Smart cities and future mobility

Answering new challenges of the modern technologies and requirements of the present-day economy and taking into account directions of the Poland and Silesian Region development, the main goal of the Silesian University of Technology (SUT) is the increase of the commercialization of the R&D activity in the field of civil engineering, modern architecture and urban planning, especially concerning issues of intelligent transport within the future cities, supported by information and transportation technologies.

Computer aided processes and numerical analysis constitute important specialization of the Silesian University of Technology within Priority Research Field No. 4 (P0B4). Self-developed IT tools, including artificial intelligence tools, are used for computer aided design and optimization of the urban transportation systems, civil engineering and data analysis for the diagnostic and expert processes in civil engineering and transport, including air transportation.

Silesian University of Technology is a precursor in the Building Information Modelling (BIM) applications in transportation, industrial and civil engineering as well as parametric design tools applications in modern architecture and urban planning.

On the basis of the marketing research, there was established, a unique in Poland, Silesian R&D Centre for the Sustainable Engineering (CESS). As a result of the cooperation with industrial partners and both Polish and foreign R&D organizations, there was enabled complex research of the innovative and intelligent building materials as well as materials recovered from the recycling processes, assessment of the conditions of the existing buildings and advanced numerical analysis.

As far as civil engineering is concerned, specialization of the Silesian University of Technology covers wide scope research of the modern materials (e.g. construction glass) and functionalized materials (e.g. carbon based materials - coordinated by SUT European project INSYSM or nanocarbon based materials – European patent application with Strasbourg University), applied for monitoring, enforcing and protection of the civil structures, as well as diagnostic instruments (e.g. autonomics inspection drones with BIM environment recording – 3 Polish patent applications and 1 European patent application) applied for the city and transportation infrastructure. These solutions enable extension of the constructions lifetime and reliability, reducing its environmental footprint. They enable also collection of the important data online from the city constructions and their acquisition to the BIM environment which can feed the city safety and management systems.

Important specialization in that research field is elaboration of the new construction materials based on industrial wastes, including power station and coal mine wastes (e.g. European project H2020 RISE REMINE) and others, e.g. based on carbon fibre laminates, car tyres and others. Important part of these research covers ecologic,
cementless concrete - functionalized geopolymer. Silesian University of Technology operates also a unique certified laboratory for the monitoring of the physic-mechanical properties of the natural and urbanized environments, including database containing information about examined objects that can be used for the safe management of the road and railway infrastructure and assessment of the acoustic hazard.

Silesian University of Technology is also the leader in the regional electromobility development, which shall constitute one of the essential elements of the future integrated intelligent city transportation system (ITS), that will enable high quality services and will be compliant with the sustainable development concept. Observing this, the research of the new fuels and drive systems, innovative forms of mobility (carsharing, bikesharing), and concepts of their applications, seem to be indispensible. Reduction of the pollution emission (especially CO₂) at the cities of the Silesia agglomeration seems to be one of the most essential aspects of these research. Research challenges cover also so called “vision zero”, i.e. introducing the form of mobility, that will enable reduction of the death accidents to the minimum (realization of the 4 H2020 projects). Increase of the transportation safety depends also on the new air traffic navigation systems and railway control. Also the research of the increase of the capacity of railway tracks and safety in railway and air traffic, seem to be indispensible for optimization of the multimodal transportation operators in the logistic chains. Planned research should increase efficiency of the transport in future cities. Silesian University of Technology in a member of the Silesian Aviation Cluster and actively cooperates with the aviation business and industrial environment partners. SUT cooperates with the biggest international manufacturers of the aircraft engines (establishing of the ACL Group - Aviation Coatings Laboratory), that resulted in granting European patent No. EP 2 366 729 – „AGB case with improved fireproof resistance by using protective coatings”.

Undoubtedly, the market advantage of the SUT in the field of the intelligent cities and future mobility, results from the advanced research of the structures of integrated optics, because acquisition and transmission of the information is the basis the development in that field. Financing of the research projects in that field was granted by the Polish Ministry of Defense and National Science Centre (NCN). Within the nearest 3 years, the research projects covering integrated optics development for sensor applications will be carried out by the HYPHa consortium and financed by the Foundation for Polish Science. Conditions of the research activities at SUT, in the field of the sensor technologies will be significantly improved in the nearest future, due to the development of the research equipment as the result of the project “Creation of the highly specialized spectrometric laboratory for chemical and physical sensorics”, within the consortium NLOPT – National Laboratory for Photonics and Quantum Technologies. Research teams from the SUT Institute of Electronics and Optoelectronics Dept. were granted the Centre of Excellence certificate. The most outstanding achievement of the former research in optoelectronics was the technology of the waveguide layers manufacturing according to the zol-zel and dip-coating method. The results of the sensorics research were widely published in the scientific journals. Many of them were published commonly with the foreign universities from Europe, Asia, North America and Africa.
Within the described research field “Modern transport, future mobility”, Silesian University of Technology deals with the modern design and manufacturing technologies, obeying the rules of the sustainable development and citizens care, with the special regard for the seniors (Lab 60+) and builds concept of the innovative future based on the resources of the heritage of the local culture and openness for the globalized world, having in mind the own tradition and identity. This is a huge field of multidiscipline cooperation of scientists representing various scientific disciplines. That is why the development of the research, answering nowadays challenges, covering: new functions of the buildings and urban areas, new technologies and materials, new user needs and new design approach with the participation of the local communities (social participation) and with the regard for the extremely essential processes of the population getting old as well as climate changes, must be undertaken. In the coming perspective, on the basis of the research carried on and cooperation with the partners, Silesian University of Technology shall become the most important link between the science and the social and industrial environment in the Silesia region, in Poland and in the international area.