SCIM (Sustainable City Information Model):
State-of-the-art planning instruments for sustainable urban districts

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ABSTRACT: It is seldom possible to build prototypes during urban planning. For this reason, simulation is of increasing importance to allow experimentation with various scenarios in the early stages of a project. The Sustainable City Information Model (SCIM) – a 3D urban or district model enriched with extensive information – enables holistic evaluation taking appropriate weather data into account. The evaluations can be generated in the 3D city model or, alternatively, the response to any specific question regarding daily, weekly or annual trends can be displayed graphically. The name SCIM stands both for the newly developed tool and generically for sustainability simulation based on 3D urban-planning models.
Keywords: sustainable city; planning tool; urban district; simulation

INTRODUCTION

Global warming, demographic change and last but not least population growth demand new approaches to urban planning. The German Federal Government proclaimed 2012 as the year of science & research and, in this context, launched the 'Future Earth' program. As part of this initiative, the Morgenstadt (City of Tomorrow) research network is making a valuable contribution to giving the general public a better scientific understanding of the city of tomorrow. Additional research projects – such as the Drees & Sommer internal 'SCIM' project – are necessary to transfer findings from research to application and planning practice

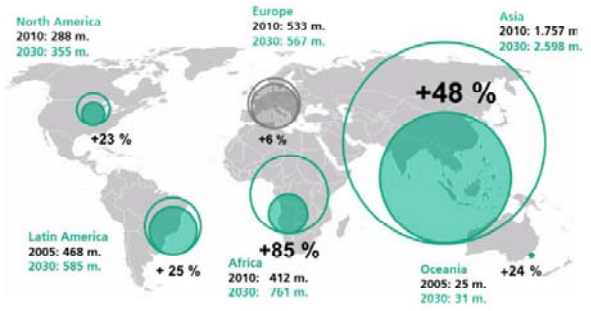

Figure 1: Global population growth
Source: Innovation network "Morgenstadt: City Insights" / Fraunhofer Institute

Even the planning of (single) sustainable buildings is very complex and represents a great challenge. Exacting resource efficiency requirements – combined with the need for comfort – make simulations necessary. This allows highly insulated, energy-efficient buildings with ventilation systems to be planned in such a way that later condensation, drafts or overheating in summer as the result of glass facades can be excluded during the early stages of planning. Building planning has undergone a quantum leap in innovation in recent years.

However, implementing individual flagship projects is not going to counteract global trends to any noticeable degree. For this reason IUDCs (integrated urban development concepts) and environmental protection concepts for local government have become common practice. Also the first Kreditanstalt für Wiederaufbau (Reconstruction Loan Corporation, KfW) programs, such as the urban energy efficiency programs started this year (432)[1], have been established. Political goals at the regional and urban planning levels have already been formulated. And awareness is growing that climate-friendly urban planning is not just a matter of adhering to local climate protection goals, but increasingly one of adopting a global leadership role.

However, the implementation and evaluation of the sustainability of individual buildings is not yet mature. The Federal Government has recognized this, and the Minister of the Environment has openly admitted that some of the stated sustainability objectives, such as the reduction of electricity consumption by 10 percent, will not be achieved by 2020. Currently, although almost every city is developing its own standards and criteria – there are hardly any real standards. There are first pioneers – such as the DGNB certification system for

urban districts that show a universal holistic approach – but they are not planning tools[2].

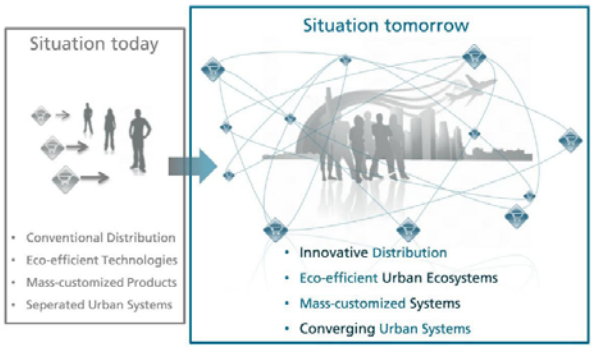

Figure 2: Changes in urban infrastructure and municipal engineering

There is basic consensus on the subject of sustainable urban planning. The triple bottom line of environmental compatibility, economy and sociocultural issues is widely accepted. And this makes planning even more complex. Planned mixed use in the city of tomorrow means much more than reducing the spatial separation of various urban functions such as living and working. A new, multifunctional approach also has to be taken to infrastructure and municipal engineering. The well-known simulation tools with a one-sided focus on solar optimization lead to rather controversial monotonous urban features and do not adequately address the complexity of a carbon-neutral district or a smart grid. The result of sustainable urban planning does not have to solely comprise compact linear rows with a southerly aspect.

Even though 3D urban models and Google tools give us the impression that reliable figures are calculated at the high-tech level of urban planning, the reality is different: Plans for achieving climate protection goals at district and city level are still calculated or estimated in a very rudimentary manner. The major challenges are therefore in the areas of applied research and planning and involve the proper implementation of the objectives derived from scientific evidence.

Technological change

Three major transformations are affecting cities. One is the technological change taking place in many sectors. For example, technological change is enabling high-tech energy-plus buildings. In the transport sector, routing is now largely effected via navigation devices or digital traffic guidance systems. And new types of drive allow carbon-neutral mobility. The second change is the increase in the speed of change and, as a result, in life cycles. Whereas only a hundred years ago buildings were still designed to last for several generations, today flexible buildings are planned for short life cycles. Significantly shorter life cycles are found in modern media, such as in IT. All of these elements can be found combined in cities. And this is what causes the great difficulty, as all of these life cycles have to be harmonized with one another. If this is not done, this results in the necessary upgrade of partial elements being delayed or assets that are still operational being destroyed in the course of upgrading old items. An example of this is the digging up of new roads to upgrade infrastructure lying beneath. These two transformation processes, which lead to ever more complex interactions between various areas of urban planning, result in the third transformation: The merging of previously separate industries. Today, for example, German Railways as a public transport operator is collaborating with automobile manufacturer Mercedes Benz to offer future mobility rather than a car or a train ticket.[3]

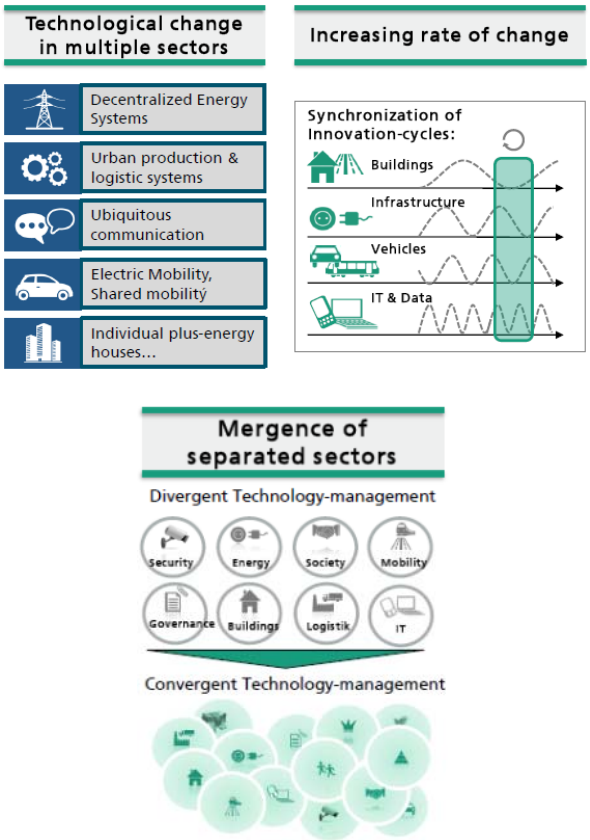

Figure 3: Changes in urban infrastructure and municipal engineering

SCIM

All these new challenges resulting from the transformation process described require innovative approaches, which have to be tested. But it is not really possible to create prototypes in urban planning, which is why simulation is of increasing importance. SCIM stands for Sustainable City Information Model. These are 3D or district models, which are enriched with extensive information: A simulation program allows holistic evaluation, taking appropriate weather data into account. The evaluations can in turn be generated in the 3D city model or graphically displaying a response to any specific question regarding daily, weekly or annual trends. The name SCIM is given by the author of this paper. It stands both for the simulation tool developed by Drees & Sommer as well as generically for the theme of sustainability simulation on the basis of urban 3D models. So SCIM-tools shall have following characteristics:

- Sustainability = holistic subject selection (e.g. energy, traffic, water and so on)
- City = territorial reflection of interactions between buildings
- Information = detailed local data's like climate data or energy standards of single building panel
- Model = 3D urban layout

In addition to conventional planning of energy efficiency and an increase the share of renewable energy, SCIM enables performance optimization of urban development models over the course of the day, or compensation for work & holiday peaks or seasonal fluctuations. This optimization offers huge potential for infrastructure improvement and cost savings in energy supply, even in small local authorities. Distribution of functions calculated by SCIM for planned urban mixed-used developments can also lead to optimization of energy performance.

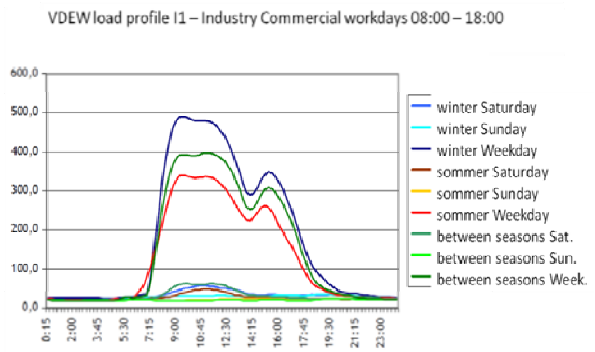

Figure 4: Commercial power consumption

SCIM can also promote the linking of different fields, such as transport and building planning. After all, the planned expansion of electromobility will also have an impact on real estate. Studies undertaken by Drees & Sommer show that the charging of employees' electric vehicles can lead to enormous increases in energy demand. Even if only 25 percent of employees charge their vehicles, the building's total energy demand is doubled. It was also established, however, that e-mobility offers tremendous opportunities and that using a smart grid, the car of tomorrow's city can be a virtual power plant (see Fig. 4). This means a car is not longer just a mean of transport, it`s a electric energy storage for the buildings of the district. The example shows clearly that innovations in urban planning can extend far beyond the provision of a new infrastructure element, such as a charging station. The holistic approach with SCIM also identifies potential savings in the public infrastructure itself.[4]

Figure 5: Vehicle to grid (V2G) – Electric vehicles as virtual power plants

APPLICATION EXAMPLES

To test the efficacy of SCIM, it has been used on well-documented projects, such as Potsdamer Platz in Berlin. Drees & Sommer and DS-plan has supported the project – from the planning stage in the 1990s and DGNB City District Certification in 2011 through to today with optimization measures for established buildings, such as the transition to 100 percent green electricity. Potsdamer Platz has both a district heating network via a central block-type thermal power station (BTTP) plant as well as Europe's largest urban stormwater management concept. This allowed testing of the broad functionality of SCIM, which – as a sustainability tool – takes water management into account and can also be applied far beyond the field of energy. Since then, a simplified version of the tool has been tested in German urban rehabilitation projects as well as in international developments, such as the redevelopment of the Expo site in Shanghai. Currently the 3D-data

transferred from a sketch-up model into the simulation platform based on TRNSYS. The results are data's as scales and schemes or into sketch-up 3D model retransferred graphics.

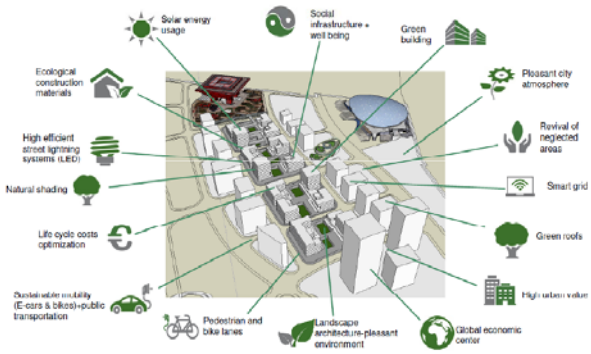

Figure 6: Sustainability aspects in the 3D model of the Shanghai Expo site

The use of the SCIM model is also being tested in the current 'Urban Tech Republic' project in Berlin as part of Drees & Sommer's innovative infrastructure concept for the principal Tegel Project GmbH. SCIM gets us one step closer to the planning goal of a networked city.

Figure 7: Rendering Berlin TXL – The Urban Tech Republic

Conclusion

SCIM will be a powerful planning tool that is able to reflect the integrated planning approach required by the sustainable urban planning with all its complexity and depth of innovation. Drees & Sommer's SCIM tool demonstrates the diverse possibilities of contemporary urban planning and offers development potential in all areas of sustainability. Currently the Tool will be develop further with GIS functions, a CityGML interface (LoD 2 or LoD 3), an more easy simulation platform for bigger districts and some grid simulation functions. In practical application, it can provide a sound basis for discussion in an interdisciplinary urban planning process and enables assessment of a range of scenarios.

Figure 8: Infrastructure planning with SCIM for sustainable urban planning

One thing is certain: The planner of the city of tomorrow requires interdisciplinary tools that are equally capable of viewing both data and urban designs, and thus contribute to a sustainable and holistic approach to urban planning. The applied researcher and urban planning stands here just on begin of the process. SCIM is independent of the future specific software tool that will prevail in the marketplace, and is to be understood as a new integral 3D planning tool that allows a holistic view of the diverse needs of sustainable urban and district planning.

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