TEACHING MATERIAL GUIDANCE

1) Title of the material

Nikitas, A.; Michalakopoulou, K.; Njoya, E.T.; Karampatzakis, D. Artificial Intelligence, Transport and the Smart City: Definitions and Dimensions of a New Mobility Era. Sustainability 2020, 12, 2789. https://doi.org/10.3390/su12072789

https://www.mdpi.com/2071-1050/12/7/2789

2) Which section of the SUMP it is relevant to?

This article is a conceptual contribution that thoroughly discusses the rarely explored nexus of artificial intelligence, transport and the smart city and how this will impact the future of cities. Therefore, the article can be linked to the third, fourth and fifth sections of the SUMP circle related respectively to the determination of planning framework, analysis of the mobility situation (in particular the analysis of problems and opportunities for all modes of transport - **subsection 3.2**.), scenario building and joint evaluation (development of scenarios of possible futures - **subsection 4.1**.) and vision and strategy development (arguments for stakeholders – **subsection 5.1**).

3) Which Mobility Manager knowledge this material is the most relevant to?

It is related to Transport and mobility planning (section 1 of the Mobility Manager competencies) especially 1b (employment of ITS/ICT and smart measures).

4) Problem approached and content overview

Problem approach – general understanding of the role of Artificial Intelligence (AI) and applying them to mobility management. Artificial intelligence (AI) is a powerful concept that is still in its infancy and which has the potential, if used responsibly, to become a vehicle for positive change that can promote a sustainable transition to a more resource-efficient living paradigm. AI with its functions and deep learning capabilities can be used as a tool that empowers machines to solve problems that can reform urban landscapes as we have known them for decades and help establish a new era - the era of the 'smart city. One of the key areas that AI can redefine is transport. Mobility provision and its impact on urban development can be significantly improved through the use of intelligent transport systems in general and automated transport in particular. This new breed of AI-based mobility, despite its machine orientation, must be a user-centric technology that 'understands' and 'satisfies' human users, markets and society as a whole. For this transformation to begin, trust must be built and risk must be eliminated. This article is a novel conceptual contribution that thoroughly discusses the rarely explored nexus of artificial intelligence, transport and the smart city and how this will impact the future of cities. It specifically covers key smart mobility initiatives such as connected and autonomous vehicles (CAVs), autonomous personal vehicles and unmanned aerial vehicles (PAVs and UAVs), and mobility as a service (MaaS), but also interventions that may act as transport enabling technologies such as the Internet of Things (IoT) and Physical Internet (PI) or reflect broader transformations such as Industry 4. 0.

This paper describes some of the key transport components that are expected to be central to the smart city of the (near?) future, focused on artificial intelligence. This study provides a research lexicon defining the concepts and their dimensions that reflect and influence the new autonomous, connected, shared and digitised mobility paradigm of tomorrow. In particular, the paper thoroughly discusses the interconnectedness of artificial intelligence, transport and the smart city, covering interventions related to connected and autonomous vehicles (CAVs), unmanned and personal aerial vehicles (UAVs and PAVs) and mobility as a service (MaaS), but also the Internet of Things (IoT), Physical Internet (PI) and Industry 4.0, three initiatives that can directly or indirectly impact transport and are critical parts of the smart city agenda.

Automated driving is widely regarded as a technology that could signal an evolution towards a major change in (automotive) mobility. CAVs are the ultimate manifestation of AI in the transport domain; AI algorithms and machine learning (ML) functions are tools that can replace human intervention and 'drive' CAVs. It is anticipated that CAVs will be able to introduce eco-driving and energy-saving features, increased safety and security standards, better allocation of road space and congestion management, and replace time spent driving with the time that can be used for more productive activities. However, despite the huge publicity, CAVs still pose more unanswered questions than definitive answers. UAVs, drones and PAVs have recently emerged as viable alternatives for solving problems that arise mainly in the areas of visual monitoring and traction surveillance. Fully autonomous UAVs and PAVs in the future will be of great importance for logistics as well as for the movement of people; they are expected to change travel patterns as we have known them for decades by vertically extending the urban landscape and transport network of future cities. MaaS, a very new transport concept whose applications are so far limited and partially implemented, promises digital packages of personalised mobility that will replace private vehicles and optimise the use and combination of several mobility alternatives. MaaS will be enabled by powerful artificial intelligence algorithms to provide holistic travel planning, booking and ticketing, and real-time, personalised and tailored information services to each consumer. MaaS can maximise its potential if it incorporates the use of CAVs in car-sharing and ride-sharing schemes as a complementary option to public transport elements. Technological trends relating to a smart city focused on artificial intelligence that can influence (or be influenced by) future mobility, such as IoT, PI and Industry 4.0, are becoming increasingly relevant and will also be considered in this paper through the lens of transport. This is because IoT will enable unprecedented levels of connectivity between users and modes; PI will revolutionise freight optimisation through digital, automated, connected and big data technologies; and Industry 4.0, which underpins the productivity of tomorrow's market, depends on intelligent transport.

The remainder of the paper presents the framework of the research methodology used, a description of the aforementioned initiatives (a chapter dedicated to each of them) and a final chapter that serves as a lexicon of the concepts considered in the previous chapters. This last part of the paper also aims to develop conclusions that bring together all the pieces of the complex puzzle of smart urban mobility and provide some key recommendations for researchers, policymakers, transport and urban planners and an agenda for future research directions.

5) Who could be interested in this material?

This work is ultimately a reference tool for students, researchers and urban planners that provides clear and systematic definitions of the ambiguous terms of tomorrow's smart mobility and describes their individual and collective roles underlying the nexus.

6) What is worth mentioning as an innovative factor for the reader?

This paper recognises the transformative capacity of AI in the smart city context and how it can be a paradigm-shifting force that will revolutionise mobility in unprecedented ways. At the same time, however, it recognises that the machine-centric identity of the new smart mobility paradigm must operate within a responsible, sustainable and user-centric architectural framework that 'understands' and 'satisfies' the human user, markets and society as a whole.

The promise of autonomous, connected, shared and digital transport provision is not enough if it does not facilitate efforts that lead to better environmental protection, resource efficiency, productivity growth, social inclusion, integration, health and well-being. People need to believe that change can indeed be beneficial for many, that they can become active and engaged participants in the new urban ecosystem, and that they can sensibly seize the opportunities presented by the artificial intelligence-transport-intelligent city nexus. To achieve this, as with any socio-technical transformation, the key is to build trust. Trust should be built through information provision, awareness campaigns, investment in research and development, systematic trials and pilots, and strategically planned incremental deployment. For any technology-centric transformation to take place and maximise its potential, risks and poisonous side-effects such as a possible increase in car accidents as a result of an increase in occupied and unoccupied CAV journeys, supported by a flawed MaaS business model that may still be primarily car-centric, must be eliminated. Smart innovation should also have an equally important socio-centric dimension. It should therefore be expected that the transition to the next mobility paradigm, which will naturally meet the needs of the smart city, will be long, varied and slow-paced, with high levels of complexity and uncertainty. Forecasting may not always be accurate in such a dynamic environment as the smart city. Successful application of AI requires a good understanding of the relationship between AI and data on the one hand, and transport system characteristics and variables on the other, so that even if the tools are readily available, change is not easy. Introducing meaningful change in an era defined by human-powered, conventionally driven, privately owned, unplugged and above-ground vehicles and their colossal impact on urban development, which has dictated how cities are designed and built for over a century, requires a strategic approach based on determination, adaptability and flexibility. Change in mobility provision cannot be accelerated until supporting technologies, regulations, educational and moral frameworks are in place that are sufficiently robust and mature to address a range of challenges, including the unknown and unprecedented.

It should be clear that CAV, UAV, PAV, MaaS, IoT and PI - are not a panacea that will fix everything that is wrong with the concepts and practicalities of urban mobility and the smart city. Despite their transformative power, these inspiring pillars of the coming world of travel cannot, on their own, solve all the problems that built environments and transport networks currently face and may face in the future. Instead, they should be seen as complementary pieces of the multi-dimensional and interdisciplinary jigsaw puzzle that is the smart city, and should be combined, in terms of transport, with TOD, automated public transport, travel demand management tools and path calibration measures.

We also need to appreciate that the smart city narrative as a whole is not just about transport, but has dimensions of energy, telecommunications, waste management, food supply, water and wastewater, infrastructure, smart buildings, public safety, business and industry that need to be equally considered. However, AI, with its instrumentation and control, connectivity, interoperability, security and privacy, data management, cloud computing and analytics functions, can again become a tool for positive change in all the key elements that make up the complete smart city framework. Finally, this thesis highlights that the impact of smart cities extends far beyond the domain of cities as it affects challenges related to global competitiveness, sustainability and climate change, social inclusion and employment.

7) Limitations

The problem was analysed at a high level of generality. Nevertheless, the presented general conclusions may serve as an inspiration for Polish cities regarding problems that may occur during the implementation of new technologies and services using AI solutions.