Metropolitan regions North Carolina and FrankfurtRheinMain - a comparison of structures, demographics and economic power in relation to smart services

Christian SCHACHTNER,
Vice President and Professor Business Informatics with focus at digitalization in the public sector
RheinMain University of Applied Sciences, Wiesbaden, Germany
christian.schachtner@hs-rm.de

Nadine BAUMANN,
Substitute Professor Business Informatics with focus at digitalization in the public sector
RheinMain University of Applied Sciences, Wiesbaden, Germany
baumann.nadine@mail.de

Abstract
The article compares the digital transformation strategies and regional development trajectories of North Carolina and the FrankfurtRheinMain metropolitan region, examining how structural, demographic and economic conditions shape their capacity to deploy smart services and strengthen competitiveness. Objectives are to analyze similarities and differences in digital infrastructure, skills, governance and inclusion, and to assess how regional characteristics influence the design and impact of digital initiatives. This is important because both regions are economically strong hubs that seek to leverage digitalization for long-term growth, social inclusion and quality of life. The study builds on concepts of smart cities, digital equity, regional innovation systems and metropolitan governance, and connects US debates on closing the digital divide with European discussions on smart city development and digital regional policy. It links empirical data and policy documents from North Carolina's digital equity and broadband programs with strategic initiatives and statistical profiles of FrankfurtRheinMain as a German metropolitan region. Methodologically, the paper applies a comparative case study approach, combining document analysis of policy strategies, investment programs and regional statistics with a structured cross-case comparison along the dimensions of infrastructure, skills, social inclusion and economic orientation. Results show that North Carolina prioritizes massive investment in basic broadband infrastructure and targeted measures against the digital divide, while FrankfurtRheinMain builds on a more advanced infrastructure to focus on smart city projects, 5G rollout and digitalization of finance and urban services. Both regions strongly emphasize digital skills, but differ in their instruments for social inclusion, with North Carolina relying more on affordability programs and device access, and FrankfurtRheinMain concentrating on groups with specific participation barriers. The findings imply that academics and policymakers should treat digital transformation as context-dependent, requiring place-sensitive mixes of infrastructure investment, skills development and governance coordination. For practitioners, the study highlights transferable practices in smart city development from FrankfurtRheinMain and in digital equity and inclusion from North Carolina. The paper's value lies in offering a structured, transatlantic comparison that integrates economic, infrastructural and social dimensions of digital transformation at regional scale. It contributes an original dual focus on smart services and digital equity, demonstrating how two advanced regions can follow divergent yet complementary paths toward similar strategic goals, and outlining concrete areas where mutual policy learning is feasible.

Keywords: digital regional development; digital infrastructure comparison; governance coordination.

1. Introduction
This study examines the structural, demographic and economic differences between the US state of North Carolina and the German metropolitan region of FrankfurtRheinMain. Both regions play an important role in their respective

countries and have interesting parallels and differences that warrant a comparative analysis. In today's digitalised environment, regional initiatives to promote digital infrastructure and skills are crucial for economic and social development [1] , [2].

North Carolina has made significant investments in broadband infrastructure expansion in recent years to close the digital divide and promote digital participation for all populations. The state relies on massive government funding programs, such as the Digital Navigator Initiative and the Affordable Connectivity Program, to improve access to high-speed internet and digital devices for disadvantaged households [1], [3]. At the same time, digital literacy and education programs are offered to prepare the population for the demands of the digital economy [4].

The FrankfurtRheinMain metropolitan region, on the other hand, builds on an already strong digital infrastructure and is increasingly focusing on the development of smart city solutions, the digitization of the financial sector and the promotion of start-ups and innovation [2]. The region is pursuing a strategy aimed at integrating digital technologies into urban infrastructure and expanding 5G networks. In addition, programmes for the digitalisation of educational institutions and the further training of skilled workers are being implemented [5], [6].

The comparative analysis shows that both regions pursue similar strategic goals in order to maintain and expand their economic competitiveness. The focus on education, research and innovation as well as the promotion of future-oriented industries are central elements. North Carolina places particular emphasis on closing the digital divide and promoting digital participation, while FrankfurtRheinMain emphasizes the development of smart city concepts and the integration of digital technologies into business and administration [1], [2].

Mutual recognition and the exchange of best practices can be of great benefit to both regions. North Carolina could benefit from FrankfurtRheinMain's experience in developing smart city solutions, while FrankfurtRheinMain can learn from North Carolina's approaches to promoting digital inclusion [5], [6].

2. State of research

Digital transformation in metropolitan regions is a central research field of business informatics that deals with the integration of digital technologies into urban and regional infrastructures, administrations and business [7]. In particular, the focus is on the development of smart city concepts and the implementation of digital services, as they have a direct impact on quality of life, competitiveness and sustainable development [8].

The literature shows that metropolitan regions such as FrankfurtRheinMain and US metropolises such as North Carolina have different starting points and challenges, but pursue common strategic goals: strengthening digital infrastructure, promoting digital skills and improving citizen participation [7], [8]. Another aspects as the role of business continuity management (BCM) for public institutions in the context of digital crisis scenarios, underlining the need for integrated risk management [9].

The State of Research shows an increasing importance of empirical case studies that identify regional differences and best practices [10]. Typical research questions concern the effectiveness of digitalisation strategies, the role of governance models and the impact on social inclusion. So, Schachtner and Baumann (2024) emphasize the importance of certified digital skills for municipal decision-makers to successfully shape the transformation and ensure sustainable governance [11]. The development of STEM competencies through innovative learning formats such as "Object-Based STEM Learning" (OBSL) is also cited as key to digital transformation in education [12]. In addition, the link between digital skills and social inclusion in the public sector will be discussed, with recommendations for targeted training programmes being formulated [13]. For example, the Municipal Typology Model Smart City (KTMSC) is used as a methodological instrument for classifying and evaluating municipal digitalization measures [8].

The research emphasizes that digital transformation is a context-dependent process shaped by regional structures, political frameworks, and the interconnectedness of business, administration, and civil society [14]. In addition, the importance of citizen participation and bottom-up approaches for the design of smart cities is emphasized, as they increase the acceptance and effectiveness of digital measures [15].

3. Empirical methodology

The case study is a suitable methodology for the study of digital transformation in metropolitan regions, as it examines complex phenomena in a natural context that are difficult to define [10]. The present study uses a qualitative-empirical case study methodology based on the triangulation of different data sources to comprehensively capture the complexity and contextual dependency of digital transformation processes in metropolitan regions [16], [17]. The case regions (FrankfurtRheinMain and North Carolina) are selected according to the criterion of representativeness for different governance and infrastructure contexts, including both urban and regional levels. The data collection combines guideline-based expert interviews with representatives from administration, business and civil society, a systematic document analysis of strategy papers, project reports and public statistics as well as a content-analytical evaluation of relevant scientific literature [17].

The data are evaluated by means of qualitative content analysis according to Mayring (2015), whereby the categorization is inductively derived from the empirical material. The validity of the results is ensured by the systematic return of the results to the experts (member check) and the transparent documentation of the analysis processes. The methodological approach follows the standards of case study research in business informatics, as described for example by Wilde (2006), and takes into account the special features of the investigation of smart city and digitization processes in urban and regional contexts [10], [18].

4. Results

This chapter compares North Carolina and the FrankfurtRheinMain region, with a special focus on digital projects, data use, and citizen participation. Both regions rely on digital innovations to improve administration, boost the economy and improve the quality of life of their citizens.

4.1 Digital strategies and projects in the FrankfurtRheinMain region

In recent years, the FrankfurtRheinMain metropolitan region has made considerable efforts to expand its digital infrastructure and promote digital projects. Initiatives such as the "Gigabit Region FrankfurtRheinMain" aim to ensure nationwide broadband coverage and create the basis for innovative digital applications (FrankfurtRheinMain Regional Association). The region's "digitalization strategy" includes various projects in areas such as smart city, e-government, digital education and healthcare (Statista, 2025).

Some concrete examples of digital projects in the FrankfurtRheinMain region are [6]:

1. Smart city initiatives: Cities such as Frankfurt am Main and Darmstadt are embracing smart technologies to optimize traffic, increase energy efficiency, and increase safety.
2. E-government services: Many municipalities already offer online services for citizens, such as applying for documents, registering businesses or paying fees.
3. Open data initiatives: Some cities make publicly available data available to promote transparency and enable innovation.

4.2 Digital innovation and civic engagement in North Carolina

"Local Government in North Carolina" emphasizes the growing importance of citizen academies and other innovative approaches to citizen participation [19]. Local governments in North Carolina are increasingly using digital tools to improve communication with citizens and facilitate participation in decision-making processes.

Some examples of digital innovation in North Carolina include:

1. Online portals for citizen services: Many counties and cities offer online portals through which citizens can access information, submit applications, and receive services.
2. Social media channels: Local governments use social media to inform citizens about current events, gather feedback and initiate discussions.
3. Online participation platforms: Some municipalities rely on special online platforms to involve citizens in planning processes and to take their opinions into account.
4. Augmented Reality (AR) Features: The current edition of "Local Government in North Carolina" uses augmented reality to make content more interactive and accessible [19].

4.3 Digital initiatives in North Carolina

North Carolina has made significant efforts in recent years to close the digital divide and improve the state's digital infrastructure. In November 2021, the North Carolina government invested more than $1 billion from the American Rescue Plan Act to achieve ambitious digital development goals [20].

4.3.1 Infrastructure investments

One of the main goals of the initiative is to invest $971 million in the expansion of critical infrastructure. This is intended to provide 98% of underserved households with internet speeds of 100/20 Mbps, with the infrastructure designed for future speeds of 100/100 Mbps. This massive investment underscores the state's commitment to providing high-speed internet coverage across the board [3].

4.3.2 Digital literacy and awareness raising

In addition to infrastructure, North Carolina is investing $50 million in digital awareness programs, as well as digital literacy and skills measures. This initiative aims to better prepare the population for the demands of the digital economy and ensure that all citizens can benefit from technological advances [21].

4.3.3 Affordable connectivity program

Another focus is on promoting participation in the Affordable Connectivity Program, which aims to make internet access more affordable for low-income households. This measure directly addresses the problem of the digital divide, which is often caused by financial barriers.

4.3.4 Statistical findings

The need for these initiatives is underpinned by recent statistics [22]:

1. 91% of jobs in North Carolina definitely or probably require digital skills.

2. 85% of households in North Carolina had an internet connection between 2017 and 2021.
3. 430,000 households in North Carolina do not own a PC or laptop.

These figures illustrate both the progress and the existing challenges in the field of digital inclusion.

4.3.5 Regional initiatives

Individual counties in North Carolina have developed their own digital equity plans. One example is Forsyth County, which unveiled the "Connecting Forsyth County" plan in 2021. This plan aims to improve digital infrastructure, promote digital inclusion and increase the digital literacy of the population [22]. Such local initiatives complement government efforts and enable more targeted adaptation to regional needs.

4.4 Digital initiatives in FrankfurtRheinMain

The FrankfurtRheinMain region in Germany is also pursuing ambitious goals in the field of digitalization, with a stronger focus on developing a smart city and promoting the digital economy [2].

4.4.1 Smart city initiatives

FrankfurtRheinMain has set itself the goal of becoming a leading smart city region in Europe. These include projects to improve urban mobility, increase energy efficiency and optimise urban services through the use of digital technologies.

4.4.2 Digital economic development

The region attaches great importance to promoting start-ups and supporting established companies in their digital transformation. Initiatives such as the "Digital Hub FrankfurtRheinMain" offer platforms for innovations and cooperation between companies, research institutions and start-ups.

4.4.3 Broadband expansion

Similar to North Carolina, the expansion of the digital infrastructure is also being pushed forward in FrankfurtRheinMain. However, the focus here is more on densifying the existing network and introducing 5G technologies, as basic coverage is already at a higher level than in many parts of North Carolina.

4.4.4 Digital education

The region is investing in the digitization of schools and in programs to promote digital skills. This includes equipping educational institutions with modern technology as well as continuing education of teachers and developing digital curricula.

5. Discussion

5.1 Discourse: Digital transformation in metropolitan regions

The comparative analysis of digital initiatives in North Carolina and FrankfurtRheinMain reveals both significant similarities and profound differences in approach and challenges [20], [2]. North Carolina faces the challenge of securing basic digital services, especially in rural areas, as evidenced by massive investments of over $971 million in broadband expansion [20]. In contrast, FrankfurtRheinMain already has a well-developed basic infrastructure and focuses on the densification of the network as well as the introduction of advanced technologies such as 5G [2].

In terms of promoting digital skills, both regions rely on extensive programmes. North Carolina is investing $50 million in efforts to increase digital education and skills, as 91 percent of jobs require digital skills [22]. FrankfurtRheinMain focuses more strongly on the integration of digital education into the existing school system and the further training of specialists in order to drive the digital transformation in business and administration [2].

The differences in the management of the digital divide are striking. North Carolina places particular emphasis on programs such as the Affordable Connectivity Program to provide low-income households with access to the internet — a key approach, as approximately 430,000 households do not have their own PC or laptop [22]. In FrankfurtRheinMain, the digital divide is less pronounced, which is due to a higher average income and better basic services; nevertheless, there are targeted measures to promote the digital participation of older and disadvantaged groups [2].

Both regions emphasise the importance of digitalisation for their economic development. North Carolina benefits from its strong technology industry, especially Research Triangle Park, and fosters innovation-driven businesses. FrankfurtRheinMain positions itself as Europe's leading financial centre and focuses on the digitalisation of the financial sector and the promotion of FinTechs [2].

5.2 Derivations and recommendations for action

The results show that digital transformation is a context-dependent process that is shaped by the respective regional framework conditions. This results in important recommendations for action for practice and policymakers: First, infrastructure investments should be targeted at the respective deficits – in regions with low basic services (such as North Carolina), this is the creation of digital foundations, in regions with good infrastructure (such as FrankfurtRheinMain) the further development of smart city solutions [23]. Secondly, the promotion of digital skills is a key success factor that must be integrated into education systems and vocational training [2]. Third, measures to bridge the digital divide should be continuously evaluated and adapted to ensure the participation of all population groups [23].

Both regions can learn from each other: North Carolina can take over the experience in smart city concepts from FrankfurtRheinMain, while FrankfurtRheinMain can receive impulses from North Carolina for improving digital inclusion [2]. Successful digital transformation therefore requires close cooperation between administration, business and civil society, as well as a continuous exchange of best practices.

6. Conclusion

The comparative analysis of the digital transformation in the metropolitan regions of FrankfurtRheinMain and North Carolina shows that there are significant similarities despite different geographical and political framework conditions. Both regions are focusing specifically on the digitization of administrative services (e-government), the use of social media for citizen communication and the promotion of open data initiatives to increase transparency and innovation [7], [8]. In addition, specific formats such as Citizen Academies are used in both regions to promote citizen participation and understanding of local governance processes [19].

At the same time, both regions face similar challenges: data protection and data security, bridging the digital divide, the shortage of skilled IT professionals, and the interoperability of digital systems [8] [14]. These challenges make it clear that digital transformation is not a technocratic process, but is closely linked to social, organizational and political aspects.

The following recommendations for action can be derived from the findings: First, close cooperation between administration, business and science should be promoted in order to exchange best practices and develop common standards [14]. Secondly, measures to strengthen digital skills among citizens and administrative staff are essential to reduce the digital divide and increase the uptake of digital solutions [18]. Third, the creation of platforms for the exchange and joint development of digital solutions makes sense in order to exploit synergies and pool resources efficiently [24]. Finally, regional specificities and the needs of citizens should be more strongly incorporated into the design of digital transformation processes in order to achieve sustainable and inclusive outcomes [14], [24].

References

[1] NCDIT, „NC Department of Information Technology Strategic Plan 2025 – 2029,“ 2025. [Online]. Available: https://www.osbm.nc.gov/strategic-plan-ncdit/download?attachment.

[2] IHK Frankfurt, „FRANKFURTRHEINMAIN IN FIGURES,“ 2024. [Online]. Available: https://www.frankfurt-main.ihk.de/blueprint/servlet/resource/blob/6222490/00a39bef3c78b8fe22634f458240d98f/frm-in-zahlen-2024-de-data.pdf.

[3] NC Broadband, „Closing the Digital Divide in North Carolina,“ 2021. [Online]. Available: https://www.ncbroadband.gov/documents/american-rescue-plan/gov-coopers-plan-close-digital-divide-2022/open.

[4] „Digital Learning Initiative,“ 2022. [Online]. Available: https://www.dpi.nc.gov/districts-schools/districts-schools-support/digital-teaching-and-learning/digital-learning-initiative.

[5] Statista, „Facts & Figures on the FrankfurtRheinMain Metropolitan Region,“ [Online]. Available: https://de.statista.com/themen/7314/metropolregion-frankfurtrheinmain/.

[6] Regionalverband FrankfurtRheinMain, „Our topics and services,“ 2025. [Online]. Available: https://www.region-frankfurt.de.

[7] Bitkom, „Smart City Index,“ 2025. [Online]. Available: https://www.bitkom.org/Studie-Smart-City-Index .

[8] Deloitte & Fraunhofer IOSB-INA, „Smart Cities and Regions: Shaping Transformation,“ 2024. [Online]. Available: https://www.deloitte.com/de/de/Industries/government-public/research/smarte-staedte-und-regionen-studie.html.

[9] C. Schachtner, „Business Continuity Management (BCM) for public institutions,“ *Smart Cities and Regional Development (SCRD) Journal,* Bd. 9, Nr. 4, p. 23–37, 2025.

[10] T. Wilde, „Methods of Business Informatics,“ 2006. [Online]. Available: https://epub.ub.uni-muenchen.de/14146/1/hess_14146.pdf.

[11] C. Schachtner und H. Baumann, H, „Digital competencies for municipal decision-makers: Certification and training,“ *Smart Cities and Regional Development (SCRD) Journal,* Bd. 8, Nr. 3, p. 15–29, 2024.

[12] J. Shi, „Development of STEM skills and competencies through object-based STEM learning,“ *Smart Cities and Regional Development (SCRD) Journal,* Bd. 9, Nr. 4, p. 38–52.

[13] J. Kausch-Zongo und M. Schenk, „Digital competencies for municipalities – Findings from a comparative study,“ *Smart Cities and Regional Development (SCRD) Journal,* Bd. 6, Nr. 2, p. 45–60.

[14] Smart City Charter, „Digital Transformation in Municipalities,“ 2023. [Online]. Available: https://rdz.salzlandkreis.de/media/15767/anlage-1_smart-city-charta.pdf.

[15] S. Amitava, „Engage citizens to smarten city governance,“ *Smart Cities and Regional Development (SCRD) Journal,* Bd. 9, Nr. 4, pp. 1-12, 2025.

[16] R. K. Yin, Case study research and applications: Design and methods (6th ed.), Sage Publications, 2018.

[17] J. Gläser und G. Laudel, Expert Interviews and Qualitative Content Analysis as Instruments of Reconstructive Investigations (4th ed.), VS Verlag für Sozialwissenschaften, 2010.

[18] BBSR, „Urban Affairs and Spatial Development,“ 2025. [Online]. Available: https://www.bbsr.bund.de/BBSR/DE/veroeffentlichung.

[19] G. Whitaker und R. Morse, Local Government in North Carolina. School of Government, University of North Carolina at Chapel Hill, 2020.

[20] Digital Navigator Initiative, „Digital Equity Plan Final February 2024,“ 2024. [Online]. Available: https://theinstitutenc.org/wp-content/uploads/2024/08/Digital-Equity-Plan-Final-February-2024.pdf.

[21] NC DPI, „Digital Learning Initiative,“ 2022. [Online]. Available: https://www.dpi.nc.gov/districts-schools/districts-schools-support/digital-teaching-and-learning/digital-learning-initiative.

[22] ncIMPACT initiative, „Digital Access and Equity,“ 2024. [Online]. Available: https://ncimpact.sog.unc.edu/2024/04/digital-access-and-equity/ .

[23] Smart City Charter, „Shaping Digital Transformation in Municipalities in a Sustainable Manner,“ 2017. [Online]. Available: https://www.smart-city-dialog.de/system/files/media/906/1694158696/smart-city-charta-kurzfassung-de-und-en1.pdf.

[24] Shaping the region, „Recommendations for action for digital transformation,“ 2024. [Online]. Available: https://www.region-gestalten.bund.de/Region/DE/news/2411_SonderNL_Heimat2.0/6_Erfolgsfaktoren.html.