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# Abstract Smart Space and Concrete Risks

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## 1 ABSTRACT

Abstract representations of space in the smart city, like the control rooms of intelligent operation centres, simulate a panoptic gaze in order to legitimate the planning, management and control of urban space. In the corresponding language of quantified risk assessment, smart risks can be presented as objective numerical values whose probability of occurrence can be significantly reduced through smart measures for resilience. In our paper, we argue that the smart city's technological solutions aim at reducing risk, but, in fact, create the paradoxical situation that measures for technological resilience reduce some technological risks, but reproduce and even amplify risks on technological and social levels at the same time. We illustrate this argument by critically discussing the emerging smart city with a view to the narrative of technological urban improvement for the good life, which is accompanied by acceptability of, and habituation to setbacks, or to potential disruptive impacts on urban services.

Keywords: cultural practise, risk, resilience, smart city, smart space

## 2 INTRODUCTION

As a vision in the making, the "smart city" is constituting a new leitmotif in urban planning, which succeeds, overlaps with and complements previous leitmotifs, such as the creative, intelligent or global city. While visions are future oriented, they are elaborated, diffused, or discussed in the present and the promotors of rivalling visions compete for public attention and economic resources for their realisation in the here and now. These preliminary considerations demonstrate that visions and leitmotifs for urban futures frame present-day negotiations over urban issues, for example by empowering technology-centered paradigms for urban development. Visions and leitmotifs also impact on the presence by effecting anticipatory changes in urban cultural practices that adapt to an expected future, for example in the sense of re-evaluating notions of urban comfort and urban risk. This motivates our analysis of urban smartification to concentrate not only on the material aspects of smart urban technologies, but to consider these as sociotechnical and historical phenomena that are subject to change over time.

## 3 SMART URBAN ECONOMY

Baron Haussmann's rebuilding of Paris as the capital of nineteenth century modernity is a case in point for capital's power of urban transformation in cooperation with "new technologies and facilitated by new organisational forms" (Harvey 2003:13). Considered on the foil of a continuing profit crunch and overaccumulation, one important reason for pushing urban smartification in Europe and America is purely economic, since the smart city provides opportunities for massive investments and potential returns. The future global smart city market is estimated at around $ 1.56 trillion by 2020 (Frost & Sullivan: 2014). In the USA alone, there are around 26 million streetlights that could be replaced by so-called smart poles, i.e. lanterns equipped with various sensors for data collection serving as nodes in wireless networks or as human-technology interfaces. Held every year at Cannes, MIPIM (Marché International des Professionnels de l'Immobilier) is the world's leading property market that brings together potent investors, urban development companies and municipalities. Over the past years, "smart" as an urban attribute has developed into an increasingly important label for municipalities to advertise their development projects and attract investors for smart buildings, smart business parks, or entire smart cities. The vast number of sprouting private-public-partnerships for smart city building across the world testifies as much to the transformative powers of innovative urban technology.

## 4 "SMART" IN URBANISATION DISCOURSE

As a label of technological urban development, the urban attribute "smart" appeared for the first time on agenda settings during the mid-1990s when the World Forum on Smart Cities forecast that within a decade about 50,000 cities would initiate programmes for smart urban development (Hollands 2008). As “smart” has become a catchword in urbanisation discourse, it is important to consider its genealogy. A vague term like “smart” is an appropriate umbrella label under which a diversity of concepts and interests can find shelter. As Hollands (Hollands 2008:304) states, the smart city carries “numerous unspoken assumptions and a rather self-congratulatory tendency (what city does not want to be smart or intelligent?)”. In urbanisation discourses, the smart city sums up a variety of previous technologically minded leitmotifs for urban development. While the concepts of the wired and the digital city had emphasised the importance of technological infrastructures and algorithmic calculation for the city, concepts of the hybrid city, the ubiquitous city and the virtual city have promoted the increasingly sensor based digital duplication of the physical city into virtual reality. Related concepts, like those of the learning city, the intelligent city, the knowledge city or the concept of intelligent urbanism have also merged easily into the hazy concept of the smart city, since they equally respond to urban industrial decline through new urban labour, innovative technology and a competitive struggle over educated workforce.

According to Nam and Pardo (Nam and Pardo 2011:283), the term’s successful career in marketing language, where it addresses a broader range of consumers than the elitist term “intelligent”, may also have contributed to its appeal in urbanism: who does not want to be smart?

In fact, today’s positive connotations of the term “smart” stem from both the technological and the urbanist genealogies of the term. From the early 1990s onward, New Urbanism – a movement of architects and urban planners – began to promote a programme for “smart urban growth” in the U.S. With the foundation of the Smart Growth Network of the U.S. Environmental Protection Agency in 1997, the movement gained significant influence on urban development, in particular in post-industrial cities. With its agenda to densify the use of urban space through rezoning, i.e. conversion of urban industrial zones into residential and office zones, New Urbanism and smart urban growth fought urban sprawl and its associated negative impacts on the environment through commuter traffic, inefficient land-use by single detached houses or resource waste by infrastructures for scattered settlements. Instead, it promoted a healthier, more sustainable and democratic vision of urban life: cities with green spaces, walkable distances between home and work, reduced car traffic and less pollution, where citizens are encouraged to co-design implementations of the local Agenda 21 and, more recently, respond to the U.N. Sustainable Development Goals.

In parallel to this positive urbanist genealogy, the term “smart” got an equally positive coinage in technological discourse, where it relates to IT-based technologies that collect data through sensors in their environment and process the data algorithmically in order to adapt the system and influence the environment. In 1990, the New York Times first reported on a “Smart House” with computer controlled toilet functions and as of 1993, the term “Smart Home” gained purchase to define private residences equipped with automated systems to increase energy efficiency. At around the same time, the innovative Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T) was introduced to protect hard drives against risks of data loss.

In combination, , the positive urbanist and the technological coinings of “smart” endow the term with the best of connotations from the fields of technology, urbanism and sustainability: This encomasses the New School’s promise of a city design that brings together generally desirable qualities like comfort, health, sustainability, environmental friendliness, democracy and social inclusiveness, and the technological promise for a general improvement of society and for increased sustainability based on the premise that ubiquitous sensor-based monitoring in combination with artificial intelligence will attain higher degrees of efficiency, reliability and order than any human administration ever could. However, spin-doctors of companies that apply “smart” in marketing language react carefully to critiques that the smart city might create fears among citizens that the human side of the city will be compromised by technology’s dominance. They have therefore already been suggesting to rather speak of the “sensible city”.

## 5 CONCEPTUALISING SMART IMPLEMENTATIONS ACROSS URBAN SCALES AND LEVELS

An increasing range of studies have discussed and assessed the implementation of new information and communication technologies as well as artificial intelligence (AI) into the urban tissue. Here, we suggest that the manifold existing and potential future instances of urban smartification find implementation on different spatial scales, for example in a smart home, or office building, within a business park, over an entire idealtypical smart city that is interconnected, sensor monitored and AI-managed, or even over a global nexus of such interconnected smart cities. In the second place, implementation of smart technology operates on different levels of urban life by getting implemented into services of general interest such as critical infrastructures (CI) for electric power, water and communication, or into services of personal comfort, for example virtual reality apps for shopping or smart assistance for citizens in public and private spaces. Across the different spatial scales of cities and across the different levels of urban services, smart technologies offer the potential to change the lives of citizens dramatically.

## 6 PROMISES AND PARADOXES

Equipped with positive images of sustainability, security, efficiency and comfort the smart city as an emerging leitmotif for urban development communicates a vision and a promise for a better urban future, for a good life. But it also carries undeclared baggage: the sociotechnical dynamics in smart cities may lead to paradoxical denials of the initial vision and its promises, which motivates us to speak of a "good-life paradox". It describes the potential, if not likely, mismatch between expected and actual quality of urban services when intended technological improvements produce not only new technological risks, but also new social risks. As our two historical examples will show, this paradoxical mismatch is part of a reoccurring patterns in technological innovation that is all too often silently accepted by citizens, due to their habituation or defeatism in the face of mass consumerism and more general massification.

## 7 NEGLECTED RISKS OF MASS CONSUMERISM AND MASSIFICATION

Under industrial capitalism cities had become the prime locations of individualist modern consumer society and in our late modern Western societies of today, mass consumption remains a systemic requirement for the workings of today's growth oriented global capitalism. While there are potentials for smart urban services to counter growth and mass consumption, for example by providing neighbourhoods with sharing platforms or by creating low batch sizes from 3D-printing, these counter-systemic undertakings remain marginal and the dominant trend is towards mass consumerism of smart devices and smart services as crucial parts in local and global capitalist value-added chains.

How does massification impact negatively on the smart city as a sociotechnical system? In general, technical systems are designed for the long-term and their capacities are sized appropriately to the expected degree of usage in order to offer reliable services. Any system, then, has limited capacities to deal with growth. In the case of urban service systems, decentralisation and liberalisation allow the unrestricted entry of new market participants or customers (MPCs). We call massification the steady increase of MPCs, and the related increase of material, technical and other system components that is to be expected in the systems of smart urban services. Massification is the main driver for increasing systemic complexity on the one hand and for congestion and overload phenomena of. or in an urban services system on the other hand. Consequently, massification generally has the potential to increase supply risks in an urban services system.

Urban services systems are limited by the built infrastructures that only admit, for example, certain distributions of electric power, or certain rates of data traffic and they reach their limits when MPCs grow in numbers without restriction and are able to make almost unrestrained use of their individual local capabilities and possibilities. Due to this systemic massification, reliability or resilience of urban services tend to converge to adverse states, unless infrastructural improvements or enhancements occur. Thus, massification makes a system of urban services systems more vulnerable. In rare cases a trigger event may cause large numbers of MPCs to behave in the same way, which drastically impairs the performance of a system due to overloads and congestion. Shock events may force spontaneous use of the transport system that may lead to mass evacuation and cause drastic overloads and congestions, or the partial physical collapse of the transport system itself. In such cases the quality of supply of services for MPCs diminishes.

Smart urban services systems are highly complex, constituting, in fact, a system of systems, in which the provision of data based services mutually depend on other data based services. If this mutual dependency includes ever more CIs and services of general interest, we can speak of new potential risks for urban populations caused by massification. Consequently, we may assume that the quality of life in urban services systems is codetermined by the number of MPCs and their behaviour. Thus, for monolithic, non-adaptive infrastructures, which operate within certain physical barriers, the quality of services a system provides tends to deteriorate.


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Massification depends on demographic and technological developments, but also on changing cultural practices. The creeping progression of this risk driving phenomenon on different levels of urban services is more or less assessable, if not deterministic, whereas the understanding of concrete manifestations of such processes in terms of changing cultural practices needs deep analysis of corresponding scenarios, which are outside the scope of this paper. Such creeping processes do not immediately cause catastrophe, but they can lead to a gradual deterioration in service quality. This brings us back to the good-life paradox with regard to urban services for citizens' comfort: the mismatch between expected and actual service quality is all too often silently accepted, due to habituation or defeatism in the face of reoccurring patterns in technological innovation.

In the following section, we will briefly describe two examples of the good-life paradox in technological innovation that relate to the phenomenon of systemic massification. A third example depicts the current transformation of a CI (smart grid), in which experts consciously address the problem of massification. However, we argue that proposed counter measures against the paradoxical phenomena caused by massification rely on hypotheses and unproven concepts, which in itself involves enormous risks.

### 7.1 Example 1

The first example for a mismatch between expected quality of services and actual services concerns the Internet, which is based on a decentralised architecture and today allows millions of MPCs in the form of providers and consumers to function as nodes that either send or consume data respectively. In situations when many consumers from a tenement or neighbourhood use streaming services concurrently, available bandwidth is all too often far from the quality promised by the service provider through contract or advertisement. The data rate is throttled, the performance of the internet service deteriorates. Either the picture quality deteriorates to a still reasonable degree or the service breaks off. This example primarily refers to the private use of the Internet and thus above all to the satisfaction of a luxury in terms of entertainment and information. But in the smart city a whole web-based economy, a virtual urban life-world and even critical services will depend on punctual and uninterrupted data traffic and immediate answers to citizens' requests. As of today, disheartening acceptance and habituation stand in the place of a larger societal debate on the potential new risks.

Let us restate the good-life paradox in the Smart City on the basis of this example: The vision for a better urban life through smart technologies speaks of large numbers of highly interconnected MPCs, but their massification in relation to available data infrastructure and bandwidth may lead to considerable impairments in the environment of a digitised everyday life, unknown to the pre-smartified world. However, due to the steady process of massification system outages, overloads and congestions are likely to become widely shared experiences that cause habituation to and silent acceptance of quality deteriorations.

### 7.2 Example 2

If we look deeper into the historical patterns of technological innovation that promises but fails to improve the conditions of urban everyday life, the example of how individual motorised mobility evolved over the past decades in relation to urban space is striking. The technological milestone development of the automobile corresponded to the modernist vision of the self-determined individual, offering mobility to even distant destinations with bag and pack in an affordable manner and in a relatively short time. The analogy to attributes associated with the emerging notion of "smart mobility", i.e. individualided comfort, self-determination, freedom from constraints and social dependences (as in public transport with rigid timetables) is evident.

From a systemic viewpoint, it is clear to see how the dynamic of massification has time and again been scratching on the traffic system's limits, necessitating recurrently and dramatically the expansion of road infrastructure and transportion networks, within and between municipalities and cities. The first German motorway measuring 20 km connecting Cologne and Bonn was opened in 1932. The total length of all motorways in Germany today is approx. 13.000 km. In the 1960s the economy prospered strongly and the number of vehicles approached the 7 million mark. The first reported traffic jam in Germany occurred in the summer months of 1963 due to a faulty motorway construction and the total length of all traffic jams was 33 km. Today, the number of cars in Germany is about 48 million. The traffic jam length amounted to 1.7 million km in 2018 and the average number of traffic jams was about 2000 per day.

The number of vehicles involved in road transport still continues to grow – in particular with an increase in logistics and heavy goods vehicles, which is not surprising in the age of global capitalism and online shopping. The drama of rigorous expansion of road space into agricultural, natural and recreational spaces outside cities turns into a drama of densification and intensification within limited urban space, which suffers from lacking development capacity. Here, the space covered by moving or standing vehicles has increased so drastically over the past half century that further intensification is hardly imaginable. Our short historical summary on mobility development can be used as a suitable metaphor for impending phenomena of massification and the good-life paradox in the context of smart cities.

### 7.3 Example 3

Our last example refers to the current vision and plans for implementing sustainable electricity systems, which spells nothing less than an almost complete abandonment of our hitherto hierarchically structured energy landscape. Instead of a manageable number of power plants, a system consisting of multiple small (private) electricity producers is to be set up that offers renewable electricity - anyone who can afford a photovoltaic system, storage facility, etc. can enter the energy market producing and offering electricity. Maintaining grid stability under these conditions is an engineering challenge.

Although supply risks arising from the massification have been assessed qualitatively, due to many remaining uncertainties they have not yet been solved completely or satisfactorily. In addition to the technical problem of highly volatile renewable energies, the cultural and sociotechnical future behavior of MPCs is unknown. Yet, concepts must be developed to cope with such uncertainties, because the expected mass of consumers might cause extreme loads that cannot be handled by the power distribution system: either due to the fact that not enough power can be delivered or because the capacities of the physical infrastructures would be exceeded. This explains, how a new and unexperienced concept, such as “demand side management” (DSM), can gain a key place in solution scenarios, even though it is nothing more than a euphemism for customer restriction. The problem with DSM can be illustrated by the example of e-mobility: Owners of electric vehicles will not necessarily let price signals determine their charging behaviour if they need to be mobile at a certain moment.

## 8 CONCLUSION

A system whose reliability depends on the behaviour of its customers carries a new risk potential. Our analysis and examples have shown that in a smart city that offers its population access to new smart virtual solutions, massification phenomena can lead to a gradual degradation of quality of life, that creates a paradoxical mismatch with initial promises of the smart city as a leitmotif for urban development and as a vision for the good life in the city. What is more, the smart city may also produce new risks, all the more if urban smartification addresses critical services.

In view of new risks due to massification, a systemic analysis should be conducted before introducing and widely disseminating new technology in a decentralised and liberalised manner. In order to achieve real smartness with new large-scale technological transformations, such as the smartification of critical urban infrastructures, or the smart transformation of widely used services for personal urban comforts, sociotechnical pre-implementation analysis should be conducted on the basis of historical experiences with regard to the quality of services and their resilience. Wherever possible, adaptive instead of monolithic smart services should be developed with a view to fostering social resilience instead of breeding or training trust in technologies that might, or might not be able to resist shocks while impaired by a mass of users. These lessons learned are particularly pertinent when considering how the paradoxes in smart technology might endanger security and uninterrupted provision of the services of general interest.