NEXUS FORUM

BIM, CIM, IOT: the rapid rise of the new urban digitalism.

WHAT MATTERS IN THE GLOBAL CHALLENGE FOR SMART, SUSTAINABLE CITIES AND WHAT IT MEANS

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Smart city, which designates sustainable urban management through the use of technologies, has now become a widely familiar concept shaping city development in industrial and developing countries alike. Driven by the need to reduce energy use in the broader context of global warming containment, smart cities rely on the smart management of infrastructure such as grids, energy and water systems but also the monitoring of pollution and safety and the control of traffic and transit flow, especially as automated car systems develop. Resiliency to strong weather variations such as storms, hurricanes, and sea rising is also at stake.

Based on BIM (Building Information Modeling), a digital basemap centralizing all the structural components of a building, smart buildings bring that trend to new levels. Structured around three key sectors - systems and operational control, ITs and software, energy and infrastructure, BIM is about to expand rapidly, spreading the new urban digitalism. At the same time, the Internet of Things (IoT) adds to the optimization allowed by digitalization in cities and buildings, enabling private individuals in their homes to monitor the adaptive, smart regulation of equipment such as water and heating provided by building services providers (BSPs).

This note offers an advanced introduction highlighting what new step the emergence of BIM represents towards the development of connected cities, while artificial intelligence (AI) will further accelerate the technological shift already at play.

THE RISE OF SMART BUILDINGS

Smart buildings are a smart nexus between cities and their infrastructure, and urban citizens. Their impact will be decisive in the development of smart urban management by all stakeholders, from architects, constructors, realty managers and services or maintenance providers to policy makers, planners, tenants and any individual, thanks to technology.

Indeed, science and information form the cornerstone of the “smartization” of cities, buildings, and homes. In the same way smart cities rely on Information Technologies (ITs, sometimes referred to as ICTs, Information and Communication Technologies), which are critical tools for integrating and operating urban systems and helping reduce cities’ carbon footprint, ITs and digital tools are revolutionizing the AEC (Architecture, Engineering, Construction) sector and taking us a new, major step further into a connected environment.

So far, smart cities essentially meant efficient energy use by power or transit systems. Smart buildings now offer a new dimension for smart cities as we shift from a system-level to a unit-based level that allows the smart micro-management of the urban setting. Digital maps integrate a variety of components from the built structure to underground pipes and cables, water and sewage, and infrastructure data. As explained below, these data are geographically located with GIS (Geographical Information Systems), allowing interactive maps and completing 3D city maps and models.

Concerns about the efficient use of space and the expansion of sharing, from cars to flats to offices, and social trends in favor of the circular economy - for example growing food for local consumption - all combine into a new way to conceive and develop real estate projects. The rapid digitalization sees the emergence of the Internet of Services (IoS), a web of digitalized functions supporting the critical infrastructure components and services of a city. At the same time, individuals are becoming direct players in urban management, from the collaborative watering of trees and flowers in a neighborhood street to IoT at home.

These trends raise the challenge of moving from smart neighborhoods to harmonized, smart cities as a whole. It is also worth noting that the spread of technologies to make cities more interactive, efficient and agile, raises questions about the future shape of the internet. With interoperability and scalability as key requirements, unifying communications and any service related to the processing of data and information on a global scale to facilitate open urban services, will be a major challenge.

BIM IS THE NEW NAME OF THE GAME

A 3D support, BIM does not only provide a new tool to conceptualize and construct buildings, it offers a collaborative platform for all players involved, from construction to exploitation and maintenance. The digital model is replacing the various documents and drawings that traditionally used to support the work of architects, builders, electricity and plumbing providers, and many others. While traditional construction often sees valuable asset knowledge lost every time information is exchanged or different types of players communicate, BIM allows design and construction to match in a way that has never been as accurate.

BIM software has all teams working on a project not only at the AEC stage but throughout the life-cycle of a building or infrastructure project. One example is the monitoring of the construction phase, where digital visualization supports help rectify errors and anticipate hazardous conditions that may impact the life of a building. Whether by checking physically with a computer or an ipad in hands if a building conforms to the model or, as is more widely used, by scanning a building at different stages of construction by generating

point cloud data, including with the help of drones, the capacity to monitor the development of a construction site, avoiding delays, waste and discrepancies, is unique. Gains in management efficiency and cost reduction at all stages are considerable for residential and commercial buildings as well as public venues like airports, universities or parking lots.

Beyond construction and the foretelling of hazardous conditions, the major innovation of BIM as a software resides in the operations, maintenance and performance management of buildings. As BIM centralizes all information for each construction and real estate management project, it provides a single reference for decisions about individual buildings and wider property portfolios as well, based on hard facts. These include graphic and technical data on materials and equipments, from architectural design to building management. Heat management is a good example of that efficiency; with weather forecasts, buildings' thermal properties, and the patterns of domestic heating use all integrated, programming energy systems can become optimal.

BIM is a three-level tool where level 1 designates AEC, level 2 the equipments and services integrated to the building, and level 3 the real-time interactions of those equipments and services that build into the 3D model, requiring the digitalization of each device from lighting to air conditioning. Level 3 opens the way to the efficient maintenance of a building as any element is digitalized and easy to geolocalize. It also helps optimizing building management, from space occupancy to energy use. As described below, the IoT is now driving the emergence of a level 4.

Much like Internet with the military, BIM was initially promoted by U.S. federal agencies. The General Services Administration (GSA) that supervises federal buildings from construction to IT systems spurred the development of digital tools for cost efficiency purposes. Like Internet, BIM will ramify beyond the mere concentration of information; it will transform how cities live and witness the expansion of new businesses. The integration of building systems actually provides a new avenue for the development of smart cities as a whole.

CIM AND THE DATA GENERATED BY URBAN SYSTEMS

Coupling BIM with geospatial technology offers a powerful combination. GIS do not only gather data for maps, but for any object location and its surrounding environment. Whether by laser imaging first developed by the aeronautics industry or by the electromagnetic frequencies of radars informing on (under)ground conditions, GIS makes possible 3D urban planning.

Some compare cities to a human organism to illustrate the new connections allowed by the combination of information at the city, building, and individual levels; infrastructure represents the skeleton, traffic and mass transit the cardiovascular system, energy and waste the respiratory and digestive systems, and telecommunications a primitive nervous system. Intelligence is what permits that whole urban body to function well, with the brain connecting the intelligence and the nervous system. ITs fulfill that task by managing data to avoid breakdowns provoked by a glut of information in the nervous system; they support decision making in energy, transport, and security by filtering and processing data, thus representing the nevralgic point of smart cities. The IoT that allows us to interact with connected objects and devices and binds them into a network adds yet another information layer to be collected and processed, and generates BIM's level 4 where real time buildings and IOT data combine. Coupling them with GIS into city monitoring and planning tools integrating visualization techniques also becomes possible, generating cost-effective planning capabilities never seen before, including through simulations on a city scale. Singapore is one good example of 3D urban planning using geometric, geospatial, topological and legacy data.

Using fighter jets constructor Dassault Systèmes' 3DEXPERIENCity platform, Singapore's "Smart Nation" plan entails the 3digitalization of the entire city and the storing of all urban data from architecture and infrastructure to resources and inhabitant patterns, made available to citizens, businesses and government to support the smart management of existing and future infrastructure. This will help better respond to future urban needs.

In Europe, the new urban digitalism is addressed not only at the local and national level but also by the EU. The attractiveness, competitiveness, and energy efficiency of cities come into play with respect to Europe's 2020 targets on sustainable growth. The European Commission thus supports the Smart Cities Information System (SCIS) that brings together developers, cities, institutions, industry and experts from across Europe to exchange data and experience, and to collaborate on smart cities and energy efficiency projects co-funded by the European Union. SCIS showcases solutions in energy-efficient buildings, energy system integration, sustainable energy solutions on district level, smart cities and sustainable urban planning.
http://www.smartcities-infosystem.eu/content/about-smart-cities-information-system-scis

The broader economy is also impacted as new activities that did not exist a few years ago will keep growing, modeling software designers who can foresee a promising land to exploit, to Building Services Providers (BSP) who witness the emergence of many new company names.

development is undergoing far-reaching changes that open new possibilities for local officials and institutions to plan territorial development. From Qatar's 2030 Plan to NYC's smart city challenges to Tokyo to the emerging economies of Asia and Africa, BIM accelerates the transformation of how cities and buildings will be planned and managed.

Finally, with exceeding use of enabling technology, BIM and CIM will greatly impact public policy and e-governance. It will expand citizens services and impact their interactions with local governments, starting with building plan approval process; GIS mapping will help submit plans and drawings online, making approval faster, more transparent, and less costly. More broadly, empowering citizens in smart, connected cities will also contribute to general awareness of climate challenges, shaping public choices with respect to mobility, spreading the use of public transportation, clean fuels and vehicles, and inter-modality.

The spread of BIM for entire cities thus represents a new big wave where business, citizens and elected officials will approach urban issues in an entirely new, dynamic way, with data storage and security arising as vital challenges for smart cities to thrive. As test-programs are developing in various cities, the rise of automated cars driven by artificial intelligence will also add to the sea-change awaiting urban management and the intense connectivity that BIM and CIM already entail.

This is only the beginning!