WASP—HS

COMMUNITY REFERENCE MEETING: SUSTAINABILITY AND SMART CITIES

REPORT

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Introduction

From data analytics to policy, from citizen empowerment to decision support systems, artificial intelligence (AI) is a significant component of smart city implementations. This is why we must consider the broader implications of AI, smart cities, and digital transformation with regards to sustainability. The responsible use of AI in this context requires a multi-disciplinary reflection on the bottlenecks and policy levers in data and digital infrastructure, the role of research and innovation funding, and a participatory and inclusive deployment of smart city solutions.

AI-driven technologies can support city-scale optimization through data analytics, soft sensor systems and prediction systems. However, using AI technology to support better cities, comes with a cost. Developing and running AI algorithms using energy requires hardware. This comes with a price in terms of embodied emissions and the use of (rare) metals. AI can have system-level impacts on society that, in turn, affects the climate. These impacts are hard to quantify but need to be considered in the decision-making regarding smart cities. For example, even though autonomous vehicle technology can introduce efficiency gains for driving, the technology also lowers the barrier for driving and can induce new demands for individualized transportation. It is imperative that policymakers and city governments consider these challenges and realise the need for new – multi-disciplinary and multi-stakeholder – activities and skills, as well as their implications on both practice and education.

The Community Reference Meeting on Sustainability and Smart Cities was initiated with a panel discussion between Linda Gustafsson, Gender Strategist for the city of Umeå, and Martin Güll, Chief Digital Officer for the city of Helsingborg. In summary, the panel discussion contributed to the realisation that the development of smart cities is not a one-off project but a continuous and participatory process. Furthermore, this development must address differences in culture, strategies, and capabilities. In order to address these issues, the panellists invited the participants to consider how to systematically highlight and challenge power structures when innovative solutions to urban cities are found and implemented.

> *“We need to integrate an understanding of power structures and living conditions into the work with smart cities so that the solutions presented work for citizens, and challenges instead of enforcing, for example, traditional gender structures.”*
>
> **- Linda Gustafsson**

> *“You have to build culture, structure and abilities to get innovation. This basically means, get out of the way for your intrapreneurs, stop judging and start enabling.”*
>
> **- Martin Güll**

The panel discussion, and the following discussions which took place during the three round tables (described in this report), highlighted the importance of integration and of democratic principles, ensuring that no one is left behind, for the development of smart cities and the use of AI in a sustainable manner. A research roadmap that ensures alignment with these principles should include efforts in the following.

- Integration of digital and physical infrastructures, taking into account political and social processes that underlie activities in (smart) cities.
- Address the need for participatory approaches, and the importance of providing automated, timely, and actionable decision support while also providing enough transparency to keep the ‘human in the loop’.
- Multidisciplinary research on transitions and policy, that support the needs, desires, and capabilities of individuals, with special attention to diversity and integration; providing instruments that allow citizens and other stakeholders to engage in the AI system design process.
- Metrics and models that address the cost of AI, balancing diverse, possibly conflicting values, such as accuracy and computational cost.
- A sound legal and ethical scaffolding framework to ensure trust and deal with issues of liability, responsibility and trust.

WASP-HS Community Reference Meetings (CRMs)

CRMs are aimed at helping public and private organizations in Sweden with challenges and questions regarding their interests, as well as developments within WASP-HS. This is done to identify opportunities for collaboration between different sectors.

Autonomous Public Transportation Systems – Getting Across the Smart City

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Main Challenges

- The transition to shared autonomous transportation requires a rethinking of mobility and the potential to reduce traffic volume, to replace private cars, and to offer a high quality of service strongly depends on the design, implementation, and acceptance of such services.
- Shared autonomous transportation can complement or even (partially) replace traditional public transportation systems. It is challenging to identify how existing and future mobility services can be optimally combined to meet the demands of all stakeholders.
- Specific needs of various groups of travelers, for instance, young people with intellectual disabilities, as well as their abilities to interact with such services must be considered when designing and implementing autonomous public transportation – to make them accessible for all of us.
- There is a requirement for more detailed data on traveling habits to understand individual factors that affect trip demand and choice of transportation modes for different groups of travelers. This data can be used as inputs for simulations, that can facilitate the development of sustainable and flexible mobility solutions for the future.

As cities grow, the traffic volume continues to increase within urban transportation systems leading to increased congestion and pollution. In Sweden, for instance, privately owned cars constitute 80% of the total traffic volume but are on average only used for driving 30 km a day [1]. Technological developments, such as advances in artificial intelligence (AI) as well as the shift to self-driving cars and autonomous mobility, carry the potential to address sustainability challenges, while also providing more efficient, flexible, and convenient mobility solutions for travelers at an affordable price. The opportunities to lower congestion levels using methods such as autonomous car sharing and ridesharing for complementing, or partially replacing, traditional public transportation systems like buses are promising. Instead of fixed (physical) stops, such services can make use of a great number of virtual pick-up and drop-off points (PUDOs), from and to which travelers can request their trips. A dynamic and flexible transportation system without fixed schedules and a high density of PUDOs could be able to meet the rising demands of dynamic transportation services.

Simulations can be used to investigate the effects of autonomous shared transportation and to design future mobility systems such that they optimally address the traveler's needs. One simulation paradigm that is particularly well-suited for this purpose is an agent-based simulation, where the human-like behavior and needs of each traveler are modeled using AI.

However, to build realistic simulation models that can be used for designing future mobility services, there is a need to better understand the individual transportation needs of various groups of travelers. Moreover, to integrate autonomous shared mobility concepts into the existing transportation infrastructure, we also need to understand the interdependencies between different modes of transportation. This enables us to develop mobility as a service (MaaS) solutions where different modes of transportation are combined in one trip chain, e.g., autonomous vehicles that pick up passengers at their homes and bring them to a suitable bus stop. Such services can provide more efficient mobility solutions and have the potential to replace private cars. However, to realize the full potential of MaaS, they need to be individually planned to take into account the demand of the travelers, the economic efficiency of the service provider, and the strategic goals of the municipality.

In addition to feasibility aspects that might hinder the successful introduction of MaaS systems in society, it is also our responsibility to ensure that these autonomous transportation systems are accessible for all groups of travelers and to consider their individual needs. To this end, the interactions between different potential traveler groups and autonomous vehicles need to be explored. One example of a traveler group with special needs is young people with intellectual disabilities. How does removing drivers which could function as important support affect such vulnerable groups of travelers? We need to understand the entanglements between various groups of people and autonomous systems to make sure that the design is inclusive. Thoughtful design can contribute to the independence of all groups and potentially serve to give the technology broader applications. If we can design public transportation systems accessible for individuals with intellectual disabilities, they will become more accessible for all of us.

We can conclude the following directions for future research:

- To explore the needs of various groups of travelers to design autonomous transportation systems accordingly.
- Understanding, not only implementation of, but also interaction with autonomous vehicles for different vulnerable groups of travelers such as elderly or disabled travelers.
- To investigate what policy changes might be required to govern and promote this transition.
- Identify and overcome barriers in accepting and using autonomous shared mobility solutions
- To investigate the potential that autonomous vehicles and AI must develop to provide sustainable and flexible mobility solutions for the future.

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AI in Disasters and Crises – From Corona to Climate Change

Lina Rahm, KTH Royal Institute of Technology; Tatyana Sarayeva, Umeå University

Main Challenges

- Data quality: high-quality data is essential for understanding the nature of a crisis or disaster and underlying mechanisms in building reliable AI-based algorithms.
- Lack of AI-based tools supporting situational awareness and planning in civil crises and disasters.
- The importance of providing automated, timely, and actionable decision support while also providing enough transparency to keep the 'human in the loop'.
- Legal frameworks regarding data storage and processing relating to the integrity of both personal and on a group level.
- Ethical implications of AI: dual use of AI-systems in crises situations and ethical concerns between stakeholders.
- Cost of AI-based solutions for crises.

Artificial intelligence (AI) and autonomous systems (AS) are likely to change the way we model and manage crises and disaster risks. They are important tools for preparedness and planning, active management, and response to crises. In addition, AI-based tools are widely used for risk visualization and communication purposes. Realizing how crises can be very complex in information-dense situations, the roundtable aimed to open discussions about strengths, but also vulnerabilities with the use of AI and autonomous systems in preparedness for, and management of, societal crises and disasters. We see the application of AI and AS systems in different crises situations – social, environmental, infrastructural, etc. – and on different levels – international, national, or local. Academia contributes to further developments of these applications, and citizens sometimes have an opportunity to participate in local initiatives.

We identified several benefits of AI for crisis management. AI technologies help in the decision-making and modeling process. For example, the AI4ClimateAdaptation project aims to explore to what extent AI-based algorithms can be employed to evaluate the impact of weather warning systems, and to what extent we could use AI-based image and text analysis to complement existing warning systems [1].

Unmanned Aerial Vehicle (UAV), or drones, are increasingly being used to assist emergency services in situational awareness. UAVs have high-resolution cameras furnished with advanced sensors. UAVs can thereby take detailed aerial photographs and aerial videos, rapidly get data about hazards, as well as process and analyze data in a way humans cannot [2,3].

We need to mention the important role of AI in planning and modelling processes, too. The COVID-19 pandemic has caused great strain on society, not least in health care. Hospitals and care providers need good resource planning to be able to provide efficient and safe care. During the pandemic, it has become clear that the existing tools for predicting the need for care are not enough. Ericsson, Telia, and the Sahlgrenska University Hospital have initiated a collaborative research and innovation project and tested the use of AI to create insight models for planning and prediction of healthcare demands and resources [4].

AI data analysis and visualization tools also help to make sense out of media materials covering different kind of crises – pandemics, war conflicts, risks around nuclear reactors, etc. With the help of AI, experts could provide solid information about crisis situations to journalists, healthcare workers, policy makers and the public in general. The Crisis Narrative project team has designed a platform representing and visualizing such information to engage decision-makers, front-line responders, stakeholders, and the public in making sense of crises and perceptions of risk and trust [5].

Besides the positive role of AI in crisis management, we identified several vulnerabilities of AI systems. First, data quality, storage and processing are big problems. For example, vulnerable groups who are excluded in data gathering can be even more marginalized. However, inclusion in data collection can also become a vulnerability, which points to the continuing need for critical perspectives on the effects of AI and big data.

The level of access to, and quality of, information affects the decision-making before, during, and after emergencies. Important data about the area or the people in the area in question could also be lost during natural hazards or as a result of cyberattacks.

Further, AI can worsen disasters and crises in a very direct way. For example, UAVs can be manipulated by parties with malicious intentions; deep fakes and propaganda can be used to mislead people who are already in vulnerable situations due to crises; or even cause various types of social disturbances in themselves. A recent study has also revealed how AI technologies for drug discovery could be potentially misused for designing biochemical weapons [6]. Notably, there has also been an ongoing global debate around the use of lethal autonomous weapons, so-called ''slaughter bots'', and how they can change power balances in a conflict.

Finally, legal frameworks, e.g., GDPR regulation, constitute an interesting point of convergence where developer and consumer interests meet, and sometimes collide. For some developers, they can be regarded as an obstacle hindering broader application and more efficient implementation of AI systems. At the same time, legal frameworks are often trying to catch up with technical development, and as such they account for a much-needed point of reflection, where social and ethical values are considered and incorporated. As such, being proactive about how both restrictions and opportunities may be affected in a situation of crisis or disaster is important. This relates, for example, to the deployment and use of command-and-control systems, which may during a specific crisis support situational awareness and planning (through for example face recognition technologies), but which in an ordinary situation could be regarded as an infringement of privacy. Similar tensions can also be found in more mundane AI systems, such as elderly care. A Swedish pilot project, Internet of Things in Health and Care, has shown that when sensors and AI systems are used to collect, interpret, and share data about care recipients, tensions often arise in relation to care providers (which may be relatives, or institutions). Many times, the care provider wanted more, or ethically questionable, information than the care recipient was comfortable with, or willing, to share [7]. Likewise, AI systems used in smart city development, or in urban planning efforts (such as smart sanitation [8] or epidemics response [9]) may actualize unintended consequences or impact differently on different areas within a city. This means that terms (incautiously) used for evaluation, such as 'savings', 'resources' or 'efficiency', must be properly defined, and, if needed, be questioned and complemented by richer and more inclusive data and points of measurement.

The discussion of benefits and challenges of using AI and AS systems in crises led to the identification of the points of action to reduce the shortcomings. We need to become more aware of how AI systems can be developed and applied to coordinate different stakeholder interests. Risk assessment tools, complementary visualization technologies, new models of human-machine interaction, situational awareness and planning systems, and data-driven decision are all helpful when addressing crises and disasters. Nevertheless, we also need to ensure that all relevant stakeholders, and their interests, are involved in the collection and analysis processes associated with big data. We should find a balance between systems being able to provide fast and feasible decision support, but which are also comprehensible to the people who use these systems, supporting an understanding of the chains of algorithmic processing and data on which decisions are based. Finally, we need to further strengthen a holistic perspective where social sciences and technological development can work together in performing regular risk assessment of AI systems, map potential threats, and identify areas for unethical and irresponsible use of AI.

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From Boomtown to Bust: Being Critical About the Smart City

Barry Brown, Stockholm University; Mareike Glöss, KTH Royal Institute of Technology; Sergio Passero, Linköping University

Main Challenges

- Smart city technologies are increasingly part of political and social processes that take place in cities.
- In the case of the TipTap app this application became part of prolonged legal action with Stockholm Stad around who had what rights to deposit waste materials at city locations. In Toronto the Alphabet Sidewalk project was eventually defeated by both activist pressure, and legal battles over how the contract was awarded. This highlights how it is political and legal issues not technical issues that are increasingly important.
- In Sweden, regulation and development happen not only on the city, national but also the EU level and this creates a complex set of forces that influence the possibilities for smart city developments.

While the smart city has long been promised as a vision of a new type of city, in recent years these visions have been a source of considerable controversy and conflict. The recent failure of the Alphabet “sidewalk” project in Toronto stands out as a example of some of the challenges developers face. When Alphabet – or Google – proposed their plans to develop a new city district in Toronto it seemed like their plans perfectly captured a utopian view of the smart city, but with the resources to develop it in a whole new city neighborhood. Yet this project was finally cancelled – and in the ensuing debate over the failure of the project we can discover much about how smart city technology can fail to meet with broader social goals. The original goals, as stated by Daniel Doctroff for Sidewalk labs were that: “a combination of digital technologies — ubiquitous connectivity, social networks, sensing, machine learning and artificial intelligence, and new design and fabrication technologies — would help bring about a revolution in urban life. Their impact will be as profound as the steam engine, the electric grid, and the automobile”[1]. Yet the Sidewalk project became a heated source of dispute between Google, Toronto city and local activists. Indeed, one activist, Bianca Wylie eventually organized the successful effort to stop the Sidewalk project progressing – as she put it: “The smart city industry is a Trojan horse for technology companies ... They come in under the guise of environmentalism and improving quality of life, but they’re here for money ... Is A.I. and technology going to help us have a more equitable city?”

In Stockholm, more local experiences have followed a similar path. The development of the ‘tip tap’ app [2] has proven to be particularly controversial - this application makes use of the existing city waste disposal facilities but allows users to hire drivers to take their trash to the city waste facilities. Tip tap has had a difficult relationship with different city authorities – fighting legal battles with Stockholm City, but making legal agreement with others. This case raises a range of issues around the public and commercial appropriation of public facilities, confronting the public monopoly of waste management vs its privatization.

Our roundtable discussed many of these issues, with our discussion focusing on who controls the design and development of smart city visions.How do we make sure that there is equitable and even access to data that concerns how cities work, and that this data is not captured by private interests? This can be difficult when private enterprises have access to much more resources than public bodies, or can develop innovative initiatives – like TipTap – that fit with citizen’s needs, at least in part.

We went on to discuss the need to reconsider how the term ‘smart’ is used in terms of the smart city, since it is often more political than technical – apps like tiptap, or development effort like Sidewalk, are ultimately political issues and can either align or conflict with local citizen concerns.

While there are many opportunities for the development of better technologically enabled city services, it is likely that these services will fail unless they align themselves with real citizens concerns and pain points, as well as working with local actors to address local concerns for equity as well as national ownership, over technological visions or the involvement of international companies and entities.

In the context of Swedish cities we discussed how we need broadly a much more human-centered perspective, and how the lack of that perspective is not just a smart city problem. With urban planning and infrastructure, the focus is very much on the infrastructure and not the people –design practice in the city could be much better aligned with citizen needs and the political environment that cities exist in. This connects with the increasing involvement of the EU and the green transition. Change in this context will need to connect together a focus on the city, but also municipal and international concerns.

References

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WASP—HS

The vision of the Wallenberg Artificial Intelligence, Autonomous Systems and Software Program – Humanities and Society (WASP-HS) is to realize excellent research and develop competence on the opportunities and challenges of artificial intelligence and autonomous systems with a strong investment in research in humanities and social science.

The WASP-HS program is planned to run 2019 – 2028 and will form an independent and parallel program to WASP, The Wallenberg Artificial Intelligence, Autonomous Systems and Software Program.

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