Digital city and disaster twins – towards a critical understanding of cyber-physical governance

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Abstract. Digital city twins are a rapidly spreading phenomenon in digital urbanism. A particular variant are digital city twins for purposes of disaster management. The paper explores the vision of digital city twins for disaster management from a critical, STS-informed perspective. The concept of digital twin has been criticised for implying a realist epistemology and the idea that digital twins could provide an accurate representation of physical reality. This paper highlights an emerging literature that understands digital twins not as realist representations but as self-regulating cyber-physical systems capable of immediate analysis and at least partly automated self-regulating intervention based on real-time bidirectional flows of data and information between the physical and the virtual object. It argues that the vision of self-regulating digital disaster twins requires a different type of critique than the critique of epistemological realism, one that focuses on the question what actually is the system that is supposed to regulate and preserve itself. In this respect, critical analysis can derive key questions and insights from critical studies on disaster and emergency management. Drawing especially on the work of David Keen, the paper argues that the vision of a self-regulating digital disaster twin could further depoliticize disaster management, obscure the relations of power and inequality underlying the causes for and the management of disasters and, in the worst case, lead to an automated biopolitics of disposability. It concludes with the question what kind of political debate is needed to prevent this scenario.

1. Introduction

Digital twins increasingly populate our world; today, there are digital twins, or at least digital twin concepts or projects, for aircrafts, buildings, power plants, cities, newborns, tomato farms, oceans, and more. In 2021, the European Union even launched the initiative of building a digital twin of the earth[1]. The universality of the concept is striking and perhaps unprecedented, in particular when we consider that digital twins aspire to be not just a metaphor but an applicable technological approach.

In this paper, I will focus on digital twins for cities, particularly digital city twins for purposes of disaster management, and explore what a critical, STS-informed understanding of this concept might mean. The paper is based on the relevant literature and takes a theoretical perspective. I venture the thesis that what differentiates the digital twin concept from 3D models and visualisations, digital maps, simulations or dashboards, is a cybernetic vision of systemic cyber-physical self-regulation underlying it and that this poses distinct and novel questions for critical STS analysis. What questions need to be asked and which kind of issues and challenges need to be addressed if we take the cybernetic understanding of digital city twins seriously, in particular concerning the purpose of disaster management?

In the following, I will first revisit the concept of digital twin and argue that next to the prevailing (mis)understanding of digital twin as an accurate representation of reality there is also an emerging literature that conceptualises digital twins within a cybernetic framework as cyber-physical systems capable of data-based self-regulation. Next, I introduce the concept of digital city twins and argue that what distinguished them conceptually from other digital models, simulations and technologies is the capacity of ‘now-casting’, that is the capacity of immediate analysis and response to current conditions based on real-time bidirectional flows of data and information between the physical and the virtual object. I argue that the vision of digital city twins as self-regulation cyber-physical systems merits critical STS-informed analysis and assessment, which becomes particularly clear when we consider digital city twins for disaster and emergency management. The remainder of the paper is devoted to my argument that critical reflexions on digital disaster twins can derive key questions and insights from critical studies on disaster and emergency management. Against the backdrop of David Keen’s (2023) critique of disaster and emergency management, the paper argues that the vision of a self-regulating digital disaster twin, if it became true, could further depoliticize disaster management and the underlying relations of power and inequality and, in the worst case, lead to an automation of what Henry Giroux termed the biopolitics of disposability. The

[1] For a critical analysis see Rothe, Delf. 2024. ‘When the World Is an Object: On the Governmental Promise of a Digital Twin Earth.’ *International Political Sociology* 18(olae022)..

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2 Genealogy and Conceptual Ambiguity

The origins of the digital twin concept have been traced back as far as the 1970s (Lagap and Ghaffarian 2024, Mylonas et al. 2021), but it is only in the past few years that it has given rise to an exponentially growing area of research, a rapidly evolving field of technology applications, and a rapidly evolving market. Historical accounts of its evolution vary, as do definitions. According to one account, the idea of twinning in technology research and development originates in the NASA's Apollo program in 1970, which involved the creation of two identical spacecrafts one of which, named the 'twin', stayed on the ground and was used to provide assistance to the crew in space in critical situations (Lagap and Ghaffarian 2024). According to another account, the idea of what was later termed digital twin was first introduced by Michael Grieves in 2002 (Grieves 2002, Grieves 2024) as a model for Product Lifecycle Management. However, the term as such was not used until 2010 by John Vickers of NASA (Grieves 2024) and made more popular in the following years by Grieves and Vickers (Grieves 2014, Grieves and Vickers 2017). Since the mid-2010s, the literature on digital twins is growing exponentially (Ariyachandra and Wedawatta 2023, Cheng, Hou and CHeng 2023, Mohiuddin Eumi 2024).

In technological terms, there is some convergence in the literature saying that a digital twin comprises three basic components:

a) a wide variety of hardware components for collecting data such as IoT sensors, 5G networks, energy and transit data networks, but also official statistics, and social media. In the case of digital city twins, these may be data about the terrain, the built environment, mobility, energy consumption, temperature, and more, up to virus infections and other;
b) a platform for storing, integrating and processing data;
c) the analytical capacity for performing calculations, simulations, scenarios.

Despite the hype around digital twins, or perhaps because of it, there is still a considerable amount of terminological confusion, compounded by a 'growing eagerness to label everything as a digital twin' (Martinescu 2023). When doing a rough search on Google, you will quickly come across phrases such as 'a virtual representation of an object or system designed to reflect a physical object accurately' (IBM), 'a virtual replica of a physical object, person, or process' (MacKinsey & Company), 'digital images of physical objects' (Fraunhofer IKS) and the like. Such phrases show an essentially dualist, Cartesian understanding of digital twins (Kitchin and Dawkins 2024), with a human subject on the one hand and a physical world on the other, and the digital twin as an instrument for seeing and representing an object in the physical world. Within a Cartesian framework, the subject and their intentions and will to knowledge precedes the instrument; the subject uses the instrument to generate knowledge about the physical world which then allows them to form the physical world according to their preceding goals and intentions. This dualist, Cartesian conception of digital twin has been criticised from an STS-perspective for obscuring the performative nature of digital twin and reinforcing an inherent realist epistemology, casting the model as an accurate, comprehensive and objective representation of reality that, as such, would inform better, value-neutral interventions. It has also been criticised for reducing complex, local and contextual relationships to matters of efficiency and control, and for a lack of a human dimension and the absence of people designing, creating and using it (Charitonidou 2022, Kitchin and Dawkins 2024, Korenhof, Blok and Kloppenburg 2021, Korenhof, Giesbers and Sanderse 2023). This line of criticism builds on a longstanding literature in STS, critical geography, critical data studies and related fields that has extensively demonstrated that data as well as numbers, figures, statistics and models are never neutral and objective but always in one way or other value-laden and performative and this criticism certainly applies to digital twins too. However, I want to draw attention to the fact, that next to the (mis)understanding of digital twin as accurate representation of reality, there is also an emerging literature that conceptualises digital twin within a non-Cartesian, systems theory or cybernetic framework. The question I want to discuss is whether a cybernetically inspired conception of digital twins, especially digital city twins, raises novel and different questions and grounds for criticism than the Cartesian conception.

3 Cybernetic Visions

A cybernetic conception of digital twin is advocated by Tomko and Winter (Tomko and Winter 2019) who have suggested to abandon the language of replica, representation, mirror and twin altogether. They argue that, rather than the metaphor of a mirror, the metaphor of a brain in a living organism is more adequate for capturing the specific relation between the virtual and the physical object within a digital twin. Like a brain, 'the digital counterpart is coupled with the physical realm (cyber–physical) by a nerve system of sensors, actuators, and (information-processing) communication lines' (Tomko and Winter 2019, 398). For them, the coupling between the virtual and the physical counterpart also includes people communicating and interacting with the physical object as well as with its virtual counterpart. Therefore, they suggest, it would be more appropriate to speak of cyber–physical–social eco-systems than of digital twins.

The idea of creating cyber-physical systems capable of self-steering and self-organisation has a long tradition in cybernetic thinking. Andrew Pickering argues that, at least for the British tradition of cybernetics, the brain as an embodied organ in a living organism that is constantly adapting to a dynamic environment was the central and distinctive object of interest (Pickering 2010). Within a cybernetic framework, digital twins are not representations of reality but self-organising cyber-physical systems, or essential components of such systems (Casadei et al. 2022, Rocha and Barata 2021, Sepasgozar 2021). Casadei et al. for instance present a vision whereby collectives of digital twins allow cyber-physical systems to facilitate self-organisation processes and 'autonomously organise as a whole towards global goals' (Casadei et al. 2022).

In many respects, cybernetic approaches to digital twins draw on the vision of autonomic computing presented by Kephart and Chess (2003) some twenty years ago. They have argued that existing computing systems at the time had reached a level of complexity that human system integrators would soon be unable to manage. The only option to reconcile ever increasing complexity and enduring innovation would be autonomic computing which they define as 'computing systems that can manage themselves given high-level objectives from administrators.' (Kephart and Chess 2003, 41) The essence of autonomic computing, as they envisioned it, was self-management. Self-management, in turn, comprises a number of further capabilities such as self-configuration, self-optimisation, self-healing and self-protection. Casadei et al. speak of self*- capabilities. Being connected through some form of interaction feedback to the physical object, whether through automated or human decision-making or a combination of both, the virtual twin actively intervenes in the physical object, steering, controlling and optimising it.

Cybernetic conceptions of digital twins have been promoted mainly in the area of industrial processing but recently also in the area of cities, urban planning and urban infrastructures (Liu and Tian 2023). What would it mean to create a digital city twin that functions as a self-regulating, self-organising, self-optimising cyber-physical system? What would be the implications from a critical STS perspective? What questions need to be asked and which kind of issues and challenges need to be addressed if we take the cybernetic approach to digital twins seriously? A self-regulating system is not adequately understood as an instrument or a tool used by a preceding, external subject with preceding ideas and intentions. It is not so much characterised by hierarchically imposed, centralised control and preselected values and priorities than by principles of self-regulation, -organisation, and -optimisation. Therefore, I would argue, the critical question is not so much 'who is behind the steering wheel' (Korenhof, Blok and Kloppenburg 2021, 1766) but 'What is the system?'. In a self-regulating cyber-physical system, there is no one steering wheel and no one driver behind it and not necessarily a predetermined goal either, at least not a detailed one. The whole point of a self-organising system is that it organises and maintains itself by flexibly adapting to a changing environment in ways that cannot be known and predetermined in advance. Therefore, I am not sure that a cybernetically designed city twin would actually be geared at a certain predefined desired state, ideal or substantial goal that can be 'read' from it. If a digital twin actually constitutes a self-regulating cyber-physical system, it should be capable of defining what constitutes the optimum state under the respective conditions at a given point in time.

The critical question therefore might rather be: What is the system? What is the meaning of systemic self-regulation, self-improvement and self-adaptation? When and why is it considered successful? At which costs? Would there be any room for political deliberation, contest and conflict within such a system and if so, where and when? In the following, I will start to explore these questions with regard to digital city twins with a special focus on digital city twins for disaster management.

4 Twinning the City

Digital city twins, also referred to as digital urban twins, virtual city twins, smart city digital twins, urban scale digital twins and other, are a burgeoning phenomenon in digital urbanism. The digital twin concept has been promoted in the context of smart cities and urban management since around 2017 (Ferré-Bigorra, Casals and Gangolells 2022, WEF 2022). Over the past few years, the literature on digital city twins has grown exponentially (El-Agamy et al. 2024), as well as digital twin projects of cities, regions, or urban infrastructures around the world. At present, most digital city twin projects are still in the concept and planning phases (WEF 2023a) and there is reason to assume that many of these rather refer to a 3D model of the city, a digital map or a data platform without a bidirectional flow of data and information (Ferré-Bigorra, Casals and Gangolells 2022).

There is no standard definition of a digital city twin. Often, digital city twins are defined teleologically; what they are is defined by what they should be or should do, suggesting that they not only can but will and do fulfil critical functions, meet challenges, provide solutions, achieve improvements. For instance, the World Economic Forum defines a digital city twin as ‘a virtual replica of a physical city that enables simulation, monitoring, and control of complex urban scenarios, enhancing efficiency and sustainability.’ (WEF 2023b) Digital twins, so a recent review, ‘enable more informed decision-making and optimize planning, operations, finance, and strategy… help reduce carbon emissions and expedite significant projects… enable the simulation of plans before implementation, allowing for the anticipation of potential challenges’ (El-Agamy et al. 2024, 16), they enhance traffic and mobility management as well as public health and safety, reduce energy consumption, optimise supply chain management, stimulate citizen involvement and more. In short, the WEF proclaims: ‘They have the potential to transform cities into more intelligent entities, leading to high-quality urban development and sustainable growth.’ (WEF 2023a, 4)

In general, the digital city twin is conceived as a tool for urban planning and management that allows for monitoring processes and performance and running virtual what-if scenarios, and thereby provides actionable information for decision-makers in urban planning, government and management as well as in the private sector.

There are broader and more narrow, demanding concepts of digital city twins. For the latter, a distinct and constitutive feature of digital twins, as compared to other models, simulations and technologies, is the capacity of bidirectional real-time data flows: 'The big difference from traditional simulations is that digital twins use real-time data for their modelling.' (Willige 2022) Real-time data flows turn the virtual replica from a static to a dynamic digital object that allows for 'nowcasting' (ARC 2024, 1), meaning immediate analysis and response to current conditions. Digital city twins in this sense are complex cyber-physical systems where the physical and the virtual object interact with each other in both directions (Deren, Wenbo and Zhengfeng 2021, 2). They do not only allow for the generation of immersive 3D visualisations, what-if scenarios and simulations but also enable the virtual object to intervene into the physical one by exercising actions of control, adjustment or improvement. While generally, digital city twins are defined by their capability of facilitating and improving decision-making, more demanding concepts require a digital twin to be capable of performing automated decision-making.

At present, we can assume that very few existing projects labelled digital city twin, urban digital twin, smart city digital twin and the like, are based on automated bi-directional, real-time flows of data and information between the physical and the virtual object and allow for automated control, decision-making and intervention (El-Agamy et al. 2024, 30). Nevertheless, it is worth taking the idea seriously, since research and development may push existing digital city twins further in this direction. The need for critical reflexion and discussion, I believe, becomes more obvious when we look at one particular variant of digital city twins, namely digital city twins for disaster and emergency management.

5 Twinning Disaster?

Over the past few years, a series of related concepts and paradigms have been proposed such as Digital Twin Smart City for Disaster Risk Management (Ariyachandra and Wedawatta 2023), digital post-disaster risk management twinning (DPRMT) platform (Lagap and Ghaffarian 2024), Disaster City Digital Twin (DCDT) (Fan et al. 2021), or Smart City Digital Twins (SCDT) for disaster management (Ford and Wolf 2020), Digital Twin for Emergency Management of Civil Infrastructure (EMCI) (Cheng, Hou and CHeng 2023) and other. These propositions commonly start from a tableau of problems and challenges that include a growing world population, the global trend towards ongoing urbanisation, ever complex urban infrastructures, and increasing risks of natural and/or man-made disasters and catastrophes from earthquakes, landslides, climate change and extreme weather events such as floods, draughts and heatwaves, hurricanes, up to terrorist attacks, pandemics and more. Digital twin technology is promoted as a promising approach to improving the resilience of cities to disasters and emergencies by improving the capacity for disaster preparedness as well as disaster management and mitigation and post-disaster recovery. In short, digital disaster twins are being promoted as an appropriate approach to deal with the increasing complexity of cities, urban regions and infrastructures on the one hand and the increasingly probable, but incalculable, unpredictable and unprecedented occurrence of future disasters and emergencies on the other.

Digital twins for disaster management are basically conceived as decision support systems that employ simulations and scenarios to 'find the best decision for the best outcome' (Doğan, Şahin and Karaarslan 2021, 27). In the pre-disaster situation, digital twins, so the idea, can serve to make predictions about possible future disasters and the damage they may cause, develop emergency response plans and enhance disaster preparedness; in the actual event, they can provide detailed, real-time data about the situation on the ground, generate what-if scenarios to analyse and assess the outcomes of possible responses before implementing them in the real world, inform resource allocation and coordinate rescue efforts more effectively. When it comes to the expected benefits of digital twins in disaster management, resilience is a recurring theme. Digital twins are promoted as an effective approach to improving the resilience of cities and communities to natural disasters, enhancing climate resilience, improving urban resilience, building resilient smart cities, and the like. Overall, we can note a pervasive discursive articulation of digital city twin, disaster, emergency, decision-making, efficient management, and resilience, however without resilience being explained in more detail.

Like digital twins in general, digital disaster twins are composed of data-collecting hardware components, data management components like data platforms, and software components for data analytics and generating simulations and scenarios. Data can be collected by satellites, drones, sensors and cameras installed in buildings, infrastructures, vehicles and more, smartphones (e.g. GPS coordinates), all kind of Internet of Things (IoT) devices, but also from existing data repositories such as Building Information Modeling (BIM), census records, official statistics and other. In addition, peculiar methods of data collection in disaster twin concepts are social sensing and mobile crowd sensing. At this point, the criticism that 'digital twin approaches have been largely ignorant of people and what relates to them' (Charitonidou 2022, 242) requires qualification. These models and concepts actually do assign a key role to people, however it is important to examine which role and what for. Crowdsourcing, here, means harnessing a diverse group of people to collect first-hand, real-time disaster-related information and report it to an online platform. In addition, 'crowdsourcing for data processing refers to approaches in which people implement human-easy and computer-difficult tasks (e.g. labeling images, adding coordinates, tagging reports with categories, etc.) to generate structured, high quality, interpreted data for decision-making or machine learning' (Fan et al. 2021, 4). Crowdsourcing for collecting or processing data, thus, is based on people’s voluntary participation. This is not necessarily the case with social sensing.

Social sensing is a data collection method used to extract information from social media platforms such as Twitter and Facebook with the help of Natural Language Processing (NLP) (Lagap and Ghaffarian 2024). Social sensing has the potential, so the suggestions, to provide real-time data that may serve to indicate the onset of a disaster as well as the location, scale and severity of the damage that has occurred and thereby enhance effective decision-making. It is also mentioned as a method to acquire information about people’s behaviour, interactions, movements and emotions in a disaster situation, under the premise to enhance effective decision-making (Fan et al. 2021, Lagap and Ghaffarian 2024). Smartphone users can, for instance, take pictures of damaged buildings or infrastructure and share these, together with the related geolocation data, with the authorities. In addition, tapping into people’s smartphones may serve to track people’s movements, both in advance, for purposes of generating plausible scenarios, and in real-time for knowing and steering actual movements in disaster situations. Thereby, so the idea, smartphone and social media users can provide data on how people responded to a situation of crisis or disaster and thereby contribute to effective decision-making – whether voluntarily or involuntarily.

But what is `effective´ decision-making in this context? What makes decisions more effective, in which respect and in whose perspective? And what does effective decision-making mean when decisions are not just informed but automated and executed by a cyber-physical system called digital twin?

It is difficult to find more concrete descriptions of how exactly a digital twin could improve the effectiveness and efficiency of disaster management. We learn that automated data flows will inform better, faster and more efficient decisions about the size and composition of rescue teams, equipment, mode of transportation and the like. One more concrete example are flood gauges with automated reporting. But decision-making may also target people and their way of acting: ‘To avoid chaos, the analyses’ conclusions can be utilised to guide people’s movements following the accident.’ (Ariyachandra and Wedawatta 2023)

6 Subjects of Twins

At present, it is not clear, whether and to which extent there are already digital disaster twins that enable automated bidirectional data-based interactions between the physical and the virtual object. Only very few applications of digital twin technology in disaster management in the literature do describe the ‘V2P [virtual object to physical object] twinning process consistently’ in more detail (Zio and Miqueles 2024, 8). As yet, most if not all conceptions for digital disaster twins seem to aim at better, more efficient decisions of human operators, not automated decisions by the cyber-physical system. In case of the latter, automated decision-making could involve, for instance, the automated closing or opening of flood gates in response to certain data, but it could also mean to direct people out of or into certain spatial areas.

The difficulty in finding more concrete use case descriptions, however, is in fact related to the nature of the matter: After all, the idea and the expected benefit of digital disaster twins is not least that they do *not* rely on pre-defined contingency plans, with pre-defined goals, targets, rules and measures for a pre-defined set of situations. Instead, the advantage of digital disaster twins, so the idea, is precisely that they allow for efficient, flexible, and immediate responses to an unlimited scope of possible events of disaster and emergency, including unprecedented ones for which there is no blueprint yet. Digital twins, in other words, promise to offer an approach that is not geared at concrete scenarios but is sufficiently open, flexible and, in a sense, abstract or universal to deal with situations of disaster, crisis and emergency that cannot be concretised in advance. Ideally, a digital disaster twin is a 'universal tool' (Charitonidou 2022, 243) for dealing with unspecified disasters and emergencies.

In my view, it is important to see that the idea of a 'universal' digital disaster twin - one that will immediately and efficiently 'find the best decision for the best outcome' in any kind of situation – corresponds to a dynamic, self-regulating, self-learning, self-updating cyber-physical system based on continuous, automated, bidirectional data-flows between the physical and the virtual object, where the virtual counterpart does not merely *in*form but *per*forms decision-making. The problem with a 'universal disaster twin', I would contend, is not so much that it would be based on standardised patterns, norms and procedures that are ignorant of local people and local specifics, of people's needs and feelings, the diversity among the population, the socio-economic and demographic features of the community and the like. The universality of the 'ideal' digital disaster twin stems from its capacity to respond to concrete local situations on the basis of real-time data; it is not just executing a set of predefined, in-built standards, rules, norms, and procedures. The dynamic disaster twin does not gloss over people and local specifics, but on the contrary seeks to collect, process and integrate as much data as possible from and about as many concrete local people and specifics as possible. This certainly includes surveillance systems, where people are subject to data collection without consenting or even without registering, but also forms of active engagement where people are encouraged and enrolled to collect data and contribute to improving data quality by, for instance, labelling, categorising, and reporting errors. In short, the digital disaster twin does not ignore people but involves mechanisms of subjecting them to surveillance and control and activating them as responsible data workers in situations of disaster and emergency, thus mechanisms of subjectification in the double sense explicated by Foucault.

7 Sovereign Twin?

There are certainly good reasons to expect that disasters will become more frequent, more complex, more devastating and less manageable in the near future, due to climate change, extreme weather events and environmental destruction, but also due to failed states, corrupt governments, dysfunctional institutions, erosion of international cooperation and more. Hence, there is certainly a strong case for improving disaster prevention, preparedness, mitigation and recovery systems and it is quite conceivable that digital disaster twins hold the potential to make disaster management operations faster, more effective and more efficient. Yet, the question is: what means effective and efficient? In relation to what? At what costs? What actually means ‘management’? What counts as benefit, what not? What counts as a disaster, what not? What could be down-sides, social implications, or new risks involved? And where is the place to debate these questions? These are political questions to which there are no merely technological answers. In case of digital disaster twins, I would argue, they should be discussed against the insights of critical disaster and emergency studies. In order to assess the potential of digital disaster twins to improve disaster management, I would hold, we need to critically explore the meaning, ambivalences, problems and pitfalls of disaster and emergency management in the first place in order to be able to reflect on the question whether and if so when and how digital twins could rather resolve or rather exacerbate them. It is not doable within the scope of this paper to provide a comprehensive review of critical disaster and emergency studies. To make a start, I will draw on David Keen’s When Disasters Come Home’ (Keen 2023). Keen argues that disasters and emergencies do not just happen but are often actively created and exploited or sustained by powerful forces. Hence, disaster and emergency relief will remain patchy and largely futile until the underlying causes for creating or sustaining disasters are not being addressed.

Keen raises a number of points that are of utmost importance for a critical reflection on digital disaster twins: First: What counts as disaster or emergency? Keen points out that the Oxford Dictionary of English and the American Merriam-Webster dictionary both define a disaster as a ‘sudden’ event that causes great damage, loss or destruction (Keen 2023, 2). Likewise, we could add, an emergency is commonly defined by terms such as ‘unforeseen’, ‘urgent’, ‘suddenly’, ‘unexpectedly’[2]. For one thing, this understanding of disaster and emergency excludes situations that also cause great damage, destruction and loss of life but do so over an extended period of time. Also, in the aftermath of

[2] The Cambridge Academic Content Dictionary, for instance, defines emergency as ‘a dangerous or serious situation, such as an accident, that happens suddenly or unexpectedly and needs immediate action” (quoted at https://dictionary.cambridge.org/dictionary/english/emergency, last access 26 March 2025) . The Merriam-Webster defines emergency as ‘an unforeseen combination of circumstances or the resulting state that calls for immediate action’ (https://www.merriam-webster.com/dictionary/emergency, last access 26 March 2025).

disasters, it often turns out that they had not been unexpected at all, but result from long-term underlying problems such as neglect of domestic infrastructure and warning systems, failure to control compliance with building codes and safety regulations or to maintain contingency plans and store medication, protective gear and equipment. In particular, the long-term neglect and underfunding of public health care systems exacerbate disasters and their consequences - or could actually be considered a disaster in itself. The same is true to escalating social inequality, mass poverty, mass incarceration, and poor social security systems. Hence, many disasters and much suffering and loss of life could be averted if it was not for the lack of political will to address these underlying problems. Furthermore, disasters and emergencies tend to be defined by contrasting them with a situation of normality. Accordingly, the function of disaster management is to restore normality as fast and effectively as possible. But what counts as normality? Which interventions to restore 'normality' provide support and relief for whom? And, 'isn't the process of reconstruction and the process of ‚getting back to normal' actually a rather direct route back to the vulnerabilities and grievances that created the disaster in the first place?' (Keen 2023, 39)

One could go further and examine the top priority of disaster and emergency management: Saving lives or saving 'the system'? Whose lives and which 'system'? Keen reminds us of Hurricane Katrina, where people were trapped without water, food or shelter in the flooded parts of the city, which, not coincidentally, were the parts where poorer and black people lived. We are also reminded of the fact that in the early phase of the COVID-pandemic, UK ministers ordered to discharge thousands of patients from hospital and move them to care homes without testing them for COVID in order to vacate hospital beds and protect the National Health System from being overburdened. A few weeks later, almost 1,000 care homes reported an outbreak of COVID (Keen 2023, 119). More generally, efforts of closing borders in Europe and elsewhere to seal oneself off from people seeking refuge from the disasters in their home country means that 'threatened populations are turned into threatening populations' (Keen 2023,46). Henry Giroux speaks of a 'new biopolitics of disposability': vulnerable populations like the poor, people of colour, the elderly, or people with disabilities, 'not only have to fend for themselves in the face of life's tragedies but are also supposed to do it without being seen by the dominant society.' (Giroux 2006, 175)

Coming back to digital disaster twins, I suggest we can derive a number of questions from these considerations: Who defines the disaster or emergency and how? In other words: Will decision-making about whether and when an intervention is necessary and what kind of intervention it should be, be automated? If so, who is accountable for the decision and its outcomes? Who determines whether in retrospect the intervention has been helpful and legitimate? Will there be any pre-determined priorities, rules or standards that would define the scope of possible decisions and interventions, or should decision-making be left entirely to the discretion of the -cyber-physical system in order to