

# Wrocław - towards a Smart City

2018

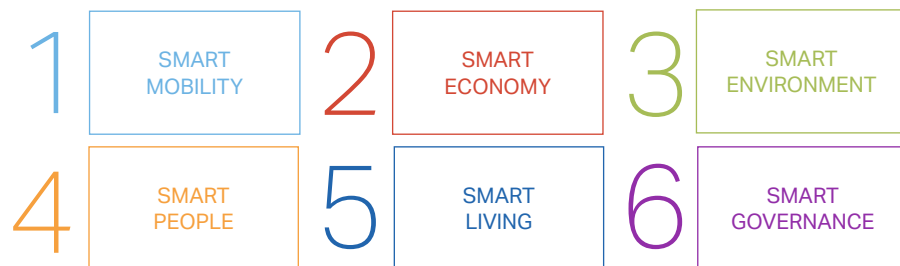


# WHAT CHARACTERISES A SMART CITY?

Every year the number of people living in cities is growing fast. The authorities and inhabitants of cities continually face new challenges related to transport, waste management, housing, protection of the natural environment, health services, education, and safety. At the same time, we all have an interest in cities becoming as citizen-friendly as possible, providing good conditions for life, work, learning and leisure.

The idea of the smart city is a response to such needs and concerns, together with the advent of new possibilities made possible by technological progress. A smart city provides high quality living, and grows in a sustainable way thanks to the use of modern technological solutions.

We can distinguish 6 areas which carry equal weight for a city to develop in a sustainable way and to become authentic 'smart hubs':



The roadmap for creating a smart city requires the implementation of multidimensional strategies encompassing all of the aforementioned domains. In reality, it is about using solutions from the Internet of Things (IoT), Big Data and artificial intelligence (AI) to make more accurate choices, resulting in a better quality of life for all – a decline in crime, a shortening of commute time, a lowering of CO<sub>2</sub> emissions, savings in the use of water and electricity, etc. New technologies allow us to share data in real time (e.g. the location of public transport vehicles), and to recognise specific behaviour patterns, which can then be turned into carefully tailored solutions, optimising the city's activities and generating savings in costs and time.

The key to all this is the interaction between the city authorities and their citizens. When creating a smart city, the active participation of citizens, companies and organisations is crucial as they are one and all co-creators of the city. According to the Smart City 3.0 concept, they are no longer merely passive consumers and recipients of services.

Three generations of smart cities, differing in the factors that drive development and determine courses of action:

**Smart Cities 1.0** are driven by technologies. Their creators encourage the authorities to implement technologies to improve the effectiveness of city management. Unfortunately, cities are often unable to fully utilise the potential offered and understand the true impact of technology on improving citizens' quality of life.

**Smart Cities 2.0** are supported by technology, but governed by city authorities who create numerous programmes and projects aimed at improving the citizens' quality of life. Modern technologies are used as a tool to solve particular problems in various domains of life.

**Smart Cities 3.0** are cities co-created by citizens. They are the newest generation of intelligent cities, where citizens play an important role in the decision making process e.g. via social participation and independent initiatives. Projects dedicated to society play a key role.

## WHAT IS A SMART CITY?

” A sustainable and intelligent city is an innovative place which uses information-communication technology (ICT) and other methods to improve the quality of life of the citizens, raise the effectiveness of management and providing services, and raise competitiveness while simultaneously focusing on the needs of the current and future generations, and respecting economic, social and environmental values’ ”

Source: International Telecommunication Union (ITU)

1

### SMART MOBILITY

This relates mostly to infrastructure and transport. It means creating intelligent, integrated, clean energy transport systems, which make commuting in the city or finding a free parking space easier. This, in turn, helps to decrease air pollution and save time. The area includes all mobile solutions which grant fast access to data.



2

### SMART ECONOMY

This is a highly-efficient and technologically-advanced economy which supports entrepreneurship, the labour market and tourism. Furthermore, it gives rise to innovative business models, while simultaneously encouraging and introducing local initiatives, supporting the creative sector, and actively educating and providing citizens with growth opportunities.

3

### SMART ENVIRONMENT

This means the sustainable use of natural resources, a more efficient consumption of electricity and water, and better waste management. It encompasses care for air quality and green spaces, with a striving to increase the scale of use of renewable energy sources, the limiting of CO<sub>2</sub> emissions, and a growth in sustainable development.



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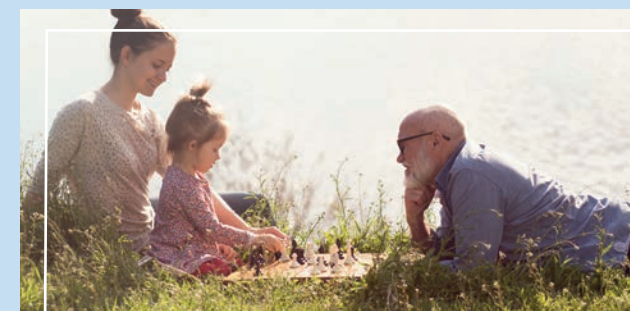
### SMART PEOPLE

This concerns providing the possibility for growth in a diverse, tolerant and creative society. What matters is offering a wide range of educational opportunities, initiating change, increasing social awareness, and promoting systematic quality raising, creativity, and the ability to collaborate.

5

### SMART LIVING

This means the implemented initiatives should focus on the needs of current and future generations by providing conditions for a safe and healthy life, rich cultural opportunities, affordable housing, entertainment, easy access to educational infrastructure, and effective communication and services.



6

### SMART GOVERNANCE

Here, the authority's role is to organise and integrate specific elements of the smart city. An intelligent city is a place where the actions of the town hall are fully transparent, public services are available to all and provided at a high level. Social participation and co-deciding by all citizens play a key role.

KEY SMART CITY AREAS



# WROCLAW TOWARDS A SMART CITY

The initiatives of the city authorities bringing Wrocław closer to becoming a smart and sustainably-developing city.

## INTELLIGENT TRANSPORT

### SMART TRIP

Started in 2016, the project analyses transport resources i.e. roads, car parking, rental cars, bikes, and trams. Its aim is to optimise the use of such resources. The advanced version of the tool includes the traveller's preferences used as a guideline for choosing the best means of transport and the optimum route, while helping to minimise travel costs and assist with payment. The 'Mobill' app is a result of the work of the project.

### THE 'MOBILL' APP

The app lets users plan their journey optimally by using public transport and easy payment methods. The app locates the user according to their GPS coordinates, and then shows the optimum route via public transport. The Mobill system operates thanks to Bluetooth transmitters and beacons, located on trams and buses. Mobill's services also include access to a guide giving information about events taking place in the city

Wrocław is the first city in Poland to install 1,000 beacons on public transport vehicles.

### VOZILLA - ELECTRIC CAR RENTAL FROM THE CITY

At the end of 2017, 190 cars were available for rent via the use of a smartphone and a registered account on a dedicated app. The service has additional benefits for its users. They can park the Vozilla vehicles free of charge in the city centre, and use bus lanes.

### ITS - INTELLIGENT TRANSPORT SYSTEM IN WROCLAW

The system utilises data from road management and measurement devices (e.g. cameras, detectors and bus stop information boards), and public transport; processing it and sharing with commuters in real time. Info points deliver real time information about the location of buses and trams to passengers. Based on the data, the system can adjust the traffic lights to optimise the flow of road traffic.

## UNDER DEVELOPMENT

### INTELLIGENT PARKING

This is a pilot project in the area of Zapolska St., which has been under development for over two years. It is aimed at choosing the best way of enabling the identification of free parking spaces, suggesting the best places to park, and sharing the information with drivers.

## ENVIRONMENT

### SMARTFLOW

A tool developed by the Municipal Water and Sewage Company and Microsoft, which enables the monitoring of the condition of the sewer system. Thanks to data collected from sensors located throughout the city, it is possible to accurately locate any system breakdowns. SmartFlow gathers historical data thanks to which problems can be solved even faster and with decreased damage to the network. In 2016, half a billion of litres of water was saved thanks to SmartFlow.

### THE WROCLAW ELECTRIC VEHICLE CHARGING SYSTEM

The project is aimed at promoting eco-friendly travel by electric car. The plan includes building an infrastructure for charging electric vehicles. The charging network created so far in Wrocław, consists of ten terminals.

### 'HEAT ISLAND' MEASUREMENT

The project has been underway since the start of 2018. By combining data from temperature and air humidity sensors, it is possible to identify which parts of Wrocław are experiencing excessive temperatures, along with the times at which the highs are experienced. Tackling 'heat islands' and improving the quality of life in such areas will be made possible thanks to initiatives such as tree planting and the provision of water curtains

## INFRASTRUCTURE

### CITY INTERNET

Providing access to free, wireless internet in the public areas of the city – tourist spots, where culture thrives and people meet. The city internet in Wrocław is available in more than 550 spots, and is one the largest networks in Poland.

### LoRaWan (WIRELESS COMMUNICATION SYSTEM)

The project, jointly run by by Thaumatec and Wrocław University of Technology has been ongoing since the middle of 2017. It is aimed at developing a low power radio network using LoRaWan technology, which will be helpful in introducing the Internet of Things (IoT) solutions. The network needs very little energy, is much safer than alternatives, has a greater reach, and is cheaper to build. According to the 'Polish Startups 2017' report, Wrocław has the highest number of companies working on IoT projects, offering a clear indication of why the LoRaWan network is constantly growing.

### INTELLIGENT LIGHTING

The Philips CityTouch system and LED technology are being used as part of the intelligent public areas remote lighting system, which has already been implemented in the Nowe Zerniki estate (WUWA2, Wohnung und Werkraum). As a result, less energy is consumed overall, and the brightness of the lighting is adjusted according to the time of day and amount of traffic.

## PEOPLE

### WROCLAW TALKS

A platform for wider social consultation, as well as the organising of citizens meetings and group workshops dedicated to solving particular problems. The discussion topics include, for example, public space planning and public transportation. The website provides free legal support and enables the filing of complaints.

### THE WROCLAW CITIZEN BUDGET

A participation budget shaped by all the city's citizens. The project focuses on the participation of the inhabitants of Wrocław in the debate about the city's important issues, as well as the choice of projects to address them. As a result the citizens can choose the direction in which the city will evolve.

### SENIORS CENTRE

A knowledge-sharing platform for pensioners, as well as companies and institutions which work for and on behalf of older citizens. The centre runs a variety of activation programs and projects such as the Seniors Days, The Senior Club Federation, A Place Friendly to Seniors, and the Senior Club Academy.



## EDUCATION

### EDU-MAN

A project started in 2007. It focuses on developing the city's telecommunication network, and building a fibre-optic network to connect buildings and facilities across the city. Such a network ensures the requisite level of data transmission. The MAN Wrocław network now includes education centres, which has led to the creation of an educational sub-network, EDU-MAN. It connects over 250 education centres in one cohesive data transmission system. Joining the project gives benefits such as lower phone call costs. Additionally, the IT Services Centre has bought new printers and computers from the centres. The project plans to link kindergartens to the network in the near future.

## LIFESTYLE

### WROCLAW HOUSING COOPERATIVES

Initiatives undertaken by inhabitants who assume the role of developers and create a living place tailor-made for their needs. Individuals can opt to purchase land together in order to build a housing estate. Future inhabitants can independently decide how the site will be developed, divided up and financed. In the Nowe Żerniki area, three cooperatives have already completed their buildings.

### OPEN PAYMENT

A system using pay pass technology for the public transport system. New ticket validators have been installed on the trams and buses of Wrocław, thanks to which it is possible to pay for travel with a Bancard, Urbancard EP, or smartphone. After paying for the ride, the passenger does not receive a paper ticket; the validator instead converts the number of the card used into a token located in the central system.

### URBANCARD PREMIUM

A city card for the citizens of Wrocław (adults and children), thanks to which they can pay for, for example, public transport tickets. The card holders also have access to a number of additional benefits such as discounts in Partner Points which offer cheaper theatre or zoo tickets, discounts in shopping malls, the option to pay for parking, or lending a book from the public library. The program, as another of its aims, encourages citizens to pay their income tax in Wrocław.

## ECONOMY

### STARTUPS

Wrocław is second only to Warsaw in terms of start-up activity. The city places even greater focus than the capital on supporting such entities. The start-up database, by default, is intended to include all start-up data created in or active in Wrocław. The project will also showcase start-up creators and organize business events. Young entrepreneurs will be offered mentoring and special development projects in the near future.

### OPEN DATA

Open data is information or data collection available to everyone free of charge. Such data can be shared and used without any restrictions, for both non-commercial and commercial purposes. It is gathered and made public in order to stimulate entrepreneurship, increase engagement in the city's development and plans, and to serve as evidence of the transparency of the city hall's activities. Open data is divided into categories, such as transport, sport and leisure, education, and spatial data.

### CITYLAB

An initiative that offers entrepreneurs, start-ups, and researchers the possibility to test their projects and tools on the living urban tissue, in order to positively influence the functioning of the city. The priority is to gain knowledge and research innovative technologies which can enhance the environment and health of Wrocław's citizens.

## GOVERNANCE

### MOBILE CITIZEN ASSISTANT (MAM)

An app for citizens actively participating in the life of the city. Available since September 2016. Citizens can use the app to directly contact specific services when they become aware that the city's infrastructure is not functioning correctly, or to report a breakdown or the need for intervention of some kind.

### WROCLAW SPACE INFORMATION SYSTEM

The system is aimed at acquiring, processing and presenting spatial data, along with accompanying descriptions of the city's properties. The system is updated in real time, and serves as a foundation for running and managing the city, as well as being a source of knowledge about the cityscape.

### ePUAP

The Electronic Public Administration Services Platform (EPASP, or ePUAP in Polish) is a tool providing access to public administration services for Wrocław's inhabitants, entrepreneurs and institutions. By using the platform, it is possible to remotely file complaints, submit suggestions and ideas to public offices, and register changes of address.

### PLIP

The Wrocław Information and Payment Platform is a tool which uses the citizen's EPASP profile to check, calculate and regulate tax payments and additional legal payments via the internet. It includes such things as property and land taxes, as well as rental payments due to the Municipality of Wrocław.

## UNDER DEVELOPMENT

### E-APPLICATION - ORDERING LICENCE PLATES

The service eliminates the need to visit the municipal office to order and collect car licence plates. Residents of neighbouring municipalities can save the long waiting time for the processing of their application by making use of the appropriate service offered by the Wrocław Municipal Office.

### INTELLIGENT CITIZEN INFORMATION MANAGEMENT

The project is aimed at collecting data based on satisfaction surveys which are available to the citizens of Wrocław and tourists visiting the city. The survey aims to measure the level of satisfaction with life and the city infrastructure in Wrocław, in line with the Evidence Based Management philosophy ('management of the human experience').

## AWARDS

**Green & Smart City Awards (2018)** – a prize awarded during the Smart City Expo summit in China in the Top Level Design category for mobile apps. It involved 15 projects using AI solutions in urban space, and serving to improve the quality of citizens' lives, as well as 2 ecological projects. The prize was awarded to Wrocław for the third time.

**City of the year, with more than 500,000 (2018)** – a prize awarded during the Smart City Forum for innovative solutions in electro mobility: 'Vozilla' Urban Electric Car Rentals, and cashless city 'smart payments'

**IPMA (2017 & 2016)** – a prize awarded to the Project Management Office, for the best run social project in Poland in the Polish Project Excellence Award competition, organized by the International Project Management Association Poland.

**Public incentives in transport (2016)** – a prize awarded during the Euro-China Smart Mobility Conference 2016 in Shenzhen for modern innovations in transport which encourage citizens to choose public transport.

**City of the year, with more than 500,000 inhabitants (2016)** – a statuette awarded at the Smart City Forum for the vision of building Wrocław as a smart city founded on strategy, citizens and communication, quality of life, growth and creativity visible in, for example, the use of open data and the promotion of the start-up environment.

**CINEV Smart Mobility in Smart City (2015)** – a prize awarded in Hong Kong for the integration of the public transport network.



# SMART CITY WROCLAW – THE CITY OF START-UPS

An smart Wrocław is a Wrocław based on technology. It is even better if the technology is created and developed in the city. The technology should influence the lives of citizens while, simultaneously, having a much broader reach to be able to impact far beyond the administrative boundaries of the city. A true smart city does not float in a vacuum, but serves as an important hub for the international exchange of technological thought, knowledge and capital.

To actively participate in this exchange, Wrocław has been pursuing a consistently pro-investment policy for many years. It is focused on attracting companies (both Polish and foreign) who are developing interesting technological projects, and supporting the growth of entities already present in the city. The local government is especially interested in research and development projects which bring significant added value to the economy.

Additionally, the sector of young, local, creative, technological companies with large growth potential receives strong support. Today, we would call such entities start-ups.

By supporting start-ups, Wrocław assumes 4 roles:

- as the creator of a modern research infrastructure** (Wrocław Technology Park, or the Polish Centre for Technological Research – the former Wrocław EIT Plus Research Centre);
- as a client/recipient of innovations created by local start-ups** (i.e. the Explain Everything education app for Wrocław's schools);
- as a partner in the start-up accelerator program** (MIT Enterprise Forum Poland);
- as an initiator of projects aimed at integrating the start-up society more widely** (the work of the Startup Wrocław team).

The Startup Wrocław team acts as part of the Agency for the Development of the Wrocław Agglomeration (ARAW). Its task is to provide comprehensive support for local start-ups, consisting of four elements:

- Networking** – integrating the start-up ecosystem into Wrocław;
- Events** – organization of technology and start-up events;
- Start-up base** – the information portal <https://www.wroclaw.pl/startup/> and the unique knowledgebase of the Wrocław start-ups it contains;
- Promotion and Support** – support in relations with major investors, media and business institutions.

Without doubt, Wrocław is amongst the most dynamically growing start-up centres not only in Poland, but also in Central and Eastern Europe. Evidence of this can be found in the city's lofty, second place in the report 'Start-ups in Poland', prepared by the Startup Poland Foundation. Wrocław is the hometown of the XTPL start-up, which was awarded the Economic Prize of the President of Poland in the 2017 start-up category. Wrocław is the city in which five innovators under the age of 35 were chosen by the prestigious MIT Technology Review for their work. It is also the place where the three fastest growing companies in CEE, according to Deloitte, have their headquarters (Tooploox, Droids On Roids, Monterail).

The Wrocław based Piwik PRO was chosen as one of the most promising European start-ups within the project 'Startup Europe Comes to Silicon Valley', organised in conjunction with the European Parliament, the European Commission, the international organization Mind the Bridge, and the EIT Digital accelerator.

The potential of Wrocław's young tech companies has caught the attention of

international brands such as Nokia and Skanska. In 2018, these companies decided to invest in the city's start-ups. With this in mind, Nokia opened the 'Nokia Garage' innovation centre, while Skanska teamed up with Business Link to launch a space called 'Business Link Green2Day'. If we add to this all of the pre-existing and new initiatives created by representatives of the local environment, we can see that Wrocław is experiencing a high tide of growth options for start-ups. The number of venture capitalists wanting to support start-ups in the city is growing. Wrocław is also receiving interest from foreign investors. Representative of Angels Den, a UK-based international online investment platform, are active here as well.

Actions undertaken by local representatives of the Startup Poland Foundation, PLUGin POLISH INNOVATION DIASPORA, and the Startup Founders association are vital for the start-up sector. The growth of entrepreneurship is further supported by the Wrocław new technology cluster, ITCorner, the globally-recognized Wrocław brand, LiveChat, along with other dynamic start-ups such as Tooploox, Droids On Roids, and Brand24, as well as many more individuals, companies, institutions and informal groups. What's particularly interesting is that many local start-ups reinforce the new technologies and social changes which shape the smart city with their products and services. Among their ranks can be found; Blebox (IoT), byteLake (AI), Zrzutka.pl (crowdfunding), Data Walk (big data), FlashRobotics (social robotics), Saule Technologies (new energy sources), 3YOURMIND (3D printing), Erly (sharing economy), the League of Extraordinary Minds (gamification), or RezerwujSport (digital platforms). A feedback loop can be clearly observed in Wrocław linking the Smart City and the smart companies which operate in it. As a smart city, Wrocław wants to attract talent upon which its future growth and accomplishments can be based.



<b>+15</b>	CO-WORKING SPACES
<b>+10</b>	INCUBATORS
<b>+10</b>	SUPPORT ORGANIZATIONS
<b>+499</b>	TECHNOLOGY EVENTS
<b>+200</b>	START-UPS
<b>+25</b>	UNIVERSITIES
<b>+15</b>	INVESTMENT FUNDS

**THE START-UP  
ECOSYSTEM  
IN WROCLAW**



# SMART WROCLAW - AN INNOVATIVE CLOSED CIRCULATION PROCESS

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The intelligence of a metropolis is a smart closed circulation process in which new technologies are implemented, big amounts of various data types and information on the functioning of the city are collected and analyzed, conclusions are drawn from the completed analyses, decisions are made and actions implemented to manage, steer and optimize processes taking place in the city. The aim of this process is to improve the quality of life as well as the safety and cost optimization in all aspects of the city's functioning.

Nowadays, everything has to be smart, or to be more precise: wise, intelligent and clever. The smartphones we carry in our pockets, the smart cars we ride, the smart buildings we live in, and the smart city we would like to dwell in. In reality, almost every aspect of the environment and human life is measured and monitored. It's done on the one hand to protect, and on the other to make our functioning in the urbanized and mechanized world easier.

Building a smart city has an evolutionary nature and is a long-term process which often requires large financial means for researching new technologies and implementing them. The Internet of Things (IoT), Big Data (BD), Artificial Intelligence (AI) or Robotics Processed Automation (RPA) are the main four directions of the technological revolution of today which impact the foundations of modern cities: environment, transport, infrastructure, management, education,

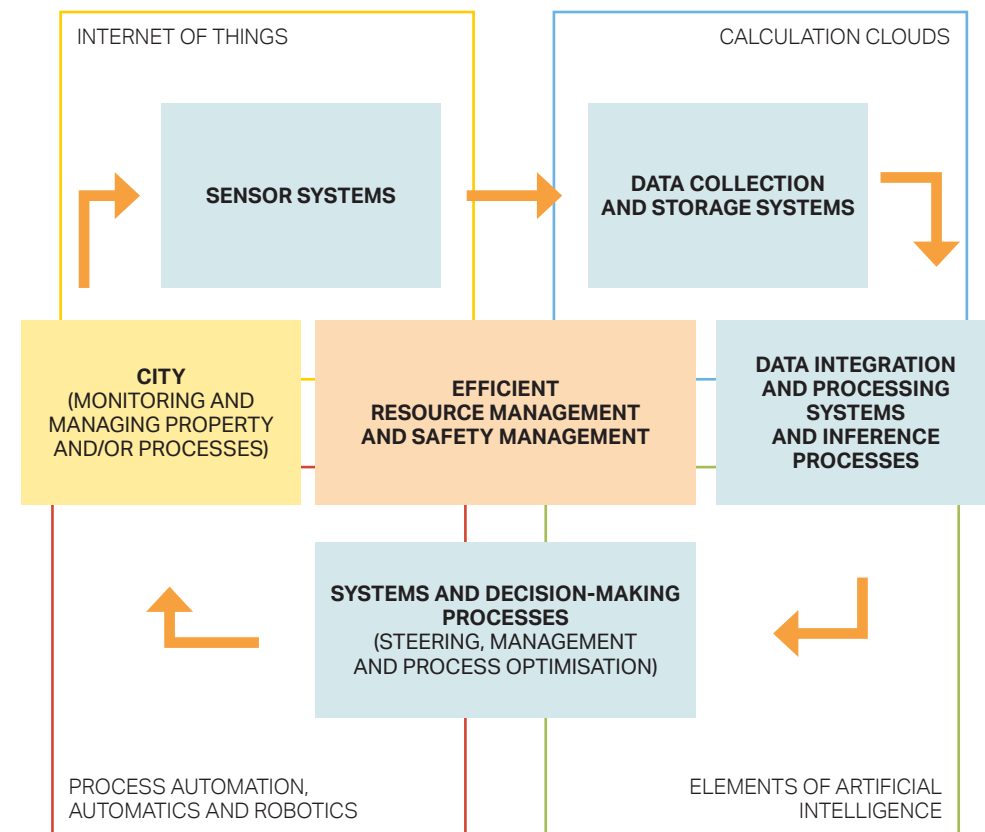
lifestyle and economy. In 2017, according to the IESE Cities in Motion Index, Wrocław was one of the two Polish cities listed in the first one hundred of the smartest cities in the world. This was a result of the pro-innovative approach of the town hall, as well as actions of numerous companies, institutions, universities and research & science centers operating in the city, interested in education and implementing innovative technologies in the abovementioned directions.

In order to speak that devices, machines or even cities are smart, they must first learn something. They learn through data collected with beacons and sensors installed in especially dedicated measurement systems or available via the Internet of Things. Modern sensors built with MEMS (MicroElectroMechanical System) technology are key in this area. They are based on micro electromechanical devices. Thanks to miniaturization, sensors can be installed virtually everywhere today.

The growing number of available sensors and recorded data requires high-speed transmission networks and capacious ICT systems. A new generation of electric installations build in the KONNEX/KNX standard proves helpful here as it enables common communication between all electricity receivers in a building, as well as high-speed fiber networks which use DWDM and 100 Gb Ethernet technologies, ZigBee, WiFi & LTE radio systems, or the currently developed 5G

network which will offer a data transferring speed from 10 up to 100 Gbps. In comparison, the currently developed LTE technology allows Internet access with a bit rate of 300 Mbps. Big data storage and collection already has existing solutions based on big mass memory matrix systems (also available in the cloud computing). The future, however, belongs to the SDS (Software Defined Storage) technology. It is based on separating software of mass memory services from the hardware on which it is installed.

In the integration, processing and analysis of large data collections, or simply Big Data, and Artificial Intelligence the main role is played by fast and efficient server systems and calculation algorithms based on them, which enable prediction – a rational and scientific forecast of future events based on time and cross-section data. Such processes require new processing technologies (i.e. Hadoop, HBase or MongoDB) and algorithms stimulating rules that govern human actions and are able to use them in the proper way. An example of such solutions are programs for recognition of text, image, sound, scanned 3D objects, anomalies and trends in registered time characteristics, and machine learning programs. Big Data services are provided in specialized data processing centers. Such locations in Wrocław include i.e. the WCSS - Wrocław Centre for Networking and Supercomputing (WASK network operator) or the Information Services Center in Wrocław (MAN Wrocław operator).



Smart city as an innovative closed-circuit process

Data received directly from sensor systems as well as information and conclusions obtained from systems analyzing source data serve as the basis for decision making in city management and steering processes. More often, human management and steering in specialized management centers is replaced by AI elements in form of automated processes executed remotely by computer applications. They automatically oversee executive elements such as actuators, motors, levers, amplifiers, signaling devices, information boards, or complete robots.

Buildings are one of main elements which form a city. It is where we spend the majority of our lives in the city, both at work and outside of it. That is why they should create a friendly environment for effective work and leisure, and enable optimal space and resources management at minimal costs. Smart buildings and settlements are key to building smart cities. Integrating all tele-technical systems, shared cabling of signal transmitters controlling the majority of installations, and central management and monitoring systems enable effective space management and optimizing its efficiency. An example of the development of smart settlements of the

future in Wrocław may be the model settlement of **Nowe Żerniki** – located in the western part of the city and already under construction. It was inspired by the avant-garde project of the WuWA settlement from the beginning of the 20th century. The architecture, urban planning, and technological solutions fulfill the highest standards and have to answer to the real needs of the dwellers.

Wrocław has become one the trailblazers in implementing the concept of smart cities in Poland, thanks to conducting a row of research, educational and project actions in the area of solutions dedicated to constructing SmartCity. The scientific, research and educational potential of Wrocław is reflected i.a. by respected polish universities such as the Wrocław University of Science and Technology, the Wrocław University of Economics, the University of Wrocław, the Wrocław Medical University, or the Wrocław University of Environmental and Life Sciences, which serve as the forge of management teams and a source of ideas and development of innovative technologies for SmartCity solutions.



## WUWA2

or the **Nowe Żerniki** model estate is located in the western part of Wrocław. The name WUWA2 refers to the 1929 WUWA2 exhibition (in German 'Wohnungs- und Werkraumausstellung', or an exhibition of housing and the workplace) when the German Werkbund organization presented its idea of a model estate. It was an experimental program which led to the creation of modern, functional and cheap apartments.

The project's foundations served as the starting point for a joint initiative between the City of Wrocław, The Lower Silesian District Architects' Chamber of the Republic of Poland, and the Wrocław Association of the Architects of the Republic of Poland. They created the model estate of Nowe Żerniki, using Wrocław's most talented architects as project designers. The project was intended to adhere to sustainable construction norms, be resident-friendly, and support the idea of community building. As a result, Nowe Żerniki

became an estate consisting of detached and semi-detached family homes, football pitches, playgrounds, kindergartens, service and retail spots, numerous green areas including green rooftops on some buildings. Additionally, the Nowe Żerniki estate has implemented many modern innovations, such as intelligent and energy-efficient lighting which adapts itself to the time of day and weather, photovoltaic solar panels which generate electricity, and open basins where rain and waste water is gathered for re-use.



What would a smart city be without smart properties?

Can a city be smart without smart apartment buildings and commercial properties?

Why do buildings have to be smart?



The ‘smart’ concept has become increasingly important in recent years. Everything around us is smart. We use smartphones and smartwatches, and our cars are intelligent. The time has arrived for us to live in smart cities, the likes of which would not be possible without smart buildings for us to live and work in. As we spend the majority of our time indoors, our buildings have to adapt to our smart needs and create an environment consistent with that of the smart city.

A smart building is often seen from the perspective of advanced technologies. However, this is only one aspect; perhaps of greater importance is for the building to be a combination of intelligent space and the kind of functional design that allows its users to feel comfortable in it. Of course, technologies are there to support the creators of smart concepts in their aims, but integrated systems of an interdisciplinary character, encompassing the IoT, rainwater re-cycling systems, and

energy-efficient LED lighting, have become the standard in office properties. With time, new, more technologically-advanced systems will be developed. It is likely they will become widely used to support the organisation of our everyday work via smartphone apps – they will adjust the lighting, temperature, humidity, and book a conference room for a meeting or a parking space for a client.

Technologies aid architects and developers in creating ecological properties with green certifications. Office projects are sustainable buildings when they maintain a level of cost-effectiveness, comfort and eco-friendly design. Ecology is one of the pillars of a smart office building. The use of local and recycled construction materials, and implemented systems ensure the awarding of a better grade during the multi-criteria certification process. This takes into account such areas as; energy efficiency, effective water management, indoor environment quality, waste reduction, levels of recycling, construction materials, along with connecting transport and overall location.

A smart office is flexible. It enables work in any corner or place, and the furnishings, equipment and surroundings invite people to spend time there. The notion of biophilia is now made use of in office design. It is the natural need for one organism to be near another. Biophilic design, increasingly used by architects, focuses on the incorporation of as much greenery as

possible in the property and its surroundings. Green walls are a feature of common reception areas and conference rooms, as well as spaces leased by particular tenants. Properties which have a large outdoor area can create an attractive garden where people can walk, relax, and enjoy lunch. Real, living forms of nature are used in offices, such as trees, natural light, water, and the seasons, as well as natural materials, textures, colours and shapes which stem from nature. They are designed to bring us closer to nature and create a place which reduces stress, and increases productivity and creativity. Of no lesser importance, perhaps, is the promotion of well-being, and an attendant decrease in absenteeism.

An office building cannot be an island in the city. The concept of a smart property connects buildings with the urban tissue in a way that allows all citizens to explore their potential, rather than only people working in the selected office building. As a result, places are created to serve as event spaces open to all interested people, often outside of business hours. Summer cinemas, exhibitions, and fan zones are organised in common spaces in buildings, as well as in specially designed spaces outdoors.

**What will the intelligent property of the future be like?**

There is a tendency for technologies and new legal regulations to steer us towards zero-energy properties: buildings with a zero net energy consumption and zero CO<sub>2</sub> emissions. The outcome will be the creation of the best possible workplace conditions, worthy of the WELL certificates which will become the market standard.

According to data from the World Business Council for Sustainable Development, cities currently generate some 80% of the total global demand for electricity, and emit some 70% of greenhouse gases. In a similar vein, the main recipients of electricity and producers of greenhouse gases in cities are buildings. Thus, cities have to strive for more energy-efficient and environmentally-friendly properties as this is key in improving the health and life quality of their citizens.



- an office complex currently in the planning phase, which will be located on Fabryczna St. in Wrocław. The complex will offer more than 50,000 sq m of space. Thanks to the proximity of the Wrocław Technology Park and the Wrocław Industrial Park, tenants will have easy access to experts in new technology, IT and production. The investment will be fully integrated into the urban tissue and will adhere to the norms of sustainable construction. A green patio will be created in front of the building. Additionally, the former railway will serve as a promenade. By using advanced technology, lower energy consumption and more effective waste management will be possible. This will lead to the minimising of air-conditioning and heating costs. Pin Park will be developed in collaboration with local

experts. The project will be co-designed by the AP Szczepaniak Studio and the Biology University of Wrocław. At the same time, Pin Park supports local initiatives: it has, for example, sponsored the projects of students of the Wrocław University of Technology. Thanks to the reconstruction of Strzegomska St. and Fabryczna St., the construction of the tram line to Nowy Dwór, and the renovation of the Wrocław Muchobór railway station, the complex will be easily accessible by public transportation. It is worth mentioning that Pin Park will be included in the decision-making process for re-organising local infrastructure. Additionally, two bike lanes and car parks (useable by, for example, Vozilla vehicles) will be constructed near the complex.



City Forum is an office complex with a total area of more than 24,000 sq m, located in the centre of Wrocław on Wróblewskiego Square. The convenient location, with almost 500 daily bus and tram connections, and infrastructure for cyclists with lockers and showers at the end of it, enables a comfortable journey to work both by bike and public transport. The idea of the project is to build new spaces open to citizens, and integrated with the urban tissue. During the completion of the complex, a vast leisure and recreation area was designed in the form of an urban garden and indoor green patio. The service and retail part of the office property was designed by the developer to be a multi-functional event centre with a wide range of food and drink services on offer to Wrocław's citizens. City

Forum meets LEED requirements at the GOLD level which is clear evidence of its high energy efficiency – energy consumption is 53% lower than in reference buildings, while water consumption is 40% lower. The innovations implemented help minimize the amount of waste produced, and the use of low-emission materials and the creation of multiple green areas in the complex, contribute to the high quality of the indoor climate. Innovatively, the developer is preparing a healthy lifestyle program for future tenants' employees. On the one hand, it will allow a better understanding of the technology implemented in the building; on the other, it will encourage office users to keep active and look after the natural environment.





# SMART OFFICE

In smart cities, developing intelligent and sustainable construction practices and materials is just as important as investments in the public sector and infrastructure, and systems which improve the quality of citizens' lives. The perfect urban landscape with smart houses and offices which provide friendly workplaces in office buildings that adjust to the employees' needs, is still to come. Nevertheless, modern office buildings already have access to advanced innovations in building automation and the Internet of Things, which allow flexible responses to cater to employee needs. Solutions already exist to improve the comfort of office users, while simultaneously raising the energy efficiency of the building and lowering its negative impact on the natural environment.

Changes in office space are becoming more visible. Intelligent offices are synonymous with new technologies and innovations, ecological solutions, and sustainable development. First and foremost, we have offices which suit the needs of the employees in them. The key to creating such a space is to identify the needs of the team, followed by appropriately arranging and personalising the workplace. Only with the knowledge of how the teams work and what they need to act effectively, are we able to introduce effective changes. Apart from expert analyses which point out how to optimally arrange a space and make the most of its potential, social participation is becoming increasingly significant.

The trend, which can already be observed at local community level as well as citywide, is now entering the office environment. Social participation in the workplace or the office building means sharing responsibility for the office space with the users, treating it as a common good, and consulting changes to be made to and events to be held in the space with the users. A result of such social consultations, coupled with expert analyses, are made-to-measure space arrangements. They are characterized by mobility, multi-functionality and flexibility. The solutions they offer enable the carrying out of various types of task in a single place. The nature of work has changed. According to research, individual workplaces are now used for only 43% of working time.

As a result, a growing number of entities are striving to organise optimised office spaces. More conference rooms, silent work zones, acoustic cabins, networking zones, phone booths and other zones matching employees' needs are being introduced to offices. This kind of space arrangement is designed to enhance effectiveness and the well-being of employees in the office. Such enhancements are further improved by the use of appropriate technologies – from messengers and electronic document flow, through reservation and office resource management systems, to artificial intelligence which collects data from various platforms and forecasts business needs.

It seems certain that in the future, properties and office spaces designed according to the WELL certification standard will have a major impact on shaping the modern work environment. Certification systems focused on human comfort and workplace quality are based on the assumption that we spend the majority of our time in buildings which significantly influence our well-being. The competition to attract the best employees is leading many organisations to take a step further in trying to create optimum workplace conditions. This means arranging the office in a way beneficial for the health and well-being of employees.

Following the 'smart' and 'well-being' trends, employers are already changing their office spaces. They are creating technologically advanced, pro-health and user-friendly spaces. The office space more and more features ergonomic work places with dedicated relaxation zones and other innovations

to satisfy employees' needs. All of this is designed to benefit health, boost productivity, and improve efficiency and effectiveness in the workplace.

It is worth mentioning that the transformation of cities into intelligent hubs working for the benefit of all social groups is a long term process. That said, employees can already create and shape intelligent workplaces – in

flexible offices which take into account the employees' preferences, improve their health and care for the environment. In this way each one of them contributes to the wider idea of the smart city.

## NEW TECHNOLOGIES IN THE SMART OFFICE

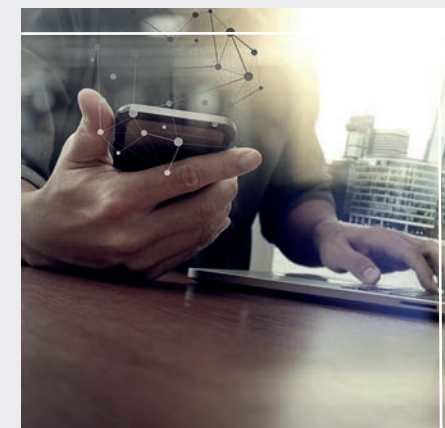
Office sector IT technologies offer a variety of collaboration options, along with communication and data exchange possibilities. They can also change the way we perceive the workplace. Modern offices implement numerous IT solutions to improve the comfort of the users, whilst simultaneously lowering the operating costs of the office space. Examples of this are presented below. It is to be expected that a major growth in

the use of big data (analyses of major data collections) will take place soon. This will enable the analysis of user behaviour and the ways in which offices are used. Thanks to big data analysis, buildings can better adapt to the users' preferences. This, in turn, provides a higher level of comfort for work in the office, helps reduce water and electricity consumption, and optimises operating costs for the office space.



### SOCIOMETRIC BADGES

Previous office space arrangement decisions were often based on employee surveys or the ideas and whims of managers. Today, organisations have access to, for example, employee observation results, call data records, system access data logs, and room reservation information. Such information allows the designing of space adapted to the real expectations of the employee. Some companies use sociometric badges, which measure the way employees interact with each other and at what level they interact, using behavioural data and artificial intelligence. Such systems record the tone of voice and how active a user remains in a conversation. In this way, to facilitate better cooperation, it can be established which departments should be located next to each other.



### SMART SPACE

Companies which allow the management of offices via mobile apps are becoming more popular and more visible on the labour market. Such systems offer a functionality which effectively integrates the office space with the true needs of the employee. The apps offer a wide range of services, such as: real time conference room booking (sensors record lack of movement in rooms, which then register in the system as available); enabling employees to enter the office badge-free (sensors identify data and open doors). Additionally, such systems will allow building users to report, via the app, issues within the building, and the property management will be automatically notified.



### BEACONS, SENSORS

Certain technologies allow the understanding of how employees use their space. Thanks to such devices large amounts of data can be gathered to measure things such as, individual or group time of work, checking frequency of inter-team communication, calculation of optimum ambient temperature as chosen by the users of the space. Such information helps create a working environment in which the employees don't need to adjust themselves to the space, because the space adjusts itself to them.

New, innovative technological solutions are under constant development for use in office buildings. The question of just how intelligent offices will become in the future as yet remains unanswered. That said, smart cities are already characterised by ecosystems which promote the development of such technologies and innovations. In Wrocław, such a role is played by **Nokia Garage**.

The innovation centre created in Wrocław combines the technology-centric Nokia with start-ups, innovators, researchers and future business partners. The space brings together innovation-minded people, who are willing and able to share their knowledge and experience, in a place where they can receive support in new technologies and project development. The creators of Nokia Garage focus on concepts such as, the Internet of Things (IoT), virtual and augmented reality, and artificial intelligence.





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