INAUGURAL LECTURE

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Civic Prototyping

a creative encounter between design prototypes and engaged citizens

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Hogeschool Rotterdam Uitgeverij

ISBN: 9789493012295
First edition, july 2022

This book is a publication by Hogeschool Rotterdam Uitgeverij
P.O. box 25035
3001 HA Rotterdam

DTP - The creative hub, Canon

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a creative encounter between design prototypes and engaged citizens

Inaugural lecture

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Rotterdam, 6 july 2022

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Introduction

My parents gave me my first computer, when I was eight. I'm not sure if they had a very clear idea of what that thing was, or what they wanted me to do with it. Nonetheless, they rightly believed that computers would shape the future, and that I had to be made familiar with what this future was about to bring. The computer I received, an Atari 65XL, did initially not have the option to load or save programs. The separate floppy drive station was out of stock, and I had to wait for months until it finally was delivered. In the meantime, my uncle showed me the cult computer magazine 'Bajtek' (published in the communist Poland, where I was born and raised), which had a section called 'Programming kindergarten'. It contained short programs written in a now archaic programming language called Basic, that I could retype on my computer, and that would for example make an aeroplane made out of a few letters and signs move on the screen, or allow me to solve a simple mathematical puzzle. I couldn't save my code creations, but I learned the very basics of programming by changing little parts of the code, and observing the effects. My second-favourite toy was Lego blocks. I could spend days building and improving all kinds of robots and spaceships, and imagining a future where these kinds of digital machines would fill the world around me. When the time came to pick a profession, I was torn between wanting to do something creative, and wanting to do something with technology. The creative side won, and I chose to study architecture. My second choice would have been robotics, but I found the dryness of engineering daunting. Industrial design, which seemed like a good choice too, was at the time taught solely at art schools in Poland, and mainly concerned with making products that looked good, and less with how they worked or what purpose they served. User experience (UX) design simply didn't exist yet, neither as a term nor as something anyone could study.

During my architectural studies I learned practical design skills, and how to use a computer as a convenient replacement for the traditional drawing board. Yet, it was only during an Erasmus exchange at TU Delft, that I found what I was really looking for in a study. I subscribed to courses at prof. Kas Oosterhuis' Hyperbody group, who back then tried to push all possible boundaries of using digital technologies in architecture. As his students, we built interactive models of interactive buildings in a 3D computer game engine. We also built physical, full-scale prototypes of parts of those buildings. And we explored how computers could be used to generate complex building forms impossible for a person to

draw, and how numerically controlled machines could automatically produce components for these buildings. I followed Kas, his university group and his architectural practice for years. It was a great professional experience that also fuelled my PhD research on design methods for interactive buildings. Yet, the closer we got to making interactive buildings technologically possible, the less convinced I became about their practical purpose. Somehow, in all the cool visualisations, simulations and prototypes, we missed the everyday, nitty-gritty, practical usability of the otherwise spectacularly looking structures. I turned to the Industrial Design faculty in Delft, as a place renowned for its expertise and research on user-centred design. I was lucky to get an assistant professor position there, with prof. Pieter Jan Stappers, a key co-design scholar, as my mentor. I used my time there to investigate the nuances of prototyping as a research-through-design activity, and a way to engage experts and non-experts alike in a design process. And now, I've taken another leap in my career, starting a lectorate at Rotterdam University of Applied Sciences to bring my research on, through and for design prototyping closer to practice, and closer to the people affected by the prototypes.

Over three decades after I received my first bulky computer, I find myself sitting on the train. I use my smartphone strapped in a 3D-printed cover to watch video clips shared on social media. The clips feature life-like Boston Dynamics robot prototypes navigating city streets. A colleague calls me via MS Teams on my smartphone. We have a productive discussion and send each other digital notes and files as we talk. Without my colleague noticing, I read an incoming message from my wife, reminding me to buy bread on the way home. Minutes later, I leave the train. I swipe my public transport card with RFID chip across a digital terminal. The gate automatically opens and lets me through, and the travel fee is instantly deducted from my digital bank account, taking into consideration the length of the trip, the time of the day, and the discounts I was eligible for, all of which my phone instantly notifies me of. I keep the phone in my hand and use it to start a shared e-scooter parked on the pavement. I ride the scooter home, while following the GPS navigation on my phone to avoid unexpected road closures. While effortlessly riding the silent scooter through the park, I suddenly realise that the digital future I was imagining when playing with Lego as a child, is already here. Yet, somehow, the world around us doesn't feel like the science-fiction utopia we all hoped it to be. Many things have become simpler and faster, but other things have become more complex and difficult. And having my head busy with these thoughts, I forget to buy bread on the way home.

Technology surrounds us, and shapes our lives in ways we don't even notice when consumed by day-to-day activities. In that, technological innovation continues to both solve and create new problems. For example, the Internet used to be seen as an enabler of free speech, equality and democracy. In the meantime it has also brought us fake news, misinformation, and increasing social polarisation. Newly emerging technologies, such as artificial intelligence, carry similar hopes and fears. What exactly do these technologies mean and how will they affect our daily lives? Can we control and shape them as citizens, or will they control us? These questions are difficult to answer, because they involve complex socio-technological phenomena that are impossible to predict.

My professional career has revolved around making prototypes, researching how prototypes influence designers and designing, and looking for better ways to prototype. Through my work, I've come to see the value of prototypes in reducing complex socio-technological issues to concrete and communicable objects and situations. I've also come to understand the value of prototyping as a skill that not only designers or engineers can benefit from. The term Civic Prototyping is a shorthand for making prototyping accessible to anyone trying to improve the world around them, and thereby making involved technologies easier not only to consume, but also to contest and innovate with. The overarching goal of the Civic Prototyping lectorate is to develop Civic Prototyping methods and instruments and to investigate how Civic Prototyping processes can be facilitated in the city.

Next to supporting innovation, prototypes also enable serendipitous encounters of people, views, and ideas, unleashing new creative opportunities, projects, interests, and collaborations. This book is organised around a series of examples that illustrate such encounters, not only in their physical sense, but also as combinations of concepts that usually are not found next to each other, but when put together open new perspectives on design in the digital world.

Figure 1. Harm van Beek trying out a 1,5 metre-distance-indicating-device-prototype on the streets of Rotterdam. (Photo: © The Incredible Machine)

CHAPTER 1

Design prototyping meets civic engagement

In March 2020 the Dutch government announced the 'intelligent lockdown' in response to the accelerating COVID pandemic. Shortly after that, a Rotterdam-based designer Harm van Beek designed and built a prototype, which made a few headlines, as in the newspaper 'Algemeen Dagblad' (Liukku, 2020). The new regulations required everyone to keep 1,5 metre distance from each other in public spaces, and van Beek's prototype was a direct response to this new social and organisational challenge. It was ingeniously simple. It consisted of a stick attached to a person's back, with a laser pointer on its top, and a mirror spinning on a battery-powered computer fan. All was held together by Lego blocks and duct tape. The laser and the spinning mirror were positioned so that the laser projected a circle of 1,5 metre on the ground surrounding its wearer, indicating to passers-by the minimum distance they were supposed to keep from him.

The prototype was a response to a new, complex and uncertain situation. Nobody knew then how the COVID pandemic would unfold, what measures would follow, and how the everyday lives of people would become affected. Harm van Beek explained that people went out and didn't know exactly how far to keep their distance, and he had to come up with something more imaginative. He did what designers do best. He came up with a creative response to this situation, prototyped it and tried it out. His prototype did not aspire to be a 'solution' to all the complex challenges imposed by the pandemic on society. It was merely a way to make a small step in making one abstract rule more tangible, and to help people understand its daily-life implications.

At the same time, van Beek's act of building and trying out his prototype was also an act of civic engagement. He wasn't commissioned to design and build his prototype by a client. He took action as a concerned citizen struggling

with a difficult situation, which affected his ability to participate in the public life of the city. By engaging with others on the street while wearing his prototype, and by recording and sharing his experience, he provided a new voice in the public debate, and, through that, he presumably helped others to better understand and deal with the new reality of COVID-induced limitations.

Van Beek's prototype is to me a result of a creative encounter of two activities that don't often go together. Design prototyping is what designers do as part of their creative process. Civic engagement is what citizens do when they take action to improve their neighbourhood and local community. 'Civic prototyping' is a shorthand term for a combination of these two activities, and this chapter unfolds what such a combination entails.

Why the new term 'civic prototyping'?

Civic prototyping is a term that emerged during a series of discussions I've had with my colleagues at Research Centre Creating010 of Rotterdam University of Applied Sciences. I was looking for a name that would somehow relate to my research interests in the phenomenon of design prototyping and the role it can play in supporting civic engagement. The name civic prototyping seemed to resonate well with everyone. But is it really necessary to come up with a new term like this when there are already so many different and well-established names out there for different types of design? There are design disciplines distinguished by what is being designed, such as product design, architectural design, interaction design or service design. There are also design domains distinguished by how designers go about designing, such as user-centred design, co-design, or evidence-based design. Finally, other fields of design, such as critical design, transition design, research through design, social design or systemic design, denote the different purposes that designs may have. Each of such diverse, but often overlapping, areas of design has its own communities, which continue debating, researching and publishing on different ways of doing design.

Across these different discourses there seems to be one clear trend: the diversity of ways one could be a designer is growing, and the expectation that designers tackle challenges of increasing complexity increases. This has a lot to do with the evolution and complexity of digital technologies. Both interaction design and user-centred design emerged in the 1980s from a need to design

digital systems that not only perform certain functions, but also engage with people in meaningful interactions (Norman & Draper, 1986). Experience design followed in the 1990s to encompass not only the interactions between people and products, but also the larger contexts of these interactions (Norman et al., 1995). Service design, and product-service system design were an answer to growing intricacy of digital systems, and involvement of multiple artificial, human and organisational actors. The current wave of systemic design takes its concern for large scale effects of designed systems and their interactions with each other on the society and environment at large a step further, at the scale of interplay of multiple services, organisations and communities. In this quest for leveraging design to address increasingly bigger and more complex problems of the world, while embracing challenging technologies such as the Internet of Things or Artificial Intelligence as design material, it's easy to lose sight of the mundane, everyday considerations. By this I don't only mean concern for the everyday situations faced by people, and the impact that complex innovation has on them. I also mean the need to give these people a voice in shaping their own future in this increasingly complex world, in parallel, or in opposition to what big-tech corporations or governments may prescribe as being best for them. Civic prototyping is for me a way to put non-designers in the driver's seat of socio-technological transformations that happen in the very context of their everyday lives.

The designer's way of going about problems

Designers, such as van Beek in my example, have a distinct way of dealing with problems they encounter. The universal logic of a design process is quite straightforward. It involves investigating the problems and opportunities at hand and coming up with creative solutions or interventions. The designer's way of investigating problems and creating solutions is unique, because designers keep moving back and forth between these two activities.
Such moving back and forth happens on different timescales. When sketching an idea, a designer repeatedly steps back from the drawing, reflects on it, and makes adjustments, and often produces tens or hundreds of such drawings. Donald Schön (Schön, 1983) called this 'making moves'. When working with prototypes, designers similarly test quick mock-ups to validate their assumptions, sometimes resulting in hundreds of prototypes being built for a single project. Finally, the entire design process is often purposefully repeated multiple times, because validation of a detailed design concept often leads to new insights, to questioning the initial design assignment, and to reformulating (or: reframing, as introduced, and in 2015 extensively discussed by Kees Dorst) the initially stated problems. In a sense, such iterations of moving back and

forth between problem investigation and solution forming often continue after an explicit design process is finished. Digital apps and services are continuously assessed and updated after being released. Such an iterative approach makes designing messy, but also allows for 'out of the box' ways to approach the design 'problems' and 'solutions'[1] at hand.

Design thinking

The last two decades there is a growing recognition of the distinct qualities of designing. In 2008 Tim Brown, chair of the acclaimed design agency IDEO, explained designing as a seemingly chaotic "creative human-centred discovery process (...) followed by iterative cycles of prototyping, testing, and refinement" (Brown, 2008, p. 4), and promoted the term 'design thinking' as a way to apply this process to fields outside of design. Many designers I know frown when 'design thinking' is mentioned. It has become a hype in the last decade to use the design thinking banner to apply designer's ways of creative problem solving to traditionally non-design disciplines, ranging from business innovation to politics. While designers may complain about 'bastardisation' of their professional expertise, adoption of design thinking shows that designing has something unique to offer as a mindset.

Research through design

While the design thinking buzz focuses on the unique way designers deliver creative solutions, the notion of 'research through design' (RtD) emerged from the appreciation of the distinct way in which designers learn through designing and prototyping interventions. "If you want truly to understand something, try to change it" is a seminal statement appropriated to Kurt Levin, the early pioneer of action research (Tolman, 1996). The process through which designers inject their creative interventions into the world around them, and assess and reflect on the

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1 Nigel Cross and Kees Dorst have popularised this view of a design process through their seminal paper 'Creativity in the design process: co-evolution of problem-solution' (2001). Over twenty years later, there is an ongoing debate if we should at all use the words 'problem' and 'solution' in design. The word 'problem' has negative connotations, and excludes cases when designers don't respond to a clear negative situation at hand, but to a positively framed opportunity for improvement (for example see Desmet and Pohlmeyer, 2013. The word 'solution' implies that what designers create will be an ultimate answer to the problems at hand, while it is unavoidable that once some problems are resolved, new, unexpected ones may arise. To quote Kees Dorst: "Design is not about creating 'solutions' in the same sense that we create solutions to mathematical equations, as absolute truths in an abstract world. Designers create proposed solutions that can be judged on a sliding scale of better or worse relative to the needs of stakeholders" (Dorst, 2015, p.43). Nonetheless, both 'problems' and 'solutions' are deeply ingrained in the vocabulary of designers, and for the sake of clarity, I'll use both terms as a shorthand for respectively 'problems and opportunities' and 'solutions and interventions'.

impact of these interventions on the world bears many similarities with action research. "Design research both inspires imagination and informs intuition through a variety of methods with related intents: to expose patterns underlying the rich reality of people's behaviours and experiences, to explore reactions to probes and prototypes, and to shed light on the unknown through iterative hypothesis and experiment", according to Jane Fulton Suri (Fulton Suri, 2008, p.54). This quote perfectly captures my understanding of what RtD is, the kind of hands-on, practical investigation into the design context that is an integral part of doing design.

The academic discourse on RtD unfolding over the past two decades is primarily concerned with recognising the value of such investigation, the knowledge it produces, and developing better methods for the legitimation of this knowledge.[2] RtD has become a method and community of its practitioners, and the first RtD conference was organised in 2015. What made this conference exceptional was its catering to both academics and design practitioners, bringing together various styles of doing applied design research, and leveraging design prototypes as a valid form of passing on design knowledge. In 2019 I was involved in organising the RtD conference in Delft, where we have experienced how the discourse on applied design research has matured over the past years. Yet, the diversity of RtD approaches has also prompted a discussion on what constitutes a 'good' RtD practice, that guarantees the validity and generalisability of knowledge generated through applied design research, and that can be taught to new generations of designers.

Design prototyping

Images of a design thinking process typically feature people discussing things around whiteboards packed with post-its and sketches. The RtD discourse and conference series have been explicit in giving a much more prominent role to prototyping and prototypes as a central activity and object of design. Much has been written about prototypes and their role in a design process. Generally, a prototype is typically defined as "anything that someone builds to represent a 'product' or experience before the actual artefact or event is completed" (Sanders & Stappers, 2016, p. 62), and as "a representation of a design idea, regardless of medium" (Houde & Hill, 1997, p. 369). Yet, I don't fully agree with such definitions. If a prototype were any representation of a design idea, a drawing of such an idea should also be called a prototype. Yet, when designers say 'prototype' they typically mean something more than a drawing.

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2 Stappers and Giaccardi have presented a comprehensive overview of the discourse on RtD, in their article 'Research through Design' (2017).

Regarding the etymology of the word prototype, the prefix 'proto' comes from Greek and has the basic meaning 'first in time' or 'first formed' (www.merriam-webster.com). It implies something that is 'first of a new type', or in other words, something new that has never existed before. In that sense, a prototype is not just a representation of a designed artefact, but more its early version. This early version may be highly incomplete, approximate and partial, yet it is different from a drawing, as it can be put into use in the world. In that sense, a prototype is much more than a sketch or drawing, because it can be used, embedded in the world around it, and change the world in some unexpected ways.

To me, the very activity of creating a prototype and confronting it with the world is a cornerstone of designing. A prototype converges all insights, ideas and abilities of designers working together. It supports designers in the communication with each other, clients, external experts, and prospective users, of how the problems at hand are framed, and how they could be solved. In that, a prototype functions as a 'boundary object' (Star & Griesemer, 1989) and enables the formation of a 'community of practice' (Wenger, 1999) that can stretch far beyond those who are directly involved in its making. Van Beek's prototype of a social distancer is a perfect example of that. By trying it out in public and by sharing it through social media and newspapers, it has reached thousands of people, triggered their critical thoughts on the COVID social distancing regulations and in many ways challenged the public debate on the potential repercussions of these regulations. Through such 'confrontations with the world', prototypes are instrumental in generating new knowledge. An experiment is one distinct form of such a confrontation, where a prototype is being tested in a controlled environment to validate a known hypothesis. Yet, designers employ a wide range of other ways of confronting their prototypes with the world and learning from it. Very often these are informal, haphazardly conjured situations that generate new experiences enabled by prototypes of designed interventions. Buchenau and Suri call these prototypes 'experience prototypes' (Buchenau & Suri, 2000), as newness lies not only in the artefact, but also in the way that people perceive and engage with it. In van Beek's case, the prototype was not just a curious device on a stick, but the act of walking with it through the streets of Rotterdam, directly or indirectly engaging with passers-by.

Prototypes converge the insights, ideas and skills of designers. Yet, by confronting prototypes with the world, designers also generate new insights, ideas and develop new skills that, in turn, their next prototypes will embody. This confrontation can take a lot of forms, and the discourse on RtD engages with a broad range of research methods borrowed from fields ranging from engineering to social sciences. Arguably this diversity is both the advantage and the Achilles heel of RtD, as one RtD process can't be compared to another. Compare for example a rigorous usability assessment of a car interface prototype (Meschtscherjakov et al., 2009) and an autobiographical

research on transforming a van into a camper prototype (Desjardins & Wakkary, 2016). The assessment involves statistical analyses of car interface variants to study people's perception of the specific, explicitly formulated and comparable (with other studies) aspects such as behavioural intention of use, perceived usefulness, and perceived ease of use. In the autobiographical research the researcher investigates at once the subjective, embedded experience of the designer, the maker and the user of the modified car, over the period of multiple months, aiming to capture not specific aspects, but the entirety of the involved experience. While both examples could be described as RtD, the act of designing and realising several prototypes and confronting them with the world is the only similarity between them.

Regardless of the research attitudes, designers like van Beek (from my opening example) regularly go out of their design studios, ateliers and labs and bring their prototypes to the streets. In many cases this is done as part of their design research, as a deliberate action to obtain new insights from the reactions of people to the prototype. In the case of van Beek, the purpose is not given. Was his intention to obtain new insights? To show off his idea? To provoke a discussion? Was it a genuine attempt to use his prototype as a practical solution for keeping distance to passers-by? Or, all of the above?

Civic engagement

Whatever van Beek's motivation for building his prototype and taking it to the streets of Rotterdam may have been, I see his action as a form of civic engagement – an intervention that, whether in a provocative or practical way, has directly (albeit only slightly) influenced his neighbourhood and its local community. There is a subtle difference between the English words 'civic' as in 'civic engagement', and 'civil' as in 'civil society', which the Dutch language doesn't capture well. 'Civil' is rather broad, meaning the part of society that is not related to the government or other organisations. In that sense, 'civil society' is the 'third sector' of society, distinct from government and business, and including the family and the private sphere. 'Civic', on the other hand, means something that is 'of a town or city, or the people who live in it' (dictionary.cambridge.org). In that sense, the word 'civic' denotes phenomena much more local and context-specific than what 'civil' typically refers to. In that context, the term 'civic engagement' refers to the "ways in which citizens participate in the life of a community in order to improve conditions for others or to help shape the community's future" (Adler & Goggin, 2005, p. 1). The term 'civics' refers to the social science dealing with the rights and duties of citizens (Geddes, 1906), but here too, the emphasis on the local aspects of citizenship is implied. Throughout this publication, I will follow Carl DiSalvo in using the term 'civics' as a shorthand for 'democracy in the small',

to describe "situated experiences that strive toward forms of togetherness that enable collective agency and communal life" (DiSalvo, 2022, p. 19) DiSalvo's 'democracy in the small' can take many forms, which range in scale, duration and involved parties. On the smallest scale this may involve individual volunteerism, but can also engage larger communities, governmental and non-governmental organisations. Civic engagement can involve people taking direct action to change their neighbourhood, or indirectly through influence exercised on other public or private parties.[3] It often takes form of 'tactical urbansim' (Brenner, 2015, p.112-121; Mould, 2014, p.529-539), which is a general term for small-scale citizen-initiated interventions into the city, which may become catalysts of larger change (Silva, 2016, 1040-1051).

Rotterdam is a city known for the no-nonsense hands-on attitude of its citizens towards shaping their own city, and is prolific with civic initiatives. These can take the form of small and one-off initiatives in local community centres, libraries or private homes, such as neighbours meeting together to cook, to organise a street party, to learn painting together, or to take action to clean up their street and plant flowers after removing pavement tiles. There are also larger initiatives, both in terms of the number of people involved, as in duration and complexity. Those include, for example, bottom-up citizen initiatives to take over maintenance of local parks, or management of street waste removal, all requiring collaboration with the local government, local organisations, businesses, organising finances, and setting up organisational structures needed to sustain initiatives over time. Each such initiative is different, faces different challenges, has different goals, and builds on different motivations of its participants. Each such community needs to organise itself in a creative way, with some form of trial and error process, and a lot of learning-as-it-goes involved. In other words, there seems to be a lot of designing, iterating, prototyping, learning and even RtD involved in the civic life of Rotterdam.

Civic prototyping

The statement that everyone is, or can be, a designer is not new. For example, Herbert Simon wrote in the *Science of the artificial*: "Everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (Simon, 1969, p. 129), and Victor Papanek wrote in *Design for the real world*: "All men are designers. All that we do, almost all the time, is design, for design is

3 While civic engagement is often political in its nature, I side with Ekman and Amnå who advocate a distinction between civic engagement and political participation, where the first is a 'latent' form of participation, not requiring or directly related to explicitly formed political views, as discussed in 'Political Participation and Civic Engagement' (Ekman & Amnå, 2012).

basic to all human activity" (Papanek, 1984, p. 3). Yet, there is a difference of skill and expertise in how designers and non-experts go about designing. In *Design, when everybody designs*, Ezio Manzini (2015) clarifies this difference by using the term 'diffuse design' to denote design performed by non-experts with their intuitive design capacity, and the term 'expert design' which is design performed by trained design professionals. This distinction is not binary, and the various forms of co-design, co-creation and participatory design are positioned between diffuse design and expert design, enabling a variety of forms of engaging non-professionals in design activities. Stappers and Sanders (2008) argue for involving non-professionals in design as 'experts on their own experience'. Yet, in many discussed examples the leading purpose of such engagement is to generate new insights for designers, rather than practical solutions or new knowledge for non-professionals. The 'community-based design' recently advocated for by Norman and Spencer (2019), is a perspective on co-design where the design process is driven by a community of people who experience the addressed problems and have first-hand knowledge of these problems, who will be affected by the designed intervention, and who will take an active role in implementing and co-owning the intervention.

One position to take is to maintain the status quo distinction between expert design and diffuse design, drawing a clear line between expert and non-expert forms of design. Through investigation of civic prototyping as a process I aspire to follow Norman's view on community-based design, where these two forms of designs merge. Yet within that aspiration, I have also specifically chosen to focus on the role that prototyping can play as a central activity in such processes. Designer's ways of iterative reframing of problems, building experiential prototypes, confronting these prototypes with the world, and learning from these confrontations promise to support DiSalvo's 'democracy in the small'. By applying designer's approaches themselves, citizen-driven 'mini-publics' (Escobar & Elstub, 2017) can leverage their personal, direct knowledge of the local neighbourhood and community and their challenges. At the same time, interventions developed from within the community inspire a sense of ownership, trust, and understanding that interventions from the outside do not have. In that sense, civic prototyping is a process that is led and owned by the local community, where designers, experts, local government, business or academic partners participate as guests, rather than leaders.

The challenges of civic prototyping

Seeing citizens as owners of a design process, naturally opens up a question about what should be the role of designers as guests in that process? There are two distinct perspectives one can take when answering this question.

The first perspective is that of a designer being directly engaged in performed civic prototyping activities. One role that design professionals are well equipped to take here is that of a process facilitator. Another role is that of an expert participant, such as design researcher, supporting citizens in articulation of tacit needs, problems, or underlying assumptions. There is also the role of an expert designer, a person who can translate vague ideas into concrete intervention plans. The second perspective is of the designer as a tool maker, well-illustrated by Stappers and Sleeswijk Visser (2014). In this perspective designers may not even be directly involved in the civic prototyping process, but they design tools supporting the processes and activities performed by others. In my research I don't focus exclusively on one of these two perspectives, but rather on the interplay between them.

I did a series of studies on understanding design processes performed by students, and supporting iterative prototyping as a central design activity, predominantly in the context of design studio education. At the same time I was involved in organising a series of civic hackathons, events aimed to engage citizens in coming up with creative use of technology to improve their neighbourhood (Jaśkiewicz et al., 2020). I remember the reflection I had that organising a design session with relatively inexperienced students, and a civic hackathon with citizens and local government representatives have obvious differences, but also many parallels. On the one hand design students are trained in a variety of user research skills, creative techniques, visualisation and working with technology, making them jacks-of-all-trades and enabling them to reformulate problems based on insights formulated from various perspectives, and come up with solutions that equally combine different types of knowledge in innovative ways. On the other hand, although non-designers as individuals are typically less broadly skilled, they do have an in-depth (although often non-explicit) understanding of the problems and opportunities of the context of their everyday lives, and often possess unique skills coming from their individual professional backgrounds. In both cases the challenge of a design studio coach, or a civic hackathon facilitator is similar. It is to guide the collaborating group of people towards a shared articulation of the problem they are going to address, come up with a prototype of the envisioned solution to that problem, confront that prototype with the world and learn from that confrontation, possibly in multiple iterations.

The challenges of supporting such a process are threefold. First, there is the 'prototyping literacy' challenge, which I understand as the need for each involved person to be able to engage in the process of prototyping as a move between problem and solution space. Second, there is the 'civic capacity' challenge, meaning the need to build the capacity of a group of people to work together in a constructive way in a broader context of a city, being a complex socio-technical system. Third, there is the 'inclusive engagement' challenge, meaning the need to include the diversity of voices and expertise in the civic prototyping process.
As a society we need pragmatic tools, strategies, and methods to unlock the ability of local communities to actively, directly participate in the (increasingly digital) transformation of the world around them. And it is through these three challenges that we can approach this goal. The next three chapters address these challenges one by one. In each chapter I have tried to frame the given challenge from the perspective of two concepts 'creatively' meeting each other - sometimes causing friction, but eventually establishing a productive relationship.

Figure 2. During the COVID lockdown Daniël Albering 'prototyped' a personal delivery of books to his bookstore clients in Rotterdam as a way to keep personal contact with them and not lose them to large online bookstores. (Photo: © Jan Kok | Boomerang Fotografie)

CHAPTER 2

Learning by doing meets researching through designing

During the COVID pandemic the Dutch government introduced several lockdowns and a variety of social restrictions. For extended periods physical shops had to close, forcing their owners to come up with alternative ways of sustaining their businesses. Like many other shopkeepers, Daniël Albering, owner of Rotterdam children's bookstore De Kleine Kapitein started delivering goods to his clients himself (van Heel, 2021). His clients could reach him by phone or e-mail, he advised them personally about which books to buy and he delivered the books to their doorstep, sometimes until late evening hours. He claims it was important for him to maintain personal relationship with his clients, something that big online shops don't do, and which is the reason many people still prefer to buy books in his shop. Many shopkeepers innovated in similar ways as Daniël Albering. Some chose social media as a way to maintain contact with their customers, others chose internet communicators, often in tandem with web-shops, created on an ad hoc basis, using ready-to-use web service templates. Shops put up posters in their shop windows, often featuring QR codes, to inform passers-by how to reach them directly or access their improvised web shops without violating the pandemic regulations.
In a sense, the pandemic has forced each of these shopkeepers to become designers, to creatively explore the opportunities of digital technologies, and to quickly implement, try out and improve new ways to stay in contact with their customers. At the same time, when one reflects on the everyday struggles during the COVID pandemic, besides many losses it has brought, it has also changed our society. Out of the countless small innovations of individual shopkeepers, employees and employers adapting to remote working or inventing new organisational models, local and national governments coming up with restrictions and policies, and their success or failure in everyday execution and effects on the pandemic, as a society, we have collectively generated new, practical, cross-disciplinary knowledge on how to change many everyday situations we took for granted. We leveraged

digital technologies to find alternative ways of do our everyday activities, such as shopping or having work meetings. And, in a sense, we have all become researchers contributing to that knowledge. This might all not have been a rigorous scientific experiment, but it has taught us a lot, and it does bear many similarities with RtD. In a sense, we've all been engaged in various forms of prototyping iterations. We were continuously trying out new ways to deal with the new situation, coming up with solutions, personally learning from these solutions, and trying to validate acquired knowledge.

This chapter explores the 'creative encounter', and the involved friction, between the process of learning by prototyping and the process of RtD.

Design thinking meets lean start-up

The case of Albering illustrates an iterative process of trying out new business opportunities, and improving or even entirely reorganising involved services. Such continuous evaluations and adjustments have for a long-time been known to be the key to business success. Digital technologies have additionally empowered the ability of businesses to iterate. Digital services are relatively easy to update. For example, a layout of an online shop website can be adjusted almost instantly, given that one has the expertise to do so. At the same time, digital services also allow the continuous collection and analysis of usage statistics and other data about the business's performance. Eric Ries' book *Lean Startup* (2011) has become a 'bible' for many digital technology start-ups, by advocating fast cycles of measurable validation of digital services through objective metrics and their continuous improvement, or 'pivoting' business propositions when needed.
A lean start-up has many similarities with design thinking (Müller & Thoring, 2012). Yet, when I consider the example of the Rotterdam bookkeeper Albering, I don't see an aggressive profit-driven iteration of a start-up. Albering's concerns were not about losing profit or turnover (the typical start-up metrics), but about losing the personal contact with his customers. That is something he believed is central to his business, but also something difficult to measure, or to directly translate to a web shop feature. Being confronted with not seeing his customers in person, he also learned about the values and personal drivers behind his everyday work. By starting the personal delivery of books he enforced this belief, while learning new ways to run his business.

Learning by doing

Through his actions, Albering engaged in a process of learning by doing (or experiential learning). The learning by doing concept was formulated by John Dewey, one of the key constructivist philosophers, as part of his agenda of implanting democracy in education (Dewey, 1923). Learning by doing is based on the general idea that hands-on experiences leave deeper marks towards the development of the creative individual than experiences induced by uniform second-hand knowledge. Yet, for Dewey, experience was not the only prerequisite of learning. He was known to have said: "We do not learn from experience. We learn from reflecting on experience." Dewey emphasised that in a learning context, reflection is not just a passive recollection of an event. It is a deliberate process, an "active, persistent and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it, and further conclusions to which it leads" (Dewey, 1933, p. 6). Another influential scholar on this matter, Donald Schön, built further on Dewey's work. He studied reflection as part of professional practice and development, including among designers. Schön (1987) claimed that reflection helps practitioners in making their tacit (hidden) knowledge explicit; it helps articulate what practitioners do instinctively. He also argued that such reflection can help practitioners be better in their practice and become experts in what they do. Schön defined two types of reflection: reflection *in* action and reflection *on* action (Schön, 1987). Reflection in action is the thinking process happening when performing a certain activity, that guides how one responds to the situation at hand while the situation unfolds. Reflection on action happens retrospectively. It is a broader reflection that can include reconsidering the situation and making plans for how to act differently in the future.

I don't know in what ways Albering exactly reflected on running his bookstore business when the pandemic regulations were introduced. I imagine it was not easy for him, going through different aspects of his experience as a bookkeeper and pondering how to deal with the new situation. Nonetheless, it's also likely that the importance of direct contact with his customers was something he was aware of for a long time, and that reflection on the new situation simply helped him to translate that knowledge into an idea for a new course of action.

21st century skills

It's unlikely that Albering learned his skills of running a bookstore through factual, knowledge about books, but instead acquired his skills through his practice. Contemporary views on education also depart from knowledge as a collection of facts, that can be acquired by memorising textbooks. Since the 1980s, a growing

number of governmental, NGO, academic, and business institutions has been involved in identifying skills and competencies needed by people as part of contemporary society. Out of these initiatives emerged the concept of the 21st century skills. The consensus is to frame these skills outside of traditionally established professional and academic disciplines. Trilling and Fadel (2009) provide an excellent, in-depth overview of the 21st century skill domain. In their overview learning and innovation skills take the centre stage. These skills include critical thinking and problem solving, creativity and innovation, and communication and collaboration. Next to them, there are life and career skills, and information, media and technology skills. Altogether, rather than constituting a fixed set of knowledge, the 21st century skills combined provide a set of skills required to function in a contemporary society, and to autonomously and creatively guide one's learning experience. In a sense, the core design skill of organising and executing a process of realising creative prototypes and learning from them has many parallels with the 21st century skills. One could even go as far as saying that 21st century skills are in fact core design skills (Koh et al., 2015), and by extension of that, that Albering is an example of a person fluent in 21st century skills.

Reflection in design

Daniël Albering and designer Harm van Beek from the earlier example both engaged in some form of prototyping. One prototyped a new way of running his business, the other a wearable device showing distance. Both of them must have reflected in and on their actions, yet we don't know how exactly these reflections occurred. Probably they looked very different for each of them. Perhaps they involved writing some things down on a quiet evening, thinking things through while walking in the park, or discussing the thought with a partner or friends. It is often not a single topic that people learn about, nor is there one type of knowledge that people acquire in such situations. Many of their learnings are tacit, and manifest themselves in their future actions rather than in what they ever say or write. Many of their observations, impressions and thoughts also get lost and forgotten in between their prototyping iterations.

Over the past years I have investigated ways in which personal design knowledge can be structured, captured, and shared. In a series of studies, my colleagues and I have analysed the design research documentation of large groups of design students. Our analysis revealed three ways to differentiate the various kinds of the design knowledge they documented. First, we found that knowledge was either related to the domain of design context, or to the design process. Design context knowledge dealt with understanding the situations that the designer was intending to change. Design process knowledge dealt with understanding

the design process, tools and methods that the designer used. Second, we encountered three distinct types of knowledge descriptions. There were declarative statements, commonly referred to as 'insights', that described what designers perceived as truth. There were also procedural descriptions, which we've termed know-how. They described a process needed to follow to reach a certain result. Know-how typically related to a skill or ability that the designers acquired. There were also statements of a speculative nature, that we called 'assumptions', 'design hypotheses', or simply 'ideas'. They described what designers expected that a specific intervention would achieve. Third, we found that the topic of the acquired knowledge differed. Some focused on individual people, others on society at large, or on technology, while in many cases multiple topics were addressed in combination.

Understanding the different ways to organise designers' knowledge allowed us to develop a tool to help design students in reflecting on- and articulating their design-acquired knowledge in a structured way. This tool or 'reflection card', is a simple A4-sized digital form, which includes a depiction of a design or prototype, a brief description of the way it was tried out, a list of up to three insights, know-how or ideas about the design context, and a short description of new knowledge gained about designing. The reflection card was a compulsory deliverable for students in several design studio courses, and design students were required to individually fill in a card for every design or prototype iteration they had created (in some cases amounting to twenty cards per project). The cards forced design students to briefly reflect on their design process and its results, and articulate the most recently acquired knowledge. In that, the cards helped design students in dealing with design fixation, and to see the progress across the project. The cards also supported sharing the tacit knowledge acquired by students with their teammates and coaches. In this, they changed the content of the project meetings from talking about the designs and prototypes created by students, to also focusing on the knowledge acquired by students, its validity and application in other areas. Based on our analysis, using reflection cards involved a sequence of six distinct activities:

1. Changing mindset from design-oriented to research-oriented
2. Articulating knowledge
3. Generalising knowledge
4. Exchanging knowledge with others
5. Validating knowledge
6. Applying knowledge to own design

In each of these activities designers encountered different kinds of challenges. Design students were often tempted to describe what they did rather than what they had learned. Writing very project specific notes tended to be much easier than making a more generally applicable statement. However, making the effort to articulate and generalise their insights, know-how and ideas, turned out to be a valuable means for communicating with others directly or indirectly involved in the design process. Design students who were better at articulating their knowledge, received more valuable feedback from peers and coaches, and were able to communicate their project better to the outside world. The articulation of knowledge obtained while still involved in the design process also enabled serendipitous connections among students from different teams, and sparking collaboration opportunities. Instead of merely discussing the designs, the design students more frequently exchanged insights, know-how and ideas, turning the design studio into a design research community.

My studies have also shown that reflection is a difficult thing to learn. Students fell back on routinely accounting their recent design activities in a diary fashion, writing down what they had done and when, rather than explain what these activities had actually taught them. I can imagine it hasn't been easy for the two people from my examples either. A small part of the valuable reflections of Harm van Beek and Daniël Albering were captured in news articles featuring them, but I guess they too would have struggled in explaining exactly what they had intuitively learned while respectively building a strange contraption and reorganising the business. Reflecting is difficult, and articulating and sharing reflections with others even more so.

The subjectivity of knowledge

While Albering was busy delivering books to his customers, another Rotterdammer, Willem Engel, was busy setting up his controversial organisation Viruswaanzin, releasing videos negating the COVID pandemic's existence, undermining government's measures and spreading conspiracy theories. One may question whether Engel's belief in the information he spread was genuine, but it definitely was for many of his followers and for the donors to his organisation. A protest against COVID measures is a form of civic engagement, and acquiring information from social media is a form of learning. I could even argue that Willem Engel had both acquired and shown exceptional 21st century skills, critically challenging information provided by the government and pharmaceutical companies involved in developing COVID vaccines, while leveraging digital technologies to spread his theories and making a career out of these skills. His actions can also be seen

as a form of civic engagement. In fact, the likelihood that one will believe in conspiracy theories is higher among citizens who are engaged in their community than among those who are socially isolated (Cox, 2021). This can be explained by the idea of 'tribal epistemology', according to which information is evaluated based on the degree to which information "supports the tribe's values and goals and is vouchsafed by tribal leaders" (Roberts, 2017)., rather than on empirical evidence or observable facts. While such 'tribal epistemology' might to a small degree be valuable for democratic debate, the radicalisation of ungrounded, or falsely grounded viewpoints can have devastating consequences on cities and their communities, such as the violent protests that took place in Rotterdam on the 19th of November 2021 in opposition to COVID measures. Many cars were burned down, shops devastated, and people injured (Oosterom, 2022).

The key difference between learning and researching is that the latter is a systematic and rigorous process aimed at generating knowledge that is objective and generalisable. In that sense, research is an answer to the emergence of potentially dangerous 'tribal epistemology'. At the same time, the positivistic rigidity of scientific research makes it impossible to embed in the learning processes of our everyday civic lives. The practice of RtD might provide a middle ground here.

Learning versus researching

Learning through reflection in and on designing or prototyping is not the same as performing research as part of a design process. Intuitively we understand the difference between learning and researching. Learning is personal, and it doesn't have to involve unique, new knowledge. When you learn, you acquire knowledge or a skill that may have existed for a long time. Learning also involves a subjective perspective on what is true, and one's subjective insights may be deemed untrue by others. Researching, on the other hand, is supposed to produce new and objective knowledge. The scientific method has been devised and practised for centuries to warrant such objectivity. It involves rigorous observation, formulating inductive hypotheses, experimental- and measurement-based testing of deductions drawn from these hypotheses, and validation of the hypotheses based on the experimental findings. The scientific method is strongly rooted in positivism, a philosophical system that holds that all knowledge is something that comes from things that can be measured and proved by logic. The positivist approach to knowledge is in many ways the opposite of that of constructivism. In the constructivist view, people construct knowledge through their intelligence, experiences and interactions with the world, including other people, and subjective

experiences. The constructivist perspective on knowledge has been highly influenced by John Dewey's view on learning4, and followed by the work of Schön and design methods scholars building on it. In the constructivist view there is not one objective truth: each person constructs his or her own truth by learning through his or her own experiences.

The tension between positivist and constructivist ways of looking at knowledge has had a big influence on how we look at designing, with the constructivist view gaining the upper hand in this context. Attempts have been made to mould design processes into the positivistic mindset. In the late 1960s Herbert Simon was one of the proponents of the design methodology that approached design as a formalised problem solving process governed by logical rules (Simon, 1969). However, this perspective was never widely embraced by designers. As argued by Dorst, this is due to the 'ill-defined' nature of design problems, which cannot be 'solved' in a linear fashion and require abductive reasoning (Dorst, 2003). Designing seems bound to be chaotic in many ways in order to accommodate serendipitous discoveries, account for subjective views and support continuous reframing of problems that designers deal with.

With that, I do not wish to say there is no room for rationality in design. Quite the opposite, rational, and even scientifically rigorous research has been successfully embedded in many forms of designing. Research methods have become part of most design education programs worldwide. Design schools routinely teach students how to collect and interpret scientific knowledge, and use research methods borrowed from 'soft' as well as 'hard' sciences. They often use 'generative' research to understand the design context, and 'evaluative' research to assess the prototype's operation, both in terms of its influence of people, as its technical performance. In that sense, design and research are deeply intertwined. Yet, next to explicitly performed research activities, designing includes many other forms of learning. RtD is an attempt to grasp and leverage the interplay of rigorous and more subjective forms of knowledge generation while designing. This is achieved by recognising the value of knowledge generated outside of explicit research activities, especially those activities that involve making and trying out prototypes (Stappers & Giaccardi, 2017). To quote Stappers: "The designing act of creating prototypes is in itself a potential generator of knowledge (if only its insights do not disappear into the prototype, but are fed back into the disciplinary and cross-disciplinary platforms that can fit these insights into the growth of theory)" (Stappers, 2007, p. 87).

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4 Dewey himself is typically viewed as philosopher that connects constructivist and pragmatist views, as elaborately discussed in John Dewey between pragmatism and constructivism (Hickman et al., 2009).

Does this mean we could also consider Albering's process of coming up with personal book deliveries as a form of RtD? Probably not, as his experience is not sufficiently generalised to contribute to the shared body of knowledge others could benefit from. But we could also turn this question around, and ask ourselves what would it take to support people like Albering in their ability to share their knowledge and skills, so that others can benefit from their experiences? And, how can we support people to discern trustworthy knowledge from knowledge produced by the likes of the conspiracy theorist Willem Engel?

What is prototyping literacy?

The discussion on how expert and non-expert designers learn and research opens up three questions that I find very important for further research and practice of civic prototyping. The first question is: how can we support citizens better in learning from their experiences with prototypes? The second question is: how can we help citizens translate this knowledge into new prototypes? And the third question is: how can the knowledge they develop be generalised beyond the local, context-specific situations, and be validated and shared with others? The ability to create a prototype, to learn from it and to share that knowledge constitutes what I call 'prototyping literacy'. Prototyping literacy is in some ways similar to the notion of 'digital literacy'. "Digital literacy involves more than the mere ability to use software or operate a digital device. It includes a large variety of complex cognitive, motor, sociological, and emotional skills, which users need in order to function effectively in digital environments" (Eshet-Alkalai, 2004, p. 1). Similarly, we can see prototyping literacy as not only the ability to build a prototype, but also the ability to embed the designer's process of prototyping into the activities of everyday life.

Digital technologies are so ubiquitous in the modern world, that digital literacy is in many ways a prerequisite for prototyping literacy. The fast spread of the COVID virus across the world was only possible because of globalisation, which in turn was only possible because of transportation technologies and the IT digital services supporting these. In 2019, before the pandemic, approximately 4.5 billion passengers took 42 million flights worldwide enabling global spread of a new virus. Yet, it's also digital technology that allowed people to deal with the consequences of COVID-19. Remote working and online shopping allowed people to continue with many of their professional and personal activities while in lockdown. The ability to work and innovate with the help of digital technologies has become not just an opportunity, but a necessity for many. Like Albering, who was able to take orders online, some small entrepreneurs leveraged their (sometimes basic) digital skills to adapt to the new situation. Others, more adept with technology, made significant

additional profits. Many of those who couldn't adapt to the situation, went bankrupt. There are new digital technologies that will influence our society in the near future. Artificial Intelligence is being developed quickly. Autonomous vehicles will proliferate. Quantum computing might be one of the next big technological leaps. Each of these technologies will undoubtedly bring opportunities, but is also bound to have negative consequences. Big-tech corporations have a major advantage in the field of innovation with digital technologies. Through civic prototyping I hope to contribute in at least a small way to levelling the playing field for local entrepreneurs and civic activists, allowing them to leverage technologies to their advantage and to have a say in how technology will shape their lives.

Prototyping literacy is not only about knowing how to create prototypes, but also about being able to learn through them, and to share this knowledge with others. Digital literacy needs to be part of prototyping literacy. On the one hand people need support in understanding technology and the opportunities it brings for their own innovations. On the other hand, the threshold for working with technology needs to be reduced. Technology needs to be transparent and easy to innovate with. Instead of technological black boxes, we need glass boxes, or even better, playful technological blocks to build new things with. While prototyping literacy is a quality of an individual person, people don't live in isolation. Acquiring skills and knowledge is a social process, and a community of active and skilled citizens can achieve significantly more than a single, even most highly capable person.

Figure 3. Annet van Otterloo (left) was one of the initiators of a citizen initiative to take over local market garbage removal from the municipality of Rotterdam. (Photo: © Open overheid)

CHAPTER 3

Smart citizens meet the smart city

Rotterdam is home to many citizen communities that jointly 'prototype' ways to improve their city. For example, in the Afrikaanderwijk, one of the districts of Rotterdam-Zuid, residents have been frustrated with the way the municipality dealt with trash generated by the local market, and organised themselves to take over the street cleaning process. The market, which takes place twice a week on the main square of the Afrikaanderwijk, is a vibrant event that produces a lot of trash left over by sellers and clients. The municipality services used to clean up the square at the end of the day. Not only was waste not being separated, but by the time municipal services usually arrived, wind would often already had scattered much of the trash throughout the entire neighbourhood. Annet van Otterlo, a local civic activist leading the foundation 'Afrikaanderwijk Coöperatie', was one of the initiators of the plan to take over the cleaning of the market from the municipality, organising it locally, making sure that the cleaning was done better, and providing work to many unemployed local residents (Open overheid, n.d.). Organising this initiative was a complex process and involved many actors. On the one hand, van Otterlo and other activists had to find local residents willing to do the cleaning work and figure out the practical logistics of the work that needed to be done. On the other hand, they engaged in multiple discussions with related organisations and local businesses to ensure support and funding for the initiative. For example, a local housing corporation, that at first used an external company to clean the entrances to their houses, agreed to contract this job to the local residents instead. Ultimately, the Afrikaanderwijk Coöperatie submitted a 'Right to Challenge' proposal to the Rotterdam municipality. Right to Challenge is a policy that was new at the time of this initiative, and that allows citizens to challenge the municipality to take over their tasks if they think they can do it better or more efficiently for the same budget. The proposal of the Afrikaanderwijk Wijkcoöperatie was approved, and local citizens coordinated by van Otterlo started a street cleaning enterprise that continues to operate to date.

The Afrikaanderwijk Coöperatie is busy with other initiatives as well. It runs the community centre Gemaal op Zuid, hosts community cooking sessions, has initiated a free second-hand bike programme for local citizens who can't afford bikes, organises cultural activities, has set up a digital platform intended to share current community activities happening in the neighbourhood, and actively shares their experiences with other citizen communities, government agencies and universities. Similarly to earlier examples of individual civic activists, each initiative of the Afrikaanderwijk Coöperatie generates new knowledge. However, in this case, this knowledge comes from a network of many involved actors. One person may have the expertise in writing a project proposal, another in segregating garbage, yet another may know who to reach out to get a required

permit arranged. However, the capacity of the community to improve its neighbourhood lies not only in the collection of individual abilities, skills and knowledge. It also lies in the way the community organises itself, communicates, builds, exchanges and puts this knowledge to use.

There are many different communities in Rotterdam that engage in various forms of civic action. While the Afrikaanderwijk Coöperatie is exceptionally well organised and active, many smaller citizen communities organize themselves as well, especially when the common good is at stake. For example, Club Cool is a collaboration between residents, local entrepreneurs, project developers and the municipality of Rotterdam, dealing with organising and discussing transformations in the Rotterdam Cool Zuid area. The area includes one of the most popular streets of Rotterdam, the Witte de Withstraat, and the surrounding neighbourhood where new high-rise buildings are being developed. Just like the garbage problem was a crisis situation in the Afrikaanderwijk that triggered citizens to take action, the new developments in Cool Zuid triggered local citizens to become actively involved in matters of their neighbourhood. In Cool Zuid the clash of interests of various parties is more prominent than in the Afrikaanderwijk. The municipality wants to realise their vision for this part of the city. Project developers seek to increase their profits. Local business owners see opportunities in intensified developments in the area, but also potential competition to their businesses. In the context of all these interests, local inhabitants try to maintain the quality of their neighbourhood, including green leisure spaces, street safety, air quality, or even simply maintaining sufficient sunlight on the streets, as this is gradually being taken away by overshadowing sky-scrapers. Club Cool is an active community, publishing a bi-monthly newsletter, organising events in the local community centre, and representing the voice of the inhabitants in the debate on further developments of the area.

Cities like Rotterdam continuously change, and this change doesn't only mean proliferation of new high-rise buildings, or gentrification of neighbourhoods, but also accommodation of new technologies that drive new services. Recent examples include shared electric scooters, or fast grocery deliveries, which often cause nuisance and disturbance in the public space, while they are a convenience to many at the same time. Another example is the electrification of cars, the need to install charging stations and to create new regulations around them. We can be certain that the impact of digital technologies on cities will continue to grow. Rotterdam, like many other cities, is working to develop an Urban Digital Twin. This is a virtual representation of the city, which collects real-time and static data from multiple sources, such as traffic sensors, security cameras, weather stations, or land registry data, and can be used to run AI-simulations predicting various occurrences in the city. This can be seen as an opportunity to improve the functioning of cities, but also raises many ethical questions about the transparency of the decision making process, and ability to contest decisions made by technology. In the near future, digital twins will probably be used to steer traffic, both car and pedestrian, implement security measures, or aid decision-making processes. At the same time, in the next ten years various forms of autonomous vehicles will be introduced in the cities. Not just passenger cars or public transport vehicles, but also street cleaning vehicles, delivery vehicles, mobile automated vendors, or security monitoring and enforcing devices. Civic engagement already faces many barriers, and introduction of complex technological innovations to cities that are difficult for non-experts to understand hinders civic engagement even more. How can we turn this trend around? This chapter focuses on the creative encounter between the smart citizens engaged in improving their city, and the city itself becoming a 'smart city', being increasingly driven by digital technologies and promising to use these technologies to solve the multitude of everyday problems of its inhabitants.

Civic engagement in a smart city

The future of cities appears to be all-digital. Everyday objects will be infused with sensors monitoring the world around. Machine learning and Artificial Intelligence will use collected data to predict events, and to control cities' operation. The promise that comes with smart cities is that all such technology will improve traffic, safety, and overall efficiency of cities. But this is a seemingly utopian vision promoted by many big-tech companies in countless online video clips. Visions of technology-driven smart cities gather growing criticism (Green,

2019). The very concept of a smart city implies the central role of technology in the city's operation. The cases where smart city infrastructures have been initiated show that, on the one hand, promised benefits are often more difficult and complex to achieve than it may seem, and that, on the other hand, introducing new technological solutions also introduces many new problems. What's even more concerning is that smart city technologies are often introduced as a replacement for long-established democratic processes to maintain compliance to local regulations, to hold authorities responsible and accountable for things that go wrong, and to correct the working of the city once concerns emerge.

In a sense, a democratic process, and especially local democracies, are iterative in their very essence. Regulations and policies are a form of a prototype put in place to solve an observed problem. Democratic instruments ensure that these 'prototypes' can be contested, fixed, or replaced if they do not work. Such mechanisms of contestation are not by default embedded in smart city technologies. What's more, these technologies are rarely transparent to citizens, not only because of their technical complexity, but also due to corporate secrecy of their developers. As a result, cities' operation is increasingly driven by technological 'black boxes'.

The technology-driven perspective on smart cities involves a reduction of complex relationships between citizen communities, urban infrastructures and governance into technological solutions. Such transformation of the very foundations of urban life and its governance is bound to lead to cities that are 'smart' in the sense of using elaborate technology, but at the same time lack the mechanisms for self-improvement and prevention of various forms of inequality or injustice. Following the technology-driven developments of smart cities puts us at the risk that the technology itself will be used as an excuse for governments to engage in discriminatory practices, surveillance and control, and will enable prioritization of corporate and governmental above civic interests, while reducing citizens' civic agency to the consumption of digital services.

A call for shifting the focus of the smart cities from controlling to supporting the agency of 'smart citizens' has been popularised by an online manifesto by Dan Hill. He describes smart citizens as "citizens using social media and related technologies to organise and act", and states that "the most interesting and productive use of contemporary technology in the city is here, literally in the hands of citizens, via phones and social media" (Hill, 2013). This statement has been adopted by scholars such as Hemmet and Townsend to start a vibrant debate, linking the concept of a smart citizen to the long-standing urban planning discourses, including Geddes' work on civics, and Jane Jacobs' plea for urban planning institutions to account for the voice and views of citizens (Jacobs, 1961).

What emerges is an alternative view on a smart city that engages its inhabitants as autonomous actors, who contribute to the shaping of the physical, as well as the digital layers of the city. The question I ask myself is how we can turn the encounter between the smart city and its smart citizens from a potential conflict to a constructive collaboration? How can smart city technology be leveraged as a means for supporting DiSalvo's 'democracy in the small', and empower local communities like this in the Afrikaanderwijk, or Cool Zuid?

Communities of (digital civic) practice

Next to well organised civic communities such as in the Afrikaanderwijk, or Cool Zuid, many other forms of civic participation can be found in Rotterdam. There are many small and casually interacting groups of citizens, coming together to organise a street party or a street market. There are also communities with a stronger professional focus. For example BlueCity is a start-up incubator bringing together creative entrepreneurs aiming at improving circularity and biodiversity in Rotterdam. BlueCity start-ups share a converted building of the former subtropical swimming oasis Tropicana. By working in one location, it's easier for community members to meet each other, to exchange ideas, knowledge and know-how, to work on prototypes in a shared workshop and to organise shared events, many also open to people from outside the community. A civic community doesn't have to have a clear boundary. Another example is the community of people engaged in the development of the Luchtsingel. The Luchtsingel is a pedestrian bridge connecting three areas in the centre of Rotterdam, previously separated by train tracks and a busy road. The project was initiated by the Rotterdam-based architecture office Zus Architecten. The idea gained a lot of support from the local citizens. It was funded through a crowd-funding campaign matched with a subsidy from the municipality as part of its Stadsinitiatief programme (van Raak, 2014). The bridge has become one of the landmarks of the city, but it has also been a steppingstone for other developments. Other projects and initiatives followed, such as the ongoing development of the Luchtpark on the former elevated rail tracks to which the Luchtsingel provided access. At the same time, it has also been a learning process for the municipality, which faced criticism for selectively financing a limited number of large projects through their Stadsinitiatief programme. In consequence it led to the creation of a new funding programme called CityLab010, in place of the Stadsinitiatief ("Rotterdam lanceert opvolger bekritiseerd Stadsinitiatief", 2015), which provides funding to a larger number of projects and involves less bureaucracy and preparation. There is no fixed group of people engaged in all the initiatives, but there still is a continuity of ideas and of the development of capacity to transform the city.

In all above cases some kind of community of practice has been involved. A 'community of practice' is a group of people who "share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Wenger, 2011, p. 1)[5]. Communities of practice often evolve as a result of the joint activities of people sharing a particular interest or place[6], but can also be deliberately created with the aim of gaining knowledge related to a particular topic or application. By sharing information and experiences with each other, people can learn and gain opportunities for personal and professional growth. The idea of 'practice' is central here, as it involves the creation of a shared repertoire of In such a setting, a group of practitioners may engage in a casual chat over coffee, and not even be aware that this chat can be a valuable exchange of practical knowledge. While the term community of practice is relatively new, communities of practice are in fact an old phenomenon, and a fundamental way for humans to learn from shared and informally communicated experiences. In a way, it also expands on John Dewey's idea of learning by doing, by positioning the learning in the broader context of a community. It is not only about individuals who learn, but the entire community of people that is engaged in the production of practical knowledge. The learning in turn happens by trying out new things in the context of their habitat.

Communities of practice also develop around more technology-oriented topics. Hackerspaces or makerspaces are examples of communities of practice bringing people together to share practical experiences in learning respectively digital technologies (hardware and software) and making skills (manual, machine-based and computer numerical control). Similarly, hackathons are short term events where the organisers put forth a challenge, that participating volunteers compete in addressing, typically through quickly 'hacked together' digital technology implementation, for example in the form of a mobile phone app or a digital service prototype. Yet, the purpose of attending a hackathon for most participants lies not in the making of that prototype, but in learning new skills and meeting people to learn practical skills from. The idea of a hackathon has been applied with success beyond the strictly technological sphere. Civic hackathons apply the same format to solving local community challenges, with or without requiring digital prototypes as required outputs.

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5 While the quote comes from Communities of practice: A brief introduction (Wenger, 2011), this concept was first proposed in 1991 by cognitive anthropologist Jean Lave and educational theorist Etienne Wenger in their book Situational learning. Wenger then greatly expanded this concept in his 1998 book Communities of practice.

6 'Third places' are important loci for communities of practice. The third place is the social environment separate from the 'first place' of home and the 'second place' of work. The concept and its relevance for building the conditions for civic engagement has been popularised by Oldenburg (1999).

A different kind of a community of practice often emerges around 'citizen science' projects. Citizen science stands for a research project which involves non-professional scientists, typically in the process of data collection. The Luchtclub organised by the municipality of Rotterdam is an example of citizen science. The municipality shared 900 sensor devices among volunteering citizens from different areas of Rotterdam. The citizens then installed the sensors on their homes, and used them to perform local measurements of the local air quality. All the measured data is displayed on the online platform 'Samen meten' of the Dutch National Institute for Public Health and the Environment (RIVM), next to measurements performed by other air quality sensors across the country. Involved citizens exchange their insights among others on a social media group, where comments such as "the neighbour started a barbecue and all my measurements went off the chart" often start long discussions relating to air quality, but often engage many other everyday topics as well.

Citizen science is often advocated as a way to engage citizens in scientific research and share scientific knowledge with them. A meta-study of European citizen science projects has shown, however, that this is not always a reality. While researchers organising the research are often convinced that they share a lot of information with the involved citizens, citizens often can't find this information, or don't access it. They typically report other citizen scientists they encounter during the project as the most important source of knowledge and motivation to carry on with contributing to the project.

Civic capacity

The concept of the community of practice provides a perspective on learning as something that happens in a social setting, often through informal communications. When investigating communities of practice engaged in various forms of civic prototyping, the question arises how the individual learning processes of community members together contribute to the ability of that community to improve their city.

Capacity development[7] is a concept frequently used in the context of international organisations such as EC, UN or OECD, governmental agencies and non-governmental organisations to describe the "process whereby people, organisations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time" (OECD, 2006, p. 9), where 'capacity' is "the ability of people, organisations and society as a whole to manage their affairs successfully" (OECD, 2006, p. 8).

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7 Capacity development is also frequently referred to as 'capacity building', yet capacity development has nowadays become the preferred term, to emphasise that capacity of a community is not being built from scratch, but enhanced.

It is a broad concept, typically appearing in the context of policy making and governance, and its impact on citizens' ability to thrive in the given administrative context. The term 'social capacity' is closely related to capacity development. Litchterman defined it as "people's ability to work together to organise public relationships, rather than give responsibility for those relationships wholly to state actors or the flux of market exchange" (Lichterman, 2009, p. 1). Albeit subtly, this concept emphasises what seems to be the essence of the combined efforts of citizens in the different civic communities from my Rotterdam examples. Social capacity emphasises the citizens' ability to communicate and act reflectively, to coordinate their efforts, and to engage in problem solving. It doesn't exclude situations where state or market actors are involved, but emphasises the central role of civic actors and the involvement of a variety of socially diverse groups and people, while accounting for the agency of the community, and its engagement with citizens.

'Social learning' (Bandura & Walters, 1977) is part of capacity development. It is a process in which people acquire skills and knowledge through interactions with each other, and copying of each other's behaviours. In the previous section I discussed learning from an individual person's perspective. On the one hand, the value of social capacity lies in the diversity of knowledge and the skills that different community members bring. On the other hand, through social learning, the community members also develop a pool of shared skills and abilities[8].

Finally, the notion of 'civic capacity' is closely related to the above concepts. Briggs defines it as "not merely a capacity to set directions collectively but also to devise and implement the means of acting together more effectively, with and beyond government" (Briggs, 2009, p.ix) and calls it "capacity for creative collective action – that is, for not just pulling in one direction but managing to discover a promising direction and pursue it effectively" (Briggs, 2009, p.x). Hereby, this notion emphasises the value of the creative abilities of a group of citizens, and their joint ability to apply this creativity alongside other skills and knowledge to influence not only its social, but also their physical context. Clearly, the notion of civic capacity resonates well with the aims of civic prototyping.

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8 The perspective on social capacity as a combination of individual expert skills and shared skills has been discussed in depth in 'Hacking the Hackathon Format to Empower Citizens in Outsmarting "smart" Cities' (Jaśkiewicz et al., 2019).

Boundary objects

There are many ways to study the social capacity of communities. Yet, rather than studying existing communities, my key research interest is to understand how approaches borrowed from design prototyping can support their social capacity development. When taking the process of creating a prototype, confronting it with the world, learning from it, and projecting it on the case of a community project, the jointly envisioned and developed prototype brings together the ideas, skills, and knowledge of all engaged community members. At the same time, the realisation of a prototype leads to personal learning, which is different for each involved person. For example, a citizen-scientist installing a sensor on his balcony, might devise a unique way of attaching the device to the balustrade, which other citizen-scientists will adopt. That skill might be of little concern to the researcher involved in the same project, whose main learning might be about the inaccuracies in data coming from sensors installed in non-uniformly prescribed locations. Nonetheless, the sensor will still make communication between the researcher and the citizen-scientist easier. While concerned with different problems, carrying out their discussion around the sensor allows them to understand each other's concerns better. In the above example, the sensor takes the role of a boundary object. A 'boundary object' (Star & Griesemer, 1989) is an object that is recognizable enough for people with different backgrounds, using different terminologies, or having different goals, to help them translate their ideas between each other. In that sense, prototypes (whether a physical object, or something more abstract, such as an event or an initiative) typically take the role of boundary object in groups engaged in their making and trying out (Bogers & Horst, 2014). Prototypes such as boundary objects draw a group of people around them, support the communication, act as meaningful knowledge carriers, and are a manifestation of the skills of individual group members, and the capacity of the group as a whole to realise, and put the prototype to use. In that sense prototypes are also valuable objects to study. By studying the prototype, we can assess the capacity of the group that made it.

The boundary object role of a prototype is also key to understanding the role of prototypes as research-supporting artefacts. While people are 'experts on their own experience', much of their expertise is tacit. The expertise manifests itself in their actions, but is often difficult to put into words. For example, citizens engaged in the cleaning up of the Afrikaanderwijk market have a practical understanding of when specific kinds of garbage are likely to be found, how to segregate different types of garbage, or how the cleaning up process is organised among initiative participants. Yet, explaining the intricacy of these activities before executing them would be very challenging. In this case the actual activity of cleaning up was a prototype when it was tried out for the very first time. Observing this activity

while engaged in it, talking to each other about it, sharing pictures, pointing to places where difficulties emerged allows to capture and communicate the complexity of the process, share it, and improve it.

The power of self-determination

The power of prototypes as boundary objects to consolidate a community with a shared goal, is valuable in its own right. A civic community is a community of practice, in the sense of people being joined by the practice of aiming to change the city in some way, and prototyping that change together. At the same time,

individuals contribute, and acquire different skills in the process, forming a multidisciplinary team. This phenomenon is similar to how multidisciplinary teams function in many organisations.

Fred Emery was a pioneer of the idea of using locally self-managing, semi-autonomous teams operating within industrial companies, and proved the increased efficiency of such teams and the benefits to companies engaging them in this way (Emery et al., 1976). Emery leveraged system theories and concepts in his work, looking at a company as an open socio-technical system, and, for example, investigating the implication of boundary control in such a system. Emery's work was much ahead of its time. Almost half a century later, companies have transitioned en masse to organisational models based on small teams with high autonomy. The trend has been strongly influenced by agile software development practices, and was increasingly adopted by non-technology companies, including banks, insurance companies and even governmental agencies. Agile organisations involve lightweight documentation, iterative work, and removal of many aspects of hierarchical structures, with work outputs taking on the role of a boundary object within and across cooperating teams (Kasauli et al., 2020).

The good performance of autonomous teams doesn't come as a surprise when looked at through the psychological lens of Ryan and Deci's Self-Determination Theory (Ryan & Deci, 2000). This is a widely appreciated psychological theory explaining the mechanism governing human motivation. Extrinsic motivation is driven by external rewards, such as monetary compensation. Yet, studies show that extrinsic motivation is also short-lived, and that the effect of rewards wears off. Intrinsic motivation, on the contrary, comes from a person's internally-motivated interest. The three universal drivers of intrinsic motivation are autonomy (being in control of one's own life), competence (ability to do something, and becoming better at it), and relatedness to other people (including the sense of

purpose as part of a social group someone identifies with) (Ryan & Deci, 2000). Working in a small, autonomous team, on a well-defined output has a direct influence on the perception of one's autonomy, competence and relatedness to other team members, and to the larger organisation as a 'team of teams'. In that way, the teams' intrinsic motivation and engagement in the work is significantly increased. By analogy, small teams of citizens and experts working on concrete prototypes for the city, develop a similar intrinsic drive to do their work.

The joint ability to make new stuff

The encounter between smart citizens and a smart city is in fact an encounter between two organisational perspectives. On the one hand, smart cities are now still being developed from a centralised, hierarchical perspective of a (local) government, taking the responsibility for cities' infrastructures, and expecting full control of their operation. This plays well with ambitions of big-tech companies, who still aspire to have technological monopolies on smart city infrastructures. On the other hand, smart citizens expect to be part of the socio-technological systems of their cities. They also represent a perspective on the city as a system in perpetual motion and transformation, that are too complex to control or design in one move, and require small and big perpetual iterations, adjustments, and some degree of trial and error. As I've argued, from different angles, the second perspective is much more suitable for dealing with cities' complexity, and engaging with local democracy.

Rotterdam is a city which has embraced community engagement in shaping itself, and has developed a variety of instruments for supporting it. It seems to be an excellent starting point for further exploring how local groups having social capacity can be engaged in shaping Rotterdam not only as a physical space, but also as a complex socio-technological system that is in perpetual motion and transformation. This challenge comes with many questions, the central one being how we know when this is successful. A start-up's success can be measured by its profit or turnover. A community's success in positively transforming the city around them is substantially more difficult to grasp. If we are to support local communities in building capacity and through prototyping their neighbourhood, and generating valuable knowledge in the process, the overarching research challenge is to understand better how these communities function, and to develop practical tools, methods and strategies for supporting them. At the same time, if we are to see civic prototyping as a form of 'democracy in the small' there is also the question of how to make this process equally engaging for all citizens.

Figure 4. The ‘march with the mothers’ in Rotterdam reminded the public opinion and the government that for many citizens the notorious ‘toeslagenaffaire’ had still not been resolved. (Photo: © RTV Rijnmond)

CHAPTER 4

Digital inclusion meets co-design

On the 11th of November 2021, over a hundred people marched in protest through Rotterdam (RTV Rijnmond, 2021). They called the protest the 'Mars met de Moeders' (march with the mothers), and demanded overdue compensations for those who were wrongly fined and declared 'frauds' in a notorious childcare benefits scandal, the 'toeslagenaffaire'. The scandal had led to the resignation of the Dutch government earlier that year, and dominated the headlines for many months. The cause of the scandal was the policy by which, between 2013 and 2019, the Dutch Tax and Customs Administration wrongly accused about 26,000 parents of fraudulently claiming child care benefits, and required them to pay back the allowances they had received earlier on. For many families this added up to tens of thousands of euros in fines, driving some of the involved low-income families into severe financial hardship. Most affected families were of migrant origin, and this was no coincidence. As judged in the court case investigation, not only were the penalties unjust and ungrounded, but the tax authorities deliberately targeted migrant families, by illegally registering data of citizens' double nationality. Double nationality was then used as an indicator in a digital system that automatically designated certain child care benefit applications as high-risk, and in another system as an indicator for likeliness of being part of organised fraud. In situations where irregularities were found in the administration of involved child care providers, not only the child care providers, but also the parents without any involvement or knowledge of these irregularities were fined and marked as 'fraudulent' in governmental records. This carried severe financial implications for affected parents, but also became an obstacle when obtaining loans, applying for jobs or receiving other governmental benefits. When the 'march with the mothers' took place, the perception of the general public was that the scandal had been resolved long ago. Yet, apparently many families were still waiting to receive compensation and struggled with being unjustly treated. While watching the scandal unfold

in the public news, it had been striking how difficult it was for the government to rectify the unlawful fines, records and procedures, and to fix the flawed systems in place.

Many discussions about the 'toeslagenaffaire' come down to putting the blame on politicians' and government agencies. Yet, digital technology and how it was designed can also be seen as one of the key, albeit indirect, culprits in the scandal. First, the digitally stored data allowed the tax authorities to target migrants. Second, the targeting wasn't executed by a person, but by a digital system. In reality, the data wasn't stored in one place, and the 'system' was not a single program, but was distributed between various agencies, servers, and locations. The intricacy of involved systems made the decision to include double

nationality as an indicator for potential fraud so difficult to revert, that it took years to remove unlawfully stored data and unjust fraud registration, causing further damage to affected parents.

Digitalisation of public institutions does seem to have countless benefits. It reduces costs, and makes administration faster and simpler for both the government and citizens. It is also less prone to human error. At the same time, it clearly carries the risk of not only registering but also exaggerating human biases, and resulting in exclusion or unfair treatment of entire groups of citizens, who often happen to be the ones who are more vulnerable than others. The 'toeslagenaffaire' shows how bad design can have devastating effects on people, and how lack of feedback and redesign mechanisms embedded in a digital system can make it difficult to fix. Designers have become adept at designing things better, by co-designing them jointly with future users and experts. At the same time, the tax system that malfunctioned, had been part of a democratic process, which in some ways malfunctioned as well, but, which in other ways did eventually become an enabler for fixing the problem.

This chapter deals with the challenge of including the diversity of voices and expertise in the increasingly digital civic life. To this end, it explores the idea of a creative encounter between the digital inclusion as an aspiration and co-design as a mechanism for reaching that aspiration.

Digital exclusion

The 'toeslagenaffaire' may seem like an extreme example. It affected thousands of people, it caused the government to resign, and it shook the entire country. However, digital technology also causes exclusion in many mundane, everyday situations. Self-service counters in grocery stores with digital payment terminals greatly accelerate the shops' service speed, reduce the required space and operation costs, and for many shoppers are of added convenience. At the same time, for some people, for example the elderly, people with disabilities or those without a compliant bank card, the grocery shopping experience in a self-service store may be significantly more difficult, if not impossible.

The concept of the 'digital divide' emerged in the mid-1990's. It was then used to highlight a divide between people who have access and use digital media, and those who do not. The meaning of the digital divide has changed over the years. Originally it was used to distinguish people having a computer with internet access from those who did not. Since then, the landscape of options for a person to be digitally connected has greatly diversified. A computer is no longer the only, or even primary device for accessing the internet. In the Netherlands 95,7% of people own a smartphone, 88% use social media (Kemp, 2021). A growing number of household appliances are also connected to the internet, including televisions, but also heating systems, entertainment systems, security cameras, doorbells, kitchen appliances, or other white goods. In that context, it is no longer the question of access to the internet, but the type of use and the ability to use the involved technology, in other words the 'digital literacy'. Jan van Dijk (2020) distinguishes six groups of digital skills, including operational (button knowledge), formal (e.g. browsing and navigating), information (e.g. searching), communication (e.g. e-mailing), content creation (e.g. making a social media post) and strategic (deliberate use of a digital medium to achieve a goal).[9] This list, in its apparent exhaustiveness, may give the impression that digital literacy is a static skillset, but it is not, as digital technologies continue to change. Van Dijk argues to relate the digital skills to 21st century skills, which put more emphasis on the ability to learn new things, where technical and information skills are related to communication, collaboration, creativity, critical thinking and problem-solving, all potentially involving digital technologies. From that perspective, digital literacy can be considered not so much an ability to use digital technology in a certain way, but more an ability to acquire new digital skills. In other words, a young person might not have the knowledge of how a digital checkout in a self-service grocery store works, but may still have good ability to quickly figure out how it works. The same checkout might be impossible to use (without assistance) for an elderly person who had earlier learned to operate it, if a software update changed the layout of the interface.

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9 This view on digital literacy is visualised in figures 5.1. and 5.5. in The digital divide (van Dijk, 2020).

The digital literacy is instrumental at different meta-levels[10] of interacting with digital technologies. At the first meta-level, dominant in the discourse on digital literacy, people are viewed as users of technology. There, literacy refers to the ability to use that technology, as in the above example of the store checkout. At the second meta-level, one level higher, people are viewed as creators of that technology. In case of the store checkout, we don't normally think of shoppers as having any influence on the design of the checkout. Nonetheless, some form of user research has very likely been performed when the checkouts were being designed, and shoppers have the opportunity to complain to the store staff, to the parent company, or contact consumer authorities if they suspect their rights have been violated. At the third meta-level, concerned with methods rather than use or design, the store may implement a different process of engaging its customers in the design process of their shops, to ensure their shopping experience is more inclusive. What applies to the design of a shop, can equally apply to the design of a city service, park or policy, and the engagement of people in the process of designing occurs under the umbrella term of co-design.

From co-design to community-based design

Co-design is a form of designing that actively engages stakeholders in the design process. Next to prospective users of the designed solution, the stakeholders can be external experts, clients, or anyone else whom the solution may affect or whose expertise may be of value for the design process. Co-design comes from a long tradition of involving non-designers in design. It can be traced back to Scandinavian trade unions that extended the workplace democracy movement into the right of workers to be involved in design of IT systems that impacted their job. It was called 'cooperative design', but was translated to 'participatory design' when implemented in the American context in the 1970s, to make it sound less collectivistic (and socialist). This translation already shows the tension in interpretation of this term. Cooperative design was aiming to engage people on democratic and equal terms in the design process. Participatory design was less unambiguous in terms of how people are to be involved. Co-creation is yet another concept related to co-design. It emerged in the early 2000s, for the first time used in Prahalad and Ramaswamy's article 'Co-Opting Customer Competence' in the Harvard Business Review (Prahalad & Ramaswamy, 2000). Co-creation is a very broad term that goes beyond design discipline, and is applied in business, marketing or governance, typically as an interaction between customers and some enterprise or organisation (Sanders & Stappers 2012).

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10 The idea of meta-levels in design is well illustrated in 'Meta-levels in design research' (Stappers & Sleeswijk Visser, 2014).

Co-design as a term entered popular use more recently, and is often used synonymously with participatory design or co-creation. It doesn't have a clear point of origin. Arguably, it gained popularity for its shortness, while also being the abbreviation of the original term 'cooperative design', and the prefix 'co-' also being interpreted as standing for 'community', 'collaboration' or 'communication'. Clearly, each of these terms has different origins, and each of them is tied to a different discourse and emphasises slightly different aspects of engaging non-designers in designing. Nonetheless, the term co-design is often used as shorthand for all of them. In a recent video, Don Norman (2020) has made a plea for 'community-based design'[11], as a form of co-design where a community of people is in the lead of the design process, owning it rather than merely being engaged and participating in it. Similarly, a co-design practitioner, Kelly Ann McKercher, argues for seeing co-design as a long process of not only engaging, but also sustaining engagement of the people for whom design solutions are intended, from early design steps all the way to implementation and beyond (McKercher, 2020). The different degrees to which people affected by design can be given agency in the design process has many parallels with different degrees to which citizens can participate in shaping their community and neighbourhood.

Inclusive citizen participation

I couldn't find better words to explain the main challenge of citizen participation, than what Sherry Arnstein wrote back in 1969:

The idea of citizen participation is a little like eating spinach: no one is against it in principle, because it is good for you. Participation of the governed in their government is, in theory, the cornerstone of democracy – a revered idea that is vigorously applauded by virtually everyone. The applause is reduced to polite handclaps, however, when this principle is advocated by the have-not blacks, Mexican-Americans, Puerto Ricans, Indians, Eskimos, and whites. And when the have-nots define participation as redistribution of power, the American consensus on the fundamental principle explodes into many shades of outright racial, ethnic, ideological, and political opposition. (Arnstein, 1969, p. 216)

11 The concept as such was initially introduced in 'Community-based, Human-centered Design' (Norman & Spencer, 2019).

In her publication, Arnstein (1969) introduced the seminal ladder of citizen participation. The ladder model describes different degrees to which citizens can be engaged in public decision making. On this ladder manipulation and therapy are forms of non-engagement. Informing, consultation and placation are forms of tokenized involvement. Only partnership, delegated power and citizen control are 'real' forms of participation, where citizens are given actual power. Interestingly, the ladder model also applied to co-design processes, where various forms of agency can be given to participants.

At the same time, an adverse consideration applies to the involvement of those who participate. Arnstein makes the case for 'have-nots' as being typically underrepresented in public decision making, and similarly, many co-design efforts are limited to a narrow group of participants. For example, the co-design session on dealing with low literacy organised as part of the Dutch Design Week in 2019 (VNG, 2019) involved mainly people with higher education, only one person with limited first-hand experience of being low-literate, and not a single person of non-western ethnicity. I don't bring this up to undermine the intentions or efforts of the session organisers. There is obvious value in such sessions, even if they lack inclusivity. My point here is to illustrate a general tendency. It is substantially more difficult to organise a co-design activity that is inclusive, and even more so one that sustains participation beyond a one-time event, than a session or workgroup catered to experts with professional interest in the topic. This can also be due to the less-educated, lower-income, or unaware groups of people not being able to join, not perceiving the value, or not being relevantly compensated for participation.

I look at co-design through the lens of its potential to support inclusive civic engagement and to be part of the 'democracy in the small'. Figure 5 illustrates the three dimensions of co-design inclusivity. First, the agency of participants needs to be high on Arnstein's ladder, giving people real influence and control over the designed solution. Second, the process needs to engage a diverse group of participants, representing all involved citizen groups, organisations and expertise areas. Finally, the engagements of the participants should be sustained throughout the co-design process, as opposed to a single co-design event embedded in an otherwise non-cooperative design process.

Figure 5. The three axes of participant engagement in a co-design process determine the inclusiveness of that process. (Diagram: author, Assets: © pch.vector / Freepik)

The challenges of inclusive prototyping

The 'march with the mothers' protesters did not go to the streets because the interaction with the tax system interface was exclusive. They were protesting because the democratic process of contesting the flawed system was too slow and inefficient, lasting for years, while leaving them without compensation and means to live. If I were to translate it to the co-design terminology, I could say they protested against prototyping iterations that took too long, against their short-lived and tokenized involvement in the design process, and against poor transparency of the designed solutions. In other words, the protesters needed a more 'inclusive engagement' in designing, prototyping, and contesting the systems that have such profound influence on their lives. Civic prototyping aspires to provide an answer to those objections, by leveraging fast-paced prototyping as a way to engage a more inclusive group of people, and by increasing the transparency of what is being designed and implemented.

Figure 6. An interactive prototype built during the City of Things hackathon, raised various questions about the role of autonomous robots in the public space of Rotterdam. (Photo: author)

CHAPTER 5

Small prototypes meet big socio-technological systems

On the 8th of April 2022, Iskander Smit and I organised a one-day hackathon, as part of the IoT day of Rotterdam University of Applied Sciences. The hackathon was inspired by the CityLab010 project 'City of Things' we are working on. The goal of the project is to explore ways to engage citizens of Rotterdam in shaping the near future of the city, which we expect will become home to autonomous vehicles of different sorts, such as delivery vehicles, cleaning robots, mobile vendors, or security monitoring and enforcing objects. We don't know what these things will be exactly, but we can expect them to profoundly affect what public spaces of the city will look like, and we believe citizens should have an active role in shaping that future.

The hackathon was in a way our first prototype of a 'tool' for engaging citizens in the creation of autonomous 'city-things'. We were lucky to be given the opportunity to organise the event at the VONK innovation centre located in the middle of the municipality of Rotterdam. We prepared five ready-to-use platforms on which remote controlled robots on wheels could be built. We brought a lot of scrap materials and tools. We promoted the event where we could. Fifteen people, mostly students, registered and formed four teams. The participants had little time and full freedom to build a prototype of a robot they thought Rotterdam and its citizens needed. One team built a robot for carrying shopping bags for tired pedestrians. Another team built a robot carrying a slogan 'you are seen', which broke down and became rebuilt into a mobile bed for the homeless. The third team made a small ambulance robot. The fourth team built a robot carrying a punching bag, devised to become a friendly distraction and an outlet for the energy of the troublemaking teenagers that the team recognised as a real nuisance in the city centre. The four teams took the prototypes to the streets of Rotterdam. They simulated the autonomous behaviour of prototyped robots by controlling them from the distance. They enacted different scenarios, observed reactions

of passers-by, and interviewed the passers-by. At the end of the day, the teams presented their project at a public event, and a jury of experts awarded prizes.

The prototypes built during the hackathon merged the perceptions of the respective team members of what problems Rotterdam and its citizens struggled with. It helped participants exchange ideas, and apply their individual skills in the fast-paced process of building the prototypes and taking them out into the city. The confrontation with the city and citizens, jury members, and other teams was an intense learning process. For example, the team that prototyped a robot that would help people carry their bags, realised that people on the street didn't trust the device with their belongings.

It brought up the discussion about a more general notion of trust towards Artificial Intelligence, as well as about the intrusiveness of AI-driven robots, especially in the context of such a system being a commercial service. The prototypes were presented to a bigger audience of the IoT-day event, consisting of experts and academics in digital technologies. In that, they influenced broader discussions, and created a likely ripple effect in the broader expert community. At the same time, multiple participants expressed eager interest in developing their prototypes further. One of the teams kept the prototype and continued interviewing passers-by on their way home, sharing the recorded films via the spontaneously created social media group with other hackathon participants. The prototypes were quickly-made, ad-hoc, short-lived, interventions in the city. Nonetheless, there is a chance that they will have some, perhaps only very modest, influence on how the city and its citizens will perceive and shape the transition towards embedding AI-driven objects in the complex socio-technological system of Rotterdam.

Prototypes as catalysts

In our hackathon, as in hackathons in general, prototypes played a central role. They became catalysts of prototyping literacy, civic capacity and inclusive prototyping; explained through the three 'encounters' that I've discussed in previous chapters.

First, the prototypes enabled participants to learn. Each participant came to the hackathon with a certain understanding of Rotterdam and its problems. Some participants were Rotterdammers, others extrapolated their experiences of living in other cities or towns. While working on the prototypes, participants learned to use the prototyping platform, and came up with ideas and ways to implement these

ideas in a prototype. After taking the prototypes to the streets, and engaging the prototypes with passers-by, they obtained new insights about the city and its inhabitants. The prototypes were conversation starters between hackathon participants and passers-by, helping them to articulate their views on problems encountered in the city, opportunities for using AI, or critical views on the technology.

Second, through working and trying out a shared prototype, participants developed a capacity to work together as a team. While some participants registered as a group, each team involved at least one person that wasn't previously acquainted with the other team members. Team members had to recognise each other's skills, develop a way to efficiently communicate with each other (sometimes overcoming a language barrier), and communicate their ideas and insights to others. Third, the hackathon format appealed to participants with different professional experience, ranging from design to technical informatics. Some participants were English-speaking, ethnicity varied, but only two participants were female, and only two participants were above the age of thirty. The prototypes brought into the city engaged more diverse passers-by. There were elderly people, youngsters, parents with children, but also police-officers in training and security guards. In all these ways the prototypes helped in learning, building group capacity, and engaging diverse people in the process. It also happened on a very small scale, as part of a very short event, with little direct, lasting effect on the city.

Scaling forward, up and sideways

Our hackathon was an exciting, one-off event. Yet, I would not qualify it as a proper example of civic prototyping. It didn't emerge out of a civic engagement initiative, nor did it directly lead to one. The teams were small, and mostly made up of students. To become truly 'civic', the initiative would need to be scaled *'sideways'* by involving a larger group of diverse citizens, experts and stakeholders. The diversity in teams would allow to tackle issues such as implications of prototypes on the immense variety of everyday situations people in the city encounter, identifying involved ethical dilemmas through different participant point of views, and contributing specialised expertise. In other words, such scaling *sideways* would require inclusive engagement. At the same time the 'prototyping literacy' of participants in our hackathon was also limited. We offered them materials and organisational structure through which they were able to quickly build make-believe prototypes. However, there is a long way from such quick and dirty prototypes to artifacts and services that they could meaningfully embed into their everyday life activities. The prototypes in tandem with prototyping abilities

of their makers would need to be scaled *up* to unfold the process further. Finally, the event itself was short-lived. To have a lasting impact on the city, it would need to be scaled *forward* – extended in time, pursued throughout more iterations, activities and initiatives, while building civic capacity of engaged citizens. I see these three conceptual 'scaling' directions as the key practical challenges of civic prototyping, as illustrated in figure 7.

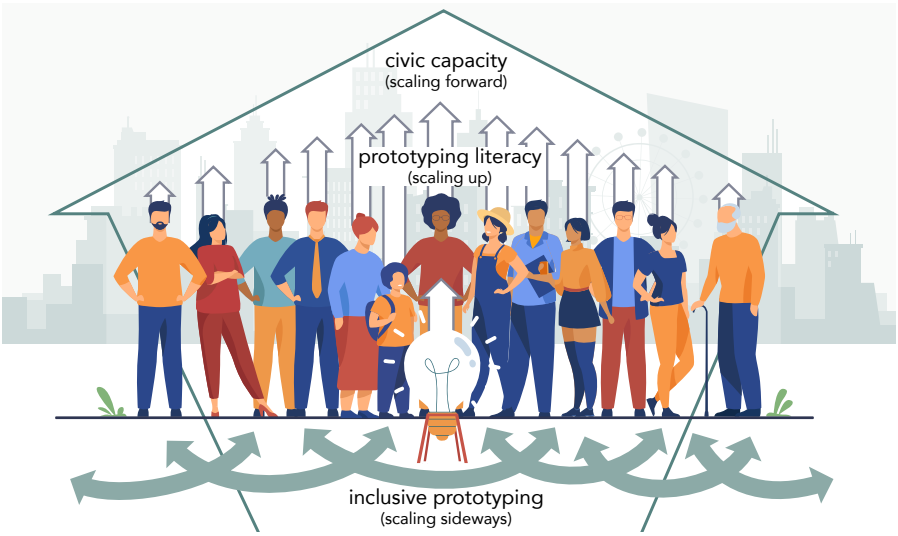

Figure 7. The key challenges of civic prototyping are to support inclusive engagement of citizens and stakeholders in the civic prototyping process (scaling sideways), to support the growth of citizens' prototyping literacy (scaling up), and to support their joint civic capacity to iteratively improve the socio-technological systems that they are part of (scaling forward). (Diagram: author, Assets: © pch.vector, rawpixel.com / Freepik)

Contestability by design, feedback loops and nested iterations

Civic prototyping is an iterative process. At its very core is the iteration of creating a prototype, confronting it with the world and learning from it. This can happen in hours, as in the case of our hackathon. It can also take days, weeks or months to realise more complex, functional prototypes, including prototypes of new activities performed in the city. There is value in such iterations beyond the learning processes and capacity development of engaged citizens. Kars Alfrink et al. make a case for the need to continuously contest technological interventions in cities (Alfrink et al., 2020). The influence of technology on the individual citizen experiences, and on the city as a system, can never be fully predicted, and needs continuous evaluation and

adjustments to the systems. It is a fundamental form of a feedback loop, when the effects of a system's performance are being observed, and the system's operation adjusted to improve desirable, and reduce undesirable effects. The challenge lies in the complexity of socio-technological systems' effects. It is not a matter of one or two easily measurable dimensions that need to be monitored. On the contrary. In the case of the system indicating fraudulent citizens involved in the 'toeslagenaffaire', the system might have been highly successful in some aspects, such as success percentage of correctly estimated fraud cases. Yet, there was no feedback mechanism in place to correct the system for false-positive indications, or violation of legal or ethical norms. The system was not designed to be contested.

In the case of the projects in our hackathon, the feedback loops were almost immediate. A simple comment, or a flaw in an early, sketchy prototype, can trigger a small team working on it to change the design drastically, or even come up with a whole new concept. Were the teams to proceed with the work on their ideas, each iteration would result in more detailed prototypes, costing more time, energy, and resources to develop, extending the duration of each iteration, and being more and more difficult to be altered. Democracy is also an iterative process. In the Netherlands most elections, on national and local scale, happen every four years, and they are the core mechanism of citizens expressing their critique of the country, region, city, or local community. Organising a protest, starting a citizen initiative, or filing a legal complaint are some more direct, and immediate ways to provide a form of feedback, and potentially trigger change. Those too involve different time scales. A legal complaint of an individual citizen about being unrightfully fined, is an immediate action that can be done in a matter of hours. Organising a protest or starting a class action lawsuit can take months or years until they have effect on the system at hand. The aspiration I have for the process of civic prototyping is to enable citizens to take direct action, so that it can have a direct effect on the socio-technological systems that operate in their neighbourhoods. In a sense, that implies taking feedback shortcuts, when it comes to executing 'democracy in the small'. At the same time, it also requires new regulations and policies enabling such 'contestability by design'.

Civic prototyping meets systemic design

Technology makes the design problems citizens face increasingly complex. At the same time the use of a participatory approach to deal with these problems is gaining ground. For example, Rotterdam's policy of the right to challenge, the CityLab010 program and the new VONK innovation centre of the municipality are all instruments to engage a range of citizens, experts and other stakeholders in development and implementation of new systems and policies. Co-design,

co-creation, participatory design and design thinking are buzzwords that are frequently mentioned in such contexts. Conversely, 'systemic design' has emerged as a higher-level concept that combines elements of systems thinking with design. Systemic design deals with the long-term, large-scale, and high-complexity repercussions of participatory policy making. It also creates "the conditions for stakeholders to more meaningfully participate in building shared knowledge and taking collective action" (Blomkamp, 2021, p. 1).

Mieke van der Bijl-Brouwer and Bridget Malcolm (2020) have recently proposed five systemic design principles: 1) opening up and acknowledging the interrelatedness of problems; 2) developing empathy with the system; 3) strengthening human relationships to enable creativity and learning; 4) influencing mental models to enable change; and 5) adopting an evolutionary design approach to desired systemic change. Clearly, the above principles resonate well with my analysis of the notion of civic prototyping. The knowledge of and about the system at hand and its context (1, 2, 4), the capacity to learn and be creative as a community (3), and change as an 'evolutionary', iterative, continuous process rather than a one-off intervention, are at the core of the systemic design discourse. Such a meta-perspective is needed. Our world is facing urgent and complex challenges where the sustainable transition and the digital transition overlap (Irwin, 2015). Sustainable transition needs digital transition, while the digital transition keeps surprising us with its many undesirable side effects —not the least of which being information bubbles and the polarisation of our society.

There is a substantial body of theoretical work that deals with complexity of designing socio-technological systems. Among many others, Bruno Latour is a philosopher and sociologist, who developed the 'actor-network theory' (Latour, 2007) as a theoretical tool for understanding the complexity of interactions between human and non-human actors in the shaping of the complex social processes. Latour recognises the challenges of the practical use of his theories, and the complexity involved in any attempt to give shape and direction to any socio-technological system of continuously interacting with each other actors (Latour & Yaneva, 2012). I share the enthusiasm of many about systemic design and its ambitions, and I am fond of attempts to capture and understand the involved complexity, but I also recognise the practical futility of designing systems with such complexity. Therefore, I chose to focus on the small, local interventions as the starting point for change on a systemic level. Instead of predicting large-scale effects of small-scale interventions, we can embrace continuous, iterative assessment, contestation and adaptation of interventions into the socio-technological fabric of the city as an inherent part of civic prototyping.

Prototyping facilitators and toolmakers

To make the City of Things hackathon happen, we had to invest much time and energy in preparing it. The platform used for making the prototypes started as a hobby project of mine. I hacked a popular self-balancing board using open-source firmware. I designed a generic, easy to build cart using components of the self-balancing board and simple off-the-shelf elements. I tested it together with my kids, went through a few iterations, and eventually assembled five devices with help of Rotterdam University of Applied Sciences staff and students at our makerspace, the Stadslab. We had to prepare a plan for the day, and procedures for organising teams, guiding teams, and troubleshooting. We had to provide tools and materials, find a suitable venue, and coordinate different aspects of facilitation. We also had to 'design' the assignment for participants. We were a team of four facilitating the hackathon, assisted by two municipality staff members, and many more people were involved in preparation and coordination of the event.

Giving design agency to non-experts, brings up the question of the role of design professionals. "Design experts should consider their creativity and culture as tools to support the capability of other actors to design in a dialogic way. In other words, they should agree to be part of a broad design process that they can trigger, support, but not control", according to Manzini (2015, p. 67). In these words, Manzini argues for designers to support civic design (and, by extension, civic prototyping) not as facilitators in the background, but also as active stakeholders in the process, with unique skills and capabilities. At the same time, I truly believe in the need for citizens to own the design process they are engaged in, to be 'in the driver's seat', rather than just taking part. For that reason, I'm not satisfied with a hackathon as a format for engaging citizens. We need to find better ways to enable their sustained agency in a design process, and I'm convinced prototypes and prototyping can be a vehicle for that.

At the same time, the 'facilitation' of a civic prototyping process is an endeavour that can span multiple projects and activities. I explained above how my building of a platform for prototyping remote-controlled robots was part of the preparation of the hackathon. However, it was in fact a different activity altogether. I actually always intended the platform to be a tool for others to build prototypes on, and the hackathon was just an opportune moment to test how others would do so. The platform was a tool, and this time I took on the role of a toolmaker. Running the hackathon has helped me develop this tool further, and I plan to continue doing so, and engaging others in the process.

Yet, civic prototyping tools are not only the technical stuff that people need to build prototypes. They also include the more conceptual tools needed to learn from these prototypes, to share that knowledge with each other and build group capacity, to engage a diverse bunch of people in that group, and to organise the process as a whole. In that sense, methods, strategies, but also places where civic prototyping can happen, supporting policies, subsidies and governmental programs are all 'tools' as well, which need to be designed, prototyped, tested and learned from.

From the classroom to the city

I have focused on bringing the benefits of hands-on designing to the citizens. Yet, the majority of the participants in the hackathon I fondly used as an illustration at the start of this chapter were students. This is no coincidence. While Manzini emphasises the difference between design professionals and non-expert 'diffuse' designers, in my eyes that difference is more a gradual than a clear-cut boundary. Design students are a perfect example of that, because they are people in the process of becoming expert designers.

All second semester Communication and Multimedia Design students at Rotterdam University of Applied Sciences this year received design assignments related to the topic of 'digital accessibility'. Some clients decided not to define the assignment for the students, so the students could pick aspects of digital accessibility they themselves deemed important. Some of the initial idea presentations included issues such as young adults not being financially independent enough to move out of their parents' home, or street intimidation of or by teens and young adults. Clearly, these were topics that students had first-hand experience with, and therefore felt a high level of urgency to work on, as well as having their own real life expertise to contribute. The tools students use to come up with designs, prototype, reflect, research, and work in a team are just as relevant to them as future design professionals, as they are to them as engaged citizens who aspire to improve the world around them. In that, students can often take the role of both; experts-in-the-making and innovating citizens.

Research through civic prototyping

The questions that emerge from the previous chapters are all of a practical 'how to?' nature.
Chapter I addressed the very idea of Civic Prototyping and the broad question: how to support such a process?
Chapter II dealt with the notion of prototyping literacy, and leads to the question: how does one support people in prototyping new ideas in their own neighbourhoods, learning from these prototypes and making acquired knowledge useful for others?
Chapter III dealt with the challenge of building civic capacity. The discussion around this topic brings up the question: how support local communities in their joint capacity to work together?
Chapter IV addresses the need for citizen-driven designing to be an inclusive endeavour. It raises practical questions such as: how does one remove obstacles that hinder many underprivileged groups in being part of civic initiatives or being able to engage with digital services?
All these questions are quite broad. They address wicked problems that have more than one answer, and there is no clear way of knowing if any proposed answer is indeed the 'right' or the 'best' one. In that, these questions are perfect examples of design questions —and quite poor research questions, because of their lack of specificity.

A designer, asked to solve a 'how to?' question, is likely to design a 'tool'. In the context of civic prototyping, a tool can be a lot of different things. It can be a workshop format that supports citizens in coming up with ideas for improving their neighbourhood. It can be a kit of easy-to-use prototyping parts to help them materialise these ideas. It can be an app through which citizens can exchange gathered insights and plan next steps, a funding scheme of a municipality, an event, or a place where a civic community gathers can also be seen as a tool of sorts. I see the hackathon from the start of this section as a tool as well.
We devised the hackathon to catalyse the shared capacity of people to come up with novel urban robot ideas. As a part of that, the posters, the e-mails, and the social media posts promoting the hackathon were all tools to engage a diverse group of participants in the event. The prototyping platform we built for the hackathon was a tool to reduce the technological threshold needed to build a working prototype, and increase prototyping literacy of participants.

While the questions behind the hackathon are not specific enough to be good research questions, the hackathon itself was an excellent enabler of research. First, it enabled the participants to do research by taking the prototypes to the streets of Rotterdam, interviewing passers-by, making observations, and generating new insights about opportunities for- and risks of using AI in the city.

Second, there was research that we, the hackathon organisers, did by assessing how the tools we devised for the hackathon performed, what types of situations they created, and how they affected prototyping literacy, civic capacity, and inclusive designing during, as well as after the event.

The notions of prototyping literacy, civic capacity, and inclusive prototyping define the three main research areas of the lectorate Civic Prototyping. At the same time, the strategy of the lectorate is to give prototypes, including prototypes of tools, a central role in research. The prototypes support generative inquiry into the contexts of civic action. In that they can function, for example, as sensitizing objects, design probes, or items for object-oriented interviews. Prototypes also enable evaluative research, where a broad range of qualitative and quantitative methods can be used to perform the assessment of prototypes themselves, their use in their context, as well as short- and long-term effects. The advantage of this strategy is threefold. First, it enables cross-disciplinary research, engaging different research domains, traditions, and specialisations around one prototype. Second, in the spirit of RtD, it allows for research that is performed iteratively, and which can engage re-designs of prototypes between iterations. Third, it encourages practice-oriented research by translating research results to input for next prototypes. Such prototypes then also become carriers of performed research, making its outcomes easy to explain to the outside world.

Next to their central role in research, the role of prototypes as boundary objects fosters the creation of communities of practice and other forms of collaborations. Prototypes can simultaneously engage students, professionals, citizens, and researchers. Students design, develop, test, and learn from prototypes through assignments. In the Rotterdam University of Applied Sciences context, this applies not only to students following creative programmes such as Communication and Multimedia Design, or Creative Media and Game Technologies, but also to other programs such as Technical Informatics, where it is common to build technical prototypes, or Communications, where, for example, a proposed communication strategy can be seen as a prototype of sorts. Prototypes that can be experienced, touched, tried out, also allow professionals and experts from different disciplines to engage with student work. In that sense, citizens are a specific kind of expert. They are experts on their own neighbourhoods and communities, and through prototypes they are able to share their tacit knowledge as equals. Finally, researchers, including researching teachers, can leverage prototypes to do research on topics close to their individual interests, and using research methods most suited for the job.

Prototypes are also deeply embedded in the DNA of Rotterdam University of Applied Sciences. The Institute for Communication, Media and Information Technology, and Research Centre Creating010 jointly operate the makerspace called Stadslab, that supports students and researchers in creating prototypes. The RDM Centre of Expertise (CoE) takes prototyping to a much higher level of professionalism, providing not only an extensive range of advanced prototyping facilities, but also a variety of expert communities of practice under its four key themes of 'resilient city', 'energy transition', 'logistics and mobility', and 'next port industry' (www.rdmcoe.nl). Yet, other parts of Rotterdam University of Applied Sciences also routinely engage in prototyping. For example, Create4Care (Hogeschool Rotterdam, n.d.) has been initiated by Research Centre Innovations in Care as a prototyping facility embedded at the Erasmus Academic Hospital, where students and researchers collaborate on innovative healthcare products. To give another example, the Expertise Centre Social Innovation (EMI) engaged students and researchers to develop 'de DigiKoffer' (EMI op Zuid, n.d.), a collection of tools to support the elderly in using digital technologies.

The mission of the lectorate Civic Prototyping is not only to fit into this prototyping DNA of Rotterdam University of Applied Sciences, but also to contribute to it on the methodological level, especially when it comes to developing better tools and methods for engaging non-experts in various forms of innovation through prototyping.

Conclusion

Throughout the different chapters of this publication, I have explained the notion of civic prototyping, and its three challenges: prototyping literacy, civic capacity, and inclusive engagement. I also discussed how these challenges translate to the opportunities for scaling civic prototyping activities 'up', 'forward', and 'sideways', and how giving prototypes a central role is a cornerstone of research, collaboration, education-engagement strategy for the lectorate.

This entire publication has been organised around the idea of a series of creative encounters between different concepts. I am truly convinced that by creating better and more inclusive prototyping tools, platforms and methods, we can leverage prototypes to be catalysts of these and many other creative encounters.

Rotterdam University of Applied Sciences is an institution that already brings together students, researchers, practitioners, local governments, and increasingly citizens as well. I am excited about the role that the lectorate Civic Prototyping can play in further enhancing new forms of cross-disciplinary, innovative collaborations.

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About Tomasz Jaśkiewicz

Tomasz Jaśkiewicz is professor of Civic Prototyping at the Research Centre Creating 010 of Rotterdam University of Applied Sciences. He conducts research into new methods, tools, and strategies for involving people in the city in digital innovation of their social and physical living environment.

Tomasz has a background in architecture and urban planning, and has practical work experience developing experimental architecture projects, interactive installations, and digital design tools. He obtained his MSc degrees in architecture and urban planning from TU Delft and from Gdansk University of Technology. He obtained his doctorate from TU Delft, at the Faculty of Architecture, where he researched tools and methods for designing adaptive buildings. Since 2014, he has worked as an assistant professor at the Faculty of Industrial Design Engineering at TU Delft, where he has focused his research on exploratory prototyping as a strategy for dealing with the complexity inherent to designing interactive environments. In parallel, he has also done research on social practices within flexible office ecosystems and 'smart' urban contexts. His research touches on themes such as sustainability, behavioural change, participatory design, IoT, AI and big data. As a professor of Civic Prototyping, Tomasz focuses on involving people in the city in the design, transformation, and development of complex socio-technological ecosystems.

Acknowledgements

Throughout my life I have encountered many special people who shaped my identity in different kinds of ways. Besides those mentioned in the publication, I would like to thank everyone who has influenced and challenged me over the years; my colleagues past and present, my friends, and not least my family. Especially my children Ollie and Benji, the most amazing prototypes from which I keep learning every day.

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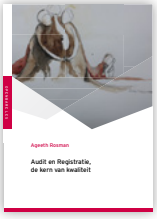

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Tomasz Jaśkiewicz

Civic Prototyping

a creative encounter between design prototypes and engaged citizens

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The term Civic Prototyping is a shorthand for making creative prototyping accessible to anyone who tries to improve the world around them. This means contesting, hacking and innovating with technology on your own terms. This also means creatively engaging technology as a tool for supporting "democracy in the small".

Technology surrounds us, and shapes our lives in ways we don't even notice when consumed by day-to-day activities. In that, technological innovation continues to both solve and create new problems. For example, the Internet used to be seen as an enabler of free speech, equality and democracy. In the meantime it has also brought us fake news, misinformation, and increasing social polarisation. Newly emerging technologies, such as artificial intelligence, carry similar hopes and fears. What exactly do these technologies mean and how will they affect our daily lives? Can we control and shape them as citizens, or will they control us? These questions are difficult to answer, because they involve complex socio-technological phenomena that are impossible to predict. Civic Prototyping is all about giving everyone an equal opportunity to take an active role in shaping the unpredictable future.

Tomasz Jaśkiewicz is professor of Civic Prototyping at the Research Centre Creating 010 at the Rotterdam University of Applied Sciences and design fellow at the Industrial Design Engineering faculty at the Delft University of Technology.

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