AIOTI

**Alliance for
Internet of Things
Innovation**

WG URBAN SOCIETY:
CONTRIBUTION TO RECOVERY AND RESILIENCE IN EUROPE

May 2021

CONTENTS

Introduction

While amid the pandemic, now more than ever, we need to think about rebuilding and rebooting our society, communities, and related economy. It urges us to reflect and think about the various societal challenges at hand and address these efficiently.

AIOTI's Working Group Urban Society[1] supports the needed holistic approach and convergence by integrating and touching societal challenges, not only the horizontals but also the vertical domains intertwined and part of Urban Society as a whole. Therefore, this document is a joint-effort made in co-creation and cross fertilization within the different domains, hereby referred as the different working groups within AIOTI's Urban Society, Health, Innovation Ecosystems, Standardization, Policy & Strategies, Taskforce IoT Security, Taskforce IoT Privacy.

Powerful tools have been developed within the AIOTI community in order to address these societal challenges[2] and bring to light the best scenarios based on a data-driven socio-economic model in which sharing, collecting, storing, analyzing, processing and visualizing large amounts of data is crucial for its success and in order to make Europe climate neutral, smart, green, resilient and digital with a human-centric approach. We will do this while maintaining privacy and security, reducing cost, emissions and energy consumption by bringing reliable, future-proof, scalable and sustainable solutions.

The scenarios in scope touch base on all seven (7) components/domains published by the Commission[3], but discuss in more detail four (4) out of the seven (7) components. Since everything is interconnected and domains are intertwined within ecosystems, we chose to address multiple domains and integrate them in one document. The use cases displayed in this document can be used cross-domain which increases efficiency, economies of scale, job creation, accelerates implementation and reduces costs. The components this document addresses are: 'Clean, Smart and Fair Urban Mobility', 'Reskill & Upskill', 'Digital Connectivity' and 'Public Administration'.

We included the Public Administration in our document since teaming up with local administrations, in PPP (public-private-partnership) is prioritized. Only together we will be able to mitigate the social and economic impact of the coronavirus pandemic. We can all testify to the paradigm shift we face, in which the profound realization has occurred that the only way forward towards a more resilient and greener future is the human-centric approach by addressing the societal challenges. We do realize the urgency, not only for ourselves but for the future generations to come, to serve and do things differently. This can only occur by shifting away from the technical- & shareholder-centric approach. After all, digital serves and facilitates humans needs and wellbeing, not the way around. We look forward to collaborating on different levels with local, (cross-)sectorial, (cross-)regional, Member States, The European Union, periphery and beyond in order to lean in, deploy, implement, interact to (re)-built our societies.

AIOTI supports the focus on digital[4] and green[5] technologies in the overall EU Recovery Fund package, particularly the Recovery and Resilience Facility[6], which will bring jobs and economic growth. All scenarios we address in this document are digital objectives in order to push the Digital Economy and Society[7] based on the three main pillars of the European Commission: more Green, more Digital and more Resilient.

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[1] Association Internet of Things Innovation: www.aioti.eu
[2] Institute For Future of Living; Intertwined Societal Challenges: https://instituteforfutureofliving.org/
[3] Recovery and Resilience Plan: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en
[4] The European Digital Strategy: https://ec.europa.eu/digital-single-market/en/content/european-digital-strategy
[5] European Commission, Communication from the Commission on the European Green Deal: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2019%3A640%3AFIN
[6] Recovery and Resilience Plan: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en
[7] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12870-European-Health-Emergency-Preparedness-and-Response-Authority-HERA-

1.   Improving Health & Social Resilience Addressing the components Clean, Smart and Fair Urban Mobility and Reskill and Upskill

Digitalization has been a key enabler for resilience. The impact of the crisis has been mostly determined by size, sector and digital readiness. Digital technologies have proved themselves to be essential for society, citizens and businesses during the Covid-19 crisis. There has been a digital leap in the last year where speed of change has been shown and crucial for society. For example, before the crisis 52 per cent of the workforce needed to be reskilled over the next five years due to digitization but now it looks like this must happen in the next months.

The investments in clean and intelligent urban mobility will improve public health through decreased (air) and other pollution and noise, increased safety and more active lifestyles. Through a wider access to sustainable urban mobility and the reduction of travel times, labour productivity and labour market participation will increase. Nevertheless, during Covid we have realized that mobility has dropped tremendously. Even though, with the knowledge of today, we have the belief that our lives will soon get back to what we have been used to with respect to our mobility standards pre-Covid. Still, we need to prepare for an era of pandemics. Therefore, social resilience also means workforce adaptability, reskilling and upskilling support school-to-work transitions and reducing the length of unemployment and inactivity in order to strengthen social resilience and inclusion. This means training opportunities including low-qualified/skilled adults and people with a migrant background need to learn digital skills in order to access the online services, be part of remote working and distance learning. All these elements support economic and social resilience in the context of the current crisis.

Increasing crisis reaction and crisis preparedness

The outbreak of the COVID-19 pandemic revealed vulnerabilities in European health preparedness and crisis response for serious cross-border threats to health. Novel technologies can help to improve the current health crisis toolbox by either offering off-the shelf solutions. This also means adaptation of better track-and trace intelligence, tailored digital intervention mechanisms. With current IoT intelligence, Internet of Medical Things (IoMT) technology there is a better opportunity to improve the knowledge and intelligence capacities serving this purpose which currently do not exist in Europe[8].

The outbreak of COVID-19 has shown that the use of healthcare resources needs to be prioritized in order to properly tackle the pandemic and to and to continue carrying out the most urgent interventions from common pathologies. In this line, new medical services should be developed to optimize the scarce healthcare resources. Patients remote assistance and remote monitoring are two services that can be implemented with that objective. The proposed use case consists of implementing these two services in a controlled but real pilot in order to validate the obtained improvements and measure the better use of healthcare resources.

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[8] European Health Emergency Preparedness and Response Authority (HERA): https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12870-European-Health-Emergency-Preparedness-and-Response-Authority-HERA-

The two services, patients remote assistance and remote monitoring, would enable remote homecare and monitoring channels to deliver the communications between patients and doctors. Remote monitoring and assistance services would allow us to collect data from the connected medical devices at home (scale, tensiometer pulsioximeter, thermometer, activity wristband, among others), register the data in a Health Platform and the doctors could consult the patient's information and contact them if necessary.

The pandemic has also shown the importance of the design of safe and healthy indoor environments that minimize the transmission of infectious diseases. UV-C disinfection technologies are an established technology that are assisting the battle against the current pandemic and have been proven to inactivate, without exception, all bacteria and viruses against which it has been tested, including among others those causing tuberculosis, influenza, the common cold and SARS-CoV-2.[9] Installing UV-C disinfection technologies can therefore help ensure healthy indoor spaces and prepare people for future pandemics. As an example, UV-C disinfection technologies have been employed at the Gatwick Airport to disinfect luggage trays.[10]

Major catastrophes demand efficient coordination and control of resources in order to ensure people's safety. In the era of 5G and IoT, networks and applications play a fundamental role in monitoring and decision-making in all areas involved. With the intent of minimising the negative impact of these accidents, and ensuring steady minimum telecommunication services, so that the emergency protocol can be quickly, effectively and easily put into practice, Smart Event Processor (SEP) is a framework designed to be deployed at the edge of the network with the main goal of providing real-time monitoring of data originated from IoT devices, such as probes and sensors, and generate complex events based on data correlation.

The large amounts of raw data are processed by SEP and ultimately will generate complex events and transfer them to a third-party control application running in the cloud. The focus is to target the post-catastrophe remaining infrastructures and develop protocols, interfaces and other solutions to ensure the automatic recovery of the telecommunications system of the city. Due to the large quantity of raw data generated by sensors in comparison with the quantity of generated complex events, the amount of data transferred to the cloud/core of the networks is highly reduced which improves the real-time processing performance of the whole system

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[9] Study performed by Bianco et al in Italy, Source: Global Lighting Association, Germicidal UV-C Irradiation: Sources, Products and Applications, link: https://www.globallightingassociation.org/images/files/GLA_-_Germicidal_UV-C_Irradiation_Sources_Products_Applications.pdf
[10] Gatwick first UK airport to install UV cleaning treatment for security trays: http://www.airport-business.com/2020/09/gatwick-first-uk-airport-install-uv-cleaning-treatment-security-trays/

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Air Pollution in Urban Regions

Even with global warming reaching just 1.5 , as set out in the Paris Agreement[11], 350 million more people could be exposed to deadly heat stress by 2050 with the number of heat-stressed megacities doubling from today's levels (Ebi et al., 2018)[12]. All populations will be affected by climate change, but some are more vulnerable than others. People living on small islands, developing states and other coastal regions, megacities, mountainous or polar regions are particularly vulnerable. Extreme high air temperatures contribute directly to deaths from cardiovascular and respiratory disease, particularly among elderly people. In the heat wave of summer 2003 in Europe for example, more than 70 000 excess deaths were recorded[13]. In 2016, 7 million global deaths were attributable to the joint effects of ambient and household air pollution ([14]WHO, 2018a) including deaths from lung cancer, chronic respiratory diseases, cardiovascular diseases. Premature death from illness and disabilities caused by air pollution are not rare since air pollution is a major cause of premature death and disease and is the single largest environmental health risk in Europe[15].

A meaningful use case proposed in this topic is the implementation of a real-time air quality monitoring solution based on static and mobile stations in a city with several actions:

1. Identifying in real-time those places of the city where the limits of the air quality index have been exceeded and raise alerts when the levels are passed out

2. Collecting air quality data from several points of the city to forecast the air quality index in the next hours/week

3. Providing an analytics platform to support experts to identify in a clearer way the patterns and evolution of the pollution in each place of the city and identify actions to impact in the improvement of the air quality, especially in those where the forecasting is worst.

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[11] Paris Agreement: https://ec.europa.eu/clima/policies/international/negotiations/paris_en

[12] Ebi K, Campbell-Lendrum D, Wyns A (2018). The 1.5 health report: synthesis on health & climate science in the IPCC SR1.5. Geneva: World Health Organization (https://www.who.int/globalchange/181008_the_1_5_healthreport.pdf

[13] Death toll exceeded 10.000 in Europe during the summer of 2003. https://pubmed.ncbi.nlm.nih.gov/18241810/

[14] WHO(2018a). Ambient (outdoor) air pollution. Key facts [website]. Geneva: World Health Organization (http://www.who.int/news-room/fact-sheets/detail/ambient-%28outdoor%29-air-quality-and-health, accessed 22 February 2021).

[15] Air pollution: how it affects our health: https://www.eea.europa.eu/themes/air/health-impacts-of-air-pollution

The deployment of this kind of solution could support the improvement of people's health in cities. Moreover, this use case is aligned with the aim of the EU to become climate-neutral by 2050 – an economy with net-zero greenhouse gas emissions. An increasing number of City Authorities are implementing measures to reach the Goal 11 of the 2030 Agenda "Make cities and human settlements inclusive, safe, resilient and sustainable". For instance, the Spanish government passed in May 2020 the Climate Change and Energy Transition Law where it is foreseen that Low Emission Zones in cities with more than 50.000 inhabitants will be mandatory from 2023, forbidding access to diesel vehicles in urban centers of cities. This type of initiative fosters the reduction of traffic intensity, the renovation of the vehicles fleet towards more sustainable technologies and impacts the pollution levels of the cities and therefore citizens' health. The proposed use case consists of implementing a comprehensive solution for the control of these Low Emission Zones with the following actions:

- Managing the access authorizations according to the vehicle contaminant type

- Managing the access authorization according to the end-user group (emergencies, retail, schools, public and private parking, load services, pharma logistics, etc.)

- Monitoring and registering the access to the zone by surveillance cameras and access control systems

- Automatic generation of sanction proposals (in case of no authorization)

- Managing variable messaging panels

- Providing an analytics platform to support experts to identify in more clearly way the patterns and evolution of the air quality of the zone and identifying actions to impact in the improvement of the air quality and configuration/update of restrictions in a smart way

The deployment of this kind of solution can not only reduce considerably the pollution in the Low Emission Zones of the cities but also the impact on the ambient noise of such zones.

Fighting Physical inactivity in Urban Regions

Worldwide, 1 in 4 adults and 3 in 4 adolescents (aged 11-17 years) not currently meet the global recommendations for physical activity set by WHO (WHO,[16] 2018c). This represents 1-3% of national health care costs across all European countries. Due to changing patterns of transportation, increased use of urbanization and technology, the levels of inactivity can be as high as 70% with a significant correlation of increase of inactivity in countries which develop economically.

Energy-related behaviors (physical activity, sedentary behavior) are main modifiable determinants of several non-communicable health conditions, e.g. diabetes type 2, overweight and obesity, and track into adulthood. Promoting these behaviors among youngsters can have great health and societal gains. Meeting recommended levels for these behaviors is especially low among adolescents, girls and those of lower socio-economic status.

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[16] WHO (2018c). Global action plan on physical activity 2018-2030: more active people for a healthier world. Geneva: World Health Organization.

An intervention to promote energy related behaviors among adolescents is thus indicated, and may also address social inclusion. Exergames, which require movement to be played, have great yet underused potential to promote these behaviors. To fully utilize this potential, exergames can be combined with IoT wearables, such as smart textiles, in order to promote moderate-to-vigorous physical activity; to be more tailored to the individual user; and to be more engaging.

Noise and Mental health in Urban Society

Health impacts of environmental noise are a growing concern among both the general public and policy-makers in Europe. The most important source of environmental noise in Europe is road traffic which affects 20% of the EU population who live in areas where noise levels are considered harmful to health with shown evidence on the relationship between environmental noise and specific health effects, including cardiovascular disease, cognitive impairment, sleep disturbance and tinnitus (EEA report, Noise in Europe 2020)[17]

Life expectancy has increased, and in many cases a greater quality of life for older people is achievable. However, the prevalence of dementia increases with age and incidence of dementia, and Alzheimer's disease, frailty, Parkinson's, and cardiovascular disease, are expected to triple by 2050. A community-based care approach enabling independent living has many positive benefits for people with dementia. There is a need for constant monitoring and assistance, intervention, and support, causing a considerable financial and human burden on individuals and their caregivers. Interconnected sensing technology, such as IoT wearables and devices, present a promising solution for objective, reliable, and remote monitoring, assessment, and support through ambient assisted living.

According with latest studies[18], exposure to ambient air pollution is ubiquitous globally and has been associated with various adverse health outcomes in children and adults, including asthma, cardiovascular disease, respiratory disorders, adverse pregnancy outcomes, and all-cause mortality. Attention and memory tend to be the cognitive domains most impacted by noise. The stress response leads to vascular changes that can pave the way for cardiovascular disease and vascular dementia. Meta-analyses indicate that each 10 dB(A) increase in environmental noise increases the risk for adverse cardiovascular outcomes, including hypertension and heart attacks, by 7 to 17%[19]. Due to the strong connection between heart health and brain health, these negative effects on the cardiovascular system may account for some of the increased dementia risk from noise pollution. Exposure to noise during the night can impair sleep quality, which has additional negative health consequences. Chronic activation of the arousal-stress response can also cause oxidative stress, which is another driver of dementia.

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[17] Environmental noise in Europe 2020: https://www.eea.europa.eu/publications/environmental-noise-in-europe
[18] Ambient Air Pollution, Noise, and Late-Life Cognitive Decline and Dementia Risk: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6544148/#:~:text=Although%20current%20evidence%20is%20still,chronic%20and%20affect%20large%20populations.
[19] Do loud noise harm the brain?: https://www.alzdiscovery.org/cognitive-vitality/blog/do-loud-noises-harm-the-brain#ref-8

Noise may be particularly problematic for people with dementia because they do not have enough brain resources to filter the noise and perform other cognitive functions at the same time. Individuals with dementia may need a period of uninterrupted silence to allow them to fully utilize their limited cognitive resources, which may lead to more meaningful interactions. In this context, mobile intelligent devices and innovative digitally assisted personal mobility technologies specifically designed for people with cognitive decline could be the most relevant solutions to help them. People with cognitive decline (patients) can be connected to the network via smart watches capable of logging and sending the position and health parameters (e.g. heart beat), speed, distance, device status, notifications and alerts and caregivers/relatives/ physicians can be engaged in the network via mobile devices like Smartphone or tablet. This type of application installed on mobile devices facilitates access to relevant patient data like location and health parameters. Moreover, they may receive notifications and alerts if the set rules (intervals and parameters) are violated by their patients. For instance, the caregiver may define safety areas and when the patient leaves that specific area, the application can notify the caregiver accordingly. A set of complex rules may be defined and associated to different users (patients). Moreover, this rule engine can be fed by a machine learning component inside the IT hub which aggregates previous experiences and profiles behavior. This is only an example of application that could be used when technology has become an essential and integral component in modern day living and influences the way in which we all live and work. Many areas of research and technology contribute to assistive solutions, with numerous trials undertaken to assess their feasibility. The application of several domains has been exploited to enable and improve the use of assistive technologies within the household. The collection and integration of such technologies is often referred to as Ambient Intelligence or AAL, which aims to support people by enabling them to achieve their everyday objectives.

Active and Healthy Living and Ageing

The next decade has been clearly defined by the UN as the Decade of Healthy Ageing[20], supported by the 'WHO Global Network for Age-friendly Cities' and on the recently issued report from the WIPO about Emerging Assistive Technologies[21], when it is clearly demonstrated that conventional assistive technologies, through enabling technologies such as IoT and Connectivity are now converging and being aggregated under the concept of Smart Cities and Smart Homes. In Europe by the new platform on Active and Healthy Living in the Digital World[22], that is taking the legacy from the 2012-2020 experience from the European Innovation Partnership on Active and Healthy Ageing, the Reference Site Network, where regions and municipalities are establishing themselves as relevant Living Labs where innovations on new technology, services and business have to be deployed before reaching full scale. It is clear that top down interventions from national and regional healthcare authorities that aim to better treat our population can only be effective when these interventions are standardized so to be scaled within and across regions, but at the same time they need to respond to local needs that are to be captured by cities and urban environments. It is not by chance that the concept of social medicines and AI for policy making are appearing in the new Horizon for the first time.

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[20] UN Decade of Healthy Ageing: https://www.who.int/initiatives/decade-of-healthy-ageing
[21] WIPO - Technology Trends 2021 Assistive Technologies:https://www.wipo.int/tech_trends/en/assistive_technology/
[22] European Commission, Active and Healthy Living in the Digital World: https://futurium.ec.europa.eu/en/active-and-healthy-living-digital-world

Recent experience from the 1st series of Large Scale Pilot that the EC has implemented, also impulse by the activities that AIOTI has performed in the past years allowed to generated unique knowledge on how to create, activate and empower urban ecosystems to make innovations in social care cost-effective, sustainable from a business and procurement perspective while making sure that quality of life of end-users and their social network are realistically measured through IoT, complementing standardized measurements from traditional instruments and making them more powerful and relevant. Such an experience is first of its kind in Europe and can be used as a starting point for better decision making and new structural interventions from local authorities and eventually better used of structural and regional funds through targeted interventions that will maximize success and sustainable uptake.

The weakness of the deep layer of lumbar or cervical spine muscles (so-called multifidus muscles) is among the most common causes for back pain. Frequent testing and measurements over a 20 years period of time showed a common weakness of this particular muscle group in more than 70% of investigated persons. Following a routine training has demonstrated an effective improvement in low back health. With this regard, existing physiotherapy devices can be upgraded with real-time measurements and connectivity capabilities, meeting new medical device regulations. Force and angle sensors measurement technology can be connected and integrated into a digital health framework, enabling the patient with a real-time performance visualization and the treatment data upload for a secure cloud. The clinicians can then keep track of the patient treatment and make the necessary adjustments (if needed). Physiotherapy devices and body sensors can connect over a secure network, enabling the data collection of health-related data. Moreover, an intelligent sensor network collecting citizen health and wellbeing data, can be added to complement citizen's EHR (Electronic Health Record).

According to the WHO, fear, worry, and stress have increased worldwide in the pandemic context. Restriction of movement, working from home, temporary unemployment, home-schooling of children, and lack of physical contact negatively impact people's mental, as well as physical, health. Lack of exercise, "unhealthy" eating patterns, sleep disorders, anxiety and depression have been reported by several researchers and practitioners. Complementary and Alternative Medicine (CAM) helps to cope with the adverse effects of COVID and to preserve and maintain people's health and well-being.

Beyond the crisis, CAM contributes to maintaining health and preventing disease. It offers holistic approaches and therapies supporting active and healthy living and ageing. CAM is well perceived and used by the Europeans. As an illustrative example, Harris Interactive conducted a survey on the attitude of the French to CAM in 2019. The results of the survey showed that 71% of the survey participants had already used at least one alternative medicine, with osteopathy (80%), nutrition (73%), homeopathy (72%), acupuncture (72%) and psychology (63%) in the top quintet of those best perceived and known[23]. From the economic point of view, CAM is an important sector of job creation in Europe[24] and could be considered as a vector of post-COVID economic recovery.

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[23] Observatoire des parcours de soins des Francais-Theme 3: Les Francais et les médecines douces:https://harris-interactive.fr/opinion_polls/observatoire-des-parcours-de-soins-des-francais-theme-3-les-francais-et-les-medecines-douces/
[24] According to EUROCAM, the European foundation of CAM professionals and patients, in the EU, there are approximately 145,000 dual-trained doctors, i.e. trained in conventional medicine and a particular CAM modality, such as acupuncture, anthroposophic medicine, ayurvedic medicine, herbal medicine/phytotherapy, homeopathy, naturopathy, osteopathy, chiropractic and traditional Chinese or Tibetan medicine among others. In addition, there are in the order of 160,000 non-doctor CAM practitioners practising CAM modalities such as those just mentioned, as well as other CAM therapies, such as aromatherapy, kinesiology, massage, reflexology, shiatsu, yoga, qigong, etc.

Development of local ecosystems of CAM professionals, supported by relevant digital tools, and their integration with the official healthcare system can contribute to:

- A more patient-centered healthcare, with a focus of healing of body, mind and emotions

- Empowering patients to play an active role in the healthcare and preservation process

- Creation of data-driven evidence about effectiveness of combinations of therapeutic approaches

- Promotion of a culture of healthy and wellness lifestyles

- Enhancing of community resilience towards possible future pandemics

As a possible axis of post-COVID recovery policy intervention, AIOTI proposes development of:

- digital tools supporting CAM professionals' activity

- platforms contributing to local ecosystems for active and healthy living and ageing that integrate classical and alternative methods of healthcare, ease and secure patient journeys

Indoor Environmental Quality in Urban Society

Digital solutions can combine high energy savings with vast advancements in well-being, comfort, and productivity. Such human-centric approach of energy savings-driven digital solutions can be encapsulated by Indoor Environmental Quality (IEQ), which is fostering healthy buildings. IEQ includes amongst others a lighting design adapted to the needs of the occupant, sufficient access to daylight, good air quality and ventilation, thermal comfort, and low noise levels. As people spend approximately 90 % of their time indoors, energy savings have to be coupled with healthy environments.

In the case of lighting, for instance, properly designed and well-coordinated lighting systems are one of the most cost-efficient ways to reduce energy consumption and CO_2-emissions. But, by leveraging the power of Human Centric Lighting and technical building systems, we can also improve inhabitants' health, wellbeing and productivity. Intelligent lighting systems have opened a new world of opportunities, making indoor environments more attractive and functional by allowing users to dynamically adapt light to their specific needs. Installing LED-based lighting systems that include sensors and controls will deliver significant energy savings while at the same time improve the quality of the lighting and of the environment for people.

IoT and Big Data for Smart Heating and Cooling solutions provide the possibility to interact and influence indoor environments through users. From the occupant's point of view, the ideal situation is an indoor environment that satisfies all occupants (i.e. they have no complaints) and does not unnecessarily increase the risk or severity of illness or injury. Smart systems that ensure a healthy indoor environment will also learn behavior patterns of the users/inhabitants of the building and take advantage of this knowledge to get the building ready for the predicted needs. It will try to resolve the tension between energy efficiency and quality of indoor climates that occurs e.g. after retrofitting existing buildings by offering an affordable solution.

The role of this intelligent air quality management system is to provide a healthy indoor environment in the buildings. The target system holds the functions to adjust the environmental conditions to comfortable air quality by interconnecting the environmental sensors and the purifiers. It will promote health for the people residing in the buildings for a long time by creating the comfortable indoor spaces. In the most advanced smart indoor environment systems the idea is to combine measurement data from the system's component with direct user feedback. In this case, information about the sense of comfort is queried in a high degree of detail. Sensory information will include direct measurement, e.g. temperature, and indirectly measured characteristics such as air quality and disturbing sensations. These data can be combined with user feedback and external data sources, e.g. weather forecasts. The combined data can be pre-processed and collected - examined by methods of data analysis in order to derive knowledge and to process them further. By designing the system, it is possible to learn about the quality of the technical equipment and the perceived comfort of users. Furthermore, it allows optimisation for different scenarios, e.g. energetically or in terms of comfort. With the system, the user himself is given the opportunity to articulate his well-being, in a more detailed form. Likewise, the user is informed about measures taken by the technical equipment, for example, measures based on their own feedback. In addition, the system can be used to give users recommendations on how to improve their behaviour, in the form of a decision-making support system, based on machine learning algorithms.

Water & Soil Pollution in Urban Society

Water and soil contamination represents a major environmental problem for urban areas and not only. Monitoring and controlling is a difficult task as there is still lack of relevant data available. Nevertheless, suitable monitoring is necessary so that the world can achieve sustainable growth, by maintaining a healthy urban environment.

Recently advances in IoT and machine learning methods make environmental monitoring a truly smart monitoring system in parallel with various innovative sensor technologies for water and soil quality. In this regard, Research Institutes, Universities and companies are working together in standardising IoT data and network protocols. IoT protocols will enable hardware to seamlessly exchange data and facilitate extraction.

Municipal and Agricultural Waste Management in Urban Society

Improved methods using technologies in the field of biological waste management such as anaerobic waste digestion in order to produce biogas, waste separation, reduction, reuse and recycling or reprocessing are low cost are feasible strategies for waste reduction reducing the emissions produced.

Urban waste can be seen as a resource for the whole processing chain. Encourage recycling, generate rates based on each citizen's contribution and make your city greener. Take the wheels from one controlled model by the simple presence of the containers, to one in which the necessity and quality of service prevail.

Smart Waste main features are the following:

- **Routes optimisation:** Calculation and providence of the best route to the garbage collection operators; Operation rules that can be considered in the routing algorithm: filling level; containers dimensions; last garbage collection date; vehicles dimensions; streets properties
- **Container indicators:** Occupancy level evolution and behaviour visualization; Alarms generation when the occupancy level is at or surpasses the threshold level
- **Anomalies:** Display and filtration of reported incidents; Incident type definition (type, status, geographical location and date)
- **Configurations:** Demonstration of the waste routes display functionalities and incident registration
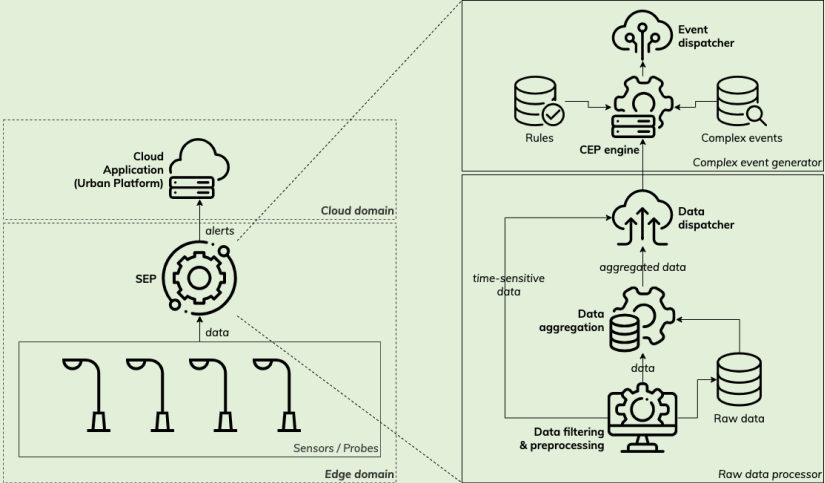
Looking at the whole, both agricultural and municipal waste are highly interlinked, and with good management, the last one can support managing compost from urban areas, to be further transformed into bio-fertilizers. As a result, agriculture must move to agroecological farming practices and incorporate bio-fertilizers. This approach is also in line with EU farm-to-fork strategies, such as waste reduction, carbon emissions reduction and supporting healthier diets. ICT technologies and decision-support tools can for sure support the management of urban compost and pave the way to enhanced recycling of food waste in agriculture.

Also, another important factor both for Agriculture and urban areas, is water quality, which is declining due to urban, industrial, and agricultural pollution. Water scarcity started to become a serious problem and in order to cope with the increasing pressure on water sources and on the declining water quality, the potential role of treated wastewater reuse as an alternative source has been thoroughly discussed by the Commission. Wastewater monitoring using ICT systems and reuse in agriculture, should be the main direction for farms nearby cities.

CASE STUDIES

The following cases studies from the AIOTI community are examples of how digital solutions can achieve a human-centric, digital and green built environment addressing the above mentioned components:

Table.1 ----- Overview of organizations/company/Research, Academia (or other) addressing the challenges mentioned in the RRF documentation in relation to this specific topic within the AIOTI community, case study description. -----		
Topic/Domain	Please, provide organizational/company/Research, Academia (or other) addressing this specific topic----	Name of Organization, Member State based in and active in Member States x,y,z.
IoT solutions crisis management	Software Imagination & Vision (SIMAVI) is an IT company with experience in the following fields of activity: R&D, Education & eTraining, eHealth, Security, eAgriculture, Customised Applications, ERP & BI, eCustoms, and Government with +1500 commercial clients and +300 successful projects. SIMAVI staff consists of IT specialists with complementary technological capabilities: IoT, Analytics, Big Data, Data mining, Cloud computing, Decision Support Systems, User interfaces, UX design, Virtual Reality (VR), Augmented Reality (AR), Serious Games and Training. SIMAVI team is covering all stages of projects development from solution design, proof of concept to prototyping and end-user implementation. SIMAVI can propose several solutions for crisis management, like, for example, FLOOD-serve platform - dedicated to citizens of pilot and partner cities aiming to contribute to flood risk mitigation. It is conceived as a two-way information gateway; citizens can look up information about floods, or they can submit information to relevant public authorities in their city, and engage in a dialogue with them. The FLOOD-serv Portal offers news, multimedia galleries and data-based flood reports in each of the participating cities; -offers general information and knowledge about floods and flood management but also specific and contextualized knowledge; -receives and monitors relevant data from internal sources (data submitted by citizens, or based on analysis of satellite pictures) and from external sources (meteorological and sensor data), generates various visualizations of data based on maps and charts, proposes response measures and tracks their evolution; -provides a direct communication channel from the citizens to the respective local authorities, enabling them to more effectively inform and engage in dialogue with those local authorities of any flood related information, in terms of risks or prevention; -produces situational awareness and risk analysis within a geographical area by means of analysis of satellite and aerial pictures (from airplanes or drones).	SIMAVI is an SME located in Bucharest, Romania and implements projects in different regions (Belgium – training provider for different EC DGs, Europe, Middle East, North Africa, CIS area)
IoT solutions crisis management	Everis is an international large company that offers its clients comprehensive business solutions covering all aspects of the value chain, from business strategy to systems implementation. As an ICT provider, Everis is organised by sectors, from the business point of view, and we count on several technological key lines: Artificial Intelligence and Big data, IoT, Blockchain, Cybersecurity and Architecture, among others. Thanks to our dual nature, both technological and business oriented, we can act as facilitators, providing a common place for technology solutions and their potential end users.	Everis is based in Spain, active in Andorra, Belgium, Italy, Luxembourg, Netherlands and Portugal. It also has offices in Switzerland and United Kingdom. Everis is part of NNTDATA:

	Everis has proposed the above-mentioned use case based on the expertise acquired in the development of an asset called "ehcos" which is a comprehensive solution for digital health management with various components and another much more incipient which is Everis "Health Universal Hub", which is an application mobile for android and ios that allows connection with medical devices and communicates this data to the ehcos application for follow-up by doctors.	https://www.nttdata.com/global/en/
IoT solutions crisis management	Ubiwhere has been designing, implementing and deploying smart urban furniture solutions that are multi-tenant and multi-technology. Solutions such as smart poles are being explored under a Joint Venture called Smartlamppost. This solution allows for a seamless housing of different equipment such as IoT gateways, WiFi Access Points, Small Cells, multipurpose video cameras, Electrical Vehicle charging stations, etc. Within the exploitation of Smartlamppost, Ubiwhere has been designing a distributed and decentralized Edge Computing Platform to run privacy-preserving and time-sensitive use cases with IoT and CCTV data sources. Smart Event Processor (SEP) is a framework designed to be deployed at the edge of the network with the main goal of providing real-time monitoring of data originated from IoT devices, such as probes and sensors, and generate complex events based on data correlation. The large amounts of raw data are processed by SEP and ultimately will generate complex events and transfer them to a third-party control application running in the cloud. Due to the large quantity of raw data generated by sensors in comparison with the quantity of generated complex events, the amount of data transferred to the cloud/core of the network is highly reduced which improves the real-time processing performance of the whole system. The SEP framework consists of two modules, 1) the Raw data processor and the 2) Complex event generator. The Raw data processor is composed of different submodules. Firstly, the sensing data provided by the sensing devices are preprocessed, filtered and stored in a database. Some types of data are time-sensitive, e.g. data coming	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

	from accelerometers capable of detecting earthquakes, which is directly sent to the data dispatcher to be sent immediately to the complex event generator. Other types of data that are more delay tolerant are processed by the data aggregation submodule and later dispatched when a configurable amount of data or elapsed time is reached. The data received from the raw data processor will be matched against rules in the rule database. If the matching is successful, complex events will be inferred and generated to send to the upper application. In some cases, the CEP engine also analyses previously generated complex events (history) to infer certain events more accurately.	
Air Pollution in Urban Regions	LifeStech has successfully coordinated the PULSE project, engaging in a collaborative dialogue with a range of stakeholders across seven global cities to transform public health from a reactive to a predictive system focused on both risk and resilience (http://www.project-pulse.eu/).	LifeSupporting Technologies - Universidad Politécnica de Madrid https://www.lst.tfo.upm.es/
Air Pollution in Urban Regions	Everis is an international large company that offers its clients comprehensive business solutions covering all aspects of the value chain, from business strategy to systems implementation. As an ICT provider, Everis is organised by sectors, from the business point of view, and we count on several technological key lines: Artificial Intelligence and Big data, IoT, Blockchain, Cybersecurity and Architecture, among others. Thanks to our dual nature, both technological and business oriented, we can act as facilitators, providing a common place for technology solutions and their potential end users. Everis has proposed the above-mentioned use cases based on the expertise acquired in the development of an asset called "Bellair" which is a real-time air quality monitoring solution, joining the capabilities of the IoT team and the needs and requirements collected from the business unit. The second use case proposed by Everis is based on the expertise acquired in the development of an asset called "Zentro" which is a comprehensive solution to control the access to Low Emission Zones in the cities, improving air quality of such zones.	Everis is based in Spain, active in Andorra, Belgium, Italy, Luxembourg, Netherlands and Portugal. It also has offices in Switzerland and United Kingdom. Everis is part of NNTDATA: https://www.nttdata.com/global/en/
Air Pollution in Urban Regions	Ubiwhere is responsible for developing a smart solution for air quality monitoring and forecasting and analysis of energy loss in cities, based on historical data from different sources, within the scope of an ongoing H2020 project called NEANIAS (which stands for "Novel EOSC Services for Emerging Atmosphere, Underwater & Space Challenges") is a project developed under the Horizon 2020 Programme, aiming to promote Open Science practices and to play an active role in the materialisation of the European Open Science Cloud (EOSC) ecosystem. The solution will be developed and validated within the project, so it can be integrated into the EOSC catalogue, for cities and research communities to benefit from the technology and the collected data to create new and innovative products. Besides the contribution this new service represents for	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

the scientific community, it is also an opportunity for Ubiwhere, that becomes capable of complementing its Urban Platform with a new functionality.
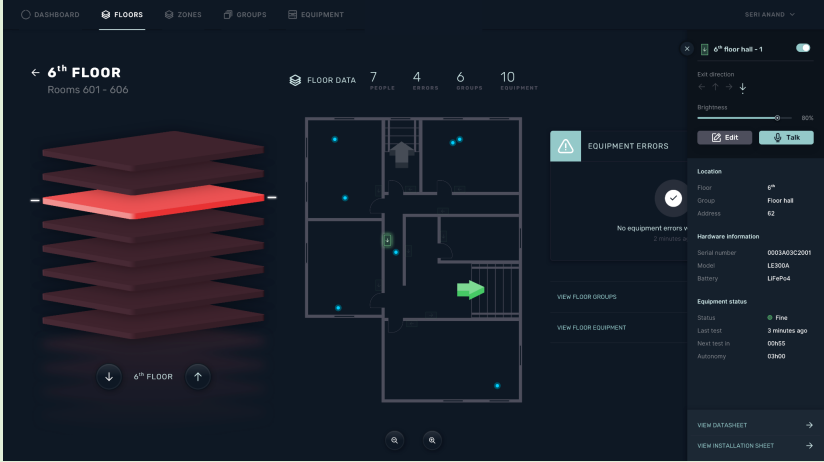
The Urban Platform was created by Ubiwhere to address cities' daily challenges and truly prepared them for the future. Easy, intuitive and comprehensive, it offers a global and integrated view of the city to Municipalities, authorities and service providers, displaying information on its several verticals, from mobility and energy to air quality and sustainability.

With the new service of atmospheric monitoring, Urban Platform offers cities valuable indicators for more efficient management of services (on the scope of Mobility, for instance), with direct impact over air quality, so they can be aligned with the European and international metrics for sustainable development (such as the UN's Sustainable Development Goals) and focus on improving the quality of life of its citizens through a clean and safe air.

IoT solutions fighting physical inactivity	UNINOVA has been conducting its research activities on IoT and CPS domains, with a focus on the digital heat sector. Through its spin-off company (Knowledgebiz, https://www.knowledgebiz.pt/), a smart textile solution combining IoT and mobile technologies was developed to promote physical activity and reduce sedentary behaviours among adolescents. The SmartLife project - Smart Clothing Gamification to promote Energy-related Behaviours among Adolescents (https://www.smartlifeproject.eu/).	UNINOVA www.uninova.pt
IoT solutions fighting physical inactivity	Rehabilitation decision support system (developed in Establish project) combines environmental sensor data with physiological and behavioural sensor data to empower patients that need rehabilitation with decision support tools for behavioural choices and treatment options. RDSS mission is to: ● monitor health parameters to constantly improve the health of the population through rehabilitation and care, specifically targeting the patient's functional aspect of integration in everyday life, environment and work, ● develop a decision support system and services based on the outdoors environment parameters and indoor location, and reduce operations costs and improve quality of the services provided.	SIMAVI www.simavi.ro

IoT solutions fighting Covid-19	Regarding the development of IoT solution focusing on the fighting of Covid-19 pandemic, UNINOVA is working on a Cyber-Physical System for Telemedicine and Intensive Care (CPS4TIC), enabling existing or new ICU structures to be transformed and operate as one ICU Hub with one central ICU and connected ICUs in peripheral hospitals. The ICU4Covid project Cyber-Physical Intensive Care Medical System for Covid-19 (https://cordis.europa.eu/project/id/101016000).	UNINOVA www.uninova.pt
Noise & Mental Health in Urban Society	Focusing on noise and mental health in urban society, UNINOVA has developed a low-cost, low energy connected health solution for carers to monitor the location and proximity of their loved ones with dementia. This solution was developed in conjunction with other partners involved in the Carelink project. (http://carelink-aal.org/). Also related with mental health, UNINOVA is currently focused on the development of a solution which provides intelligent support to patients with depression undergoing cancer treatment. Such development is being supported through the Faith project (https://www.h2020-faith.eu/).	UNINOVA www.uninova.pt
Noise & Mental Health in Urban Society	Monitoring solutions for elderly (developed in the FollowMe project) Artificial Intelligence (AI) is a highly topical issue given the fast advancement of technology. Technology evolution in AI triggers the development of innovative applications in different industries. FollowMe is a solution aiming at using AI for the benefit of people with cognitive deficiencies. SIMAVI proposes AI algorithms and techniques as a complementary solution to support people challenged by age or disease-related cognitive deficiencies. FollowMe is a complex ICT solution that facilitates assistance and support for people with cognitive impairment and their caregivers or relatives.	SIMAVI www.simavi.ro
Noise & Mental Health in Urban Society	LifeStech has developed a digital health intervention validated in the NEVERMIND project, aiming to reduce depressive symptoms in patients with severe somatic conditions, in comparison to current treatment and practice (study protocol here).	Life Supporting Technologies - Universidad Politécnica de Madrid https://www.lst.tfo.upm.es/
Active & Healthy Living and Ageing	NuMint is a start-up providing solutions for pelvic floor strengthening, complementary or alternative to the French pelvic floor rehabilitation methods (regulated activity in France). NuMint builds collaborations with midwives, kinesiologists, physiotherapists as well as with alternative medicine professionals (dulas, psychologists, sexotherapists etc) to create an ecosystem for pelvic floor care in France and Europe. The core of our activity is in the design, research and development of digital tools – IoT devices coupled with a smartphone app for patients as well as a digital platform for CAM and official healthcare professionals.	NuMint, France, e-commerce activity in Europe. www.monintimite.fr
Active & Healthy Living and Ageing	Life Stech has been the Technical Manager of the ACTIVAGE Large Scale Pilot, building on the experience of the Smart Living Environments for Ageing Well (now WG-Health). The project deployed IoT-based solutions for Active and Healthy Ageing, involving ca.10.000 users in 12 European regions and cities.	LifeSupporting Technologies - Universidad Politécnica de Madrid

	The experience is now continuing with the <u>ACTIVAGE.ORG</u> Association and through the Technical management of the <u>GATEKEEPER</u> Large Scale Pilot where IoT based solutions are now been used for innovative healthcare services for early risk detection and interventions, aiming at reach ca 40.000 users in 8 European Regional Healthcare Services. This knowledge is being built with relevant partners and stakeholders from health and social care ecosystems.	<u>https://www.lst.tfo.upm.es/</u>
Active & Healthy Living and Ageing	UNINOVA is currently coordinating an Eu project focusing on the Citizen-centred EU-EHR exchange for personalized health, Smart4Health (<u>https://smart4health.eu/en/</u>). One of the key scenarios is on back-pain injury prevention, where UNINOVA is developing an edge IoT box, capable to acquire and process sensor data from physiotherapy machines and provide real-time insights to physiotherapists practitioners. Also, two mobile APPs are being developed: (i) a mobile APP for monitoring bad posture habits for manufacturing workers is currently being developed; and (ii) a mobile app for preventing back-pain injuries, aiming to measure in real-time physiotherapy exercises, being executed in home scenario which is able to collect movement data from smart textiles and provide insights to physiotherapists practitioners.	UNINOVA www.uninova.pt
Active & Healthy Living and Ageing	Brain@Home - Brain training platform (<u>http://www.brainathome-aal.com/index.php/en/</u>) Brain@Home platform is offering an intuitive, attractive and motivational setting in which the user can enter one's known environment, and offers the opportunity to explore new areas, (e.g.cultural) experiences, relive and create memories. Brain@Home offers unprecedented new opportunities for brain training and enhancement of brain plasticity in healthy ageing by maintaining the user cognitively active trough a ecological training of those cognitive functions that are required by ageing people to live independently, interacting with physical and social environments and develop complex everyday abilities through the use of Virtual Reality based games.	SIMAVI www.simavi.ro
Active & Healthy Living and Ageing	Online platform for elderly engagement (developed in <u>Palettev2</u> project) Palette supports seniors to be active members of their community and valued participants in society, with the following characteristics: • Palette connects people to each other and to the activities/events they like: the platform shows what's going on in their village or part of town. • Palette enables people to create activities on the platform and share these with others. • Palette encourages trust among seniors in using ICT; privacy is fully guaranteed. • The platform is easy to use, also for people with low computer literacy. It has been designed with continuous contributions from seniors. Palette uses smart matching: based on the interests specified in their personal profile, users will see a selection of activities that are attractive to them.	SIMAVI www.simavi.ro

Indoor Environmental Quality	IEQ includes amongst others a lighting design adapted to the needs of the occupant, sufficient access to daylight, good air quality and ventilation, thermal comfort, and low noise levels. Better lighting, for instance, is enabled by lighting systems. There is no one-size-fits-all solution for providing better lighting. It very much depends on the application. Example of case studies: - In an office: Innogy Headquarter, Prague, Czech Republic. Project by Signify - In a nursing home: Annemarie-Griesinger-House, Germany. Project by Trilux	LightingEurope www.lightingeurope.org
Indoor Environmental Quality	Toolbox for decision support and adaptive control of air quality monitoring The air quality monitoring toolbox will be able to integrate predictive models with sensor data. Predictive models can be existing models such as an urban air quality model or based upon machine learning techniques. Steering parameters in the predictive model (e.g., the level of ventilation in a room or the traffic flow) can be flexibly selected and the desired state of the model. With data-assimilation techniques, adaptive control algorithms will integrate sensor data and model simulation results and continuously optimize the steering parameters to the desired (optimal) state. These techniques take into account the accuracy of the models and sensor information to obtain the best estimation. This toolbox will also integrate different processing technologies into a geospatial environment, providing visualization algorithms with geospatial aware complex event processing data for sensors, offering real-time analysis of movement objects, like people and vehicles. Some components can be standalone systems, other components offer specific services, and finally there is a framework with open specifications, where hardware and software modules can be plugged-in to create a full decision support system	SIMAVI www.simavi.ro
Indoor Environmental Quality	Ubiwhere is responsible for the implementation of the Smart Buildings solution, following data analytics and monitoring algorithms, providing various purposes (anomaly detection, prediction, report generation) and various stages (cleaning, selection, transformation, training, and recognition) for intelligent services for buildings and floors management:	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

- Location capabilities, leveraging CAD mapping, GPS, indoor location and privacy-preserving connectivity & service patterns analytics;
- Asset management and alerts leveraging sensors or equipment to alert relevant operators of issues, potential hazards and begin preventive maintenance;
- Automated dispatch, enabling automated dispatching of the right worker to the right place with the right equipment saves time and reduces downtime;
- Task Guidance, providing step-by-step guidance and safety reminders delivered at the right moment to help ensure adherence and reinforce situational training, with specific support to ergonomic task and workplace demands;
- Location and context-based voice or visual messages. Workers can initiate these virtual sticky notes to alert each other about temporary issues related to a particular piece of equipment or location.

Water & Soil Pollution in Urban Society	INOVAGRIA https://www.inovagria.ro/ is a software application designed to improve the lives of farmers, regardless of the size of the farm they own. Structured on several components and functionalities extremely useful for farmers, INOVAGRIA can answer the most important problems they face today: submitting applications for crop and animal subsidies, land lease management, management of agricultural works, animal register, etc. INOVAGRIA offers control and stability in an area where forecasts are the most difficult to achieve. Among other features, Invagra offers a solution for soil pollution monitoring.	SIMAVI www.simavi.ro
Municipal and Agricultural Waste Management	With Ubiwhere's Smart Waste Management System, it is simpler to manage the urban waste collection in cities. Through the placement of sensors with low energy consumption and high durability in the traditional trash bins, it is possible to keep tight control on the state of the container, its location and security, thus increasing the effectiveness and efficiency of the waste management teams. Urban waste can be seen as a resource for the whole processing chain. Encourage recycling, generate rates based on each citizen's contribution and make your city greener. Take the wheels from one controlled model by the	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

simple presence of the containers, to one in which the necessity and quality of service prevail.
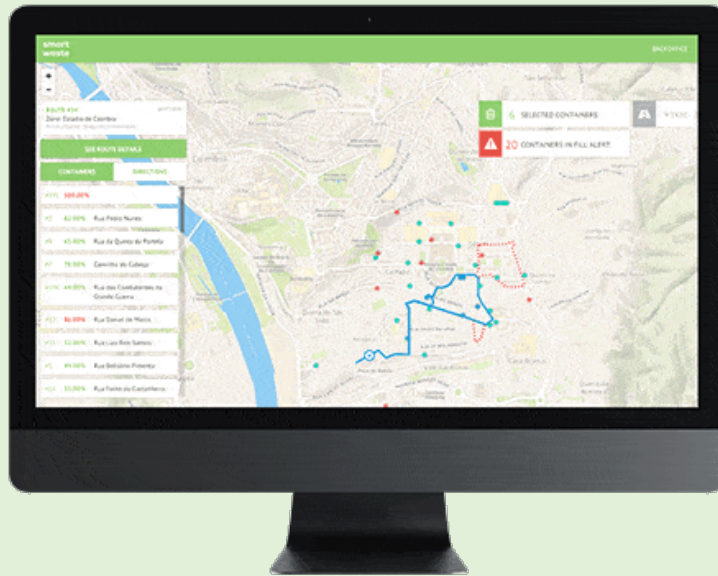
Smart Waste main features are the following:

- Routes optimization: Calculation and providence of the best route to the garbage collection operators; Operation rules that can be considered in the routing algorithm: filling level; containers dimensions; last garbage collection date; vehicles dimensions; streets properties
- Container indicators: Occupancy level evolution and behaviour visualization; Alarms generation when the occupancy level is at or surpasses the threshold level
- Anomalies: Display and filtration of reported incidents; Incident type definition (type, status, geographical location and date)
- Configurations: Demonstration of the waste routes display functionalities and incident registration

| Municipal and Agricultural Waste Management | ECOSUNT – Efficient solutions for waste management is an easy to use web solution, designed to support the waste management activity, feasible in Cloud, the application provides organizations with a significant reduction in the IT infrastructure spending. The application is designed to monitor:

 • Waste generation
 • Waste collection
 • Waste transport
 • Waste disposal by authorized firms
 • Waste treatment
 • Carrying out the reporting situations | SIMAVI

 www.simavi.ro |

	Waste recovery through	
Municipal and Agricultural Waste Management	Vicomtech's Mobilib solution offers algorithms tailored for best route calculation that can be applied for garbage collection optimization. These algorithms can be adapted to work under multiple temporal, spatial or capacity constraints.	Vicomtech is an applied Technological Research Center located in Spain, specilising in Artificial Intelligence, Visual Computing and Interaction. www.vicomtech.org

2.   Jobs, Skills and Growth: Addressing the components of Clean, Smart and Fair Urban Mobility, Reskill & Upskill, Digital Components and Cloud Capabilities and Public Administration

Tourism, hospitality and food service sectors are experiencing major disruption on the demand side due to travel disruption and social distancing. The wholesale and retail trade sectors are heavily affected by the closure of shops and sanitary measures. EU average shows a decline compared with pre-crisis level of 10%[25]. Achieving a better match between skills and labour market needs will ensure that the countries human capital is used to the fullest and will raise labour market participation, also in view of population ageing. Greater and better private and public investments in upskilling and reskilling will strengthen the innovation, competitiveness and growth potential of the economy, support the creation of new jobs, contribute to fighting social exclusion and to addressing both a shrinking working-age population and the increasing old-age dependency ratio. In 2020-Q3, employment (in terms of number of persons) increased by 1.0%, after a drop of 3.0% in the previous quarter. In December 2020, the unemployment rate stood at 8.3%, unchanged from October 2020 and 0.9 pp. higher than in December 2019. In January 2021, the Employment Expectations Indicator (EEI) decreased by 1.6 points to 88.8 after an increase of 2.2 points in the previous month. According to the Commission's surveys, employment expectations decreased by 3.4 pts. to - 10.4 in retail trade, by 1.0 to -2.2 in construction and by 0.2 pts.to -8.5 pts. in industry, while they increased only in services (by 0.3 pts. to -6.7). At the same time, consumers' unemployment expectations increased by 3.7 pts. to 51.5 pts., according to the latest Eurostat's figures[26].

Digital Skills & Jobs

Contributing to close the skills gap is essential. Increased autonomy and inclusive access to digital technologies will improve Europe's resilience and enable us to effectively address societal challenges including those related to climate change and healthcare. It will also boost competitiveness for Europe's service and manufacturing industries which increasingly rely on computing and communications infrastructures and secure data in their daily business. Cloud- & micro-electronics skills, knowledge in software and data analytics, is needed. The number of open positions for electronics engineers is growing tremendously with nearly 1.1. million job advertisements for electro-engineering workers which were placed in the EU between mid 2018 and end 2019. [27]

Investments In clean and smart mobility will create or safeguard local jobs. Through a wider access to sustainable urban mobility and the reduction of travel times, labour market participation and labour productivity will increase. They will also have Important spill-over effects on the local economy and will increase productivity due to decreased travel times. For example, they will facilitate job searches and link job seekers who are not equipped with cars to a higher number of job opportunities by giving them access to clean mobility. Smart urban mobility will reduce congestion and the time spent in traffic with a positive effect on labour productivity.

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[25] Overall EU analysis of National Initiatives on digitising industry by Valdani Vicani & Associati Economics & Policy presentation facts & figures workshop on 4 March 2021 hosted by CNECT
[26] Key indicators for the Euro Area published 12 February 2021: https://ec.europa.eu/info/sites/info/files/economy-finance/key_indicators2021_02_12.pdf
[27] European Centre for the Development of Vocational Training: https://www.cedefop.europa.eu/en

The European Commission (EC) works on several policy initiatives in order to modernise education by promoting the use of digital technologies for learning and by supporting and monitoring the progress on digitization of schools. The EC has adopted the Digital Education Action Plan (2021-2027)[28] that outlines how the EU can help people, educational institutions and education systems to make better use of digital technology for teaching and learning and to develop the digital competences and skills needed for living and working in an age of digital transformation. DigComp 2.0[29] identifies the key components of digital competence in 5 areas which can be summarised as below:

1. Information and data literacy: To articulate information needs, to locate and retrieve digital data, information and content. To judge the relevance of the source and its content. To store, manage, and organise digital data, information and content.
2. Communication and collaboration: To interact, communicate and collaborate through digital technologies while being aware of cultural and generational diversity. To participate in society through public and private digital services and participatory citizenship. To manage one's digital identity and reputation.
3. Digital content creation: To create and edit digital content to improve and integrate information and content into an existing body of knowledge while understanding how copyright and licences are to be applied. To know how to give understandable instructions for a computer system.
4. Safety: To protect devices, content, personal data and privacy in digital environments. To protect physical and psychological health, and to be aware of digital technologies for social well-being and social inclusion. To be aware of the environmental impact of digital technologies and their use.
5. Problem solving: To identify needs and problems, and to resolve conceptual problems and problem situations in digital environments. To use digital tools to innovate processes and products. To keep up to date with the digital evolution.

Technology is an integral part to accomplishing higher-order competencies, also referred to as 21st century skills, which are necessary in the 21st century workplace and life. Therefore, the education system should prepare the students for this, through development of 21st century skills such as digital literacy, communication, collaboration, critical thinking, problem solving, decision making and creativity. The depth and breadth of technologies available today affords learning environments to provide diversity and opportunity for leveraging ICT as a through line for educational change. Moreover, innovative technologies not only support new interactive pedagogical practices, but also completely transform entire learning environments. For example, VR and AR are seen as pioneering technologies for 21st-century learning. There is an exponential increase in both the number of users and their devices through which they generate and exchange various content, including rich media.

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[28] Education and Training: https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en
[29] DigComp 2.0: The Digital Competence Framework for Citizens. Update Phase 1: the Conceptual Reference Model: https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/digcomp-20-digital-competence-framework-citizens-update-phase-1-conceptual-reference-model

Current networked communications and audio-visual media technologies support - among other services - recording and sharing of pre-recorded multimedia clips, online multimedia streaming and social media information exchange. These services have bridged the gaps between people located remotely, changed the way they communicate and share information and provided them with a more complex rich media user experience. Moreover, video content is increasingly enhanced with multi-sensorial and AR/VR content, transforming slowly, but surely the manner humans interact with digital and physical real worlds. In this rapid development of the technologies, technological companies, and most of the organizations, began to realize that digital skills are vital for employees in the digital era. It is more important than ever that new employees are cross-disciplined and have both hard and soft skills. VR and AR can help enterprises develop their employees' soft skills and expertise. Employers can create VR simulations for specific situations the employees are likely to encounter. This makes the employees more comfortable in the actual situations and enables them to provide better service to the customers. These technologies are ideal for letting employees develop soft skills.

A public Administration fit for the Future

Clear goals, budgets and inclusion of stakeholders are key to success. By using the IoT technology the AIOTI community has to offer, the distinct pillars of the modern urban society, its cities and suburban areas need to all migrate to become part of a interconnect, structured ecosystem collaborating with the public domain in order to support the humans that live in urban areas by increasing the quality of life. Using this technology while maintaining privacy and security, reducing cost, emissions and energy consumption while binging reliable, future proof, scalable and sustainable. Latest EU research findings (Valdani Vicani & Associati Economics & Policy, 2021) emphasizes the fact that knowledge exchange between member states, as well as between member states and EC, bears fruit and potential for deeper collaborations should be explored. Successful projects include specific action plans: predefined steps and clearly defined responsibilities and involvement of private players favours the achievement of a measurable outcome. These initiatives should include clearly defined budgets in order to be more likely to achieve predefined results.

Focus on Digital Literacy and Inclusion

Ageing workforce, coupled with a difficulty to attract young talents: the reduction in applicants for many national civil service competitions and the high turnover of staff reflect a generalized disenchantment by highly talented professionals to choose a career in the civil service. It is harder for the public administration to attract talent. The main objective is to set up a user-friendly digital environment which increases transparency and interaction with businesses and citizens and open data use.

Cross-border and multi-country projects

Within Europe, each member state face different challenges and levels of digitization. At the same time investing sector by sector, scaling and implementing solutions cross border through multi-country projects, can be beneficial for some ecosystems like f.e. manufacturing, mobility, health, tourism, textile and the retail ecosystems. For boosting innovation capacity a well-coordinated national digitization strategy, consultation of industry representatives and cross-border -collaborations are essential. An advanced level of digital public services can have a pull effect on digitization but is not sufficient. Initiatives covering multiple industries/technologies reflect the cross-sectoral character of digitization. Member States should indicate any cross-border and multi-country projects in the plan and wisely replicate and scale up funding based on good practices.

Single point of contact - easy access to the programs - networking events

A central stakeholder and single point of contact at regional and local administrations is key. Member States should communicate at an early stage which administrations- central and/or local will be involved and how they will coordinate among themselves. Detailed information should be provided about who (SME's, businesses in general, Academia etc.) and or what is targeted by the investment. Organizing network events can accelerate the process.

Involving intermediaries for stakeholder plotting & implementation of RRF within Regional and Local Agencies

One of the challenges Member States, regional and local administrations face is identifying eligible projects for the RRF fund and proper distribution. In some cases plans are discussed directly at the Cabinet level which does not involve administration. Another challenge lots of public entities currently face is a knowledge gap on what is available on the market. In order to tackle this problem, involving intermediaries for stakeholder plotting, matching the private sector with the public sector might help to identify the right partnerships needed for the out roll of the RRF plans. Effective collaboration allows urban societies to discuss, experiment, learn, deploy, scale up and improve at higher speed, and to minimize costs and failure rates. And most importantly, shared solutions will improve lives, and help make urban societies Future-proof. Each challenge requires diverse teams and capabilities. Urban societies in the world face similar challenges in addressing local, regional and global issues, at local urban society level. Together we can move things to a new scale, and share knowledge, experience and good practices with others, whether a neighboring urban society or one on the other side of the world.

Collecting Data – Harmonization in Use of Data

The collection and usage of digital data holds significant potential to increase the efficiency and effectiveness of policy making processes. Yet often, data is stored in different formats and databases, which complicates access for users to relevant data sources. Data harmonization, meaning the integration of different data sources, is necessary to increase the efficiency of data storage, strengthen interoperability between different data sources, and ultimately foster data-driven policy-making. Knowledge and experience with relevant regulations, standards and methods that ensure harmonization of data in a compliant and ethical manner, taking into account multiple stakeholder dimensions is a prerequisite.

Furthermore, an ethical issue related to data collection is embedded in the fact that data will reflect historical, local and political conditions and values of those who collect data and those represented in the datasets. This can result in discriminating biases when, for example, algorithms are predominantly trained on 'western' data or data representing lives of men. In their book Data Feminism, D'Ignazio & Klein (2020) argue that to truly address the problem, those who are affected by AI systems need to be engaged with all AI processes and activities.[30] An inclusive approach to data collection in which the data captures a diversity of perspectives and views, including those of marginalized communities, is crucial to mitigate risks of algorithmic biases.

Ethics, Legal, Interoperability, and Standards

In the realm of data ethics, principles such as transparency, fairness and trust are guiding. Yet to truly do justice to data ethics, the socio-economic context from which the data derives and that to which outputs apply should be taken into account carefully and holistically. Legal oversight is essential to analyze these contexts and relevant stakeholder interests, to streamline data flows, to ensure compliance and to incorporate principles that contribute to more ethical and responsible data management. One of the key conditions that allows for streamlining data flows and the exchange of data is interoperability of computer systems. Legal standards are an example of tools that can be adopted by organizations to contribute to interoperability or to provide other specifications for products, services and systems. Implementation of standards is not mandatory, but common standards within the EU are useful to enable interoperability and trust on EU level.

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[30] D'Ignazio, C., & Klein, L., F. (2020). Data Feminism. MIT Press.

CASE STUDIES

Table.2 ----- Overview of organizations/company/Research, Academia (or other) addressing the challenges mentioned in the RRF documentation in relation to this specific topic within the AIOTI community, case study description. -----		
Topic/Domain	Please, provide organizational/company/Research, Academia (or other) addressing this specific topic. -----	Name of Organization, Member State based in and active in Member States x,y,z.
Digital Skills & Jobs addressing software skills	AeL Enterprise - eLearning solution for lifelong training AeL Enterprise is a complete platform for teaching, learning, evaluation and management of multimedia educational content, providing any organization with a complete, flexible and secure training solution. For optimal training, AeL Enterprise relies on the AeL digital content repository, a unique collection of multimedia learning objects that can be developed for any teaching subject, from any domain, depending on organization needs. AeL Enterprise is the optimal solution for: ● synchronous learning – the trainer coordinates the course by creating, adjusting monitoring the entire training process, from the same location or from different locations ● asynchronous learning – students / trainees / employees can study individually, at their own pace; it is adequate for distance learning testing and evaluation – measurement of the impact and efficiency of the teaching process, by providing a unitary level for evaluating	SIMAVI www.simavi.ro
Digital Skills & Jobs addressing software skills	Wand authoring tool - allows trainers to easily create a wide range of learning activities in digital format, mapped on the specific curriculum, for any type of trainee or subject, and to send these activities to trainees regardless of the device they use, both in the classroom and as a homework assignment, and to track trainees' progress in real time for a personalized and modern teaching process. With Wand, trainers can create everything they need to teach and engage their students while doing so: • Presentation activities, where they can easily aggregate information and present it in a more structured and appealing manner; • Drill-and-practice activities, to help students automate skills and improve fluidity of knowledge application; • Assessment activities, to help students correct misconceptions, reinforce key knowledge and measure their own progress; • Learning games, making learning more fun and help teachers regain their students' attention;	SIMAVI www.simavi.ro

	• Ice-breaker activities, to focus students' attention and tap into students' previous knowledge;	
Digital Skills & Jobs addressing software skills	**AR/VR for training** SIMAVI will take advantage of modern 3D technologies and software development tools to build integrated Training Environments based on intuitive and user-friendly interfaces. Augmented and Virtual Reality technologies were adopted for field and on-site operational training of the field personnel to augment the real 3D scene with three-dimensional objects, avatars, animations and audio information that will simulate real incidents and historic events. Both AR/MR and VR solutions can be integrated with a series of training capabilities that will compose different parts of the same integrated scenario that may involve all the phases of a given operation such as training for incidents, use of different types of equipment, use of resources, mitigation of potential risks, actions to be taken, etc. All the training tools will be connected to the simulation engine to be developed to produce synthetic events and data to be fed into the Extended Reality applications and facilitate the execution of the simulated operation.	SIMAVI www.simavi.ro
Intermediary role	The Institute for Future of Living is a societal, citizens' initiative. It addresses and acts locally and globally on societal challenges that others may be willing to talk about but may not be able or daring to activate and start the walk. We facilitate Private Public Partnerships (P-P-P) and collaborate with different stakeholders within the private and public sectors by bridging the gap, addressing the needs and by implementing the solutions. The Institutions works for different public administration, on International, National, Regional and Local level and brings to table what is currently on the market or by helping drafting funding and accelerator programmes. The Institute provides its expertise to the European Commission and the chairs of the Institute are also chairing at AIOTI in the areas of Policy and Strategy, Taskforce IoT Security and Urban Society. The Institute advices in several areas addressing the digital, sustainability, data and business domains from strategic, ethics, policy and legal aspects, including without limitation smart sustainable & resilient society & cities, digital identities, e-government, smart energy, smart mobility, digital transformation, sustainable development, data strategies, privacy, security, robotics, artificial intelligence, safety, skills and job, sustainable economics, data management, governance and ethics. Each challenge requires diverse teams and capabilities. Urban societies in the world face similar challenges in addressing local, regional and global issues, at local urban society level. Together we can move things to a new scale, and share knowledge, experience and good practices with others, whether a neighboring area or one on the other side of the world. Mutual understanding, learning and the impact you want to achieve as society are at the heart of the collaborative modus operandi of our Institute and our network. Effective collaboration allows multiple stakeholders within societies to discuss, experiment, learn, deploy, scale up and improve at higher speed, and to minimize costs and failure rates. And most importantly, shared solutions will improve lives, and help make urban societies Future-proof. The Institute places the symbiosis of human, societal, ecological and economic values at its heart.	Institute for Future of Living. Based in the Netherlands active in all EU countries. www.instituteforfutureofliving.org

	The Institute does not only initiate discussions about societal challenges and how to address those. It also helps navigate urban society stakeholders in this complex, converging and more and more hyper-connected domain, with the aim to enable and facilitate the respective stakeholders to implement, sustain and continuously optimize.	
Collecting Data	Arthur's Legal, Strategies & Systems. For almost 20 years, the firm has represented several hundreds of organisations – both in the private and public sector, large and small – in all phases of their respective life cycle and in the digital, sustainability, data and business domains from strategic, ethics, policy and legal aspects, including without limitation smart sustainable & resilient society & cities, digital identities, e-government, smart energy, smart mobility, digital transformation, sustainable development, data strategies, privacy, security, robotics, artificial intelligence, safety, skills and job, sustainable economics, data management, governance and ethics. On these aspects AL already provides its expertise to the European Commission for more than a decade is extensively involved in EU funded projects through studies and research projects that pertain to topics such as digital data, cloud computing, risk, safety, cybersecurity, privacy, (personal) data portability, human-centric digital transformation, applied innovation, next generation ecosystems, competence and capability building, sustainability, human values, accountability and dynamic assurance. AL is also one of the founding members of the Association for Internet of Things Innovation (AIOTI).	Arthur's Legal, Strategies & Systems. Based in the Netherlands active in all EU countries. www.arthurslegal.com www.arthurstrategies.com
Collecting Data	The Urban Platform is a solution that gathers data from quite different types of sources. This data can come from sensors, other platforms and services (via APIs) or even directly from the citizens (or communities), who provide feedback through mobile apps, surveys, and information systems. These robust data aggregation and harmonisation capabilities provide many opportunities for social and real-time analytics. The application of intelligent	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

methods, both in real-time and in batch, can offer valuable insights for the whole value chain of cities, helping in making informed decisions.
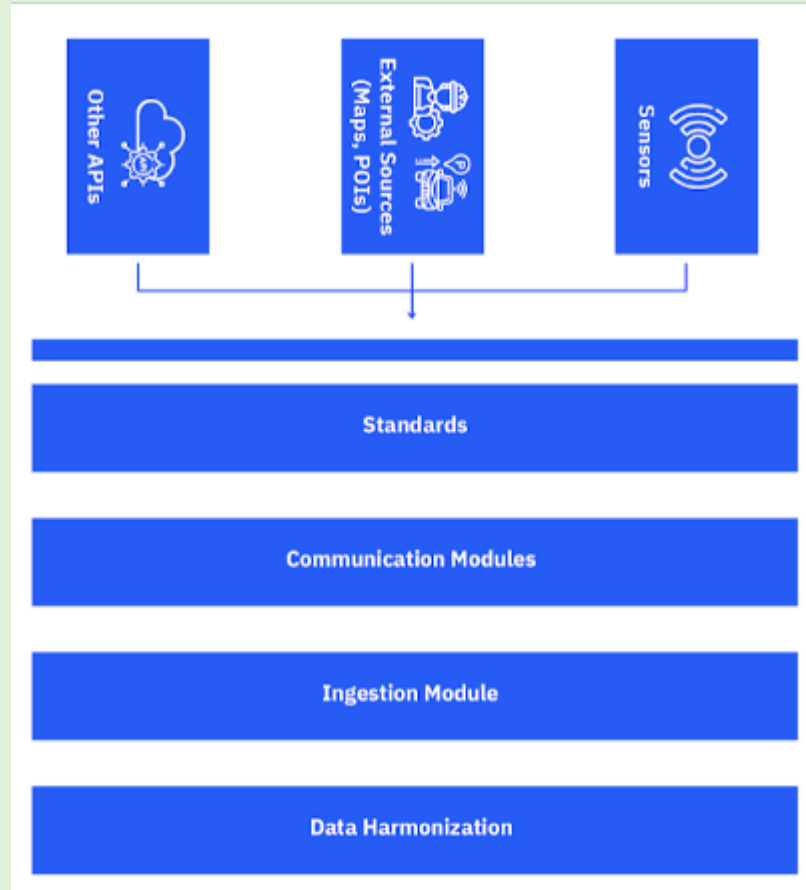
To enable multichannel communication tools, open standards for communication and data exchange are vital. Cities are becoming more aware of the limitations that come with many proprietary solutions they use, that lock the information in "silos", and are increasing the demand to use open and standardised data formats and communication protocols, to get the most value out of the deployment. Ubiwhere's experience with these formats and standards, such as FIWARE's NGSI and Smart Data Models, has been used in building the Urban Platform, giving it a competitive advantage. Another important aspect is that this also makes it easier for cities to increase their perceived transparency towards their citizens, by making it very simple to have any data they choose to be openly available.

Ethics, Legal, Interoperability and Standards	Arthur's Legal, Strategies & Systems. For almost 20 years, the firm has represented several hundreds of organisations – both in the private and public sector, large and small – in all phases of their respective life cycle and in the digital, sustainability, data and business domains from strategic, ethics, policy and legal aspects, including without limitation smart sustainable & resilient society & cities, digital identities, e-government, smart energy, smart mobility, digital transformation, sustainable development, data strategies, privacy, security, robotics, artificial intelligence, safety, skills and job, sustainable economics, data management, governance and ethics. On these aspects AL	Arthur's Legal, Strategies & Systems. Based in the Netherlands active in all EU countries. www.arthurslegal.com www.arthurstrategies.com

	already provides its expertise to the European Commission for more than a decade is extensively involved in EU funded projects through studies and research projects that pertain to topics such as digital data, cloud computing, risk, safety, cybersecurity, privacy, (personal) data portability, human-centric digital transformation, applied innovation, next generation ecosystems, competence and capability building, sustainability, human values, accountability and dynamic assurance. AL is also one of the founding members of the Association for Internet of Things Innovation (AIOTI).	
Ethics, Legal, Interoperability and Standards	Ubiwhere is a full member of ETSI, having joined in 2017 to contribute to the industry with its R&D results in the format of specifications and use cases, as well as to share its telecom and smart cities know-how and perspectives, concretely in industry specification groups such as CIM (Cross-cutting Context Information Management), MEC (Multi-Access Edge Computing), ZSM (Zero touch network & Service Management) and OSM (Open Source MANO) just to name a few. Ubiwhere has been collaborating in four Specialist Task Forces, again linked with its domains of expertise: STF561 (Smart cities and communities: standardisation to meet citizen and consumer requirements), STF551 (MEC Testing Framework) and STF569 (Testing Framework for Multi-Access Edge Computing) and STF584 (Artificial Intelligence for IoT Systems). As one of the first FIWARE success stories, leveraging the open standard NGSI in the city of Porto, Ubiwhere has also become part of the FIWARE Foundation. Moreover, Ubiwhere follows and contributes to multiple Working Groups of AIOTI (i.e. WG03 - IoT Standardisation, WG08 - Smart Cities and WG09 - Smart Mobility, among others), and also collaborates to European initiatives such as IoT-LSP (Ubiwhere has collaborated in the H2020 project Synchronicity - the IoT large-scale pilots project for smart cities as the technical partner of the city of Porto) and IoT-EPI (Ubiwhere was the use case leader for Smart Mobility and Ecological Urban Routing in the H2020 project symbIoTe). Following its strong cooperation with Open and Agile Smart Cities, and thanks to the active involvement in state-of-the-art R&D initiatives, the Portuguese SME has also started collaborating directly with the EIP-SCC and BDVA, for example through the H2020 project EMBERS, aiming at the Sustainable Urban Mobility domain.	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com
Ethics, Legal, Interoperability and Standards	SGS is interested in collaborating with thought leading manufacturers and integrators to demonstrate trust into IoT devices and services. Via the use of existing or upcoming cybersecurity standards (e.g. EN30645 and TS103701) as well as existing and upcoming certification certification schemes (e.g. fixed-time certification scheme like LINCE and BSZ) it is about to test the implementation into devices, services and systems to prepare for the demonstration of compliance. Such demonstration of compliance could be added to each case study.	SGS is the world leading testing, inspection and certification company (TIC company); www.sgs.com/cybersecurity-services

3.   Connected & Automated Multimodal Urban Mobility, Transport & Logistics Addressing the components of Clean, Smart and Fair Urban Mobility

Within this domain we tackle federated multi-modality urban mobility, transport and logistics which implies: Internet of Vehicles (land, water, air), autonomous on-demand public transportation, EVs, UAVs, MAVs, (E)VTOLs, flying cars, electric water borne transport, clean urban logistics, hydrogen aircrafts, hyperloops and the like'. For AIOTI the Data Strategy of the Commission is essential. Data is the main priority and mobility is on the first page of the Data Strategy. [31] The EU needs to take full advantage of digital solutions and intelligent transport systems (ITS) and also seize the opportunities presented by cooperative, connected, and automated mobility (CCAM). CCAM can provide mobility for all, give back valuable time and improve road safety. In order to make the digital transformation of the transport sector a reality it is crucial that key digital enables are in place. This includes network infrastructure (for example 5G), cloud-to-edge resources, data technologies, governance, electronic components for mobility as well as Artificial Intelligence. Looking ahead all mobility should be done paperless, Digital certificates for vehicles, freight transport information, drivers should be affordable and easy to use within all domains, f.e. cross-border car rentals, parking and tolls contactless payments. Real time information regarding possible free parking spots in urban areas will help decrease unnecessary air pollution. Same for better information regarding car restrictions in cities or local authorities is crucial to tackle congestion.

Research and Deployment of Innovative and Sustainable Technologies in Transport

In general a balance between data management and value-added services can be achieved through dynamic contextual transparent and accountable data sharing frameworks where the people can make a balanced and informed choice and understand whether or not to share their data. In IoV digital ecosystems even more fine-grained access to data/attributes will be required, especially in AI supported use cases to support intention assessment and collective learning.

Taking this notion of collective learning in combination with shared knowledge and an even richer data model evolves which will bring also new privacy and ethical challenges. The size, complexity and frequency of changes of the software in connected vehicles augment security and privacy challenges, such as software failures & vulnerabilities but also function creep; these will need to be continuously monitored and certified on quality, security, safety and privacy and trustworthiness. In the area of human/machine interaction and intention recognition of the (perceptive) behaviour of other vehicles, humans and related environment new security, privacy and ethical challenges will be emerging, Digitalization of transport will enable innovative mobility-related businesses and services, such as capacity planning and traffic management systems. Smart mobility will benefit from, but will also contribute to 5G roll-out, the development of artificial intelligence, block-chain, and other efficient digital technologies.

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[31]European Data Strategy: https://ec.europa.eu/info/sites/info/files/communication-european-strategy-data-19feb2020_en.pdf

Transportation sector undergoes a considerable transformation as it enters a new landscape where connectivity is seamless and mobility options and related business models are constantly increasing. Modern transportation systems and services are required to mitigate problems emerging from complex mobility environments and intensive use of transport networks including excessive CO2 emissions, high congestion levels and reduced quality of life. Due to the saturation of most urban networks, innovative solutions to the above problems need to be underpinned by collecting, processing and broadcasting large volumes of data from various sensors, systems and service providers. Furthermore, such novel transport systems have to foresee situations in near real time and provide the means for effective and proactive decisions, which in turn will deter problems before they even emerge. One of the research challenges to be addressed, is to provide the required interoperability, adaptability and sustainability in modern transport systems for a proactive and problem-free transportation system. There's a need to establish a largely scalable and distributed architecture for the management and processing of heterogeneous big-data, enabling continuous monitoring of transportation systems needs and proposing proactive decisions and actions in an automatic way.

Prioritizing rapid urban transit, cycling networks in cities, walking but also inter-urban passenger and freight travel will help in the shift to clean models of power generation. This includes fuels with reduced sulfur content, low-emissions vehicles and fuels, co-generation of heat and power, distributed energy generation like rooftop solar power, mini-grids, solar, wind or hydropower by ensuring access to affordable clean household energy solutions for lighting, heating and cooking.

Investing in smart traffic management systems, embedded sensors, and connectivity networks as well as tracking and tracing technologies, in line with GDPR, can manage traffic flows, reduce congestion and travel time, and therefore further decrease GHG emissions. In addition, collecting data from cars, public transport and micro mobility services that feed into smart traffic management systems will help the authorities to monitor, report and make informed decisions. The proposed Regulation (COM) 408 establishing a Recovery and Resilience sets a binding target of at least 20% of the plan's total allocation to contribute to the digital transition or to the challenges resulting from it (Communication COM,2020)[32].

In the post-COVID-19 era, ensuring safe travel conditions for citizens is a major issue. For this reason, special emphasis has been given to the transport sector both through the strict observance of protection measures and social distancing in public transport and through the adoption of new technologies such as disinfection systems for public vehicles. However, the safe movement of users of both active mobility and micro-mobility means, who are more exposed than car drivers, is also crucial. In this scope, a comprehensive routing service for active and micro-mobility users which suggests the safest route taking into account the areas of increased concentration of citizens should be implemented. The proposed use case is focused on the implementation of this service in order to ensure safe movement conditions for citizens in terms of social distancing and minimize the exposure risk.

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[32] Communication COM (2020) 575 on the Annual Sustainable Growth Strategy 2021 proposes setting a 20% digital target for each national Recovery and Resilience Plan: https://www.parlementairemonitor.nl/9353000/1/j4nvhdfcs8bljza_j9tvgajcor7dxyk_j9vvij5epmj1ey0/vlc5cv8q90zu

The routing service allows the collection of data from various sources such as the Bluetooth detector network, social media data, telecom data and taxi fleet data. The visualization of the data through heatmaps enables to detect the pedestrian crossing points and the areas where a large concentration of citizens is located and thus the safest route option is suggested.

Recent clean vehicles are equipped with digital components. Deployment of intelligent transport systems and 5G based infrastructure for connected and automated mobility will enhance traffic and mobility management at urban level is foreseen, together with collection of mobility data, systematic use of digital tickets and digital payment systems. Enhanced traffic and mobility management, in turn, have direct positive impacts on GHG and air pollution emissions, thus reinforcing the green transition.

The development of innovative urban mobility solutions such as mobility as a service applications, the deployment of car sharing, e-bikes and other micro mobility solutions and local passenger on-demand (taxis/private hire vehicles) and their integration with public transport are hampered by an accumulation of regulatory barriers and restrictions. Moreover, public services contracts often do not contain provisions related to the integration of new services. Finally, data is often not shared between transport operators and with the local authorities, and data sharing is further complicated by problems of interoperability.

These hurdles result in lack of incentives for private investments. A meaningful use case proposed in this topic is the planning of on-demand and sharing mobility services, including the monitoring of the operation component for these services; a multilevel decision support tool (DST) for urban mobility should be applied in order to help local authorities to define how and where these services could be implemented in the areas outside the city.

The multilevel decision support tool consists of 5 levels. Three levels create the technical core of the decision support tool, investigating the effectiveness of different urban mobility proposed schemes to the examined areas. The aim of the first level of the decision support tool is to identify applicable urban mobility interventions using geospatial data and the cost of their implementation. On the second step of the decision support tool, the goal is to propose comprehensive mobility actions by using mobility data (FCD's, sensors, BT) while providing the implementation cost of the method. Finally, in the third level of the tool an extensive transport planning analysis of the city is undertaken. Hence, transportation data (light signal timing, roads' capacity, public transport) are required in order to be assigned in the model and conclude to the feasibility of the proposals.

The remaining two levels are optional but they enhance the effectiveness and efficiency of the tool. They include the city's strategy that is a preliminary analysis of the existing infrastructure of the city and the identification of potential implementation of new one and the monitoring schedule that is implemented at the end of the last level applied in the decision support tool. The monitoring schedule is an integrated assessment tool of the efficiency of the proposed options from the previous steps. It is seamlessly related to the policy maker's final decision because it includes all the suggestions of the levels that the decision support tool examined, the implementation cost of each proposal in line with the strategic urban plan of the city. Thus, the decision support tool is an integrated framework for assessing and evaluating mobility interventions.

Surveillance and Security must be carried out in a rights-preserving way in which communities are the core of shaping digitally sound societies. Technology can enable increased safety and security. Having a multi-angled approach on assessing the overall impact of technology (benefits & risks) is a prerequisite before any technology should be implemented.

In early 2011, the World Economic Forum famously claimed that 'personal data is the new "oil" – a valuable resource of the 21st century. It will emerge as a new asset class touching on all aspects of society'.[33] But unlike oil, which is extracted from the soil, personal data are mostly derived from human values, experiences and behaviour. Moreover, the economic and political value of data grows as the accuracy, topicality and diversity increases. Shoshana Zuboff, Harvard professor and author of Surveillance Capitalism, warns for the fact that this logic leads to 'a new economic order which claims human experience as free raw material for hidden commercial practices of extraction, prediction and sales'.[34] Yet not only businesses, also governments can use these personal data to predict and shape citizen's behaviour for political interests. Recent case studies on Rohinya refugees and Ughurs show that personal data are a powerful instrument for surveillance and amplification of power asymmetries[35].

To protect individuals against potential misuse and abuse of personal data by commercial organisations and public authorities, it is crucial to ensure that robust data security mechanisms are implemented. These mechanisms could include privacy protection and non-identifiability, the provision of control to individuals over their own data, and transparency in the use of data and the output of data analyses. Yet security also implies that information technology systems and the data that flows through these should be protected against cyber threats and unauthorized access, thereby not only protecting the interests of data subjects, but also those of whom legitimately own the data.
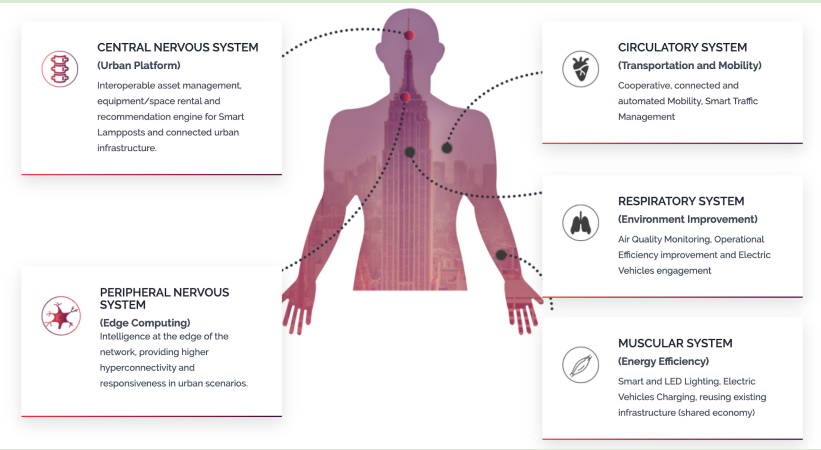
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[33] WEF. (2011). Personal Data: The Emergence of a New Asset Class (p. 40). World Economic Forum.
[34] Zuboff, S. (2019). The Age of Surveillance Capitalism: The Fight for a Human Future at the New Frontier of Power. Pofile Books Ltd.
[35] The Biometric Assemblage: Surveillance, Experimentation, Profit, and the Measuring of Refugee Bodies (2019) https://journals.sagepub.com/doi/abs/10.1177/1527476419857682

CASE STUDIES

The following cases studies from the AIOTI community are examples of how digital solutions can achieve a human-centric, digital and green built environment addressing the above mentioned components:

Table.3 ----- Overview of organizations/company/Research, Academia (or other) addressing the challenges mentioned in the RRF documentation in relation to this specific topic within the AIOTI community, case study description. -----		
Topic/Domain	Please, provide organizational/company/Research, Academia (or other) addressing this specific topic. -----	Name of Organization, Member State based in and active in Member States x,y,z.
5 G Roll Out	A city becomes unmanageable if all the intelligent systems deployed are operated by a closed and proprietary (vertical) solution, while on the other hand, the environment itself becomes unsustainable if the devices are not properly planned and installed. Ubiwhere branded this concept as the City Nervous System, an Organic Approach to City Management, with the duty of coordinating its actions and transmitting signals to and from different sections of its "body". Similar to the human nervous system, it consists of two main parts, the Urban Platform (holistic view and centralised management of a city) and the distributed network of smart urban infrastructure (powered by Edge Computing). The long-term vision of the City Nervous System is to bring together different stakeholders under a shared platform to: - intelligently plan the deployment of new and smart urban furniture; - manage telecom sites' availability and multi-tenant leases; - coordinate the deployment and maintenance of 5G networks; - allow the experimentation of end-to-end 5G network deployment in testbeds and controlled environments; - collect and process different data from diverse devices to unlock the hidden power of cross-cutting context information, while...	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

	- hosting services and applications closer to the data sources, based on Edge Computing to bootstrap Federated Learning/Analytics in specific (data protection oriented) use cases. This vision has matured along with Ubiwhere's experience in other telecom-related projects, where the SME leveraged on data science, open standards, artificial intelligence and data visualisation, and turned urban furniture (such as lampposts, cabinets or kiosks) into a neutral hosting and edge computing platform for 5G, with an initial commercial focus on mobile network operators and telecom companies.	
Artificial Intelligence which manage traffic flows, reduce congestion and travel time	Regarding the adoption of AI for managing traffic flows, UNINOVA has developed a solution for improving freight transportation and traffic connectivity through its participation in OPTIMIM project (http://www.optimumproject.eu/), which its objective has to capitalise on the benefits and potential of big data fusion and proactive behaviour in the context of diverse and multimodal transportation by designing a distributed and scalable architecture. More specifically, UNINOVA has developed a solution based on predictive models, to calculate dynamic tool prices in highways for freight operators.	UNINOVA www.uninova.pt
Artificial Intelligence which manage traffic flows, reduce congestion and travel time	Vicomtech has experience in traffic (and mobility) data-related short-term predictive solutions, analysing real historic datasets or simulation-based data. To apply these predictive solutions, in some specific use cases combined with the use of 5G, the developed algorithms have focused on local small areas such as roundabouts. In other predictive solutions, the focus was extended to city-wide analysis studying, for instance, underground parking lot occupancies, based on parking occupancy and traffic counter data.	Vicomtech is an applied Technological Research Center located in Spain, specializing in Artificial Intelligence, Visual Computing and Interaction. www.vicomtech.org
Blockchain	On Blockchain, UNINOVA is conducting research activities for track and trace products transportation conditions using IoT and sensors using distributed ledger technologies and smart contracts.	UNINOVA www.uninova.pt
Smart Traffic Management System	For traffic management systems, UNINOVA under the OPTIMUM project has developed a solution based on CEP (complex event processing), which is collecting real-time traffic data from traffic sensors, and crowdsourcing in order to detect anomalies / traffic congestions and use such insights to support operation in traffic control centres.	UNINOVA www.uninova.pt
Sensors & Connecting Networks which manage traffic flows, reduce congestion and travel time	The Hellenic Institute of Transport (HIT) is part of the Centre for Research and Technology Hellas (CERTH), which is a legal, non-profit entity. HIT's mission is to provide Transport research and to support policy- and decision-making in land, maritime, air and intermodal transport operations, organisation, planning, standardisation, economic analysis, management, mode technology and impact thereof. CERTH/HIT's main strengths and knowledge fields include analysis and optimization of transport systems and transport networks, transport modelling, real-time traffic estimation, multi-source data fusion,	CERTH-HIT is based in Greece (www.imet.gr). H.I.T.'s main buildings are located in Thessaloniki but it has also premises in Athens, Volos, Piraeus and Rhodes.

	mobility management schemes, cooperative systems and of course a good overview of ITS from the infrastructures perspective. CERTH/HIT has proposed the above-mentioned use case based on the extensive expertise acquired through the Thessaloniki Smart Mobility Living Lab (https://smartmlab.imet.gr/index.php) which is an one-stop source for mobility data and services in Greece providing novel mobility solutions to citizens based on the fusion of mobility data derived from multiple sources of its ecosystem.	
Sensors & Connecting Networks which manage traffic flows, reduce congestion and travel time	By using traffic sensors, crowdsourcing data, V2I and V2V technologies, in conjunction with traffic data standards, such as DATEX-II. UNINOVA is keen on conducting research on these topics, to provide real-time insights for drivers, about road congestion levels, emergency events, road conditions.	UNINOVA www.uninova.pt
Micro Mobility Sensors & MaaS offering	With vast experience in web and mobile development, Ubiwhere has created diverse solutions such as an intelligent service for electrical bike sharing (released as a successful spinoff called BikeEmotion) and, more recently, an M2M middleware platform for the Internet of Things in the Smart Cities domain (called the Mobility Catalogue), a catalogue to help cities achieve a true Mobility-as-a-Service (MaaS) ecosystem, assisting in every step of the way. **ADD YOUR CITIZEN CENTRIC APP HERE** **SMART CITY MOBILITY API** 📅 EVENTS 📊 REPORTING 📁 MANAGEMENT 🔀 ROUTING **INTEROPERABILITY BUNDLE** **ADD YOUR BUNDLE HERE** The Mobility Catalogue can integrate different assets for micro-mobility, such as parking and traffic sensors, as well as other devices for vehicle positioning tracking (light and electric vehicles such as bikes and scooters), as well as docks occupancy to support micro-mobility use cases: fleet management, park-and-ride route planning and promotion of sustainable behaviours through rewarding mechanisms.	Ubiwhere is an SME based in Portugal, active in the EU, with solutions available in more than 60 cities across the world. www.ubiwhere.com

| Digital tickets & digital payments | The ETS-Electronic Ticketing System aims to eliminate access gates and create an automatic authorization system with free access for customers by developing electronic tickets and geographically located devices. It developed a new back-office system for electronic tickets in the field of transport, which will streamline access and offer additional services and mobile applications. A new transport control system for open access travel (typical examples being suburban trains, buses, trams, subways, ferries). At the same time, securing electronic transactions, especially for online shopping, is an important issue. The ETS system could lead to major improvements in transport infrastructure by:

• Removal of access gates and their replacement with an access area in which to check, in a free flow of passengers, whether each passenger has a ticket and whether it is valid. This action would facilitate access to infrastructure and reduce a major constraint on building architecture.

• Providing infrastructure owners with the means to know the exact distribution of customers, how this behaves like a lot and then the possible ways of accessibility of infrastructure use, harmonization of customer density and adaptation of infrastructures to flows.

• Real-time publication of the exact location of each vehicle, based on GPS or indoor location, with records of the number of passengers

• Interaction with customers through applications targeted to their position, for sending safety / security messages, as well as for targeted advertising or entertainment.

• Improving information proposals for the purchase of tickets at kiosks or in purchasing applications

• Better security of ticket transactions both in infrastructure and online.

• Publish the waiting time for queues and the number of available seats in real time | SIMAVI

www.simavi.ro |

Mobility as a Service (MAAS)	Through the participation in two different national research projects, UNINOVA has developed a platform providing services for urban parking, which enabled the prediction of parking occupancies, in short and medium terms, enabling citizens to reserve parking places in advance. Also, it was developed a solution enabling contactless ticketing using a mobile APP for public transportation, in conjunction with a real-time analytics dashboard allowing public transport operators to analyse ticketing validations and purchasing in real-time. Several reports were generated enabling the detection of anomalies or even possible situations of frauds.	UNINOVA www.uninova.pt
Car-Sharing, e-bikes & other micro mobility solutions and local passenger on-demand solutions	The Hellenic Institute of Transport (HIT) is part of the Centre for Research and Technology Hellas (CERTH), which is a legal, non-profit entity. HIT's mission is to provide Transport research and to support policy- and decision-making in land, maritime, air and intermodal transport operations, organisation, planning, standardisation, economic analysis, management, mode technology and impact thereof. CERTH/HIT's main strengths and knowledge fields include analysis and optimization of transport systems and transport networks, transport modelling, real-time traffic estimation, multi-source data fusion, mobility management schemes, cooperative systems and of course a good overview of ITS from the infrastructures perspective. The use case proposed by CERTH/HIT is based on the expertise acquired in the development of a decision support tool for urban mobility services that aims to balance the gap between the methodological approach and the real needs of each city. The DST was developed within the European project MOMENTUM-Modelling Emerging Transport Solutions for Urban Mobility (https://h2020-momentum.eu/) funded from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 815069.	CERTH-HIT is based in Greece (www.imet.gr). H.I.T.'s main buildings are located in Thessaloniki but it has also premises in Athens, Volos, Piraeus and Rhodes.

4.   Twin Transition

Addressing the components of Clean, Smart and Fair Urban Mobility and Reskill & Upskill

The Green Deal wants to decouple economic growth from resource use by 2050, and transform 'linear' take-make-discard industrial value chains into virtuous models that design waste and pollution out of the process, keeping products and materials in use for longer and helping to regenerate ecosystems. The European Commission states that "Europe must leverage the potential of digital transformation, which is a key enabler for reaching the Green Deal objectives". Strong emphasis on green innovation and new technology – both in the production of goods and consumption of products and services – runs the risk of leaving segments of society behind. As many as 80 million Europeans do not use or have access to the Internet. For Europe's twin transition to be a just and affordable one, new skilled jobs, extensive retraining and a raft of accessible products and services are needed.

According to a recent FORENV report[36] on emerging economic, business, technological and social innovations in the green economy, local communities and social enterprises that seek to ensure benefits for people and the environment play an important role in an "inclusive circular economy". "New technology-driven business models are expected to replace many low-skilled jobs in the circular economy (e.g. driverless transport, robotics, etc.), while other technical jobs will be created". The report adds that technologies ushered in under the Green Deal offer a solution to a diminishing European labour force as populations continue to age, by replacing and enhancing labour, which "could force businesses to adapt the jobs to the skills available as each employee would be more valuable in the job market".

7 steps enabling the Twin Transition to a sustainable and digital economy:

1) Recognizing that the digital and green transitions are closely intertwined
2) Addressing the investment gap for green tech
3) Getting innovations out of the lab into the market
4) Overcoming the "Tragedy of the Commons" by publicly recognizing green tech's valuable contribution
6) Leveraging the power of digital innovation for climate action
7) Adapting digital innovation to local socio-economic and cultural contexts

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[36]The EU Environmental Foresight System (FORENV): https://op.europa.eu/en/publication-detail/-/publication/b89d6514-7268-11eb-9ac9-01aa75ed71a1/language-en/format-PDF/source-search

PRINCIPLES

In order to prepare for certain risks associated with emerging technologies such as IoT, it is crucial to build in checks and balances in the system. Incorporating principles in the early design is necessary for low-risk and future-proof information technology systems. The current doctrine on data ethics evolves around certain principles that are used to guide the design and deployment of information technology and the data that fuels it. These principles include – among many others – accountability, transparency, auditability, resilience, interoperability and trust. These principles are not exhaustive nor mutually exclusive. Rather, they embody a complex web of interconnected and partially and temporarily overlapping concepts. It is important to support systems designers and developers in the process of holistic mapping of risks associated to the technologies over their entire lifecycle, and to provide them with knowledge and tools to integrate relevant principles 'by design' as key enabler for long-term success.

RECOMMENDATIONS

1. Human-centric – it is not the technology on itself that holds the potential to do good or to cause harm, but rather the way the technology is used and deployed. Digital solutions can combine high energy savings with vast advancements in wellbeing, comfort, safety and productivity. A human-centric approach should be central to upcoming policies and investments at the EU, national and local levels. Technology is merely an instrument for interaction between humans – it embodies a way of revealing a reality as perceived by the developers and users. This is clearly illustrated by social media platforms that are known to have benefits for connecting people and making voices be heard, yet when misused, they create an environment in which political polarization and hate speech can flourish. Also smart city infrastructure can and will shape social structures. Ben Green, author of The Smart Enough City, argues that technology is not a goal on itself, and that technologies should be used for the benefit of democracy and equity to avoid unintended consequences such as increased inequalities and injustice within an urban society.[37] Because people ultimately shape technology, it is important to take into account the views, perspectives, and societal position of those designing and deploying it, as well as those on the receiving end. This will not just require a human-centric approach, but more of a persona-centric approach. Who are the users? What do their relationship to the world look like (e.g. employee, customer, partner)? And how will digital infrastructures affect these relationships? Asking these questions is essential to make technology evolve around human lives and make it adapt to local realities. It is recommended to invest in continuous participatory dialogues between a wide range of stakeholders and to incorporate feedback loops that communicate outcomes and insights of the dialogues back to those who design and deploy the systems.

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[37] Green, B. (2020). The Smart Enough City. Cambridge, MA: The MIT Press.

2. Infrastructure - digital infrastructures are key to the development. 5G will improve connection speed and allow the development of applications that require low latency, high reliability or the connection of millions of low-energy sensors. Fibre networks must be extended as quickly as possible in all areas currently served by mixed copper infrastructure. Part of the resources of the Recovery Fund should be invested in research and development of future-proof networks and infrastructure. The focus should be on infrastructure that is sustainable and user-centric, meaning it takes into account and respond to the needs of the user.

3. Digital know-how and skills – in order to do justice to the potential of digital technology, it is important to establish digital know-how and skills within urban societies. Attracting highly skilled engineers and computer scientists can help to build robust, efficient and sustainable smart technology infrastructure. Yet the digital transformation will affect many facets of life in the city, and therefore requires digital knowledge in social, legal and philosophical domains as well. Furthermore, the interests of those whose lives are impacted by the digital transformation should also be taken into account. Critics warn for the 'digital divide', meaning the gap between those who know how to use technology and gain access to the benefits, and those who do not, due to limited access to resources, lack of understanding of use or technology, or because they simply decide not to partake in smart technologies. It is recommended for cities to invest in attracting skilled workers, but also cooperate with research institutes to develop relevant interdisciplinary education programmes across various faculties.

4. Public-Private-Partnerships - The objective with this RRF is to facilitate local efforts to enhance the offer of sustainable shared mobility services, including transport on demand, to complement public transport. This reform will simplify the authorization process and provide access conditions to transport and mobility data. The reform will promote more systematic use of tenders for accessing the urban mobility services markets which will accelerate the transition towards sustainable urban mobility. A legislative framework for data sharing between transport operators will be adopted. Recent clean vehicles are equipped with digital components. This will facilitate the deployment of intelligent transport systems that will enhance traffic and mobility management at urban level, together with collection of mobility data, and systematic use of digital tickets and digital payment systems, in particular in a context of 5G based infrastructure for connected and automated mobility.

5. Top down & Bottom up - There is a need of a combined top-down, bottom-up approach where the members states, cities, regions users can define the IoT applications requirements and specifications and where the pillars of Urban Society are connected for mutual benefit. It should be novel, allowing for the coordination, monitoring, control and sharing of information.

The notions derived from the following frameworks and agreements must be taken into account and put in place in legislation through policy reforms:

1. The EU Green Public Procurement Criteria[38] should be expanded to cover all public buildings, not just offices, i.e. to public housing, hospitals, schools and libraries, whilst ensuring that digital conditionality is fully integrated.

2. The implementation of the Sustainable Finance Taxonomy Regulation[39] Technical Screening Criteria for Climate Change Mitigation and Adaptation should consider to adopt digitalization as a key instrument to foster sustainability, whilst recognizing the need to incorporate sustainability principles in the design and deployment of digital technologies.

3. Climate Neutrality by 2050[40] The production, use and end-of life of digital technologies, as well as data collection, analysis and storage, are highly energy-intensive processes with considerable climate impact. At the same time, technology can also accelerate the transition towards a sustainable and circular society. A balance need to be sought between the carbon investment and the carbon avoidance achieved by technological solutions. The EU objective to be climate neutral by 2050, incorporated in the European Green Deal and in alignment with the Paris Agreement, will be guiding for this.

4. The EU's 2030 Climate Target[41] By 2030, all greenhouse gas emissions should be reduced by 55% compared to 1990. This requires immediate action among all sectors and implies that the current design and deployment of digital technology and smart infrastructure should be strictly committed to this target.

5. Clean Energy for all Europeans Package[42] Under the Clean Energy for All Europeans Package, member states are required to implement national energy and climate plans (NECPs) over a period of 10 years, to outline strategies for the transition towards renewable energy. While digital technology can help to increase energy efficiency and establish and drive demand-response systems, opportunities for renewable power generation that fuels the digital infrastructure should also be listed as a priority.

6. Paris Agreement[43]In this agreement the role of cities, regions and local authorities have been emphasized. The agreement recognizes the role of non-party stakeholders in addressing climate change, including cities, other subnational authorities, civil society, the private sector and others. They are invited to scale up their efforts and support actions to reduce emissions, build resilience and decrease vulnerability to the adverse effects of climate change and uphold and promote regional and international cooperation.

7. Katowice Climate Package:[44] by 2025, EU Member States are required to submit a second round of Nationally Determined Contributions (NDCs) under the Paris Agreement. The UNFCCC has issued the Katowice Climate package to provide guidance for this, including a prototype public adaptation registry and a prototype NDC registry.

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[38] The EU Green Public Procurement Criteria: https://ec.europa.eu/environment/gpp/case_group_en.htm
[39] Sustainable Finance Taxonomy Regulation: https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852/amending-and-supplementary-acts/implementing-and-delegated-acts_en
[40] Climate Neutral Economy by 2050: https://ec.europa.eu/clima/policies/strategies/2050_en
[41] Climate & Energy Framework 2030: https://ec.europa.eu/clima/policies/strategies/2030_en
[42] Clean energy for all Europeans package: https://ec.europa.eu/energy/topics/energy-strategy/clean-energy-all-europeans_en
[43] Paris Agreement: https://ec.europa.eu/clima/policies/international/negotiations/paris_en
[44] Katowice Climate Package: https://unfccc.int/process-and-meetings/the-paris-agreement/the-katowice-climate-package/katowice-climate-package

ABOUT AIOTI

AIOTI is the multi-stakeholder platform for stimulating IoT Innovation in Europe, bringing together small and large companies, start-ups and scale-ups, academia, policy makers and end-users and representatives of society in an end-to-end approach. We work with partners in a global context. We strive to leverage, share and promote best practices in the IoT ecosystems, be a one-stop point of information on all relevant aspects of IoT Innovation to its members while proactively addressing key issues and roadblocks for economic growth, acceptance and adoption of IoT Innovation in society.

AIOTI's contribution goes beyond technology and addresses horizontal elements across application domains, such as matchmaking and stimulating cooperation in IoT ecosystems, creating joint research roadmaps, driving convergence of standards and interoperability and defining policies. We also put them in practice in vertical application domains with societal and economic relevance.