators in the GCC region. This is not a theoretical prediction. It is happening now.

For LLMs, the data shows that telecom companies are using these models to improve decision-making accuracy, automate customer service, and optimize network operations. The regression results ($\beta=0.32$ for business performance improvement) indicate that LLM integration is not a marginal improvement but a substantial driver of performance. The fact that 78.9 percent of surveyed companies have already adopted some form of AI suggests that the industry is past the early adopter phase and moving into mainstream implementation.

For AI agents, the picture is similar but with different emphases. AI agents showed particularly strong effects on operational efficiency ($\beta=0.41$) and customer satisfaction ($\beta=0.45$). This makes sense given that AI agents are designed for action. They do not just analyze or recommend. They execute. In network management, AI agents can detect anomalies and automatically allocate resources. In customer service, they can handle routine requests without human involvement. These capabilities have undoubtedly changed the landscape and ensured lightening faster response times, lower operational costs, and higher customer satisfaction.

Both studies identified similar challenges. Implementation costs remain a barrier, with 21.1 percent of companies yet to adopt AI. Data privacy concerns were frequently mentioned by respondents. Workforce readiness also emerged as a factor, with some professionals expressing uncertainty about how to work alongside AI systems. These challenges are real but appear to be addressable through phased implementation strategies and employee training programs.

What is clear from both studies is that the telecom industry in the GCC is changing. The old ways of managing networks manually, handling customer service with large call center teams, and making decisions based on static reports are being replaced by AI-driven approaches. LLMs and AI agents are not the same technology, and they serve different purposes, but both are contributing to this transformation. The data shows that companies that have adopted these technologies are seeing improvements in efficiency, customer satisfaction, and financial performance.

CONCLUSION

This paper presented two separate empirical studies on emerging AI trends in the GCC telecommunications sector. The first study focused on Large Language Models and found that LLM integration strongly predicts business performance improvement ($\beta=0.32$, $p<0.001$), with 78.9 percent of surveyed companies already using AI in some form and 72 percent reporting financial gains. The second study focused on AI agents and found significant impacts on operational efficiency ($\beta=0.41$, $p<0.05$) and customer satisfaction ($\beta=0.45$, $p<0.05$).

Taken together, these studies show that the telecom industry in the GCC is actively adopting AI technologies and realizing real business value. LLMs are helping companies make better decisions, automate customer interactions, and navigate

complex technical documentation. AI agents are autonomously optimizing networks, detecting fraud, and executing predictive maintenance. Neither technology is a futuristic concept. Both are in the market today, delivering efficiency gains and cost reductions.

One of the biggest and most crucial challenges remain, particularly around the exploratory and implementation costs, data privacy, and workforce readiness. But these challenges do not appear to be stopping adoption – especially in the case of the region in question, where investment is not scarce, ARPU is on the higher side and companies do not fear investing more. Thus, the trend appears to be clear: telecom companies in the GCC are moving toward AI-driven operations, and those that adopt early are seeing the benefits. Future research plans to examine how these technologies evolve as 6G networks and to further explore the generative AI capabilities – if can be amalgamated what benefit it would bring on the table. But even without waiting for future developments, the evidence from these two studies is sufficient to conclude that LLMs and AI agents are already transforming the telecommunications industry.

REFERANCES

- [1] Arab Advisors Group. (2021). GCC Telecom Market Report.
- [2] Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120.
- [3] IByra, S. (2024). How to leverage LLM and AI in telecommunications? *Vstorm*.
- [4] Cao, Y., Wang, R., Chen, M., & Barnawi, A. (2019). AI Agent in Software-Defined Network: Agent-based network service prediction and wireless resource scheduling optimization. *IEEE Internet of Things Journal*, 7(7), 5816-5826.
- [5] Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319.
- [6] Ericsson. (2021). AI: Enhancing customer experience in a complex 5G world. *Ericsson Mobility Report*.
- [7] Hazaa, B., & Mubarak, M. A. (2024). Digital transformation in the oil and gas industry in the GCC: Exploring opportunities and addressing challenges. In *Studies in Systems, Decision and Control* (pp. 641-662).
- [8] International Telecommunication Union (ITU). (2024). *Measuring Digital Development: Facts and Figures 2024*.
- [9] Karapantelakis, A., Thakur, M., Nikou, A., Moradi, F., Olrog, C., Gaim, F., Holm, H., Nimara, D. D., & Huang, V. (2024). Using Large Language Models to Understand Telecom Standards. *IEEE ICMLCN*, 440-446.
- [10] Khan, A. A., Syed, W. R., & Shujat, A. (2025). Exploring the potential of AI agents in the Telecommunications Industry: A quantitative analysis on Future Business Performance Enhancements. *Computer Engineering and Intelligent Systems*. <https://doi.org/10.7176/ceis/16-1-01>
- [11] Lin, X., Kundu, L., Dick, C., Galdon, M. A. C., Vamaraju, J., Dutta, S., & Raman, V. (2024). A primer on Generative AI for Telecom: From Theory to practice. *arXiv.org*.
- [12] Maatouk, A., Piovesan, N., Ayed, F., De Domenico, A., & Debbah, M. (2024). Large Language Models for Telecom: Forthcoming impact on the industry. *IEEE Communications Magazine*, 1-7.
- [13] Misischia, C. V., Poetze, F., & Strauss, C. (2022). Chatbots in customer service: Their relevance and impact on service quality. *Procedia Computer Science*, 201, 421-428.