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DIGITAL HEALTH ECONOMY

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Digital Health Talents on LinkedIn:

Report on Profiles and Expertise from North Rhine-Westphalia

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This study serves as a feasibility analysis aimed at exploring the professional expertise in the field of digital transformation in healthcare from North Rhine-Westphalia (NRW). By analyzing the skills and qualifications of 100 LinkedIn profiles from professionals engaged in healthcare digital transformation, we seek to understand the current landscape of expertise, focusing on their skills, qualifications, and potential. Additionally, this research will provide insights into the future skills requirements and the evolving trends in this sector. As a next step, we plan to apply for LinkedIn's API access to continue analyzing LinkedIn posts related to healthcare digital transformation, including areas such as AI, robotics, and cybersecurity. Using appropriate mathematical models, we will study the current discussion topics and emerging trends in the digital healthcare field. Stay tuned for further updates from our ongoing research.

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1. Introduction

The healthcare sector in Germany is undergoing a significant transformation driven by digitalization. Digital health technologies, ranging from telemedicine to artificial intelligence (AI) in diagnostics, are reshaping healthcare delivery. The success of this transformation depends largely on the availability of skilled professionals with interdisciplinary competencies [1–3]. However, Germany including North Rhine-Westphalia (NRW) faces a significant shortage of skilled workers in key roles critical for digital transformation efforts [4]. Given this shortage, understanding the expertise of professionals working in digital health has become a research priority. LinkedIn, a leading professional networking platform, serves as a valuable resource for analyzing the qualifications and skills of individuals in this field. Current research on this topic remains limited, which is why this study explores the expertise of digital transformation professionals in the healthcare sector of NRW, focusing on their skills, qualifications, and potential.

For this study, LinkedIn profiles were manually collected through the ATLAS account, using the keywords "digital transformation" and "healthcare," and filtered for profiles located in NRW. We applied specific selection criteria (**Table 1**) to include or exclude users, collecting 100 profiles for analysis. The data was analyzed anonymously to protect user privacy, ensuring no personal information could be traced in the final analysis.

After data collection, statistical analysis of the professional expertise and co-occurrence-analysis of self-reported skills were conducted to address the following questions:

1) What regional differences exist in the distribution of digital health professionals across NRW as represented on LinkedIn?

2) How do the educational backgrounds and professional experiences of LinkedIn users correlate with their roles in digital transformation within NRW's healthcare sector?

3) What are the most common skills and competencies among LinkedIn users working in digital transformation roles within the German healthcare sector, and what trends are observable?

Table 1. Inclusion and Exclusion Criteria of LinkedIn Users

Inclusion Criteria	Exclusion Criteria
Personal accounts	Non-personal accounts, such as institutional or business accounts
Users who post at least one post weekly	Users who post less than one post weekly
Users who list skills	Users without listed skills
Users registered in NRW	Users without a registered location or with a location outside NRW

2. Results and Discussions

Based on the analysis of the data from these 100 active digital-health professionals in LinkedIn from NRW, several key insights were derived.

2.1. Geographical Distribution of Digital-Health Talents

Figure 1 presents the geographical distribution of digital health professionals across different regions in NRW. It highlights areas with higher concentrations of these professionals and suggests possible reasons for these patterns. We calculated the number of talents from our sample in each district and city within NRW, with the relative abundance score representing the total number of professionals in each respective district or city.

The analysis reveals several trends regarding the distribution of digital expertise in the healthcare sector across NRW:

- Concentration of Digital Talents: The largest concentration of digital health professionals is found in Düsseldorf (Kreisfreie Stadt), with a relative abundance score of 32, followed closely by Köln (Kreisfreie Stadt) at 30. These cities function as key hubs for digital expertise, likely due to the presence of major healthcare institutions, IT companies, and extensive networking opportunities available in these urban centers.
- Moderate Presence in Certain Regions: Cities like Bonn, Dortmund, and Leverkusen display moderate levels of digital health professionals, with scores of 5, 4, and 4, respectively. Although these cities are not as prominent as Düsseldorf or Köln, they still play a significant role in housing the skilled workforce essential for digital transformation in healthcare.
- Limited Digital Expertise in Smaller Cities: Many smaller cities and rural areas, such as Bielefeld, Coesfeld, and Düren, show notably lower scores, often with only one or two professionals specializing in digital health. This points to a significant disparity in the distribution of digital expertise, indicating that these regions may face challenges in accessing the skills necessary for successful digital transformation in healthcare.
- Urban-Rural Disparity: The data suggests a distinct urban-rural divide. Larger cities like Düsseldorf and Köln attract more digital healthcare professionals, while rural areas and smaller towns lag behind. This disparity is likely due to the greater availability of professional opportunities, advanced infrastructure, and resources in metropolitan regions, making them more attractive to skilled professionals.

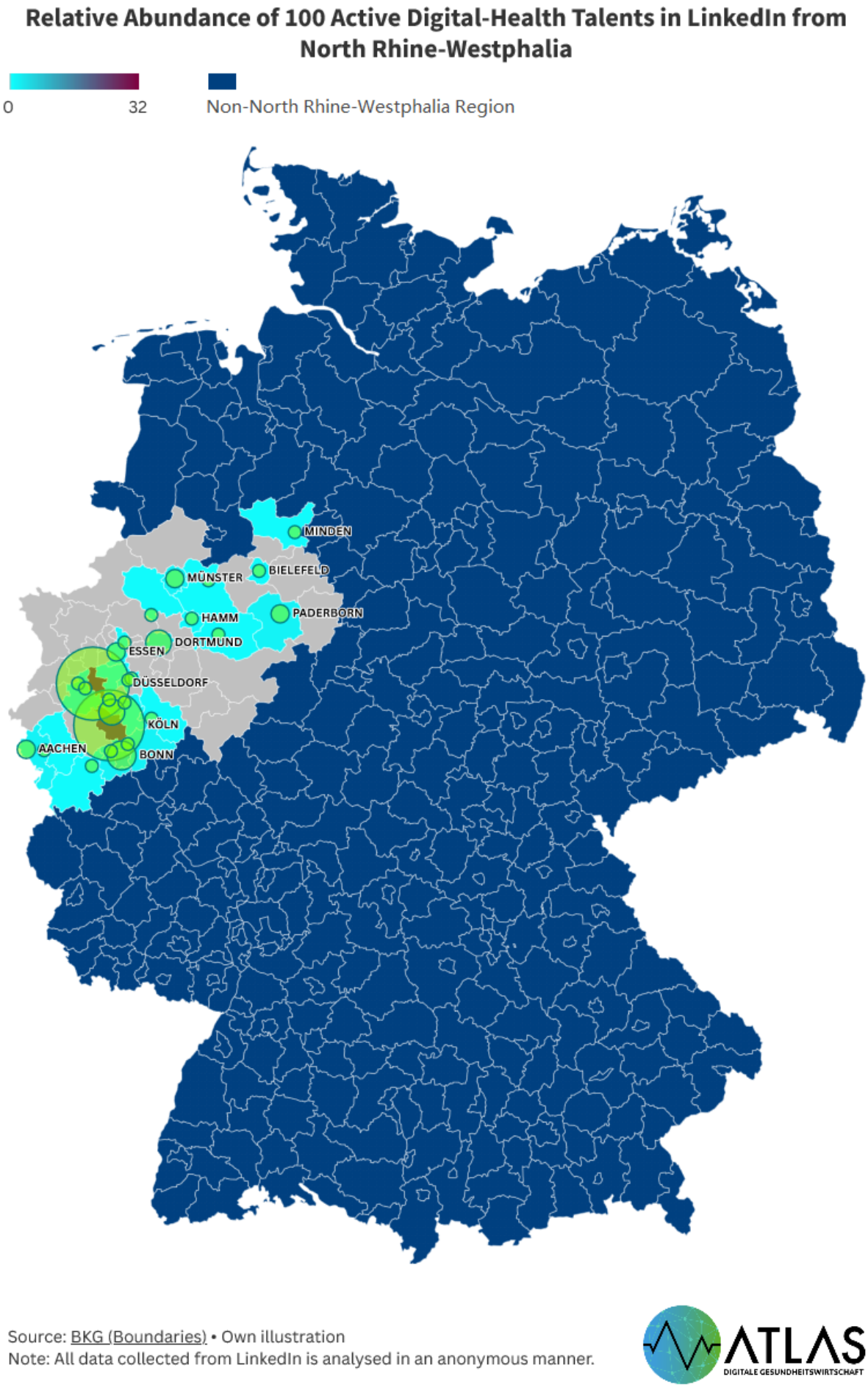


Figure 1. Relative Abundance of 100 Active Digital-Health Talents in LinkedIn from North Rhine-Westphalia

- Potential for Regional Development: Regions such as Münster, Aachen, and Paderborn, each with a relative abundance score of 2, could benefit from targeted programs aimed at attracting and retaining digital health professionals. Establishing specialized training centers or fostering collaborations between local universities and healthcare providers could help to close the skills gap in these areas, facilitating a more balanced distribution of expertise across NRW.

The findings indicate a significant concentration of digital health expertise in major urban centers within NRW, highlighting the need for strategic efforts to address the uneven distribution of talent and support the broader digital transformation of the healthcare sector. This concentration is likely influenced by factors such as the presence of leading scientific research institutions, which increase the demand for digital health expertise. Furthermore, regions with favorable investment climates and higher population densities tend to attract more professionals due to better job prospects and superior infrastructure. Addressing these imbalances through targeted initiatives could help ensure that all regions can fully benefit from advancements in digital healthcare.

2.2. Educational Backgrounds of Digital-Health Talents

A total of 91 out of 100 users provided information about their educational background. **Figure 2** illustrates the diversity in educational backgrounds among digital health professionals, providing insights into the various fields of study and qualifications held by individuals involved in this sector in NRW. From the analyse results, several key conclusions can be drawn regarding the educational profiles of those involved in digital transformation within the healthcare sector in NRW:

- Diverse Educational Backgrounds: The data highlights a wide range of academic qualifications among these professionals. Degrees span across multiple disciplines, including medicine (6 individuals), computer science (12 individuals), business administration, purchasing, and management (55 individuals), as well as specialized fields such as health economics (9 individuals) and digital health-related engineering (9 individuals). This diversity suggests that the field attracts talent with interdisciplinary skills, which are essential for addressing the complex challenges of digitalizing healthcare [5].

- Prevalence of Advanced Degrees: A considerable number of professionals hold advanced qualifications, including Master's degrees (M.Sc.), Doctorates (Ph.D. and Dr. rer.), and Diplomas. This indicates that expertise in digital transformation within healthcare often requires a high level of academic achievement, particularly in areas like healthcare management, information technology, and engineering. The presence of doctoral degrees in disciplines such as medicine, computer science, and business underscores the importance of deep subject matter expertise in driving digital initiatives.

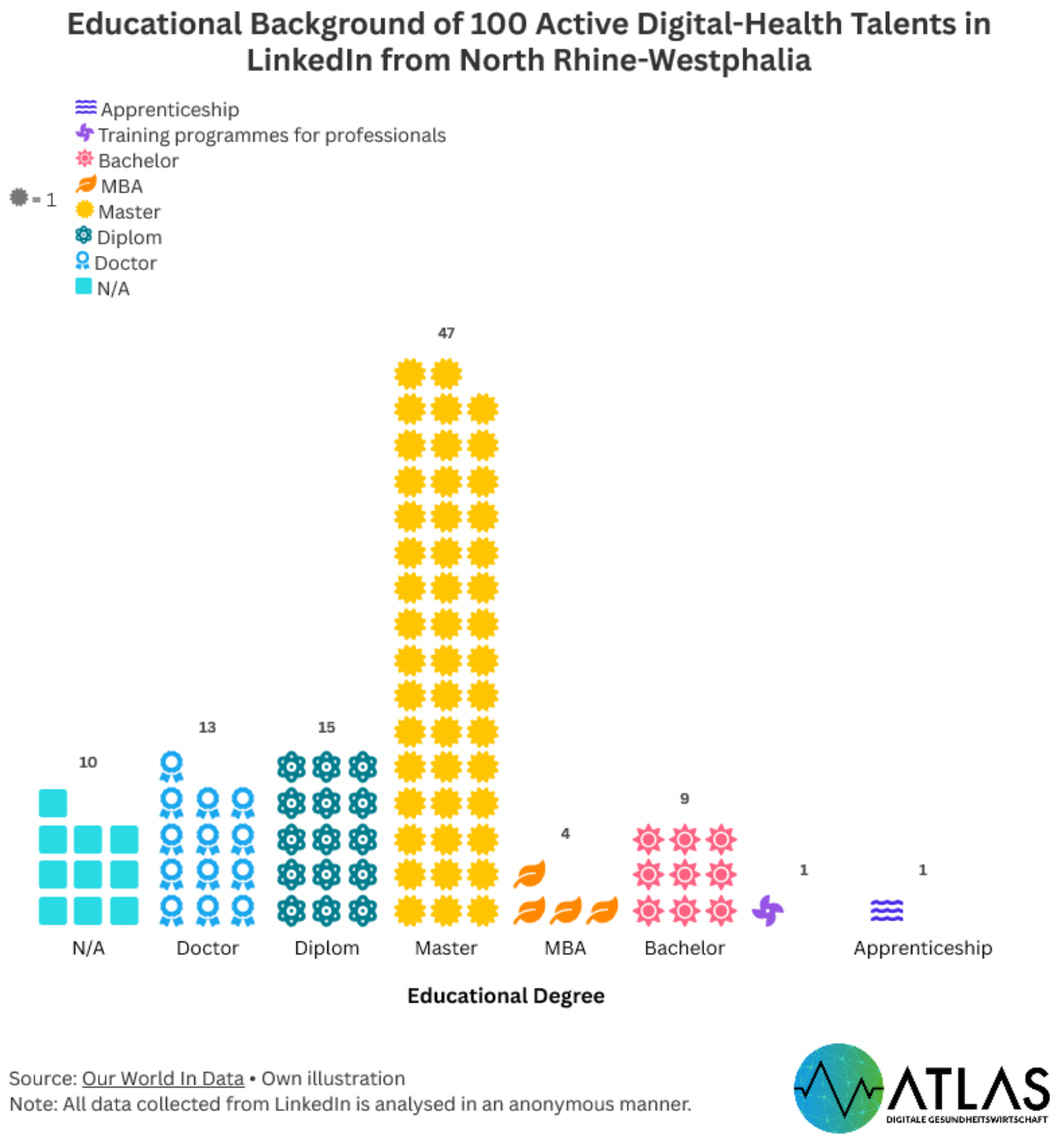


Figure 2. Educational Background of 100 Active Digital-Health Talents in LinkedIn from North Rhine-Westphalia

- Emphasis on Business and Management Skills: A significant proportion of the professionals have backgrounds in business administration, management, and digital strategy. This reflects the strategic nature of digital transformation projects, which often require strong leadership and management skills to integrate technological solutions into healthcare effectively [6]. Degrees such as MBAs and M.Sc. programs in Business Consulting & Digital Management highlight the demand for leadership capabilities in this field.
- Technical and Health IT Expertise: Many professionals have specialized in health informatics, IT management, and related technical disciplines, such as computer science and engineering. This technical expertise is critical for implementing and maintaining digital health systems, ensuring the smooth integration of technologies like telemedicine platforms, electronic health records (EHRs), and AI-based diagnostic tools into healthcare operations.
- Global Perspectives through International Education: The presence of degrees from international institutions (22 individuals), including those from universities in the UK, the USA, and other European countries, indicates that some professionals bring global perspectives to Germany's digital health sector. This international experience can be instrumental in adopting best practices and innovative solutions from other healthcare systems, further enhancing digital transformation efforts.

Overall, the diversity of educational backgrounds among digital health professionals in NRW reflects the interdisciplinary nature of the field. It demonstrates a blend of technical, strategic, and international expertise, which is essential for successfully navigating the complexities of digital transformation in healthcare.

2.3. Career Experience of Digital Talents

Based on the analysis of job titles and career paths, we created **Figure 3** to illustrate the distribution of work experience. By combining this data with information from job profiles, several key insights into the professional backgrounds of individuals working in digital transformation within the healthcare sector can be drawn:

- Experienced Leadership: A significant proportion of the professionals (44 individuals) hold senior or leadership roles, including titles such as Managing Director, Chief Technology Officer (CTO), Chief Innovation Officer, and Senior Manager. Many of these leadership roles have career start dates dating back to the 1990s and early 2000s, indicating the presence of seasoned leaders who provide strategic oversight and guide digital transformation initiatives within the healthcare sector. Their experience is critical in shaping and driving complex digital transformation projects.

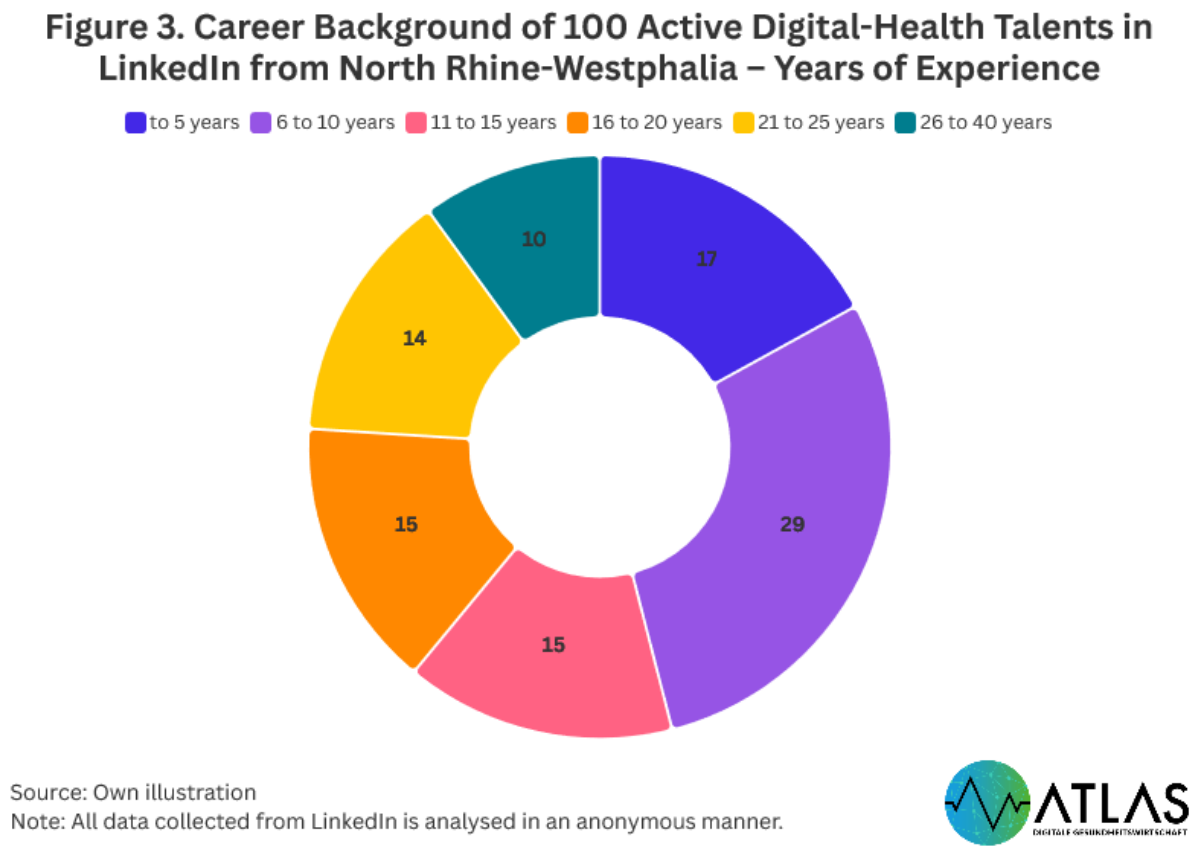


Figure 3. Career Background of 100 Active Digital-Health Talents in LinkedIn from North Rhine-Westphalia – Years of Experience

- Recent Growth in Digital Roles: The data reveals a marked increase in job roles related to digital transformation beginning around 2015. Positions such as "Project Manager for Digitalization" (8 individuals), "Consultant for Digital & AI Ethics" (9 individuals), and "Digital Product Development" (6 individuals) demonstrate the growing importance of specialized digital skills in recent years. This trend indicates an intensified focus on digital transformation in healthcare, likely driven by advancements in technology and evolving models of healthcare delivery.
- Emergence of Specialized Roles: Newer, highly specialized positions, such as "Artificial Intelligence Officer" (1 individual), "Healthcare Professional Partner" (1 individual), and "Radiology Digital Solutions Director" (1 individual), are emerging within the sector. These roles highlight the need for expertise in specific digital health applications, including AI, medical informatics, and clinical information systems. Their presence underscores the growing complexity of digital healthcare delivery and the demand for specialized skills to address these challenges.
- Blend of Traditional and Emerging Roles: The data also reflects a mix of traditional management positions, such as "Managing Partner" and "Senior Strategy Manager," alongside newer, digitally-focused roles like "Head of Transformation & Innovation Excellence" and "Digital & AI Ethics Manager." This combination suggests that while traditional leadership remains essential, the evolving needs of digital transformation are prompting organizations to create new roles specifically focused on the integration of emerging technologies into healthcare systems.
- Varied Tenure Across Professionals: The tenure of these professionals varies widely, with some having started their careers as early as the 1980s and 1990s, while others began their positions more recently, in 2021 or 2022. Overall, the professionals have diverse levels of experience, ranging from less than 5 years to more than 26 years in the field. The majority (29%) fall within the 6 to 10 years category, suggesting that a substantial portion of the workforce has accumulated significant experience but is still in the early to mid-stages of their careers. Approximately 10% of professionals have between 26 to 40 years of experience, representing highly seasoned individuals who likely play key leadership and mentoring roles. The remaining professionals are distributed fairly evenly across the 11 to 15 years (15%) and 16 to 20 years (15%) experience brackets, indicating stable growth of digital expertise over time. Around 17% of professionals have 0 to 5 years of experience, reflecting the entry of new talent into the field, which could inject fresh perspectives and innovation into digital transformation efforts.

The findings indicate a maturing landscape of digital health leadership in NRW, characterized by a balance of seasoned leaders, mid-career professionals, and newer specialists. This healthy mix of early-career, mid-career, and experienced individuals positions the region’s healthcare sector for continued innovation and stability in its digital transformation journey. The diverse career timelines ensure that there is both continuity and fresh thinking, allowing for sustainable growth and adaptation to emerging

technologies. This blend of experience and perspectives is crucial for driving innovation while maintaining strategic oversight in the rapidly evolving digital healthcare environment.

2.4. Skills and Expertise of Digital-Health Talents

First, we created Figure 4 based on the self-reported skills of the 100 LinkedIn users included in the analysis. This figure presents a word cloud that highlights the most frequently mentioned areas of expertise among digital health professionals. The size of each word corresponds to how often a particular skill is cited, offering a visual representation of key competencies. The word cloud provides a concise summary of the core skills and expertise within this talent pool, revealing several key insights into the focus areas and strengths of these professionals:

- Core Skills in Project Management: The term "Project Management" is particularly prominent, indicating that many professionals emphasize their proficiency in managing projects. This skill is crucial in digital transformation initiatives, where effective management of timelines, resources, and complex tasks is essential for successful implementation [7].
- Focus on Digital Transformation: "Digital Transformation" is a major area of expertise, reflecting the alignment of these professionals with the ongoing shift towards integrating digital technologies in healthcare. This focus highlights their role in transforming traditional healthcare practices through innovative digital solutions.
- Emphasis on Business Development and Strategy: Skills such as "Business Development," "Business Strategy," and "Management Consulting" are also frequently mentioned. This underscores the strategic orientation of many professionals, emphasizing their role in ensuring that digital solutions align with broader business goals and market demands.
- Leadership and Team Management: Skills like "Leadership," "Team Leadership," and "Change Management" are prominent, indicating the importance of guiding organizations through digital transitions. These capabilities are essential for facilitating the adoption of new technologies and leading teams through change processes [6, 7].
- Technical and Analytical Skills: The presence of terms such as "Data Analysis," "Artificial Intelligence," "Scrum," and "Agile Methodologies" reflects a strong emphasis on technical proficiency and modern development frameworks. These skills are vital for the development, deployment, and refinement of digital tools within the healthcare sector, enabling the effective use of data-driven insights and AI applications.



Figure 4. Self-Reported Skills of 100 Active Digital-Health Talents in LinkedIn from North Rhine-Westphalia

- Customer and Process Orientation: The emphasis on skills like "Customer Relationship Management (CRM)" and "Process Improvement" suggests a focus on enhancing user experience and optimizing workflows through digital solutions. This customer-centric approach is critical to ensuring that digital transformation efforts translate into tangible improvements in healthcare delivery.

The skills highlighted by these LinkedIn users represent a well-rounded mix of strategic, technical, and leadership capabilities. This suggests that digital health professionals in NRW are well-prepared to tackle the complex challenges of integrating new technologies into the healthcare sector. Their expertise aligns closely with industry needs, where a blend of strategic oversight and technical know-how is essential for driving effective digital change. This balanced skill set positions them to play a pivotal role in shaping the future of digital healthcare in the region.

Second, we conducted a co-occurrence analysis using the collated data on the skills of the digital health professionals. The results of this analysis are visualized in Figure 5, which was created using VOSviewer. This network diagram illustrates the co-occurrence of skills among 100 LinkedIn users active in digital transformation within the healthcare sector, offering insights into the relationships between various competencies and their relevance in this field.

The analysis reveals several core clusters of skills that frequently co-occur, indicating areas where expertise is concentrated. Central themes like "analytics," "service," "continuous delivery," and "software" are closely connected with other skills, highlighting their foundational role in digital transformation within the healthcare sector. These skills occupy a central position in the network, reflecting their importance in the implementation and management of digital solutions.

The diagram also identifies strategic focus areas. For example, skills related to "business strategy," "innovation," and "legal innovation" form distinct clusters, emphasizing the critical role of strategic planning and innovation management in digital transformation efforts. The connections between "business strategy" and technical skills, such as "software development life cycle" and "analytics," underscore the importance of integrating strategic oversight with technical execution in digital healthcare projects.

The integration of technical and business skills has become a notable trend. The co-occurrence of technical skills like "artificial intelligence," "high-performance computing," and "clinical trial management systems" with business-oriented skills such as "project management" and "customer relationship management (CRM)" highlights the need for a multidisciplinary approach. This integration is crucial for driving projects that align both technological advancements and business objectives.

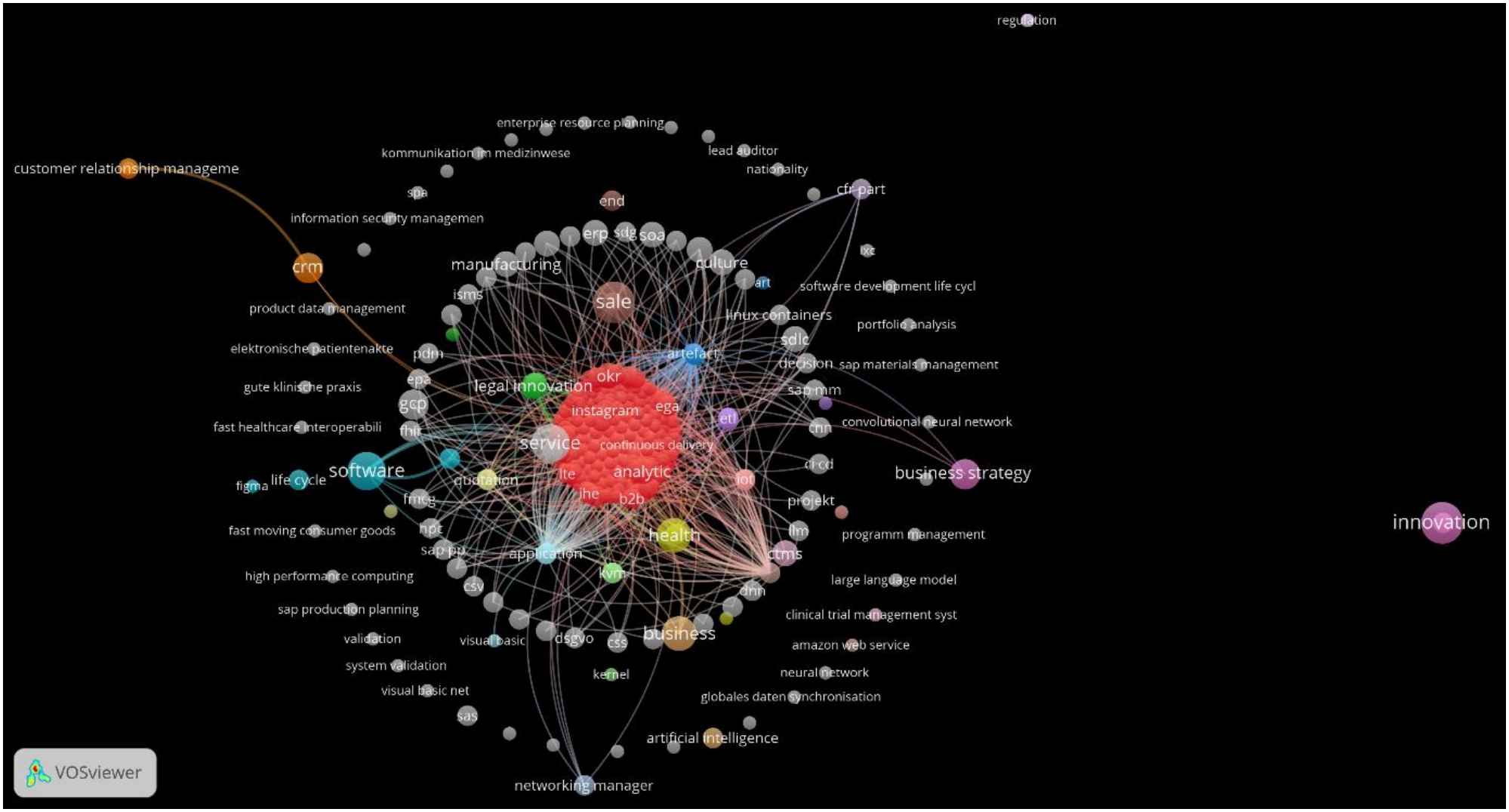


Figure 5. Network Visualization Map for The Co-Occurrence Analysis Based on Self-Reported Skills of 100 Active Digital-Health Talents in LinkedIn from North Rhine-Westphalia

New professional fields are also emerging. Skills like "continuous delivery," "cloud computing (AWS)," and "machine learning" are positioned at the intersections of different clusters, indicating their cross-functional relevance. These skills are often associated with digital transformation projects that require continuous updates, scalability, and advanced data processing capabilities within healthcare settings.

The analysis further shows an increasing emphasis on compliance and security. Skills such as "information security management" and "data synchronization" appear in the network, reflecting the critical importance of data security and regulatory compliance in digital health. This focus is likely driven by the need to adhere to regulatory requirements and protect sensitive health information in digital systems.

The presence of skills related to emerging technologies, such as "neural networks," "large language models," and "IoT," suggests a growing interest in leveraging advanced technologies to enhance healthcare outcomes. These emerging fields are seen as key areas for future growth and competitive advantage within the healthcare sector.

Overall, the co-occurrence analysis highlights a balanced integration of technical, strategic, and regulatory expertise among digital health professionals. Core competencies in analytics, software development, and service delivery are complemented by strategic management skills, underscoring the need for a holistic approach to digital transformation. The network also points to a trend of embracing advanced technologies like AI and IoT, while maintaining a strong emphasis on data security and compliance. This combination of skills is crucial for the successful adoption and implementation of digital solutions in the healthcare sector, ensuring both innovation and operational stability.

3. Conclusion

This research provides valuable insights into the skills and expertise of digital transformation professionals within Germany's healthcare sector, focusing specifically on LinkedIn users from NRW. The analysis reveals several important trends and implications for the field.

Firstly, the geographic concentration of digital health professionals, particularly in urban centers like Düsseldorf and Köln, highlights a regional disparity in the availability of digital expertise. While metropolitan areas benefit from a dense network of professionals, smaller cities and rural regions often face challenges in accessing the talent needed for digital healthcare projects. These regional imbalances can affect the equitable delivery of digital health solutions across the country. Policymakers and educational institutions should consider targeted initiatives to attract digital talent to underserved regions, thereby addressing these disparities.

The analysis of educational backgrounds reveals a diverse range of qualifications among professionals, including fields such as health informatics, business administration, and computer science. The prevalence of advanced degrees (Master's, Ph.D.) reflects the complexity of digital transformation in healthcare, which requires expertise in both technical and strategic domains. This diversity is crucial for fostering innovation and ensuring that digital solutions are effectively tailored to the specific needs of the healthcare sector. However, it also presents a challenge in aligning these varied skill sets toward a unified digital transformation strategy.

Regarding work experience, the data indicates a broad spectrum, ranging from early-career professionals to those with over 20 years of experience. This mix creates a dynamic workforce that combines the innovative approaches of newer entrants with the deep industry knowledge of seasoned professionals. However, the significant presence of mid-career professionals suggests that the digital health sector is still maturing, with potential challenges in retaining senior talent who can mentor the next generation.

The co-occurrence analysis of skills highlights the interdisciplinary nature of digital transformation efforts. Skills such as project management, analytics, digital transformation, and business strategy are closely interconnected, reflecting the multifaceted demands of successful digital initiatives. The prominence of emerging technologies like AI and IoT within the skill network underscores the sector’s forward-looking approach. However, integrating these technologies with traditional healthcare practices requires careful management to ensure that technological advancements translate into practical improvements in patient care.

Overall, the findings underscore the complexity of building a digital health workforce capable of driving innovation while addressing the unique regulatory, operational, and cultural challenges of the healthcare industry. Although there is a growing base of digital talent, strategic planning is needed to effectively integrate and leverage these skills across different regions and healthcare settings.

Limitations

Despite the valuable insights provided by this research, several limitations must be acknowledged.

First, the data for this study is derived solely from LinkedIn profiles identified through our ATLAS account search. This approach may not capture the full range of digital transformation professionals active in NRW's healthcare sector. Additionally, not all professionals use LinkedIn, and those who do may choose to highlight specific skills and experiences, potentially introducing bias.

Second, this study focuses specifically on LinkedIn users in NRW, which limits the generalizability of the findings to other regions in Germany. The digital health landscape may differ significantly in other states, necessitating further studies to comprehensively understand these regional variations.

Third, the skills and expertise analyzed in this study are self-reported by LinkedIn users, introducing a degree of subjectivity. Users may emphasize skills they perceive as marketable rather than those they use most frequently, leading to an incomplete or skewed representation of their actual competencies.

Furthermore, the data provides a snapshot of the current state of digital health expertise but does not account for changes over time. As the field of digital transformation evolves rapidly, the relevance of certain skills and roles may shift, affecting the long-term applicability of the findings. Future research could benefit from a longitudinal approach to track changes in digital health expertise over time.

Addressing these limitations in future studies could enhance our understanding of digital transformation in healthcare, providing more comprehensive and regionally inclusive insights.

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