

Rotterdam in transformation

The convergence of social, physical & digital Rotterdam

october 2024

1. The impact of digital transformation on the city

1.1 Context of major changes

Climate change, poverty, migration, lack of trust in government: this era is full of challenges. These challenges are transforming the city we can see, smell, and touch—the physical city—and the city as a community of people living together: the social city. And there is a third major change, the digital transformation, which increasingly leads to a digital city. Rotterdam is shaping this transformation in various ways.

The CIO Office of the municipality offers a forward-looking perspective on the future with this narrative, providing a coherent view of the changing city. One thing is certain: the digital transformation is just beginning. In this narrative, we will first discuss how the digital transformation is changing Rotterdam and what this means for the residents, businesses, and organizations in our city. Next, we will explain how the municipality is addressing this. Finally, we will outline future developments that are coming our way and how we plan to deal with them.

1.2 The impact of digital changes on Rotterdam

Society is becoming digital. Almost everyone has a smartphone, pays digitally, or orders items from a webshop. Physical objects are also becoming more digital; think of shared scooters, self-driving cars, or drones. This changes the way we live.

In public transport, people physically sit together in a carriage, but almost everyone is in their own digital world. This also changes the challenges facing the city. We are dealing with a digital reality that is inextricably linked to our lives. It is not a separate, parallel world. And it is certainly more than just a tool. Through this ongoing interaction, the dynamics of the city are changing.

The municipality of Rotterdam assumes a continuously interdependent social, physical, and digital reality. People easily arrange to meet friends both physically and digitally, or in a hybrid form, and engage in activities like Pokémon Go or geocaching.

They also encounter digitization in areas such as health-care, education, or payment systems. Digital transformation is taking place everywhere. This digital transformation impacts all levels and sectors of Rotterdam: the city, society, and the municipal organization.

1.3 Opportunities and challenges

The digital transformation brings both opportunities and risks. Opportunities include:

- New technologies, such as robotics, immersive technology (AR, VR, XR), generative AI (like ChatGPT), and drones for various applications in areas like healthcare and education;
- Increased digital connectivity among people through smartphones, social media, and faster networks; nieuwe vormen van participatie en democratische processen;
- New forms of participation and democratic processes;
- More efficient and effective management of the city (such as sensors in sewage systems and waste bins);
- More and better information due to greater data availability and the ability to combine this data.

However, it is not just a story of benefits. The digital reality also leads to:

- Cybercrime, such as attacks on critical infrastructures of hospitals, water and energy supply, as well as new forms of crime like deep fakes and voice cloning;
- Vulnerability because society is more dependent on well-functioning digital systems, such as ATMs;
- Bullying and hate speech on social media, leading to an increasing negative self-image among young people;
- A growing divide between those who can and cannot utilize digital opportunities;
- Space consumption and energy and water use by data centers.

The opportunities and threats make it more urgent for every organization to incorporate the digital reality as a standard consideration when determining the challenges they face.

The municipality of Rotterdam is no longer questioning whether to engage, but how to take on its role in this transformation.

2. How is the City of Rotterdam managing digital transformation?

2.1 Important principles

For the municipality, the following three principles guide the digital transformation:

✓ Society, not big tech, determines the course

Currently, digital infrastructure is entirely a private matter. There is no digital public space or infrastructure yet. The big tech companies ensure that everyone is digitally connected. Is this wise? Digital infrastructure could also serve as a utility. And isn't a digital public space¹, where we as a society set the rules, not only desirable but absolutely necessary?

To define its role, Rotterdam faces a choice between two extremes or something in between. One extreme is the "neoliberal model," where the market—big tech—decides, and the government regulates (reactively). The other extreme is "digital authoritarianism," where the government is the sole owner and controller. Complete government control, as seen in countries like China, is undesirable in Western societies. Moreover, it would underutilize the potential of the private sector.

The Netherlands largely follows the neoliberal model, which carries risks. If the market dictates digital transformation, it leads to increasing dependence on large tech companies for both government and citizens. These companies sometimes know better than the municipality about the quality of public roads, provide more current data and more accurate information, and are quicker to identify emerging pandemics.

A monopoly position of large tech companies on current information undermines our democracy. Additionally, these companies often evade responsibilities and public values such as accessibility, transparency, privacy, equality, fair pricing, and a level playing field.

Since laws and regulations to govern this are often inadequate, lacking, or delayed, a grey area arises where rules are absent in practice. Besides the existing regulations, the municipality wants to ensure that digital technologies and data are handled decently and responsibly in this grey area.

✓ Digital inclusion: No one left behind

The municipality of Rotterdam aims for a digitally inclusive society for all its residents and employees. This includes access to devices and the internet, as well as the skills and knowledge to use them effectively. If everyone is to participate, attention must also be given to the development of digital infrastructure.

Attention is also directed towards the welfare, values, and rights of Rotterdammers in the digital realm. Rotterdam strives for a digital living environment that does not discriminate or exclude people. The municipality increasingly communicates through digital means, both internally and with citizens and businesses. This growing digital service provision may lead to some people being unable or unwilling to participate in the digital world, resulting in exclusion². To prevent individuals from being cut off from society, the municipality must continue to provide non-digital services.

The digital transformation thus affects the resilience and adaptability of Rotterdam's residents, businesses, and organizations. The municipality sees it as its duty to ensure that they can benefit from the opportunities and not suffer from the risks. This includes preventing cybercrime and helping people prepare for digital changes.

Therefore, Rotterdam is committed to closing the digital divide. However, the municipality can only achieve this if the "digital leaders³" and other organizations feel jointly responsible for this goal.

✓ Data belong to everyone

It is important to establish a digital infrastructure that enables the sharing of data. To facilitate this sharing, the concept of "interoperability" is essential. It allows different organizations and systems to communicate and share real-time information through the use of a "shared language."

Focusing on this shared language for data exchange, in the form of open standards and protocols, is therefore the starting point. The underlying idea is that understanding each other's (data) language is a prerequisite for sharing and reusing data and for developing cohesive applications. This also forms the basis for interconnected applica-

tions through a sort of “app store⁴,” such as modeling tools and visualization resources. Furthermore, it is important to use generic, scalable, and maintainable data sources. To enable responsible reuse and sharing of these data sources, they must comply with the FAIR principles: Findable, Accessible, Interoperable, and Reusable.

2.2 How is Rotterdam implementing the digital transformation?

The municipality began developing the Open Urban Platform in 2019. This platform is the hub of the digital infrastructure that provides all Rotterdam residents with a safe, responsible, and transparent digital environment. It is a platform created by and for all residents, businesses, and organizations in Rotterdam.

In setting up the Open Urban Platform, the municipality employs the Digital Twin concept: all current data about Rotterdam is brought together in one common location. This allows everyone to use, add, and share data. Thus, the Open Urban Platform serves as the foundation for new applications, services, information dissemination, and participation.

For example, a housing corporation could provide 3D information of buildings to the fire department, enabling them to fight fires more effectively. Or residents might participate in a pilot project where they design in 3D for the redesign of a square in their neighborhood. Starting in January 2025, the Open Urban Platform with Digital Twin will be available for Rotterdam residents, businesses, and organizations.

2.3 Unique public-private partnership

The digital infrastructure for Rotterdam requires a clear distribution of responsibilities and powers: governance. Research shows that stakeholders have the most confidence in the success of the Open Urban Platform if a private entity is responsible for its development and operation.

Additionally, they believe that the government has an important supervisory role, particularly regarding safety and ethical considerations.

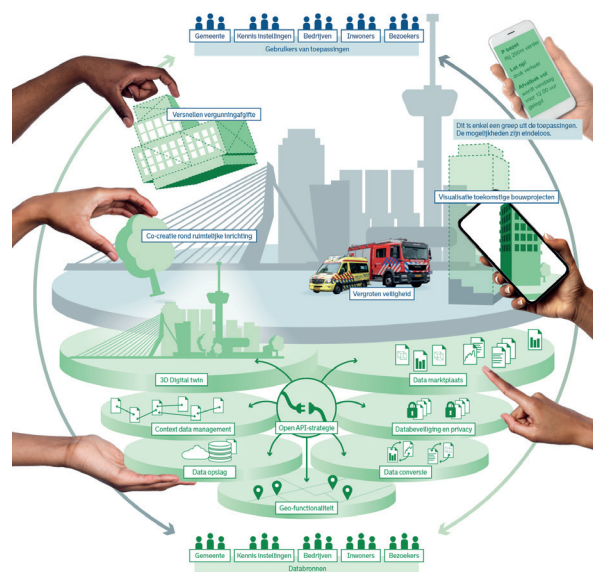
This has led to the following division of roles. A private

company, Future Insight, is responsible for the construction, launch, operation, and further development of the Open Urban Platform. The municipality, as the public entity, oversees the responsible operation of the Open Urban Platform to ensure public values such as privacy and transparency are upheld.

However, in practice, there are always situations where laws and regulations are still lacking or inadequate. For example: Are coffee shops allowed to advertise on the platform? Is there a level playing field for businesses? And what commercial reuse of collected data is permitted?

To monitor this grey area specifically, an independent governance board has been established, consisting of representatives from the municipality, the operator, the business sector, academia, and citizens. Additionally, a so-called market master (employed by the operator) oversees daily operations and reports to the governance board.

The infographic below shows the dynamics of the Open Urban Platform.



3. New horizon

3.1 Adding a social component

People are increasingly blending the physical and digital worlds, and infrastructure must support this integration. Currently, the Open Urban Platform with Digital Twin connects only the physical and digital worlds. This means it enables data exchange for elements like buildings, trees, and streetlights—in short, everything you encounter in the physical city. The next step is for people to also become part of the digital city⁵. For instance, residents could create social profiles or personal data vaults on the platform, allowing them to become “residents” of the digital city or explore Rotterdam digitally. This setup would enable a resident to apply for a permit for a dormer window, drawn onto a digital copy of their own house. In this way, the social, physical, and digital realities are intertwined. Together, we build a safe digital city, where as a resident of Rotterdam, you can be assured that your privacy is respected, your data is handled with care, and you have a say in the rules that apply. What is standard in the offline world should also be the norm online.

3.2 Metaverse/Citiverse

One of the upcoming major digital transformations facing the city is the development of the Metaverse—a new era of the internet featuring virtual digital worlds that extend real life. Here, users can create personalized avatars to interact with others, work, play games, visit museums, or buy goods in a virtual space.

The Citiverse is the European version of the “American” Metaverse. A key distinction is that the Metaverse is a private, tech-driven development, while the Citiverse is more human-centered and based on public-private collaboration.

Additionally, the Metaverse primarily aims to create a virtual (social-digital) world, whereas the Citiverse, from the outset, envisions integration with the existing physical world. Urban restructuring or new construction plans are prime examples of this.

In the Citiverse, it will be possible to calculate the effects of these plans in real-time and visualize them in various ways: through holographic tables for resident participation, through augmented reality at physical construction sites, and through a 3D city model at any location (and in

any form). The Citiverse is not a new technological development but rather a concept to articulate the potential societal impact when various new technologies converge. For instance, what will it mean when Artificial Intelligence (AI), robotics, and Virtual Reality start to reinforce each other? What will be the impact of this on the city? Rotterdam is exploring what the Citiverse entails and how the future city will look as these worlds increasingly converge. This raises many questions, such as:

- What does this mean for municipal services?
- How do we ensure everyone can participate and benefit from the opportunities?
- How do we create a safe digital environment?

3.3 Rotterdam prepares for the Citiverse

Rotterdam is a national and international leader in establishing the foundational conditions for the Citiverse. In recent years, the city has successfully developed the Rotterdam Open Urban Platform with Digital Twin, earning local, national, and even international recognition.

The Rotterdam Citiverse strategy builds on this foundation. The technologies are essential, but they are neither the starting point nor the ultimate goal; the city and its citizens are always central.

For this reason, the CIO Office is launching the Rotterdam Citiverse program. The primary goal is to present a new digital framework by 2027. This framework will further outline the implications of the Metaverse/Citiverse on Rotterdam and its residents, including the role of the municipality.

Rotterdam collaborates with many national and international organizations and networks⁶ to achieve this, such as the European project ‘x-CITE,’ in which Rotterdam and various European partners further define the Citiverse concept. Within the municipal organization, there is also coordination and collaboration across various programs.⁷

Consulted experts

(august-september 2024)

1. Arnoud Molenaar, Chief Resilience Officer, City of Rotterdam
2. Bas Boorsma, CEO, Urban Innovators Global; Professor of Practice, Thunderbird School of Global Management
3. Brenda van Breemen-Olij, Innovation Manager, Participation & Digitalization, City of Rotterdam
4. Bruno Ávila Eça de Matos, Head of Digitalization, Process and Information, Project Management Bureau, City of Amsterdam
5. Catholijn Jonker, Professor, Interactive Intelligence Group, Faculty of EEMCS, TU Delft & Explainable Artificial Intelligence, LIACS, Leiden University
6. Christina Yan Zhang, CEO, The Metaverse Institute, London; UN ITU Co-Chair on Prestandardization for the CitiVerse
7. Danny Bongers, Advisor, Process, Data & Innovation, Services Cluster, City of Rotterdam
8. Danny Colijn, Director, Customer Contact, Services Cluster, City of Rotterdam
9. Dario Keizer, Data Secretary, Sustainability Department, Urban Development Cluster, City of Rotterdam
10. Esmeralde Marsman, Process Manager, Customer Innovation Center, Services Cluster, City of Rotterdam
11. Harmen van Sprang, Founder/CEO, Sharing Cities Alliance; Coordinator, CoK Future Society Lab
12. Haydee Sheombar, Master Thesis Coach, Business Information Management; Researcher, Digital Transformation, Erasmus University Rotterdam
13. Heleen Elferink, Director, Communication, Media, and Information Technology (CMI), Rotterdam University of Applied Sciences
14. Jan Bruijn, Project Manager, DMI, NLDT Program, Directorate of Spatial Policy, Ministry of Housing and Spatial Planning
15. Jillian Benders, Process Coordinator and Advisor, Sustainability Department, Urban Development Cluster, City of Rotterdam
16. Joab de Lang, Strategist, Cyber Security, Digital Inclusion, City of Rotterdam
17. Koos Boersma, Program Manager, Geonovum
18. Lianne Sleenbos, Program Manager, Network of Local Digital Twins (NLDT), Ministry of Housing and Spatial Planning
19. Lucianne Bouman-Vermeulen, Change Manager, City of Rotterdam
20. Mark Verschuur, Team Leader, GIS & Advisory, Basic Information Department, Urban Management Cluster, City of Rotterdam
21. Martine Delannoy, Advisor, Smart & Sustainable Cities & Communities; EU Project Developer, Digital Flanders
22. Matias Ansaharju, Development Manager, City of Tampere (Finland)
23. Maurice de Beer, Duty Officer & Knowledge and Innovation Director, Rotterdam-Rijnmond Safety Region
24. Michel Grothe, Advisor, Geo-Information & Digital Twins, Geonovum
25. Miranda Saunders, Program Manager, Digital Inclusion, City of Rotterdam
26. Peter Troxler, Senior Lecturer, Rotterdam University of Applied Sciences
27. Peter van Waart, Coordinator, Smart & Societal City, CMI, Rotterdam University of Applied Sciences
28. Rebecca Moody, Assistant Professor, Erasmus University Rotterdam
29. Stephan van Aken, Policy Advisor, Innovation for a Healthy Living Environment, Environment and Healthy Living Team, Province of Utrecht
30. Tomasz Jaskiewicz, Senior Lecturer, Civic Prototyping, Rotterdam University of Applied Sciences; Design Fellow, IDE Faculty, TU Delft
31. Virginie Verstraete, Global Partnerships Coordinator, Open & Agile Smart Communities (OASC)

Notes

1. An alternative model is the “commons-based governance” approach. In this model, essential digital infrastructures, such as data and platforms, are considered public goods collectively managed by the community, with the state ensuring public values such as privacy and equality. This model is central to the digital policies of cities like Barcelona, Bologna, and Ghent. Rotterdam’s “Governance Board” model shares many similarities with this approach and may eventually evolve toward a more commons-based governance model.

2. Research shows that, in addition to seniors and people with low literacy, there is also an increase among young people and those in their twenties who either 1) wish to go “off the grid,” or 2) have so little trust or belief in current society/government that they choose to withdraw completely (such as those who no longer want to make digital payments). While these may seem like fringe groups, and the extreme cases are, this trend is present to a lesser degree in others as well.

3. Digital pioneers are those who have the knowledge and skills to leverage the opportunities of digital transformation for themselves and their communities. This can be in a professional context (from creating a digital CV to developing a new digital service or application) or in a personal context (from completing digital forms to helping children with ChatGPT).

4. In the coming period, as part of the EDIC-nLDT, there will be collaboration with the Ministry of Housing and Spatial Planning and Geonovum to develop a linked app store, making applications much more accessible. This will simplify and reduce the cost of data and application management and usage for municipalities and other organizations.

5. The principle is that physical reality is the only autonomous reality. The physical world exists independently of humans or computers. A “pure” digital reality exists only where there is machine-to-machine (M2M) communication, meaning computers talking to each other without any effect or connection to the social and/or physical world. Only when a digital choice or decision impacts the social or physical world is a connection formed. The “pure” social reality is best compared to what Yuval Noah Harari calls the “imaginary layer” in his book *Sapiens* (2011). It encompasses constructs that exist only in people’s minds, such as social constructs like money, political systems, and religion. This layer allows us to organize in large groups and develop shared frameworks of abstract values. Technically, a pure social reality doesn’t exist, as humans are physical beings who can only communicate through physical and/or digital means. This “imaginary layer” therefore has many physical and digital forms. The same applies to computers and the “pure” digital world, which also cannot exist without a physical manifestation.

6. Various academic institutions (e.g., Erasmus University Rotterdam, Rotterdam University of Applied Sciences, TU Delft), government bodies (e.g., Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations, Ministry of Housing and Spatial Planning, Rotterdam-Rijnmond Safety Region, Province of South Holland, G6, Tampere, Flemish Cities Association), companies and organizations (e.g., Veldacademie, Zadkine, Krill o.r.c.a., HOWest, Woonstad, Geonovum, SharedCitiesAlliance); networks such as Open Agile Smart Communities, Eurocities Digital Forum, EDIC-nLDT, DMI ecosystem, Boundless Data Landscape, Dutch Societal Innovation Hub, NextReality Metaverse NL, Lighthouse project, Future Society Lab.

7. Programs like VONK (digital innovation center and meeting space), Resilient Rotterdam, 3D Rotterdam, Digital Inclusion, MyRotterdam, and Rotterdam Weather Response.

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