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Summary

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There can be no doubt here: cities for the 21st century will be both sustainable and smart. The question is, what does that entail? ComplexCity is a joint effort of the three French UTs and the University of Shanghai who share common interests in this matter and who are already coming up with some early answers to the issues addressed.

Building urban science

Taking the city's urban context as the field for a study of environmental, energy-saving and societal challenges in China today, ComplexCity aims at developing multidisciplinary research that brings together social sciences and 'hard' classic science, reinforcing Franco-Chinese relationships in terms of research and innovation.

In the long term, the objective is to build an urban science that can help understand and explain how a building functions, or a street, a district, a whole city and to create innovative services to meet the needs of the business companies and the city's authorities.

"To take one example", says Fabien PFAENDER, *"the air-conditioning units in cars lead to increased street temperatures in town. With traffic figures, weather forecasts and some thermodynamic data, the increase in temperature expected can be calculated in advance. If we cross-match these data with those on Sina Weibo (the Chinese micro-blog network) it is possible to detect what foot passengers say about the situation and how they react. If they choose to avoid a given street, the sales activities of the merchants on the street will suffer! The town authorities could in this case intervene and order, for example, a road traffic diversion"*.

A triple priority scientific programme covering five sectors

Just how is ComplexCity organised? Firstly, the idea was launched in 2011 by François PECCOUD (former UTC-Compiegne President

1995-2005). From June to November 2012 a team of about 20 research scientists from the three French UTs, coordinated by Bruno BACHIMONT detailed and drafted the methodological axes according to the various skills and special competences of the UT laboratories, to the scientific challenges and possible future applications.

Three priorities were defined: data gathering and display tools; a critical analysis for social sciences and humanities and the interpretation thereof; data modelling. These three priorities cover 5 sectors with possible applications: 'geron'-technologies, modelling of urban energy flows, urban maintenance urban metabolism and, last sector that of risks factors, urban system vulnerability and resilience. The scientific contents were drafted by Benoit BECKERS and presented to the Chinese partners in November 2012. They were fully approved by the Chinese at that date. "In short, ComplexCity is a blend of two concepts: smart cities and sustainable cities. Our counterparts in Shanghai are more attached to the concept of "smart" cities", a term first coined by IBM and now an integral part of Anglo-Saxon culture".

According to this concept, tomorrow's cities will develop using networking principles and Internet. "Our UTC Urban Systems Engineering department looks more at questions of sustainability", adds Benoit BECKERS. "The scientific programme for ComplexCity combines both, complementary, points of view." The work-load framework was also greatly appreciated by the partners. "It served to convince the heads of staff at the University of Shanghai to work with us. The dynamic joint policy we initiated in 2012 is highly encouraging", says Bruno BACHIMONT. "We were the pioneers of long-term scientific research programmes between France and China", underscores Fabien PFAENDER. Now that the general framework has been defined, we have to launch precise projects, registered and approved in principle by our Chinese partners.

The trump cards of ComplexCity

The Shanghai mission (June 19-23) of the UT research team aims at "Presenting a dozen detailed projects to our Chinese counterparts, selected for their maturity, their interest for all the partners to the Programme and in terms of financial funding opportunities. They cover the following thematics: smart hospitals, and analysis of street scenes, building maintenance, gerontechnologies, urban metabolism management, etc. These projects have been readied by the French parties.

"It now remains to see which projects can be handled by the laboratories and research teams in Shanghai, adds Bruno BACHIMONT. "Both sectors of gerontechnologies and urban maintenance should prove promising. Our ambition is to launch jointly one of two flag-bearing projects by end 2013." To achieve this, the UT team must be in a position to address questions of cultural differences that can arise in the way scientists work in Europe compared with China. Bruno BACHIMONT adds, in this respect that "The way research is structured in China is much more mono-thematic and mono-disciplinary than we would see in French establishments, which are more open to the industrial world environment. We, for example, can quite readily associate social sciences to robotics research, more easily than our Shanghai counterparts can - indeed for the latter, working with IUT Group scientists is in itself a cultural revolution. We must therefore pay attention to our collaboration modes, to understand and integrate their work habits so that we can progress together."

The forces available in the ComplexCity programme are numerous: proximity with UTSeuS (Sino-European College of Technology of the University of Shanghai) which can serve to introduce our research scientists to Chinese culture; the dialogue we have instated within the UT Group, based on this joint programme; the very pragmatic approach of the Chinese actors who can bring to bear a high impact and who at the same time have high expectations from the UTs in terms of innovations and long-term visions; our location in Shanghai where every day new districts are rising, etc.

Shanghai seen as 'living lab', with the world as final ambition

"The city of Shanghai is a 'living laboratory' of all urban problems and issues, from population ageing to energy uses and waste, but these issues are multiplied tenfold compared with what we observe in French cities. Just by its sheer size and speed of change, Shanghai is a very exciting observatory, ripe for experimentations", underscores Bruno BACHIMONT; if the starting point is this city-laboratory of 25M inhabitants, then the ambition of ComplexCity will be to identify methods and models that can thereafter be applied to other major cities round the world. "Many universities, from many countries already have established an annexe in Shanghai. ComplexCity could become a 'prime attractor' for urban questions and issues. It is fairly easy to start an exchange process in such a highly concentrated focal point. We intend to integrate a wide scope of points of view to be innovative ourselves on the main question: the concept of the sustainable city", concludes Fabien PFAENDER.

A ten-year project dynamics plan

Where innovation is concerned, the objective of ComplexCity will be to establish a 10 year plan for the projects. Benoit BECKJERS is not at all short of immediate ideas, long-term dreams ... "We could maybe equip the streets with sensors for temperature, wind - something we have never been able to do in Europe, except on scaffolding which makes urban metrology very costly and short-lived. The ideal situation would be to install the sensors directly on the buildings, to help us understand and locate heat lenses for example, or to control the energy use/savings of the buildings." These devices could have undreamed of repercussions. Thanks to a continuous measurement campaign, the research scientists could develop simulations (and associate tools) to help local authorities make the right decisions in terms of future urban development plans.

Chinese cities heating the Siberian winter scenes

"It would", surmises Benoit, "prove very interesting for IPCC experts (Inter-Governmental Panel on Climate Change) whose reports are considered as highly authoritative in respect to climate trends and changes. "IPCC models use a framework meshed at 200km side, and this does not allow you to identify the effect of cities on global warming. We know that the heat produced by Chinese cities is warming up the Siberian climate, and accelerating the melting of the permafrost layers. The Eastern USA can increase Canadian temperatures by as much as 2°C through heat transfer via the jet-streams. The IPCC experts have identified these mechanisms but they need to have people on the ground, in the cities in question, to explain how an urban, environment can change local weather and climate. In a mid-term or long-term vision, the ComplexCity Programme could be oriented to address this sort of question, all the more so", concludes Benoit BECKERS, "that the urban built-up surface in China will have tripled between 2000 and 2030."

"Ten years from now, we could have projects that today lie beyond our dreams and imagination"

For Benoit, optimised urban planning, including effects of climatic change, is the only alternate way to correctly price urban space. "In the past, urban planning relied on aesthetics mainly, but today this is no longer the case. The only way to fight over-pricing and privatisation (and subsequently anarchic development of the city) is to propose a plan that optimises both energy and physics". ComplexCity is therefore to be seen as adding a stone to the concept of sustainable cities and this, according to Benoit, really is a key moment in time for the Programme. "The current state of advancement of our research allows us to predict that we shall be seeing some very interesting results in 10 years' time, notably about 'urban physics'. Thanks to 3D modelling, to satellite data, to climate and weather conditions, to the growing awareness of citizens about urban issues, our students will have the tools to take

the city concept even further and carry out some projects that today lie beyond our dreams and imagination".