UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
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MEDIA RELEASE

Future-fit African cities: UP designs digital twin city to improve metro management

PRETORIA – To manage the expansion of cities and megacities in this era of technological disruption, rapid urbanisation and climate change, remarkable new ideas and approaches to city management are being implemented worldwide, notably the 'smart city' and the 'digital twin city'.

The University of Pretoria (UP) is at the forefront of this new wave through the creation of the Hatfield Digital Twin City, a novel initiative that aims to boost service delivery with the help of smart technology.

"In making cities smarter and future fit, we need instruments to help our cities become more efficient – one such instrument is a digital twin: a smart 3D or digital mirror of the city," says postdoctoral research associate Dr Calayde Davey of UP's Department of Architecture in the Faculty of Engineering, Built Environment and Information Technology.

"We are focusing on African digital twin cities. In October 2020, we started with the Hatfield Digital Twin City (HDTC) – a 10km^2 urban area surrounding UP's main campus," Dr Davey explains. "The goal of the digital twin city is to provide real-time virtual models of the urban fabric (streets, buildings, infrastructure, etc.) along with real-time resource flows of the physical workings of the city based on monitoring, mapping and tracking information from digital sensors and communication technologies. These are used to improve the services, environments, infrastructure, performance, industry, social and health objectives of cities."

Professor Chrisna du Plessis, Chair of the School of the Built Environment and Head of the Department of Architecture, offers the example of electricity management in the vision for future cities. "In the HDTC, we aim to have a detailed smart grid of the entire precinct's electricity consumption. There are office buildings where electricity is used predominantly during the day, and you have buildings such as blocks of flats where the highest electricity use is at night. This empowers the municipality to shift electricity capacity to where and when it is needed most, and therefore to optimally manage energy consumption."

In the same vein, the digital twin city can be used to track and manage food supply flow, traffic flow, water quality and quantity, air quality, public health, disease detection, crime, biodiversity conservation, homelessness, urban development, how well buildings are performing in terms of energy and water use, but also in terms of profit, business and industry optimisation – all the components of a city.

There are several examples of single-service digital twinning in the world, such as Google Maps for traffic flow, but this is about bringing together the multiplicity of city workings and services for comprehensive twinning.

"With the HDTC, we are piloting alternative methods in data generation and low-cost technologies to leapfrog ourselves into what the future of cities, education and innovation in Africa could become," Dr Davey explains.

From a university perspective, it's the ultimate transdisciplinary initiative, as it requires all disciplines working together to create the digital matrix and offering many opportunities for skills development and education innovation. "We welcome all students and stakeholders, including the public and private sectors, to participate in the project and increase their digital, IT and machine-learning skills," Dr Davey says.

She adds that a significant spin-off of the digital twin city is its potential to create a variety of employment opportunities and develop digital and non-digital skills, as a lot of physical data capturing is necessary in terms of conversations and interviews with all communities to ensure that it is a community engaged process. A wide range of subjects need to be investigated, such as the closest fresh food purchase points, to crime patterns and water and transport availability. People who are employed to do the physical data gathering would simply use their smartphones to record answers to specific questions and send the information to the digital twin city information hub.

Dr Davey says the digital twin city initiative is being developed globally and this is South Africa's opportunity to be a continental leader. "Singapore is one of the digital twin city leaders globally, but it has more of a top-down approach, whereas we want a bottom-up approach, with all stakeholders plugging into and contributing to the initiative. One of the stakeholders in Hatfield, for example, is the Hatfield City Improvement District, which is tremendously active in the ongoing upliftment of the area, from fixing potholes and removing graffiti to working on solutions for the homeless."

Homelessness is generally associated with joblessness, though while some of the homeless in Hatfield have jobs, they cannot afford the transport to travel home each night. So they live on the streets during the week and return home on weekends. City planning in general needs to address the issue of the economically poorest sector of the population living so far from places of work. "Creating digital city tools and instruments helps us to understand patterns in a range of complex city issues, such as homelessness; this brings us closer to creating appropriate solutions," Dr Davey says.

Much of the data for the HDTC will be hosted within UP's Information Hub, which is being constructed on the main campus. Rather than being a physical hub, it is a cloud-based server managed by a data science team.

"It's a long-term innovation project," Dr Davey says, "and it is gaining national support from entities such as the South African National Treasury City Support Programme and the South African Department of Trade, Industry and Competition. A lot of questions still need to be addressed, as there isn't such a thing yet in Africa. It's exciting and we hope to move this novel initiative forward."

Captions:
1.Computer-Generated Digital Environment of the Hatfield Digital Twin City
2. Hatfield Digital Twin City Transdisciplinary Research Areas
3 Hatfield Digital Twin City Project Area

Media inquiries

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ABOUT THE UNIVERSITY OF PRETORIA

The University of Pretoria (UP) is one of the largest contact and residential universities in South Africa, with its administration offices located on the Hatfield Campus, Pretoria. This 113-year-old institution is also the largest producer of research in South Africa.

Spread over seven campuses, it has nine faculties and a business school, the Gordon Institute of Business Science (GIBS). It is the only university in the country that has a Faculty of Veterinary Science which is ranked top in Africa, and overall has 120 academic departments, as well as 92 centres and institutes, accommodating more than 55 000 students and offering about 1 100 study programmes.

UP is one of the top five universities in South Africa, according to the 2019-2020 rankings by the Center for World University Rankings. It is also ranked among the top 100 universities worldwide in three fields of study (veterinary science, theology and law), and among the top 1% in eight fields of study (agricultural sciences, clinical medicine, engineering, environment/ecology, immunology, microbiology, plant and animal sciences and social sciences).

In May 2020, the annual UK Financial Times Executive Education Rankings once again ranked GIBS as the top South African and African business school. The University also has an extensive community engagement programme with approximately 33 000 students involved in community upliftment. Furthermore, UP is building considerable capacities and strengths for the Fourth Industrial Revolution by preparing students for the world beyond university and offering work-readiness and entrepreneurship training to its students.

As one of South Africa's research-intensive universities, UP launched the Future Africa Campus in March 2019 as a hub for inter- and transdisciplinary research networks within UP and the global research community to maximise 4IR innovation and address the challenges and stresses our continent and world is facing. In addition UP also launched the Javett Art Centre in September 2019 as a driver of transdisciplinary research development between the Humanities and other faculties. In November 2020 UP launched Engineering 4.0. as a hub not only for Smart Cities and Transport, but also to link the vast resources in technology and data sciences to other faculties via Future Africa. These initiatives are stimulating new thinking at the frontier of 'science for transformation'.

For more information, go to www.up.ac.za