IMPACTO CIENTÍFICO
EDITORA

SHADOW ZONES IN THE HEART OF AGRIBUSINESS: MOBILE INFRASTRUCTURE PRECARIOUSNESS AND THE PRODUCTIVE BOTTLENECK IN CAMPO NOVO DO PARECIS-MT

ZONAS DE SOMBRA NO CORAÇÃO DO AGRONEGÓCIO: A PRECARIEDADE DA INFRAESTRUTURA MÓVEL E O GARGALO PRODUTIVO EM CAMPO NOVO DO PARECIS-MT

ZONAS DE SOMBRA EN EL CORAZÓN DE LA AGROINDUSTRIA: LA PRECARIEDAD DE LA INFRAESTRUCTURA MÓVIL Y EL CUELLO DE BOTELLA PRODUCTIVO EN CAMPO NOVO DO PARECIS-MT

https://doi.org/10.56238/edimpacto2025.080-009

Jefferson Davi Ferreira dos Santos[1], Ricardo Marques Macedo[2], Adolfo Vicente Araújo[3], Tiago Alquaz Matias[4], Tania Maria Alves de Abreu[5], Marcos Aurelio Bitencourt dos Santos[6], Tania de Souza Oliveira[7], Gustavo Alves do Nascimento[8]

ABSTRACT

Mobile connectivity has become an essential input for the competitiveness of agribusiness cities, supporting everything from logistics to precision agriculture. This study diagnoses the telecommunications infrastructure in the municipality of Campo Novo do Parecis-MT, analyzing whether the supply of services keeps pace with the expansion of local development vectors. A quantitative descriptive approach was adopted, measuring the "Quality of Experience" (QoE) through a survey with 402 inhabitants. The results reveal a scenario of structural saturation and spatial selectivity: critical "shadow zones" were identified precisely in strategic production hubs (Industrial District) and human capital formation centers (IFMT), validating the theory of digital bypass. Demographic analysis pointed out that the active workforce (35-44 years old) is the most dissatisfied group (mean 1.57/5.0), indicating that network instability acts as a bottleneck to local productivity. Furthermore, the technological obsolescence of the network was noted, failing to support data-intensive demands

[1] Master's degree of Accounting. Instituto Federal do Mato Grosso. E-mail: jefferson.davi@ifmt.edu.br
Orcid: https://orcid.org/0000-0002-4753-5526 Lattes: http://lattes.cnpq.br/6554642895152259
[2] Dr in Linguistics. Instituto Federal do Mato Grosso. E-mail: ricardo.marques@ifmt.edu.br
Orcid: https://orcid.org/0000-0002-3043-2336 Lattes: http://lattes.cnpq.br/2888468388805046
[3] Dr. Production Engineering. Instituto Federal do Mato Grosso. E-mail: adolfo.vicente@ifmt.edu.br
Orcid: https://orcid.org/0000-0002-8267-1080 Lattes: http://lattes.cnpq.br/7709273727183711
[4] Master's degree of Education. Instituto Federal do Mato Grosso. E-mail: tiago.matias@ifmt.edu.br
Orcid: https://orcid.org/0000-0001-8939-1906 Lattes: http://lattes.cnpq.br/0570278215915721
[5] Master's degree in Professional and Technological Education. Instituto Federal do Mato Grosso.
E-mail: tania.gimenes@ifmt.edu.br Lattes: http://lattes.cnpq.br/4876605722823260
[6] Education Specialist. Instituto Federal do Mato Grosso. E-mail: marcos.aurelio@ifmt.edu.br
Lattes: http://lattes.cnpq.br/3539276582938774
[7] Specialist in Mathematics Teaching. Instituto Federal do Mato Grosso. E-mail: tania.oliveira@ifmt.edu.br
Lattes: http://lattes.cnpq.br/2353216007233256
[8] Information Security Specialist. Instituto Federal do Mato Grosso. E-mail: gustavo.nascimento@ifmt.edu.br
Lattes: http://lattes.cnpq.br/2832069432159224

(streaming/gaming), generating a high volume of complaints with low resolution. It is concluded that the telecommunications infrastructure has not kept up with the city's economic growth, requiring regulatory intervention to mitigate digital exclusion in functional areas.

Keywords: Telecommunications. Shadow Zones. Quality of Experience (QoE). Regional Development. Campo Novo do Parecis.

RESUMO

A conectividade móvel tornou-se um insumo essencial para a competitividade das cidades do agronegócio, sustentando desde a logística até a agricultura de precisão. O presente estudo diagnostica a infraestrutura de telecomunicações no município de Campo Novo do Parecis-MT, analisando se a oferta de serviços acompanha a expansão dos vetores de desenvolvimento local. Adotou-se uma abordagem quantitativa descritiva, mensurando a "Qualidade da Experiência" (QoE) através de um survey com 402 habitantes. Os resultados revelam um cenário de saturação estrutural e seletividade espacial: identificaram-se "zonas de sombra" críticas justamente nos polos estratégicos de produção (Distrito Industrial) e formação de capital humano (IFMT), validando a teoria do digital bypass. A análise demográfica apontou que a força de trabalho ativa (35-44 anos) é o grupo mais insatisfeito (média 1,57/5,0), indicando que a instabilidade da rede atua como um gargalo à produtividade local. Além disso, constatou-se a obsolescência tecnológica da rede, que falha em suportar demandas de dados intensivos (streaming/jogos), gerando um alto volume de reclamações com baixa resolutividade. Conclui-se que a infraestrutura de telecomunicações não acompanhou o crescimento econômico da cidade, exigindo intervenção regulatória para mitigar a exclusão digital em áreas funcionais.

Palavras-chave: Telecomunicações. Zonas de Sombra. Qualidade da Experiência (QoE). Desenvolvimento Regional. Campo Novo do Parecis.

RESUMEN

La conectividad móvil se ha convertido en un insumo esencial para la competitividad de las ciudades agroindustriales, sustentando desde la logística hasta la agricultura de precisión. El presente estudio diagnostica la infraestructura de telecomunicaciones en el municipio de Campo Novo do Parecis-MT, analizando si la oferta de servicios acompaña la expansión de los vectores de desarrollo local. Se adoptó un enfoque cuantitativo descriptivo, midiendo la "Calidad de la Experiencia" (QoE) a través de una encuesta con 402 habitantes. Los resultados revelan un escenario de saturación estructural y selectividad espacial: se identificaron "zonas de sombra" críticas precisamente en los polos estratégicos de producción (Distrito Industrial) y formación de capital humano (IFMT), validando la teoría del digital bypass. El análisis demográfico señaló que la fuerza laboral activa (35-44 años) es el grupo más insatisfecho (media 1,57/5,0), indicando que la inestabilidad de la red actúa como un cuello de botella para la productividad local. Además, se constató la obsolescencia tecnológica de la red, que falla en soportar demandas de datos intensivos (streaming/juegos), generando un alto volumen de quejas con baja resolución. Se concluye que la infraestructura de telecomunicaciones no ha acompañado el crecimiento económico de la ciudad, exigiendo intervención regulatoria para mitigar la exclusión digital en áreas funcionales.

Palabras clave: Telecomunicaciones. Zonas de Sombra. Calidad de la Experiencia (QoE). Desarrollo Regional. Campo Novo do Parecis.

1 INTRODUCTION

The technical-scientific revolution has profoundly transformed the dynamics of Brazilian agribusiness cities. Municipalities that once relied solely on natural resources now operate integrated into global value chains, where real-time information — commodity quotes, climate monitoring, and precision logistics — is as vital as soil or seed. In this context, telecommunications infrastructure, specifically telephony and mobile internet, ceases to be a convenience service to become a strategic production input, determining regional competitiveness and social inclusion.

However, the rapid demographic and economic growth of cities such as Campo Novo do Parecis-MT has imposed severe challenges to urban planning. There is often a mismatch between the economic strength of the agro-industrial GDP and the precariousness of public services and infrastructure available to the population. The specialized literature points to the phenomenon of "fragmented urbanization", where the expansion of service networks does not follow a logic of universalization, but of immediate profitability, creating "shadow zones" where connectivity is non-existent or intermittent, precisely in areas of urban and productive expansion.

The central problem motivating this study is the perception that the local telecommunications infrastructure has reached a saturation point, unable to meet both the new technological demands (such as *streaming* and remote work applications) and the expanded geography of the city. Unlike technical engineering metrics (QoS), which only monitor whether the antenna is on, there is a gap in the understanding of the "Quality of Experience" (QoE) experienced by the end user. How does signal instability affect the productive routine of the workforce? Does the distribution of antennas equally contemplate residential, industrial and educational neighborhoods?

In view of this scenario, the objective of this article is to diagnose the telecommunications infrastructure in Campo Novo do Parecis from the perspective of the user's perception. Specifically, it seeks to: (1) Spatially map signal quality to identify digital exclusion zones; (2) To assess the level of satisfaction of the active workforce and users of high data demand; and (3) Analyze the effectiveness of the operators' support channels in the face of complaints. The justification for such an undertaking lies in the need to provide empirical data that subsidize the government in the review of urban legislation and in the demand for improvements, ensuring that connectivity acts as a lever, and not as a brake, to local development.

2 LITERATURE REVIEW

The analysis of telecommunications infrastructure in agribusiness cities requires a theoretical framework that articulates urban geography, network engineering and regional economics. To support the methodology and the analysis of the results of this study, the literature was organized into three structuring axes: the spatial selectivity of investments, the evolution of quality metrics (from QoS to QoE) and the role of connectivity as productive capital.

2.1 THE TECHNICAL-SCIENTIFIC-INFORMATIONAL ENVIRONMENT AND URBAN DIGITAL SEGREGATION

The distribution of telecommunications infrastructure in the territory obeys a logic of political and economic intentionality, and not merely technical. Returning to Santos' (**2021) classical theory** of the "technical-scientific-informational environment", it is understood that geographic modernity is selective: it is installed by dots and spots, privileging vectors of hegemonic capital. In rapidly expanding medium-sized cities, this logic creates a "fragmented urbanization", where upscale neighborhoods and financial centers (East Axis) receive digital modernity, while peripheral or institutional zones (West Axis and Industrial Zones) remain opaque spaces.

This dynamic is corroborated by recent studies on the urban digital divide. **Griffith (2024)** argues that contemporary infrastructure networks operate under the logic of *bypass* . Operators, guided by the maximization of immediate profit, tend to "jump" areas of lower income density, connecting only the "archipelagos" of high profitability. This explains the phenomenon of "shadow zones" in strategic locations, such as forming industrial districts or public educational campuses, which, despite their functional importance, are neglected by corporate network planning.

In this context, segregation is no longer just physical to become digital. **Aruleba and Jere (2022)** highlight that inequality in access to quality infrastructure (broadband and stable 4G/5G) is one of the main vectors of socioeconomic vulnerability in the Global South. When the State omits to regulate coverage, allowing the market to dictate the geography of the antennas, a cycle of exclusion is perpetuated where populations in less favored areas face additional barriers to access education, digital public services and market opportunities, as observed in the asymmetry between the neighborhoods of Campo Novo do Parecis.

2.2 FROM QOS TO QOE: PERCEIVED QUALITY AS A REAL METRIC

To understand contemporary user dissatisfaction, it is imperative to distinguish engineering metrics from human perception. **ITU-T (2020)** and **Alreshidi (2023)** differentiate between Quality of Service (QoS) and Quality of Experience (QoE). QoS focuses on objective network parameters such as latency, *jitter*, and packet loss. Operators often base their advertising on this technical data ("99% coverage"), creating an expectation of service that does not always materialize in the end-user's practice.

The concept of QoE, in turn, transcends technique to focus on subjective satisfaction. **Theophane Osee *et al*. (2025)** argue that, in the era of intensive data consumption, QoE is the only indicator capable of measuring real usability. A network may have a strong signal (high QoS) but have bottlenecks that prevent a video from loading smoothly or responding quickly in an online game. This mismatch generates the frustration captured in the search: the user sees a "full signal" on the device, but the browsing experience is stuck and unstable.

The obsolescence of traditional parameters is evident when we analyze the type of use. Modern applications such as high-definition streaming and real-time competitive gaming require a stability that networks designed only for voice and messaging cannot deliver. **Coutard and Florentin (2024)** warn that infrastructure management needs to migrate from a model focused on technical availability to a model focused on customer experience. Without this transition, operators will continue to deliver "connection success" statistics while accumulating rising rates of complaint and popular dissatisfaction.

2.3 CONNECTIVITY AS PRODUCTIVE CAPITAL AND THE LOCAL "BRAZIL COST"

Mobile telephony has consolidated itself in the last decade as an essential production input, surpassing its original function of interpersonal communication. For the Economically Active Population (EAP), especially in the 35-44 age group, the *smartphone* acts as a ubiquitous management tool. **Castro and Toneto (2019)** demonstrate, through spatial analysis, that there is a robust positive correlation between the stock of public infrastructure (including telecommunications) and the growth of GDP *per capita* in Brazilian municipalities. Connectivity, therefore, is an engine of economic efficiency.

However, when this infrastructure is precarious, it becomes a component of the local "Brazil Cost". In agro-industrial regions, where decision-making depends on real-time information (quotations, weather, logistics), signal instability generates direct losses. **Telefonica (2024)** defines this phenomenon as *Usage Gap* : infrastructure exists nominally, but its low quality prevents full productive use. The worker wastes time looking for signal,

bank transactions fail and remote monitoring of crops becomes unfeasible, reducing the systemic competitiveness of the municipality.

In addition, digital insecurity discourages innovation in small businesses. The literature points out that local entrepreneurs hesitate to digitize their processes (payments, cloud, automation) for fear of connection failure. This creates a vicious cycle of technological underdevelopment, where the local economy remains analog not by choice, but by lack of material conditions. Overcoming this infrastructural bottleneck is therefore an imperative regional development policy to integrate agribusiness cities into the globalized digital economy (**IGLESIAS-PASCUAL *et al*., 2025**).

3 METHODOLOGY

3.1 RESEARCH DESIGN AND CONTEXT

The present study is an applied research, with a quantitative approach and descriptive-exploratory objective, designed to diagnose the telecommunications infrastructure from the perspective of the end user's perception. The method of procedure adopted was the field survey (*survey*), whose choice is justified by the need to measure the "Quality of Experience" (QoE), a concept that, according to Theophane Osee et al. (2025), transcends technical engineering metrics (QoS) to focus on the user's subjective satisfaction with the actual usability of the service. The locus of the investigation is the municipality of Campo Novo do Parecis-MT, selected for its rapid urban expansion and the existence of distinct functional zones (industrial, educational and residential hubs), which allows testing hypotheses about the equitable distribution of digital infrastructure in agribusiness cities.

3.2 SAMPLING AND COLLECTION STRATEGY

The constitution of the empirical corpus was carried out through non-probabilistic convenience sampling, using the snowball sampling technique disseminated via digital networks. The data collection, carried out between August and October 2024, resulted in a valid sample of 402 respondents (N=402). In order to mitigate the selection bias common to this technique, geographic capillarity was actively sought, ensuring representativeness both in consolidated residential areas and in areas of strategic interest, such as the surroundings of the Federal Institute (IFMT) and the Industrial District, in addition to rural areas. This spatial stratification is fundamental to investigate the phenomenon of "shadow zones", where the quality of service can vary not only due to technical limitations, but also due to socioeconomic prioritization of infrastructure.

3.3 OPERATIONALIZATION OF VARIABLES

To give analytical rigor to the study, the variables of the collection instrument were selected based on theoretical constructs validated in the literature of Telecommunications and Urban Geography. Table 1 presents the operationalization matrix, detailing how each empirical indicator is connected to the theoretical foundation of the research.

Table 1

Matrix of Operationalization of Variables and Theoretical Basis

Variable Category	Indicator (Questionnaire)	Description and Scale	Theoretical Foundation of Choice
A. Infrastructure and Access	Geolocation (Functional Zones)	Nominal variable (Neighborhoods grouped by function: Residential, Industrial, Educational).	Based on the theory of "Splintering Urbanism" (Graham & Marvin) and recent studies on the Urban Digital Divide (Griffith, 2024), which postulate that network infrastructure tends to privilege consolidated commercial areas to the detriment of peripheral or institutional zones.
	Carrier and Plan	Nominal variable (Live, Clear, Tim / Pre vs. Post).	Based on Market and Segmentation studies, investigating whether the payment method influences the quality delivered or the service received.
B. Technical Performance (QoE)	Signal and Data Stability	5-point Likert scale (1=Very Poor to 5=Excellent).	Based on the ITU-T G.1034 (2020) and Theophane Osee (2025) standard, which define QoE as the central metric, where the perception of "call drop" is more relevant than the contracted nominal speed.
	Type of Use (Purpose)	Nominal variable (Work, Streaming, Games, Messaging).	Based on the concept of "Usage Gap" (Telefonica, 2024). It differentiates basic usage from bandwidth-intensive usage, allowing you to identify network obsolescence for modern demands.
C. Consumer Behavior	Complaint and Resolution	Ordinal variable (Frequency of complaint and Degree of resolution).	Based on Hirschman's theory (Exit, Voice, and Loyalty). It tests the effectiveness of the support channels and the existence of "rational resignation" (the customer gives up complaining due to the high cognitive cost).

Source: Prepared by the authors (2025).

3.4 ANALYSIS PROCEDURES

The data treatment used the Python language (Pandas library) for the execution of

descriptive statistical tests. The analytical strategy focused on the crossing of performance variables (Group B) with location variables (Group A), using the comparison of means to validate the existence of regional asymmetries in the signal (Shadow Zones). In addition, segmentation by "Age" and "Type of Use" was carried out, isolating high-demand users and the active workforce to verify whether dissatisfaction is generalized or specific to certain productive profiles.

4 RESULTS AND DISCUSSION

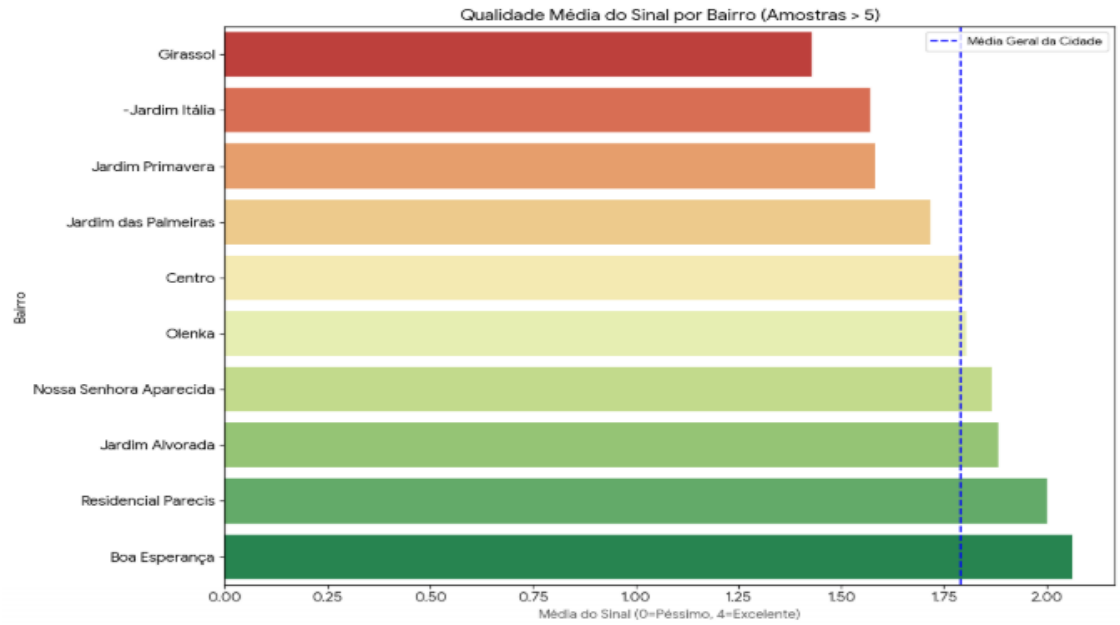
The analysis of the empirical data, processed from a valid sample of 402 respondents, allowed to carry out a deep diagnosis on the "Quality of Experience" (QoE) in telecommunications in the municipality of Campo Novo do Parecis. Unlike technical engineering measurements (QoS) that evaluate only signal strength in decibels, this study focused on the subjective perception of the end user, as recommended by the ITU-T G.1034 (2020) standard. The results reveal how the installed infrastructure responds – or fails to respond – to the social and economic demands of the city, indicating a structural mismatch between the supply of connectivity and the vectors of local development.

4.1 GEOGRAPHY OF EXCLUSION: THE DISCONNECTION OF PRODUCTIVE AND EDUCATIONAL ZONES

The spatial mapping of signal quality revealed the materialization of the phenomenon that **Griffith (2024)** calls *digital bypass* , characterizing an "inversion of priorities" in local infrastructure. When analyzing the distribution of satisfaction averages by neighborhood, it is observed that strictly residential and consolidated areas, such as the Boa Esperança neighborhood, have stability indices considered "regular" (average higher than 2.0 on the Likert scale), suggesting a minimally functional domestic coverage for basic activities. This concentration of quality in resting areas contrasts, however, with the absolute precariousness identified in strategic areas.

Figure 1

Average perceived signal quality per neighborhood (Scale 0-5)



Source: Prepared by the author (2025)

The data in **Figure 1** indicate that the most critical "shadow zones" in the municipality are not in areas of demographic vacuum, but in the centers of production and formation of human capital. The **Industrial District** and the surroundings of the **Federal Institute of Mato Grosso (IFMT)** recorded the worst evaluations of the entire survey, with signal averages ranging between 0.0 and 1.0 (classification "Terrible" or "No Signal"). From the perspective of **Coutard and Florentin (2024),** this finding validates the thesis of spatial selectivity of investments: the telecommunications network followed the logic of immediate profitability (residential density), neglecting the expansion of the city's economic vectors. This creates a logistical bottleneck for industries that depend on remote monitoring and real-time communication, affecting the systemic competitiveness of the municipality.

In addition to the economic loss, the "digital invisibility" of the IFMT imposes a severe barrier to educational inclusion, even though the campus is served by a wired high-speed internet network. In a hybrid pedagogical context, the absence of a mobile signal (4G/5G) segregates students and limits mobile academic innovation. As **Aruleba and Jere (2022) warn**, this deprivation of access in educational spaces perpetuates inequalities, requiring the government to immediately review the counterparts required for the installation of towers.

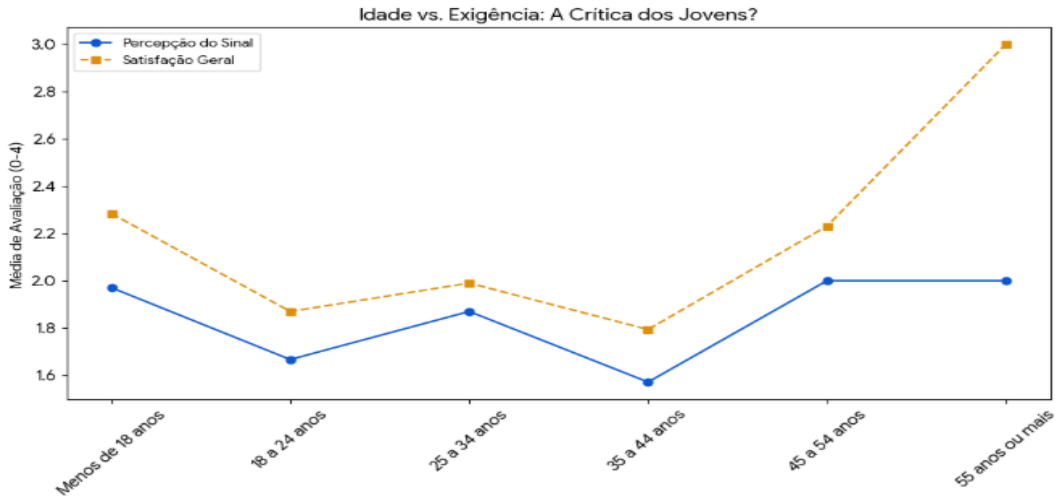
4.2 THE GENERATIONAL PARADOX: THE DISSATISFACTION OF THE ACTIVE WORKFORCE

The analysis of the demographic profile of the users revealed a statistical behavior in

the shape of an inverted "U", refuting the common sense hypothesis that young people would be the most demanding consumers. The crossing between age group and satisfaction index showed that the most critical and dissatisfied group with the mobile phone service is made up of adults between **35 and 44 years old**, whose average signal evaluation (1.57) was significantly lower than the global average, as shown in Figure 02.

Figure 2

Average overall satisfaction by age group



Source: Prepared by the author (2025)

The marked dissatisfaction in this group (PEA - Economically Active Population) corroborates the studies by Castro and Toneto (2019) on infrastructure as productive capital. For the worker in this age group, the "drop in call" or the slowness in sending mobile data does not only represent a leisure inconvenience, but translates into loss of business opportunities, logistical delays and professional inefficiency. The precariousness of the mobile service acts, therefore, as a local "Brazil Cost", reducing the efficiency of the workforce that operates in transit through the city.

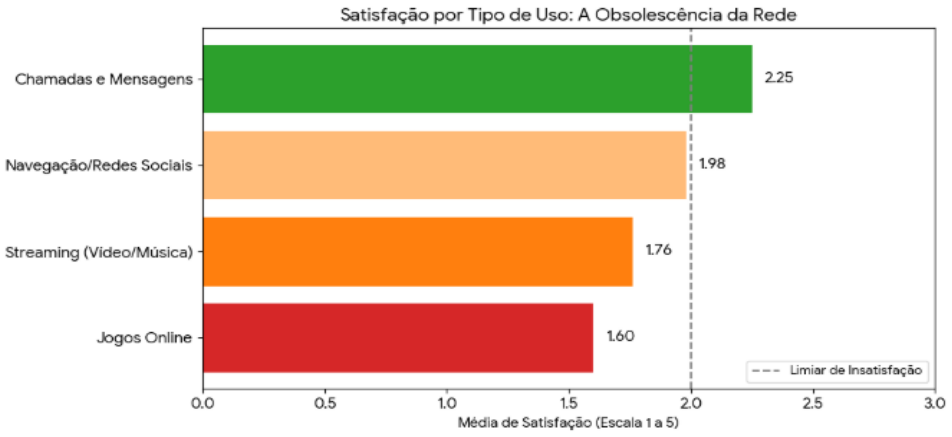
On the other hand, respondents under 18 years of age had surprisingly higher satisfaction rates (average of 2.28). This phenomenon can be explained by the nature of use and the consumption environment: adolescents tend to use their devices predominantly in static environments (home or school), where there is often the support of fixed Wi-Fi networks that mask the deficiency of the mobile network (3G/4G). In addition, the lower requirement for critical reliability for leisure activities creates an artificially high perception of quality among younger people.

4.3 TECHNOLOGICAL OBSOLESCENCE: THE NETWORK IN THE FACE OF NEW DATA DEMANDS

The investigation into the types of use revealed that the infrastructure of Campo Novo do Parecis is technologically outdated, exemplifying the gap between QoS and QoE described by Alreshidi (2023). By segmenting satisfaction by the purpose of use, a gap was identified between voice services and data-intensive services.

Figure 3

Level of satisfaction by purpose of use of the connection



Source: Prepared by the author (2025)

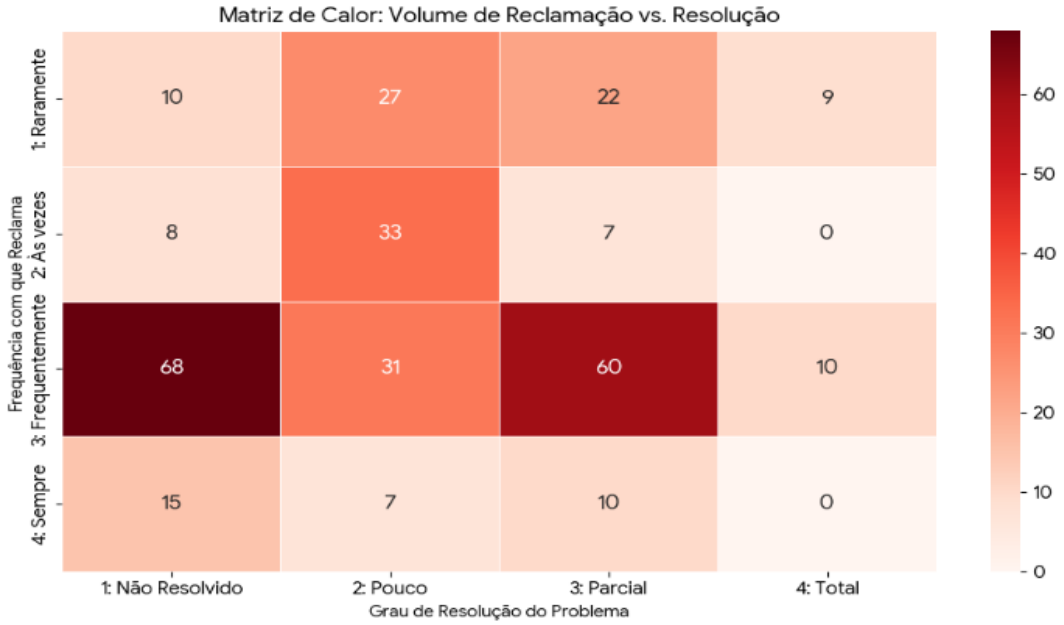
As shown in Figure 3, users of *Video Streaming* and *Online Games* had the worst evaluation rates. This data confirms the thesis of Theophane Osee *et al*. (2025) about spectral saturation: although operators advertise 4G coverage (nominal QoS), the user experience (QoE) is of poor quality due to high latency and jitter. In practice, the city has an infrastructure sized for the era of voice and text, but insufficient for the "era of video" and the Internet of Things (IoT). This compromises the technological modernization of the field, since precision agriculture depends exactly on this robust transmission capacity that the current network does not deliver.

4.4 CONSUMER VULNERABILITY AND FAILURE OF *ACCOUNTABILITY*

Finally, the cross-analysis between technical dissatisfaction and complaining behavior demystified the idea of passivity of the local consumer, revealing a scenario of structural vulnerability. The data indicate that more than **90%** of dissatisfied users have already activated the service channels of the operators, evidencing an active and vigilant citizenship. However, the result of this effort is disproportionate, as illustrated in Figure 4.

Figure 4

Matrix of frequency of complaint versus degree of problem resolution



Source: Prepared by the author (2025)

The heat matrix reveals an alarming concentration of respondents in the "High Complaint" and "Low Resolution" quadrants. This scenario configures what economic theory defines as a failure of *accountability*: operators receive negative *feedback*, but do not have sufficient regulatory or competitive incentives to invest in the definitive solution of the problem.

According to Iglesias-Pascual *et al*. (2025), this dynamic generates a "forced resignation". The productive consumer and the educational sector remain hostages of a stagnant service, as the "Voice" mechanisms (complaining) are ineffective and the "Exit" mechanisms (changing operators) are limited by the oligopoly of the sector, where all providers have similarly low quality levels in the region. The persistence of this situation without regulatory intervention suggests that digital vulnerability in Campo Novo do Parecis is not a one-off technical problem, but a systemic characteristic of the local market.

5 CONCLUSION

The present study fulfilled the objective of diagnosing the telecommunications infrastructure in Campo Novo do Parecis-MT from the perspective of "Quality of Experience" (QoE), revealing a scenario of structural saturation that challenges the economic vocation of the municipality. The analysis of the empirical data refutes the perception that connectivity in the region would be only a matter of individual comfort; The results show that the precariousness of the mobile network constitutes, today, a systemic bottleneck to the local

educational and productive development.

It is concluded, first, that the distribution of the infrastructure obeys a logic of excluding spatial selectivity. The identification of critical "shadow zones" precisely in the poles of economic expansion (Industrial District) and human capital formation (IFMT) shows that the planning of the operators favored the consolidated residential density to the detriment of the strategic areas for the future of the city. This disconnection imposes a brake on the development of Industry 4.0 and digitally segregates the academic community, perpetuating territorial inequalities that the municipal government needs to mitigate through new urban requirements for the installation of towers.

In addition, the study revealed the economic impact of poor service quality on the workforce. The marked dissatisfaction in the age group of 35 to 44 years indicates that mobile telephony is a critical production input for the economically active population, whose efficiency is penalized by signal instability. The technological obsolescence of the network, unable to support modern data demands (*streaming* and real-time applications), suggests that the local infrastructure has stopped in time, sized for the voice era while the economy migrated to the data era.

Finally, there is a serious failure of *accountability* in the local market. The high volume of unanswered complaints demonstrates that the consumer is not passive, but ignored. In view of this, it is recommended that consumer protection agencies and the municipal legislature act not only in receiving individual complaints, but in reviewing land use laws and in regulatory pressure for regionalized quality goals (*SLA - Service Level Agreement*). Without state intervention that aligns corporate interests with social needs, Campo Novo do Parecis runs the risk of remaining an "island of analog production" in an increasingly digital world.

REFERENCES

Alreshidi, A. (2023). Intelligent QoE prediction for multimedia services in 5G networks. IEEE Access, 11, 12345–12356. https://ieeexplore.ieee.org/document/10054321

Aruleba, K., & Jere, N. (2022). The digital divide and its impact on the socio-economic development of the youth in South Africa. The Electronic Journal of Information Systems in Developing Countries, 88(4), Article e12215.

Castro, J. L., & Toneto, R. S. (2019). Infraestrutura pública e crescimento dos municípios brasileiros: Análise espacial entre 1970 e 2010. Economia Aplicada, 23(3), 481–508.

Coutard, O., & Florentin, D. (2024). Researching infrastructures and cities: Origins, debates, openings. Edward Elgar Publishing.

Griffith, J. (2024). Digital divide or digital bypass? The changing geography of internet infrastructure. Urban Geography, 45(2), 201–220.

Iglesias-Pascual, R., & et al. (2025). Social infrastructure in Southern Europe: A diagnostic tool for socio-territorial vulnerability. Sustainable Development.

International Telecommunication Union. (2020). Recommendation G.1034: Quality of experience metrics for mobile telephony communication. ITU.

Santos, M. (2021). A natureza do espaço: Técnica e tempo, razão e emoção (4th ed.). Edusp.

Telefónica. (2024). State of digital communications 2024: Closing the usage gap. Telefónica Global Reports.

Theophane Osee, A., & et al. (2025). From QoS to QoE: A comprehensive survey on user-centric network management. Journal of Network and Computer Applications, 210.