Michael Dowling
Otthein Herzog

Editors

ICT as an Enabler for Intelligent City Development

Perspectives from Germany and China

MÜNCHNER KREIS
Übernationale Vereinigung für Kommunikationsforschung
Supranational Association for Communications Reseach

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Editors:

Prof. Dr. Michael Dowling
Universität Regensburg
93040 Regensburg
Michael.Dowling@wiwi.uni-regensburg.de

Prof. Dr. Otthein Herzog
Mobile, Wearable, and Intelligent Systems
TZI - Universitaet Bremen
Am Fallturm 1
28359 Bremen
herzog@tzi.de

Editor of Bookseries:
Münchner Kreis – Übernationale Vereinigung für Kommunikationsforschung e.V.
Tal 16
80331 München
www.muenchner-kreis.de
office@muenchner-kreis.de

Compilation:
Dipl.-Phys. Volker Gehrling
Münchner Kreis – Übernationale Vereinigung für Kommunikationsforschung e.V.
v.gehrling@muenchner-kreis.de

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Preface

The development of Intelligent Cities is a topic of interest to public policy makers, researchers, and businesses in both the developed and fast developing worlds. China has made Intelligent City development a national priority and has already developed a number of initiatives, not only in major cities such as Beijing and Shanghai, but in newly developing centers such as Wuxi and Ningbo. Information and Communications Technology are playing an essential role in these developments.

The Chinese Academy of Engineering, acatech – the German National Academy of Science and Engineering, and the Münchner Kreis have all been active in research and discussions concerning Intelligent City development. In a conference, these three organizations have brought together academic and business experts to present and compare research, examples, and future visions both in China and Germany for the development of Intelligent Cities using information and communication technology as an enabler. The results of this conference are of interest to researchers, business practitioners, but also local, state, and national government policy makers. This book contains the results of the conference.

The available book contains the lectures and the notes of the discussions. Sincere thanks are given to all referents and discussion participants for their input.

Michael Dowling Otthein Herzog

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1 WELCOMING ADRESSES

Prof. Arnold Picot, University of Munich and Chairman, Münchner Kreis
Prof. Henning Kagermann, President, acatech, Berlin
Prof. Pan Yunhe, Executive Vice President, Chinese Academy of engineering, Beijing
Dr. Ronald Mertz, Bavarian State Ministry for Economy, Infrastructure, Transport and Technology, Munich

Prof. Picot:
Let me cordially welcome all of you to our conference on ICT as an Enabler for Intelligent City Development: Perspectives from Germany and China. This conference has been planned and prepared by three organisations. First of all the Chinese Academy of Engineering, then acatech, the National Academy of Science and Engineering
in Germany, and last, but I hope not least, Münchner Kreis as Supranational Association for Communication Research, based here in Munich.
The Münchner Kreis, whose chairman I have the pleasure to be, is in charge of organising the venue of this conference here in Munich. It is for this reason that I take the floor first and extend to all our guests and participants a very warm and cordial welcome. Later on my colleagues on the podium will join me in welcoming you in brief introductory remarks.
Let me especially welcome our guests from China who made it all the way from Eastern Asia to Western Europe, in particular and more precisely to Munich, Bavaria, to this beautiful city, to participate in this conference. And we are all looking forward to our discussions and exchanges of views. We are grateful that you, Prof. Pan, in your capacity as Executive Vice President of the Chinese Academy of Engineering are here and will address the audience later on in some greeting remarks and with your presentation. Together with your academy you have fruitfully supported and inspired this project.
I cannot unfortunately welcome every member of the large Chinese delegation in person but let me point out that scholars of important Chinese universities and scientific organisations are among us as well as - and this is of high importance for our topic today and tomorrow – representatives and specialists from major Chinese cities, namely from the city of Ningbo, the city of Wuhan and from the province of Seijan. It is our pleasure to have you with us.
It is also my pleasure to welcome the president of acatech, Prof. Kagermann, together with his staff and members from his Academy. He has effectively pushed the ideas of this event in cooperation with the board of Münchner Kreis, in particular with my board colleague and good friend Prof. Michael Dowling whom I extend a warm welcome as well.
We are very grateful to all colleagues and friends from acatech and also to the members of Münchner Kreis, in particular to Prof. Dowling, for their thoughtful and thorough preparation of today's and tomorrow's event. This preparation not only included lots of emails, many meetings and telephone conferences but also travelling to China roughly a year ago.
The programme of our conference in my view proves that the efforts of all three cooperating partner organisations have been successful. This is a very good basis not only for the discussions of this meeting but also for a promising condition and sign for future cooperation and exchange.
Ladies and gentlemen, all over the world we are seeing the rapid development and distribution of new information and communication technologies and media. These changes are permanently affecting societies, our lives and the global transfer of knowledge. They are also transforming our cities and metropolitan areas where right now more than half of the world's population is living.

ICT is also a means to tackle and eventually overcome the great challenges that are being created by the urbanization of our world. New technical infrastructures, platforms and services open new avenues for information, communications, and also for the organisation of densely populated regions. The path to achieve this should be built upon critical but constructive future oriented analysis and expert discussion with exchange of experiences and knowledge. This goal should guide our presentations and discussions today and tomorrow and also the conversations around the formal events.
The Chinese experiences, research results, and expectations regarding smart or intelligent cities are of course very valuable for us in Europe. China with its largest national population in the world and with its striving modern industries and infrastructures can serve in many senses as a sort of role model for other urbanised regions.
On the other hand I hope that Germany and Europe might also be able to contribute to the prospects for intelligent cities based on technological and organisational abilities with complex systems and on long term experiences with running medium-sized settlements in an ever changing world.
In this spirit, ladies and gentlemen, I wish our conference the best of success with stimulating results and recommendations as well as the build up of good and sustainable mutual relationships between these two important regions of our world.
Let me now hand over to my colleague Prof. Kagermann for his introductory remarks.

Prof. Kagermann:
Prof. Pan, Prof. Picot, Dr. Mertz, ladies and gentleman. There is the nice saying that 'science is about discovery and knowledge whilst engineering is about problem solving and innovation'. I have used it to explain why many or most countries have an Academy of Engineering in addition to an Academy of Science. It is our ambition at acatech, Germany's national academy of engineering, to be this voice at home here in Germany and abroad. When we were founded in 2002 it was first about getting recognised in Germany. In the meantime we are a large network of about 400 engineers and well-known scientists working in close cooperation with representatives of different societal groups, many from business. We now have about 70 companies which have joined acatech. It is typical for projects we are conducting always to have a mix of people from science, engineering and business because we are concerned about innovation. And innovations mean at the end of the day to convert research into products we can successfully bring to the market.
We have also built relationships with other groups working in this area, for example the Association of German engineers and through Prof. Picot with the Münchner Kreis, which is why we are very happy to be here and to cooperate in this event.
In 2012 we celebrated our 10th anniversary and we decided that it is time to strive for more recognition abroad. Therefore, we intensified our cooperation with international institutions and we were very proud in particular that in May 2012 we were able to sign a memorandum of understanding with the Chinese Academy of Engineering. We have established many contacts since then and we have had several events and discussions. Recently, the president and a delegation of the Chinese Academy of Engineering came to see us in Berlin and we talked in great detail about Industry 4.0 and the challenges for the Chinese and as well for the German manufacturing sector to transform into the next generation of advanced manufacturing.
I look forward to seeing what is going to happen in China and plan to visit China next year to learn what the Chinese Academy of Engineering is doing in this respect.
Today I think is another opportunity to strengthen this good cooperation. I am happy that we choose Munich because the headquarter of acatech is in Munich. We also have offices in Brussels and Berlin.

If you look at the activities we are conducting you can put them into three major areas. One is energy and climate sustainability where we have a large-scale, multi-academy energy research project going on which contributes to the scientific foundations of the German "Energiewende", i.e. the transition to renewable energies. Another important area is technical education as we know that we have a shortage of more than 150.000 engineers in Germany. The third pillar of our activities is technologies, in particular Information and Communication technologies (ICT). ICT is a major topic because digitalisation is a key enabler for overcoming nearly all of the global challenges we are facing today. One example is healthcare: if you think about the aging population we share with our Chinese friends, the cost of the healthcare system and the topic of personalised medicine are of utmost importance, as is the topic of smart energy grids. These are all topics we are interested in. I have already mentioned smart production with Industry 4.0.
Another megatrend that was mentioned by Prof. Picot is urbanisation. More and more people want to live in cities and not only to live but to work there as well. That is the reason that we have tackled the issue of urban production with Industry 4.0, so that people can work in an urban environment which gives them a better balance of work and life.
This is a huge transformation which requires our attention. I would call it the reinvention of the system of a city, not only of urban production but also of urban mobility as well as secure infrastructures. Entirely new concepts of city managements are required. Take as an example smart buildings or smart spaces, which, by the way, are research topics of the European Institute of Technology (EIT). As acatech we have also addressed the right balance between protection against cybercrime and privacy early on.
I would also like to mention one of our first publications about a project headed by Prof. Herzog called 'Intelligent objects'. Later we focused on Cyber-physical Systems and Industry 4.0. Now we are just finishing a work on cloud computing and have recently published recommendations on internet privacy. I mention this because from my experiences during these four years I can say that we needed more and more different groups involved in the various topics. In particular when we look at internet privacy it was surprising that we required scientist from five disciplines, ranging from social sciences to economics, to tackle the relevant questions. We also involved several companies to find out about their ideas what could be a reasonable way in order to protect privacy but still get the best out of the important opportunities provided by the internet.
Collaboration between disciplines, between societal groups but also between countries is very important because the internet is global, commerce is global. We need coherent frameworks and reliable global policies. Therefore today's event is a good example for this type of collaboration and I would like to thank the Chinese Academy of Engineering and Münchner Kreis for co-organizing this with us and hope we will have inspiring discussions later on.

Prof. Picot:
Thank you very much, Prof. Kagermann! It is now my pleasure to introduce to you Prof. Pan, the Executive Vice President of the Chinese Academy of Engineering and among other things he also was a president of the Sejong University from 1995 to 2006.
He is also a well known specialist and researcher in the field of computer graphics and CAD. So, I think it is a pleasure and an honour to have you with us and we are looking forward to your introductory remarks and also later on to your presentation. Please, take the floor!

Prof. Pan Yunhe:
I greet the Chairman Prof. Arnold Picot, President Henning Kagermann and Dr. Ronald Mertz. Good morning, ladies and gentlemen. I am the present leader of the delegation of the Chinese Academy of Engineering to this conference in München. München is a world

famous city. It is said to combine great history and manufacturing capacity. In this city the elegant squares, the palace, the churches and the City hall which together with Siemens, BMW Headquarters, and The Munich University and Technical University of Munich present to the visitors the uniqueness of the city under the wisdom of the German people.
I would like to thank the German Academy of Sciences and Engineering and the Münchner Kreis for your efforts to make this event possible. The development of intelligent city has driven global interests as it brings about revolutionary change to this city and to the management modes as well as to the peoples way of working and living. All of this will drive the social development to a new high level.
Today, China is at the booming period of the industry relation and open relation. In the next twenty years, China will continue to advance on the road of convergence in the industry relation, the information relation, and the open relation. On the road, building intelligent cities will be the direction and an intelligible choice of China's open relation process which poses both a great challenge and opportunities to China.
We find it very helpful for the Chinese people and the German people to make further exchanges in the cooperation research in the intelligent city development and to explore our successful development model. Now I would like to take this opportunity to wish the event a great success.

Prof. Picot:
Thank you, Prof. Pan. Now you are going to listen to the welcoming words of Dr. Ronald Mertz. He is the head of the Department for Innovation, Research and Technology at the Bavarian Ministry for Economic Affairs, Infrastructure, Transport and Technology and he substitutes today his Minister Martin Zeil. Thank you very much for being with us. Please, Dr. Mertz!

Dr. Mertz:
Dear Prof. Pan, dear Prof. Picot, dear Prof. Kagermann, ladies and gentlemen, a very warm welcome here in Munich! State Minister Martin Zeil very much regrets that he is unable to be with you in person today. However, our Chinese guests may be aware that we have Bavarian state elections the coming weekend and one week later Bundestag elections on the federal level. So, all the politicians are touring the state to convince their voters now and to gain their support. Minister Zeil has asked me to pass on a special welcome to the delegation of the Chinese Academy of Engineering and his personal greetings and best wishes to all of you.
We are very proud that the Chinese Academy of Engineering is holding this conference together with Münchner Kreis and acatech here in Munich. I think Munich has a lot to offer as a location for this conference. First of all the State of Bavaria is home to a strong ICT industry from global players like Siemens of course to medium sized enterprises. And the Bavarian industry is ready to offer smart solutions to the world markets, also in the area of ICT applications as an enabler for Intelligent City Development. Secondly, Bavaria can offer a strong research environment, and the Münchner Kreis has a long tradition as a visionary think tank for the future of ICT in industry and society.
The Bavarian State Government is determined to offer the best possible framework conditions to help our industry take advantage of the potential of future ICT solution. We are funding a competitive education system and cutting edge basic research. We are supporting applied research and development in collaborative projects between industry and research institutions. And we are fostering innovative companies especially in the ICT sector.
We are also subsidising the extension of high speed internet connections into rural areas of Bavaria with 500 Million Euros within two years until 2014.

Finally our Ministry has presented a plan to support the further diffusion of ICT into the producing sector with 500 Million Euros over the next five years. We hope that our proposal called 'Digital Bavaria' will receive funding from the next term government and within the next election period. We in the Ministry are convinced that information and communication technologies are changing the structure of the whole economy here in Bavaria and world-wide. This will lead to entirely new value creating chains, production processes and new business models.

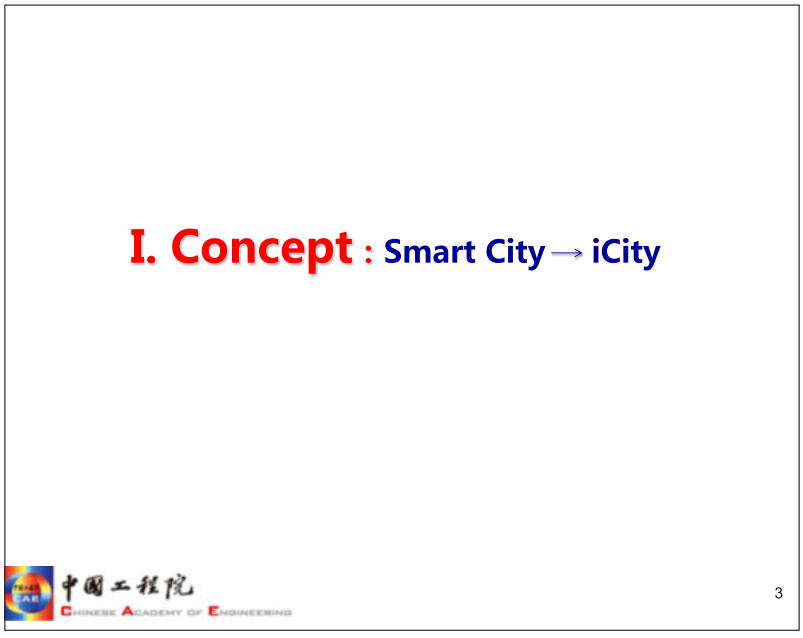
Our goal is clear: we want to take advantage of the transformation process to reach a higher level of competitiveness for our industry here in Bavaria. ICT applications for Intelligent City Development will play a key role in future markets. We are grateful for the opportunity to share the visions of the Chinese delegation on Intelligent City Development.

It might be of interest to you that the political discussion here in Bavaria is focussing very strongly and with great intensity on the digital divide between metropolitan areas and rural areas and how to overcome this digital divide. I think, of course politics has to do both, consider the development of smart cities and support the rural areas here in Bavaria.

I would like to wish this conference every success and especially to our Chinese guests a pleasant stay here in Munich.

2 Keynote Speeches

2.1 Prof. Pan Yunhe, Chinese Academy of Engineering, Beijing



1."Smart City" concept

1) IBM proposed the concept of "Smart City" in 2008: 3I (instrumented, interconnected, intelligent), providing solutions to transport, medical care, government, state grid, water utilities, etc.

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2) Digital cities were being built around the world before "smart city" was raised

All of them tend to be "smart cities"

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3) Smart Cities in China

Beijing

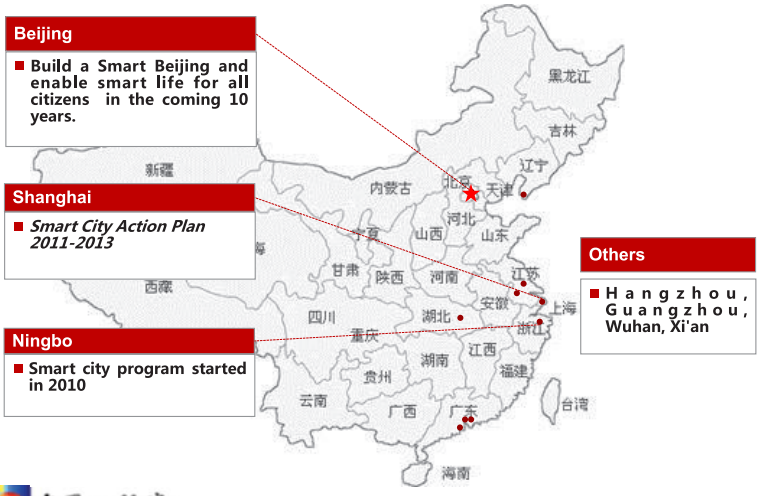
- Build a Smart Beijing and enable smart life for all citizens in the coming 10 years.

Shanghai

- *Smart City Action Plan 2011-2013*

Ningbo

- Smart city program started in 2010



Others

- Hangzhou, Guangzhou, Wuhan, Xi'an

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2. The concept changed in China

- In 2010: smart city is a new model for city development focusing on smart technologies, industries, services, managment and lifestyle based on the use of information technologies and comprehensive use of information resources.

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In May, 2011 the concept was chagned: smart city is a new model to achieve optimized socioeconomic development in cities by utilizing ICT technologies to achieve interactions and complementation between men and things.

- There is a big gap between the Mayor and the IT companies: a Mayor was disappointed after hearing the smart system plan of an IT company and said, "You don't have the vision of a Mayor".
- **what & Why?**

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3. the iCity

CAE launched a plan to study the strategy for China's ICity development in 2012

- Members of CAE disagreed with IBM 's "Smart City", because the city plan is a long-term work based on the collection of extensive data & knowledge, therefore we use the concept of "**Intelligent City**" or **iCity**。

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II. iCity in China

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iCity in four aspects identified by CAE

1. City planning and building
2. Economic and industrial development
3. Information infrastructure
4. City management and services

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1. City Building and Planning

1) Urbanization: chance and challenges

- China's urbanization rate grew by 1.34% every year in the past 15 years.
  - 1978 : 17.92%
  - 1996 : 30.48%
  - 2011 : 51.27%
  - 2012 : 52.57%

  Urban population increases by 18 million each year.
- About 200 million people will move to cities in the coming 15 years.

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2) How to avoid the traps?

- Slums

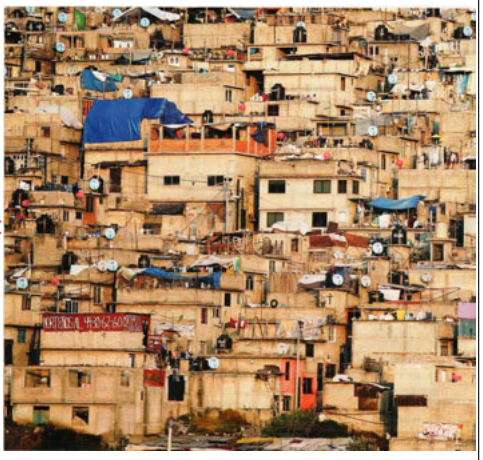
  Mexico , India
- Safety

  Johannesburg
- Pollution & Trafic Jam

London (19th century)

Kawasaki (1960s)

Beijing (now)



slums in the outskirts of Mexico City

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3) The city we want

- In China, most buildings of 40 years ago have been toren down. There must be a mistake between our forefathers and our generation.

  Q1: Are we going to repeat it after 40 years?

  Q2: How many Chinese cities can endure the test of history to be world famous like London, Paris, Prague and Florence? It is a huge challenge for our urbanization now.

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- Prof. Daniel Bell from Canada wrote in Global Times, April 10, 2012:
  - Chinese cities copied the Soviet model for 30 years, then the American model for another 30 years. These might be the worst two from the architectural perspective.
  - China should spend more time, money and efforts to protect the uniqueness of its cities to avoid homogeneity induced by globalization.
  - Cities must protect their unique culture & environment, such as Hangzhou.

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4)Three topics are focused on city planning and iCity building

a) The relations between economic development, science and technology progress, culture, management and planning of a city(Xu Qingrui, Wang Yingluo, Wang Zhongtuo)

b) Spacial organization model, intelligent transport and logistics (Zou Deci, **Wu Zhiqiang**, Shi Zhongheng)

c) Intelligent buildings and housing (Jiang Yi, Sun Yu, Ni Weidou)

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2.Economic and Industrial Development of iCity

Sound economic development is the main mission of Chinese Mayors.

- economic development in cities is the essential solution for various social problems in China. Therefore it is the main focus of the Mayors!
- What is that our Mayors are interested in ?

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1) How to develop the main industries of the city?

- Top 4 industries of China' s export (2009)
  - mechanical and electrical products: USD 536,9 billion
  - textile products: USD 161,4 billion
  - metalware: USD 77,1 billion
  - furniture and toys: USD 72,2 billion
- e.g. the textile industry , 30% of world exports come from China. How to improve the products?

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2) How to promote emerging industries?

strategic emerging industries may come from the following sectors:

(1) Information industry: chips, internet, smart technologies;

BNIC: integration of information technologies with biological, cognitive and nano technologies

(2) Biomedicine: vaccine, drugs, diagnostics and equipment

(3) Materials: information materials, high performance structural materials, biomedical materials, frontier materials

(4) Energy: efficient clean energies, smart grid

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(5) **Agriculture** molecular breeding, bioreactor

(6) **Marine science** marine exploration, transportation, biological resources, ecosystem and environment

(7) **Environment** protection, monitoring and cyclic use of water, land and air

(8) **Manufacturing** smart manufacturing, sensors, smart diagnosis

(9) **New energy vehicles** battery, engine, electric control, vehicle structure

(10) **Modern service industry**

Emerging industry? Subversive Technologies? Innovation Products?

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3)How to embrace the new technologies & the industrial revolution?

- many scholars say that the numerous new technologies may drive forward the 3rd industrial revolution ("industry 4.0").

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- **smart manufacturing** 3D printing can, by using computers, laser and powder metal or plastics, print out complex components like hip joint, teeth and airplane parts.
- **The internet** brings together innovation capacities, to connect the designer, maker, consumers, market managers together, and are bringing huge business opportunities and radical changes of society.
- **big data** large scale of data and their processing will enable new services & new market.

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4) Three topics are focused in city economic and industrial development

a) smart manufacturing (**Wu Cheng**, Sun Youxian, Xu Zhilei, Wang Tianran, Zhong Zhihua, Li Bohu)

b) smart grid and energy (**Yu Yixin**, Cen Kefa)

c) smart business and finance (Zhang Yaoxue)

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3. Information infrastructure of city

Three aspects

1) sensable city: sensors for traffic, fire control, environmental protection; smart meters for water, electricity and heating.

e.g. By 2015, Beijing will achieve sensable road 90%, environment 95%, smart electric meter 98%

2) next generation Internet

upgrade information infrastructure : Internet (broadband, ubiquitous, mobile)

e.g. Beijing's 2015 plan

residential area: 100M

community and business: 1G

key enterprises: 10G

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3) Big data and knowledge services

- Discovering new knowledge from the city big data will give a huge benefit to the Mayor, CEOs, residents of the city

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4) 3 topics of city information infrastructure:

a) information network (Liu Yunjie, Zhu Gaofeng, **Chen Junliang**, Wu Jiangxing)

b) Sensors network & GIS(Ning Jinsheng, Wang Jiayao)

c) knowledge center and informaiton processing (Li Guojie, Liu Yongcai)

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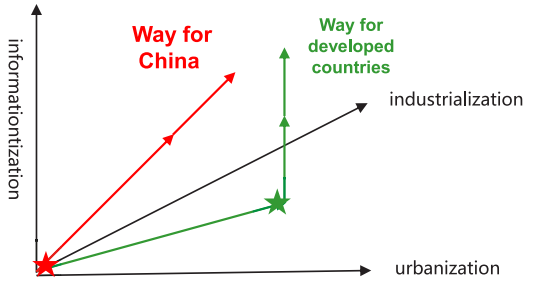
4.Uniqueness of iCity in China

- 3 Coordinate axes respectively represent informationtization, urbanization and industrialization, and China will choose a way other than US and Europe



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III. Conclusion

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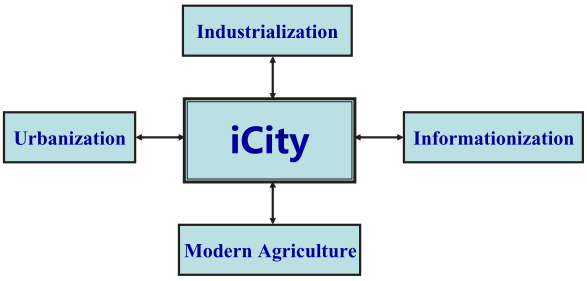
1. iCity is important, for it is interacted with industrialization, informationization, urbanization and modern agriculture development in China.



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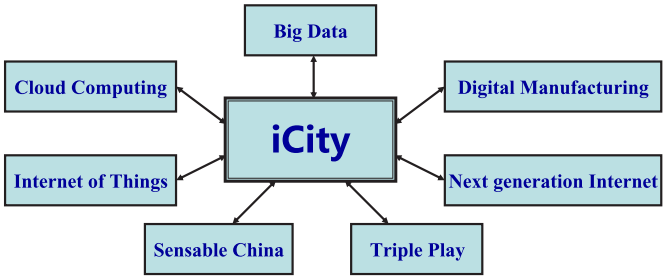
2. iCity creates huge potential for IT development, providing platform for integration of new ICT technologies.



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3. iCity also fits the management structure in China. With strong administration capacity, China city will push forward fast and sound development through iCity.

iCity is the right idea at the right place and time.

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Many cities in China, especially along the east costal area, have launched their iCity program and the IT companies are taking actions. The grand initiative shall exert huge impact in the future.

The initiative will not only benefit cities in China, but also the world!

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Thank You!

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2.2 Dr. Klaus Helmrich, Managing Board, Siemens AG, Munich

Talking about cities, talking about city management, talking about the gravity of a city is more than just an important topic. It is a movement in the world. It is a movement of many people to the city centres. In most of that we see a lot of challenges with regards to how to manage, how to organize, how to operate a city. Traditionally, cities were centres of arts, culture, trade, commerce and as well of science. Today, cities are more and more the centre of GDP growth and GDP development. In my function as Chief Technology Officer and Head of Siemens Corporate Technology I would like to cover in my presentation how we see the development, how we see the challenges and how we believe that ICT technology is a technology enabler to solve these problems.

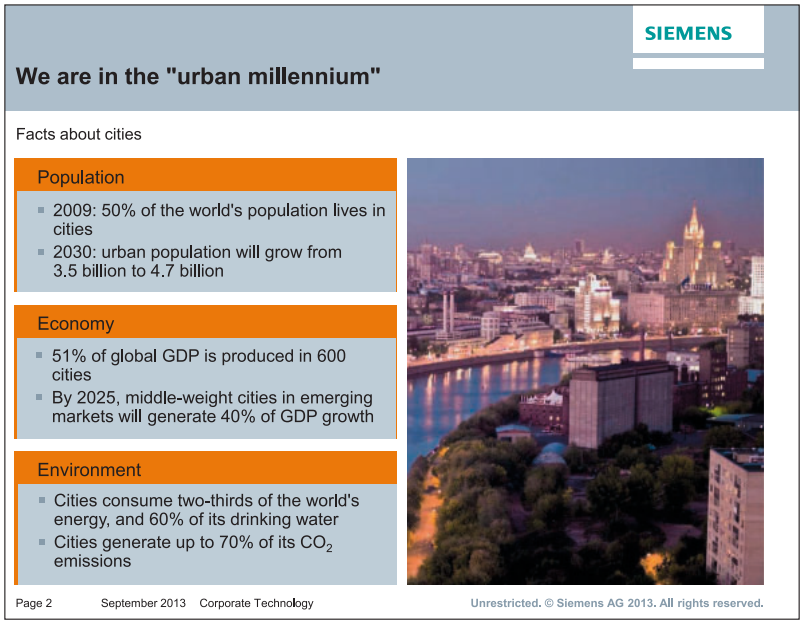


Figure 1

When we look at the current situation, how would we like to describe the expression 'urban millennium'? – Because already in 2009 50 % of world population lived in cities (Fig.1). This was the first time in human history that we have this concentration. There is the expectation that in 2030 we will see an additional increase from 3.5 billion to 4.7 billion people. We come to the standpoint that the main drivers, the global GDP drivers are located in the cities. 600 cities in the world stand for more than 51 % of GDP.

By 2025 – and I will explain this in an additional slide – we will see an additional growth of cities by 40 % in the world, which means that the environment, the hunger of a city is enormous. So, 60 % of the drinking water is consumed by cities. 70 % of CO_2 emissions are related to cities and $^2/_3$ of electrification and electric energy are consumed by cities.
So, cities are the gravity centres in the world.

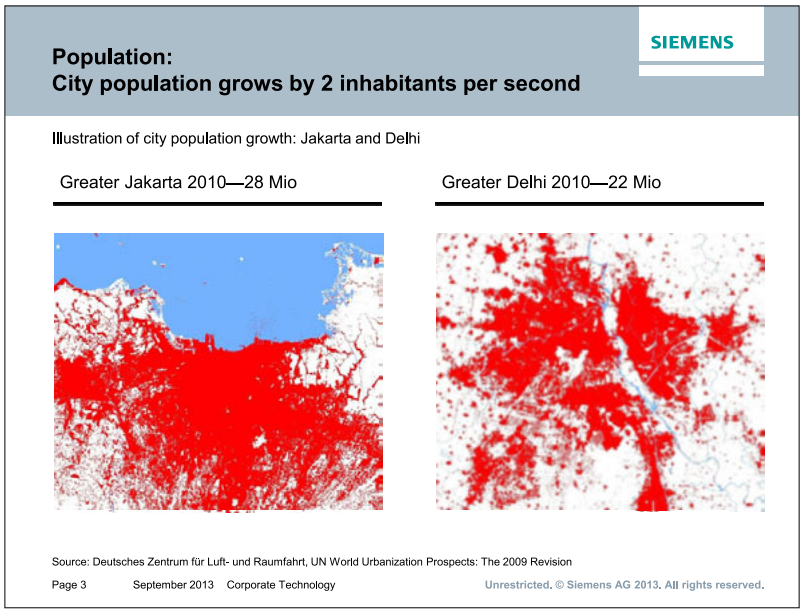


Figure 2

I will illustrate this with a picture (Fig. 2) of Jakarta and Delhi and the greater areas surrounding the cities: As you can see, Jakarta was home to 12 million people in 1975. Delhi had about four million inhabitants in 1972. Please, look at the landscape. In 1990, we see 17 million people living in Greater Jakarta – and more than 10 million in Greater Delhi. In the year 2000, Greater Jakarta had 21 million inhabitants, Greater Delhi had 16 million. And until 2010, the population further increased to 28 million or 22 million respectively.
Do you believe that this is one city? Do you believe that you can grow it, that you can control it like Munich? In don't believe that. This is a complete different set-up. You need to organize a structure like that.

I will make a comparison: I compare this structure with a company. If you as CEO run a company, and the company has a revenue of one million, compared to a company with 100 million – the main difference is the organization structure and your IT system.
The IT system provides you with the capability to be market leader in the one million area, or in the 100 million area. So, ICT is a key enabler for a company. I personally believe that ICT is the strongest enabler to run, to operate a city.

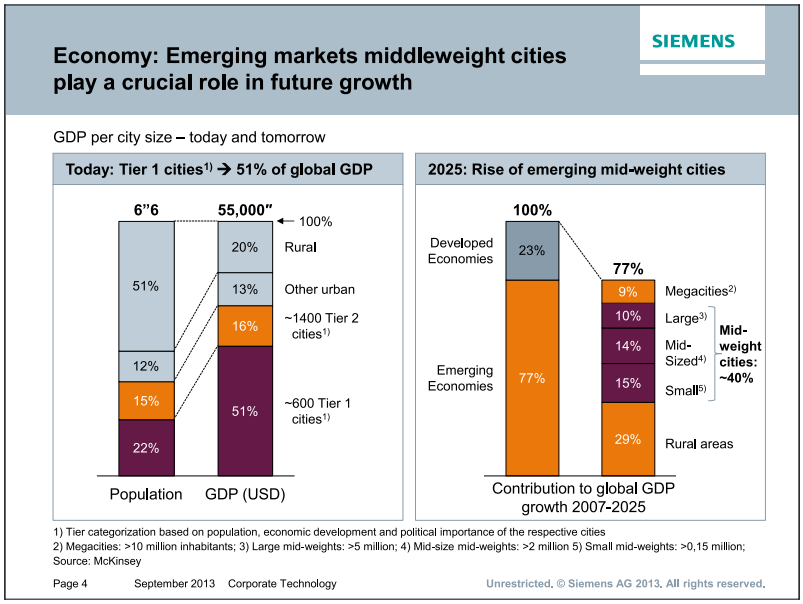


Figure 3

Here are the facts (Fig. 3): 600 – and I am looking here for the GDP – Tier 1 and 1,400 Tier 2 cities together stand for more than 60 % of GDP. On the right hand side we see this 100 % divided into developed economies and emerging economies. This is an interesting aspect. You see on the right hand side that in the future, in 2025, the expectation is that megacities with above 10 million inhabitants stand for 9 % of the growth. But more than 40 % of the growth will be generated by large, mid-sized and small mid-weight cities. So, there is an additional movement in cities, which we describe as mid-weight cities. Prof. Pan mentioned that within the next 15 years 200 million additional people will move from the rural world to the cities. You can also compare this with a number from India that I have in mind – in both cases the numbers are impressive: 30 people per minute are moving to a city in India, which means more than 15 million in one year. This is very comparable to your number in China.

Now, I want to compare this with the number inhabitants of Bavaria – which is 12.5 million. When you compare the movement from your rural areas to your cities, it is more or less equal to the entire population here in Bavaria. So, the solutions to run, to operate a state like Bavaria might be different as you run a megacity or an environment like yours in China. What I would also like to state out for the colleagues from Germany is that the picture, the necessity in China is completely different.

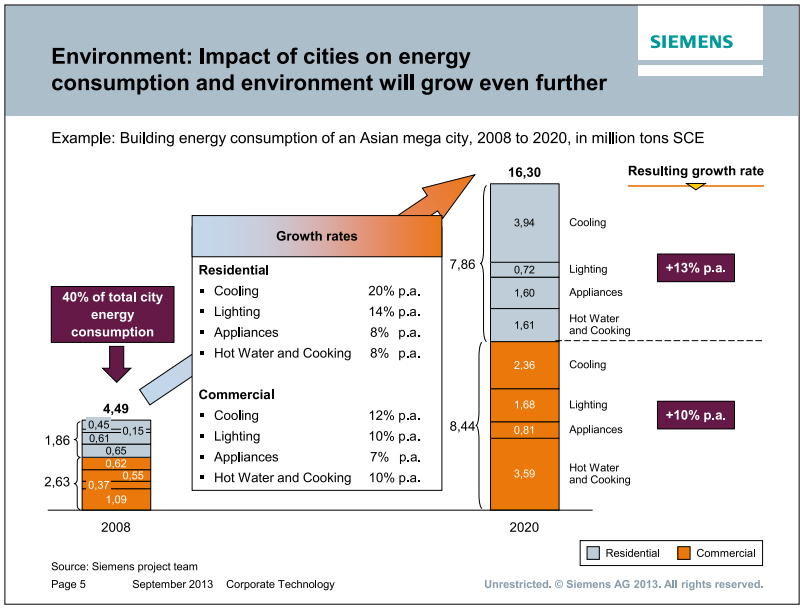


Figure 4

Here you see a picture (Fig. 4) about the consumption and the development of consumption of electricity. The picture clearly reflects how significant buildings are for a city with regards to energy consumption. It is an example of a Chinese city. We made this study. I will not name the city but it is an original number of a Chinese city. 40 % of the city's energy consumption is related to buildings – residential and commercial buildings. The growth rates – you see these in the middle – are very similar in both the residential and commercial area. In average, the expectation is that we have a higher increase in the residential buildings of 13 % and of 10 % in the commercial ones. This shows that with the quality of life increasing in the residential areas, the distribution of cooling, lighting, appliances, hot water and cooking increases as well.

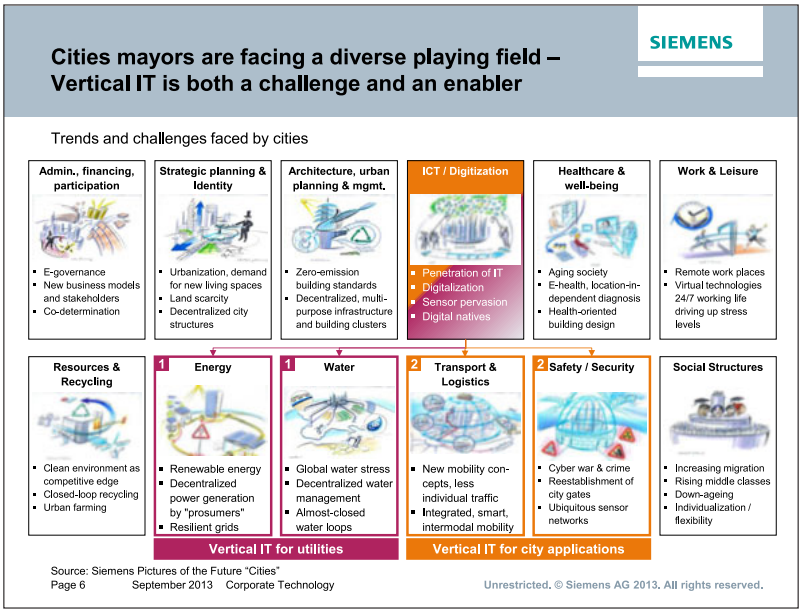


Figure 5

And this movement, the use of electricity, is going on (Fig. 5). There is also a need for how to optimize, to run a building in terms of efficiency. The movement is driven by more inhabitants and higher quality of living standards.

Siemens did a study and called the approach 'picture of the future'. It is very similar to your 'requirements', Prof. Pan, what a mayor in China is expecting to run a city. Looking at ICT there are a few fundamental elements you have to provide to be attractive as a city. You need energy, water, an optimized transportation and logistics system and you have to provide security and safety to the inhabitants. Otherwise, you will not be attractive for people to live and to work inside your environment. All other things are additional. You have to provide work and leisure. You have to bring culture —to run museums or opera houses, for instance. Thus, the four elements I mentioned before are the main pillars to run a city. To organize the whole is a clear technology oriented driven approach. ICT is for me the only way to organize it in a very efficient and ingenious way.

The question is always – and we have this debate in many cities and regions: Who is financing the entire infrastructure, who is paying for all of this, and who is using, running and operating it in a very efficient way? These stakeholders will own this environment in the end. Let me come to the importance of electricity. What can you do if you have a blackout in your city? Nothing. The elevator stops, is out of order. You cannot cook. You have no water. You have no access to any data, because the data centre is also breaking down. So, energy is the lifeblood of a city – and of the world as well. If we cannot provide a reliable energy system in a city, nothing will be working. You have chaos inside the city.

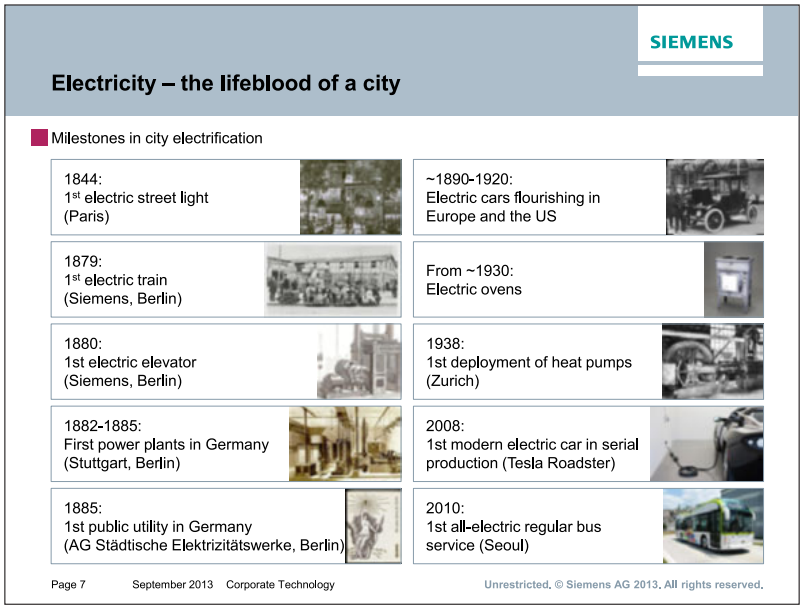


Figure 6

You see here about the development of electricity that electricity is moving forward step by step over the years, over the centuries into the applications inside a city (Fig. 6). It started in the 18th century with the electrification of the street lights. Now we are running busses, coaches, subways, trains. I expect that we will see in a few months and years even more e-cars on the streets in China. Infrastructure providing additional energy is important to optimize your traffic flow and to reduce your CO_2 emissions. This is also reality.

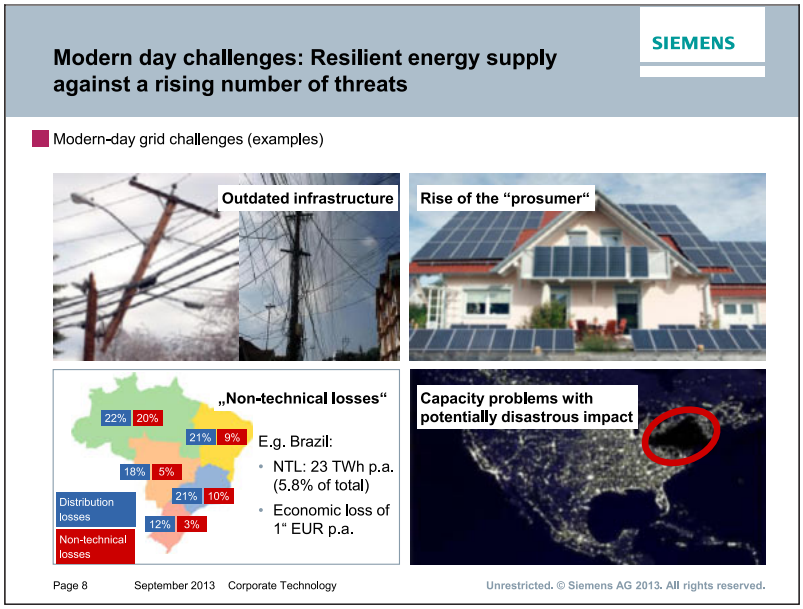


Figure 7

Here are four pictures, which I would like to describe as reality in the world (Fig. 7). In some parts of the world you have an infrastructure which is really outdated. In some parts of the world you have these wonderful houses, especially in Germany, which are not nice.
But it is very efficient that we have solar and wind. We have to integrate renewable energy into the grid system, into the energy system. Then we have capacity problems with blackouts for big areas in the world. Then we have something that we call ”non-technical losses”. These are users of energy, electricity who don't want to pay for it. This is a problem, and here is one example in Brazil. Brazil has 5.8 % losses per year, which is a damage of one billion Euros. If you are responsible for running this operation, you have a problem if you don't have this money back to finance your infrastructure and facilities. This is reality. But the point is that we cannot break down everything. We have to use it and to extend it with modern technology – and make it more efficient than it is today.

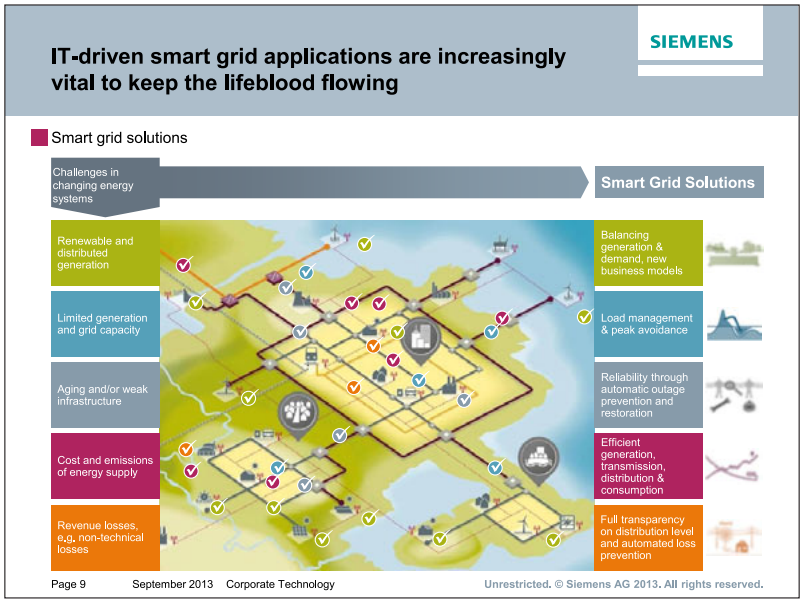


Figure 8

One solution that Mr. Pan mentioned as well is the smart grid solution (Fig. 8). But what do smart grids actually entail? Quite easy: Smart grids ensure balance between your demand and capacity, they optimize your way between the producer and the user, and they ensure complete transparency about your users. You mentioned your plans to develop Beijing with smart meters. So, this is only necessary to have transparency about what is going on. You need intelligent software, automation systems to control and to optimize your grid. It is a balance between generation, operation and the demand of your customers and users.
To do this you need a control system. You need proven technology, and you have to be able to ride the best software in form of an application on a platform. The platform has to be open because you have to integrate all the other players into the platform. And the platform has to be based on standards.

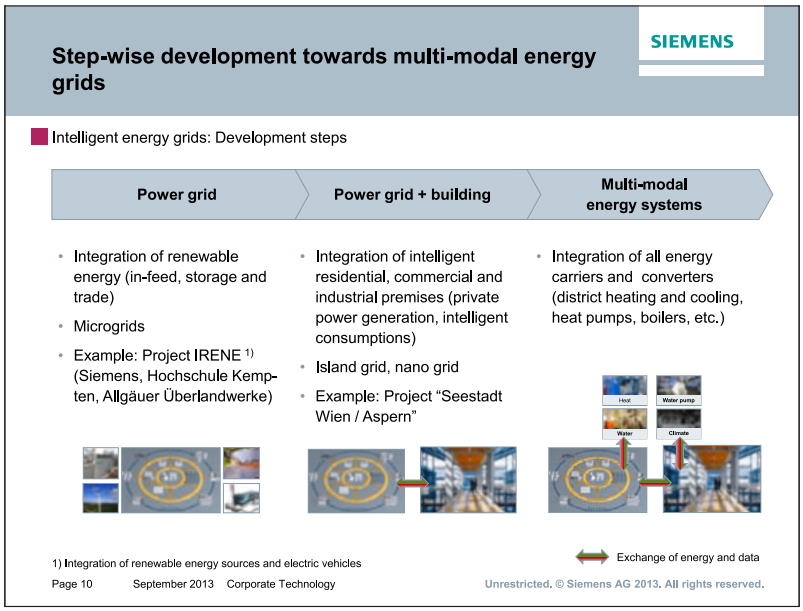


Figure 9

In my next slides I will show what we understand by a collaboration platform (Fig. 9). It is mostly a closed platform only to control one thing, for example a water system or a grid system. Regardless of which platform we talk about, smart solutions ensure the functioning of the system. But therefore, you need intelligent IC technologies. Based on that transparency you get with new technology the ability to use data. Data is now available. So, technology is storage, processor, speed – everything is here, the connection is there. The question is what can you do with all that data?

We are talking about how data can help to optimize a process, but also about how data can help to formulate and create new business models? How can you make additional service? How can you provide additional offers to your clients, customers and people living in a city environment? What we expect – and that can also be seen on the picture of Jakarta and Delhi I showed you before – is that we are in an ongoing process. The process is that we are optimizing the power grid mostly in the world, in-feed, storage, technology, micro-grid. Here in Bavaria, Germany, we have a wonderful example we realized together with the Allgäuer Überlandwerke. We have established a complete system, where we have renewable energy, storage, and we connect e-cars. We have a complete overview about the situation and the current usage of energy. How energy is provided into the grid, how much energy is used. Everything is optimized in a very efficient way. This is not only a show case. These guys are trying to find a business model to export this ingenious implementation to other cities and communities in Germany and in Europe

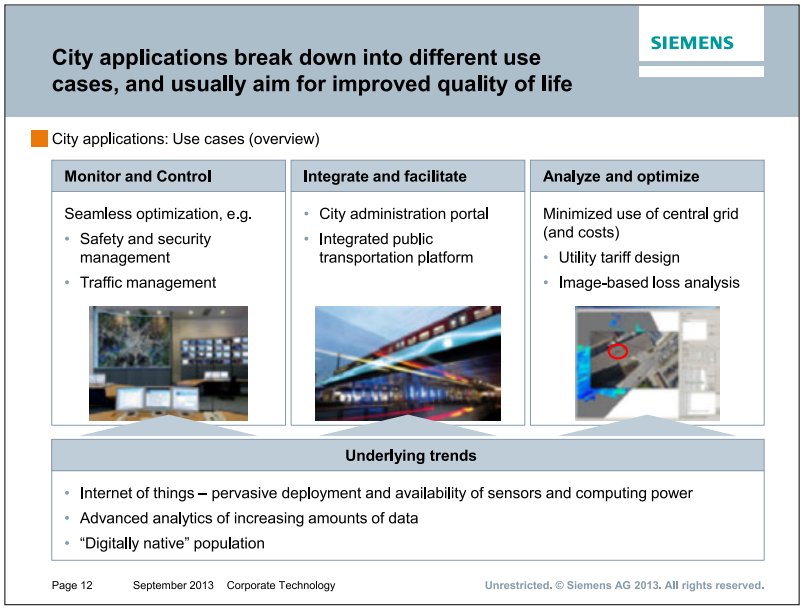


Figure 10

The next step will be a power grid and the integration of buildings (Fig. 10). I personally believe that – with regards to buildings in China as well as in the rest of the world – especially commercial buildings are reflecting more and more efforts to be independent in energy generation and also in the resource management, water, water treatment. But we have to integrate into our entire power grid system, and we talk about nano-grids.
I will show you one example in my next slide. We call it "Seestadt" and do it in cooperation with the City of Vienna. We have multi-modal electricity systems, where we integrate water, energy and in the end the sewage water for the houses and the commercial buildings. I am very happy that I can show you this wonderful example, which is a similar approach to a city in China: Tianjin. Tianjin started this initiative to become one of the best managed ecosystems in China. Here we decided to build a lab in the city. We worked very closely together with the mayor and the city on ingenious solutions to be more efficient, more enviable and more independent. This is a great opportunity for the city of Tianjin as well as for Siemens. We are very happy that we got the opportunity and the invitation to do this together with Tianjin society and responsibility managers on the government side. You see the same approach in Vienna. It is also targeting to be one of the outstanding cities in the world, and the mayor and the government of Vienna City decided to build up a complete new part of a city for 20.000 people. The idea is the integration of state analytics, the optimization, the balance between work and life in the city, to optimize user information and set up a completely new system by integrating all these wonderful things. Prof. Pan mentioned smart meters, internet and things like that to optimize the city and the way of living inside the city. The target of Vienna is to be the world-wide showcase for this kind of implementation.

The necessity for running the city in a very efficient way is monitoring and controlling, integrate and facilitate, and analyze and optimize. The underlying trend is exactly what Mr. Pan mentioned in his presentation: the way of how to use the technology of the internet.

It is how we use the data we can provide and the domain know-how. It is about the digital shadow of a building, a street, a transportation system, and about how we optimize it in a collaboration platform to be more productive, efficient and reliable.

Siemens provides one wonderful platform called Sieveillance (Fig. 11). Here we provide an entire approach for a monitor and control system to manage the invention forces of a city, the critical infrastructure like grids, like harbours, like airports, the corporate buildings and as well private buildings. Here is an ingenious platform to control and to monitor all the relevant elements, to provide the security of a city and to make sure that the inhabitants like to live in the city – in a very secure environment.

Figure 11

The next step I see on the technology basis is that we will have more integrated platforms. Here is one example from Siemens about integrated mobility platforms. I really want to elaborate here in a very detailed way, because this technology concept provides on the one side the integration of several providers for public transportation, taxis, cars, bikes, subways, trains. On the other side unified ticketing, trip scheduling and an open platform where a user can use his mobile devices to ask about the best way from A to B. He wants to have the fastest, the cheapest or the nicest one. Or he wants to know the best restaurant within the next 500 metres, or what are the best and cheapest connections during the night.

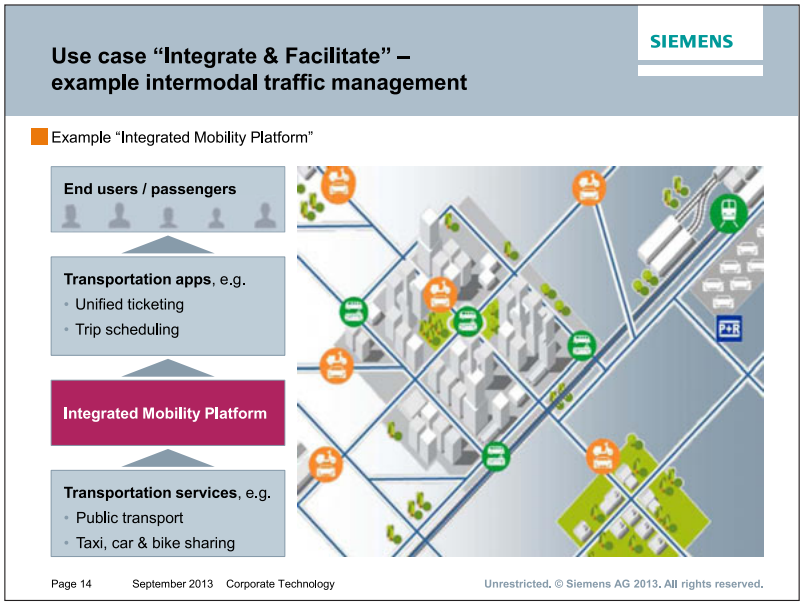


Figure 12

So, this is a platform, which manages the offers and is also open to bring additional value which is benefitting for the customer on these transportation apps, as we call it (Fig. 12). Based on these platforms – which we will see even more in the future – you need to coordinate who the owner of the IP rights is. You need to coordinate the flow of the money. You need to coordinate who is responsible for what. You need to coordinate the operation. You need to operate and to integrate different systems and different suppliers.

This is my final slide (Fig. 13). We believe that the only way to organize big cities and using ICT technology is by having unified data models and communication standards. It is necessary. It is a must to do it. Then we have to integrate all other stakeholders like power, water, traffic, transport, city administration and things like that. It is the only way to do it. I believe that this will be possible now because the technology is available and we have to integrate it in this way and have to talk to each other to make sure that we really need this data model and communication standards. Otherwise we will have single systems which are not connectivity based for other systems and we have to open up our structures so that we go for a city to manage and operate this technology in a very efficient way.

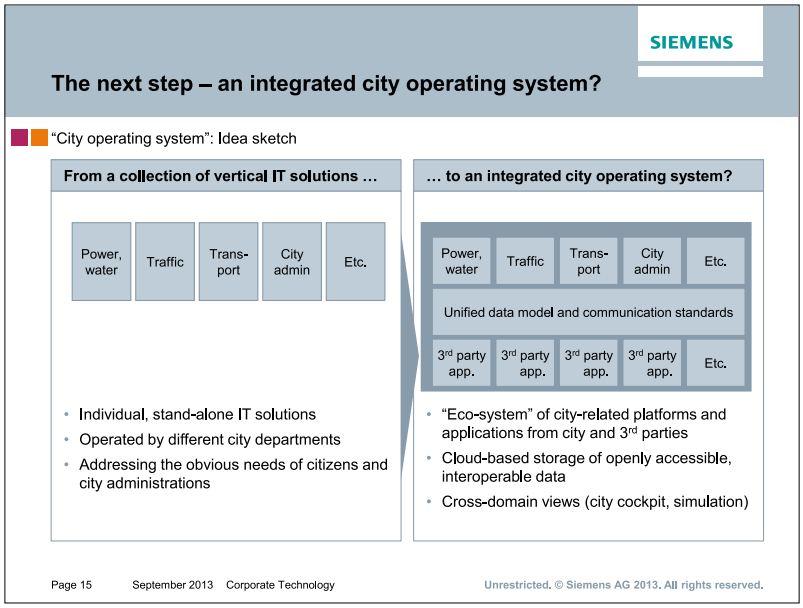


Figure 13

To sum up my presentation (Fig. 14): It is a fact we cannot ignore. Cities are growing around the globe. Cities are also providing hope for many people in the world for a better living standard, to get a job. This is also the reason for the growing of cities. The impact of cities on energy consumption will grow – this is a fact. The demands, the hunger for electricity will also grow, which is ongoing with initiatives to attract industry as well. This is reflected in the GDP growth related to the city areas. We all together have to make sure that we keep in focus the CO_2 development, that we use technologies which reduce CO_2 emission. I think we have many good ideas and many proven technologies, which help to reduce the CO_2 emissions.

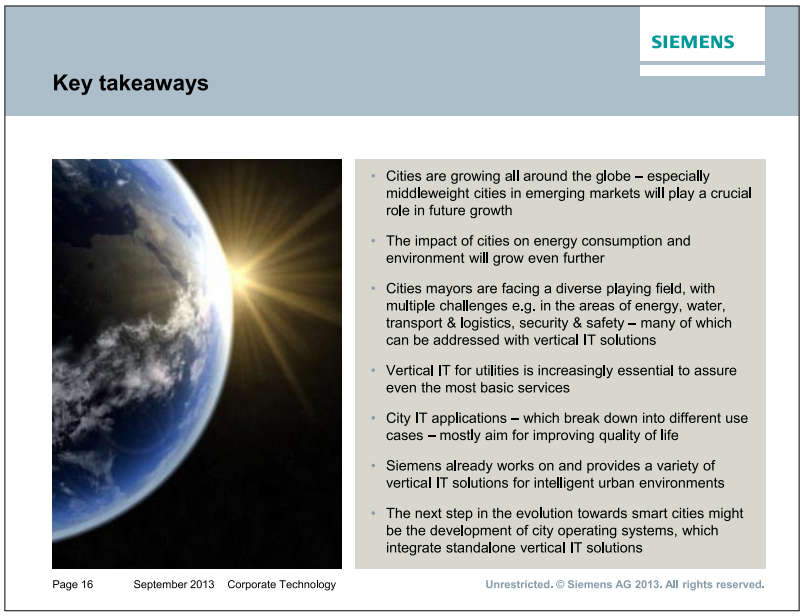


Figure 14

Vertical IT for utilities is for me the backbone to operate, to run the infrastructure of a city in a very efficient way. IT security in a city is an essential part. Otherwise we will not be attractive compared to other cities in the world, and I believe that every mayor wants to attract the best people in the world to develop the city, the standards, culture, and science. It is necessary to attract excellent people. Siemens is not only ready and prepared, but also has a clear focus on how to support this direction. I am very glad that you will have the opportunity to see tomorrow afternoon our labs at Munich. I invite you to visit interesting research areas, and I am sure that you will be convinced after that presentation that there are some good ideas how to manage a city by using ICT technology. The next step might be that we will operate based on more collaboration platforms.

3 An overview on City Smart Grid in China

Prof. Yu Yixin, Tianjin University

My talk is an overview of City Smart Grid in China. The content includes two parts.

> "A Smart Grid will be characterized by two-way floor of electricity and information to create an automated and widely distributed energy delivery network. It incorporates into the grid the benefits of distributed computing and the communications to deliver real-time information and enable the near-instantaneous balance of supply and demand at the device level."

This is the character of smart grid. I think this is the best definition of smart grid.

Part one is the needs and the requirements on city smart grids in China. I will introduce investigations on the needs and the requirements of city smart grids in China, which are based on statistics of the current operation states of primary power distribution grids of 40 large and middle sized cities, and finished by CAE and the Tianjin University.

It includes the following 5 parts:

1. Investigations on the practical distribution asset utilization
2. Investigations on the simultaneity factor
3. Investigations on the load compositions and characteristics
4. Investigations on reliabilities in urban areas
5. Investigations on distributed generations

Investigations were made on the practical distribution asset utilization in 40 cities. Two facts can be summarized from these investigations. The picture here shows the annual average utilization rates of major 10 kV equipments in 40 cities. The results show that the annual average utilization rates of the 10 kV feeders in 26 cities, which accounts for 72.5% of the 40 cities, is between 10% and 30%. The annual average utilization rates of 10 kV distribution transformers in 39 cities, which accounts for 97.5% of the 40 cities, is between 10% and 30%. The results are summarized as Fact 1 (Figure 1).

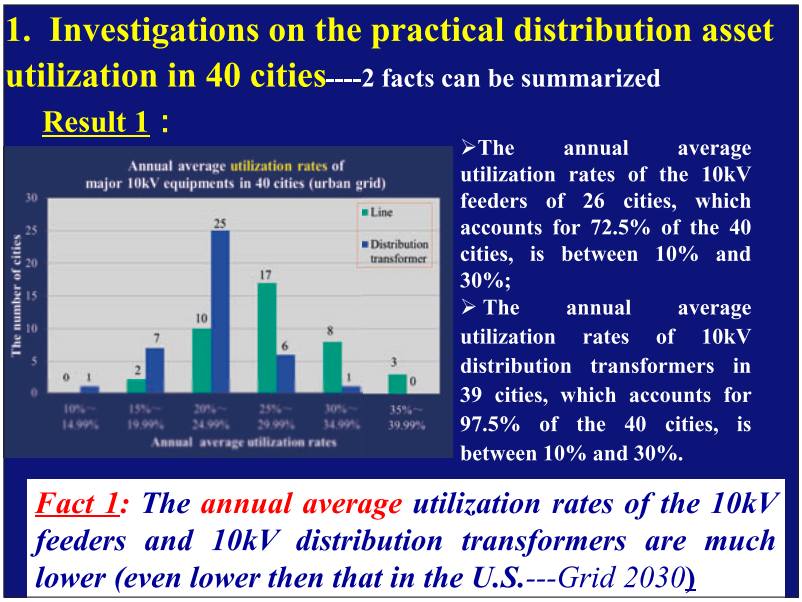


Figure 1

Fact 1: The annual average utilization rates of the 10kV feeders and 10 kV distribution transformers are much lower (even lower than in the United States, Grid 2030).

Result 2 is that at the city peak load time, the average load rates of 10 kV feeders in 36 cities are below 50 % and in 22 cities they are below 40%. And at the city peak load time, the average load rates of 10 kV distribution transformer in 38 cities are below 50 % and in 31 cities below 40 %. From Result 2 we have the Fact 2 (Figure 2).

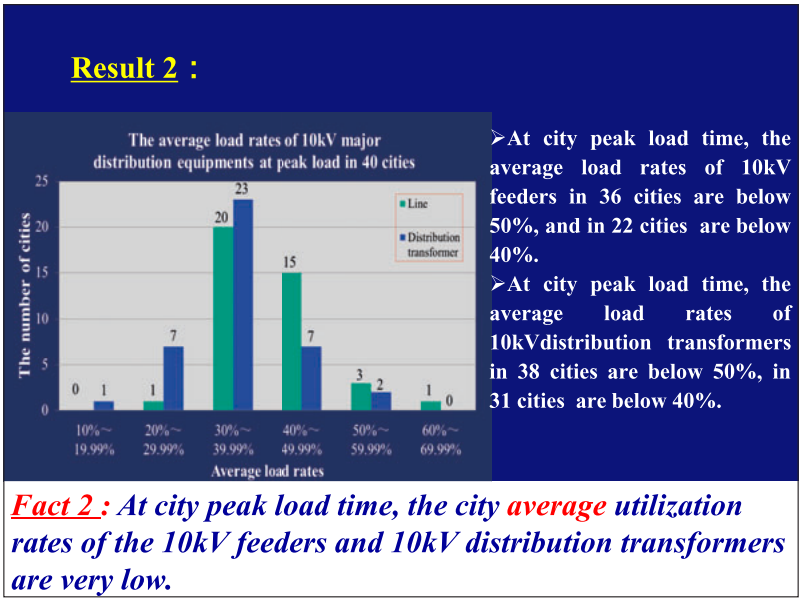


Figure 2

Fact 2: At city peak load time the city average utilization rates of 10 kV feeders and 10 kV distribution transformers are very low.

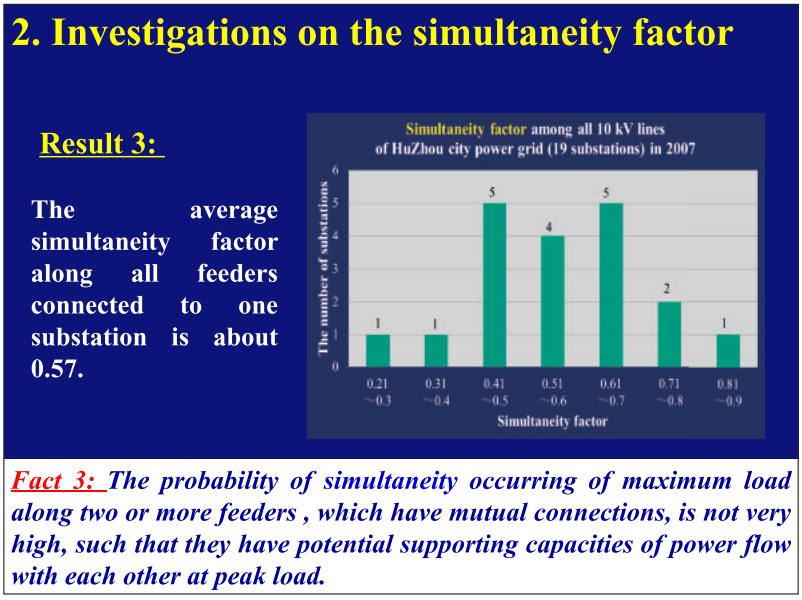


Figure 3

The second investigations are investigations on the simultaneity factor. The results are shown in figure 3. Result 3 is that the average simultaneity factor along all feeders connected to one substation is about 0.57. From Result 3, we can summarize Fact 3: The probability of simultaneity occurring of maximum load along two or more feeders, which have mutual connections, is not very high, such that they have potential supporting capacities of power flow with each other at peak load.

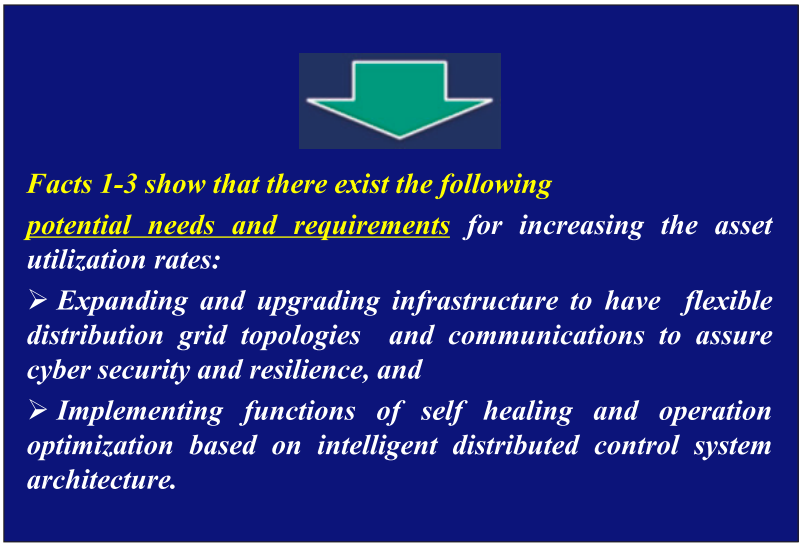


Figure 4

Facts 1–3 show that there exist the following potential needs and requirements for increasing the asset utilization rates (Figure 4). The first is expanding and upgrading infrastructure to have flexible distribution grid topologies and communications to assure cyber security and resilience. The second is implementing functions of self healing and operation optimization based on intelligent distributed control system architecture.

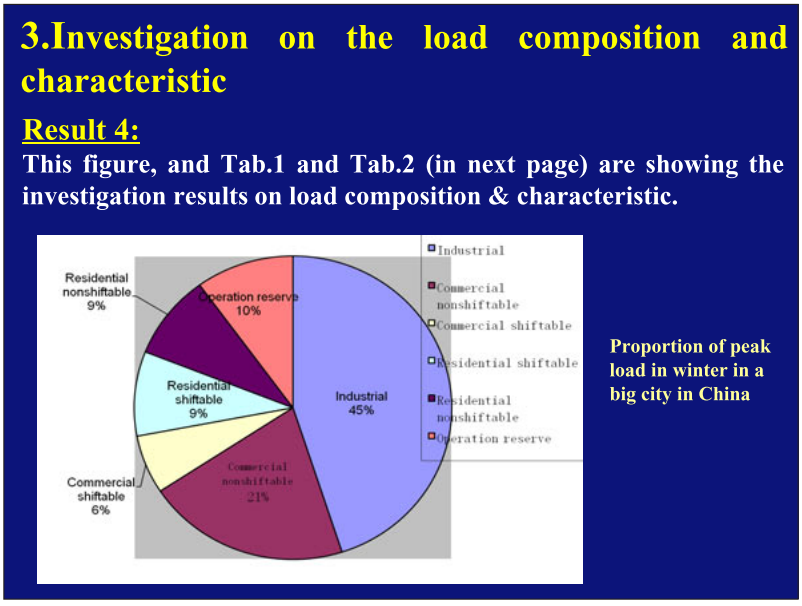
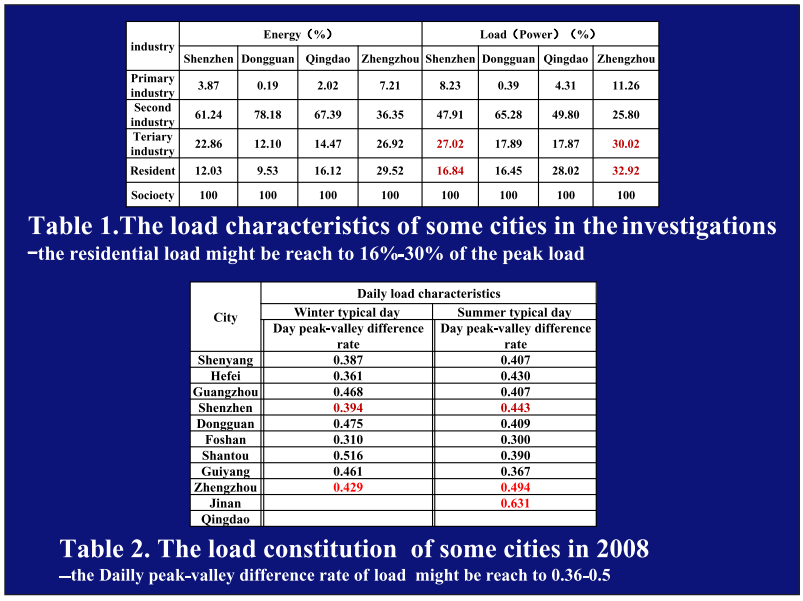


Figure 5

The 3rd investigation is on the load composition and characteristics. Result 4: This figure (Figure 5) and Tables 1 and 2 (Figure 6) show the investigation results on load composition and their characteristic. In Table 1, we see the load characteristics of some cities in the investigations. Table 2 is the load constitution of some cities in 2008 in China.



industry	Energy（%）				Load（Power）（%）			
	Shenzhen	Dongguan	Qingdao	Zhengzhou	Shenzhen	Dongguan	Qingdao	Zhengzhou
Primary industry	3.87	0.19	2.02	7.21	8.23	0.39	4.31	11.26
Second industry	61.24	78.18	67.39	36.35	47.91	65.28	49.80	25.80
Teriary industry	22.86	12.10	14.47	26.92	27.02	17.89	17.87	30.02
Resident	12.03	9.53	16.12	29.52	16.84	16.45	28.02	32.92
Socioety	100	100	100	100	100	100	100	100

Table 1.The load characteristics of some cities in the investigations

–the residential load might be reach to 16%-30% of the peak load

City	Daily load characteristics	
	Winter typical day	Summer typical day
	Day peak-valley difference rate	Day peak-valley difference rate
Shenyang	0.387	0.407
Hefei	0.361	0.430
Guangzhou	0.468	0.407
Shenzhen	0.394	0.443
Dongguan	0.475	0.409
Foshan	0.310	0.300
Shantou	0.516	0.390
Guiyang	0.461	0.367
Zhengzhou	0.429	0.494
Jinan		0.631
Qingdao		

Table 2. The load constitution of some cities in 2008

–the Dailly peak-valley difference rate of load might be reach to 0.36-0.5

Figure 6

The results are Fact 4 (Figure 7): The tertiary industry and the residential loads have enough potentials as shiftable load (grid friendly users) to help reducing the peak-valley load difference of power system.

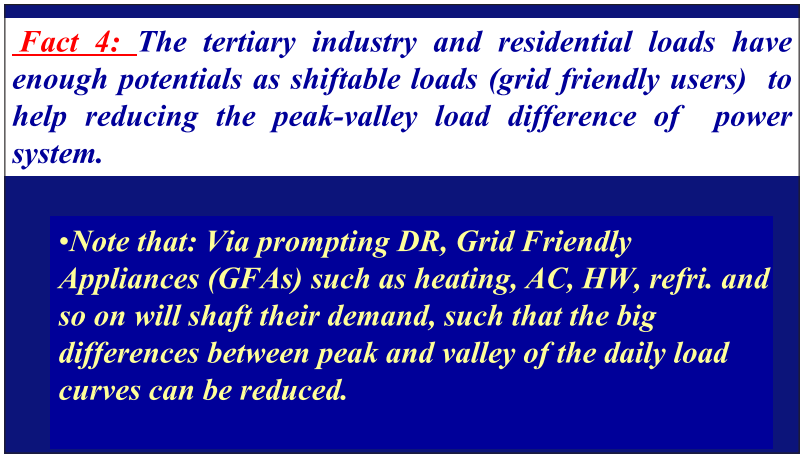


Figure 7

Note that: Via prompting demand response, grid friendly appliances such as heating, air conditioning, hot water, and refrigerator and so on will shaft their demand, such that the big differences between peak and the valley of the daily load curves can be reduced.

Figure 8

Fact 4 shows that there exist the following potential needs and requirements for active interactions between utilities and customers (Figure 8). We have to develop a mature, robust and well-integrated wholesale market and implement a device metering structure with developing smart tools and technologies to utilize demand response, the demand of load control and the electricity efficiency.

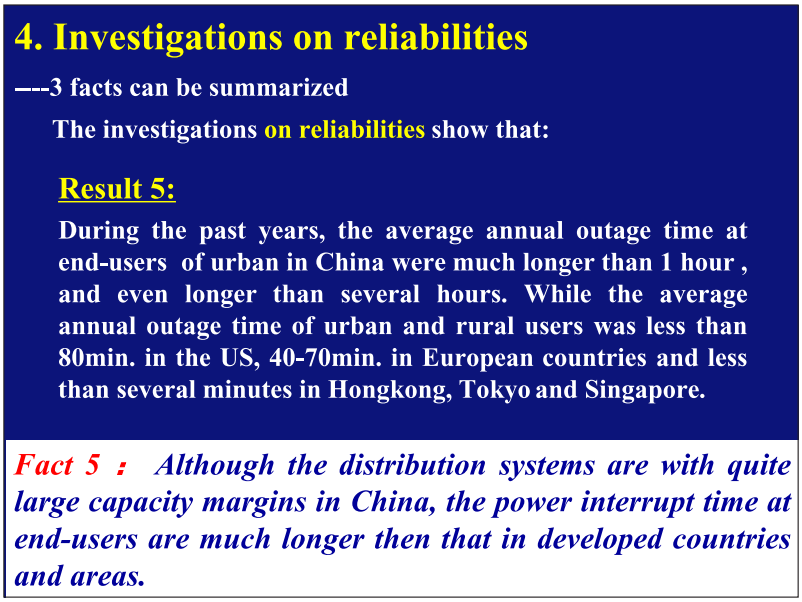


Figure 9

The 4th investigation is about reliabilities and three facts can be summarized (Figure 9). So, the investigation of the reliabilities shows the following.
Result 5: During the past years, the average annual outage time at end-users of urban in China were much longer that 1 hour and even longer than several hours. While the average annual outage time of urban and rural users was less than 80 minutes in the United States, 40–70 minutes in European countries and less than several minutes in Hong Kong, Tokyo and Singapore. Form Result 5 we have Fact 5: although the distribution systems in China are with quite large capacity margins the power interrupt time at end-user are much longer than that in the developed countries and regions.

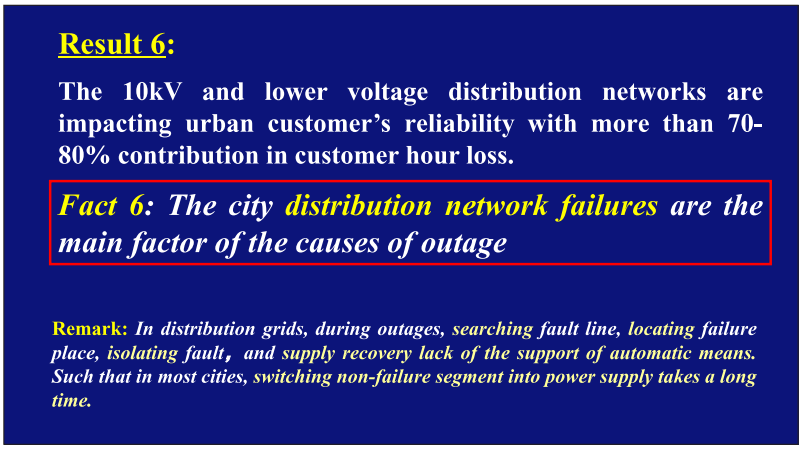


Figure 10

Result 6 (Figure 10): The 10 kV and lower voltage distribution networks are impacting urban consumer's reliability with more than 70 to 80 % contribution in customer hour loss. From these results, we have Fact 6: the city distribution network failures are the main factor of the causes of outage.

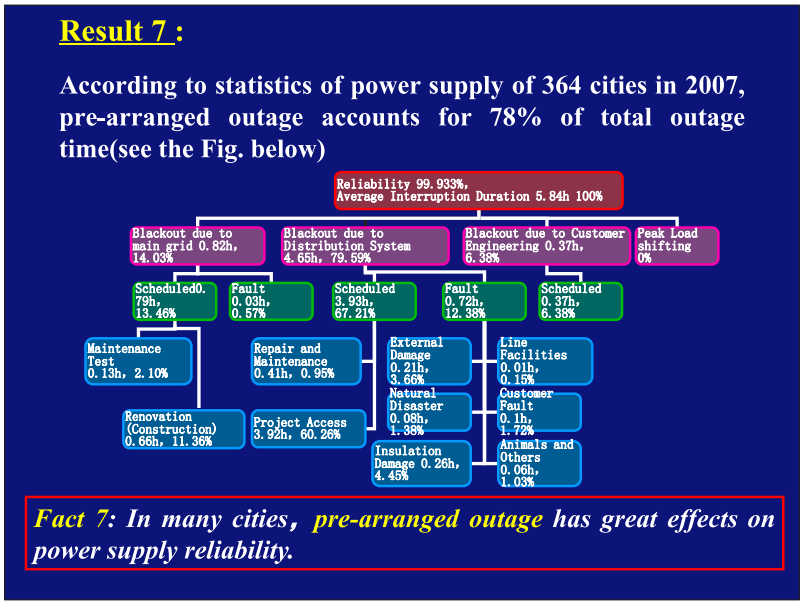


Figure 11

Result 7 (Figure 11): According to statistics of power supply of 364 cities in 2007, the pre-arranged outage accounts for 78 % of total outage time. From Result 7 we get Fact 7. Fact 7: In many cities, pre-arranged outage has great effects on power supply reliability.

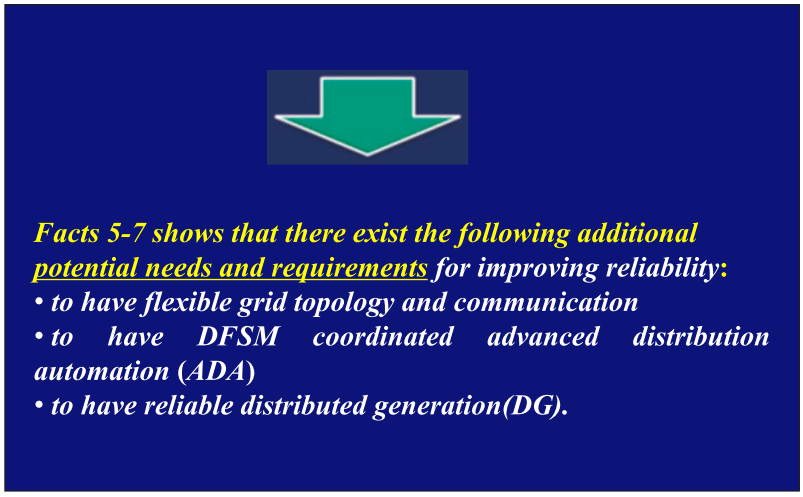


Figure 12

Facts 5–7 show that there exist the following additional potential needs and requirements for improving reliability (Figure 12). The first is to have flexible grid topology and communication. The second is to have DFSM coordinated advanced distribution automation.
The third is to have reliable distributed generation.

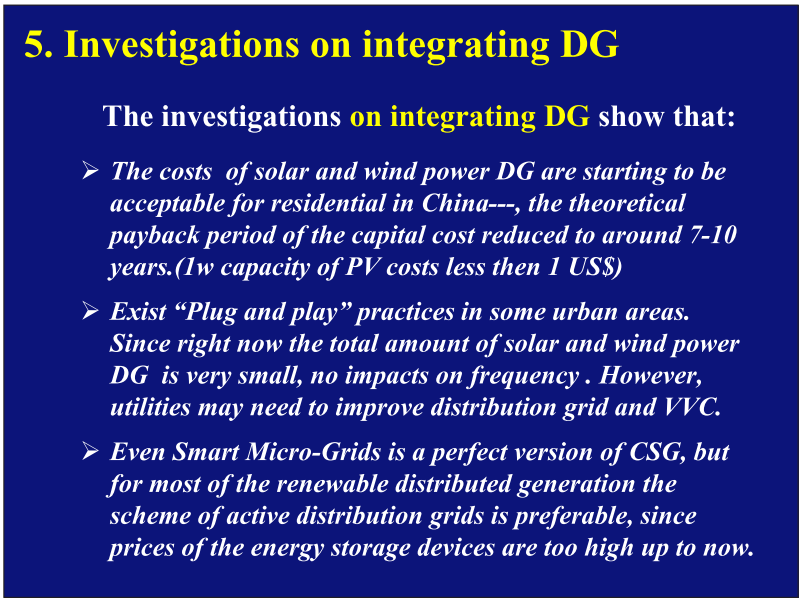


Figure 13

The fifth investigation is on integrating distributed generation (Figure 13). The investigations on integrating distributed generation show the following:

- The costs of solar and wind power distribution generation are starting to be acceptable for residential in China. The theoretical payback period of the capital cost reduced to around 7-10 years.
- There exist 'plug and play' practices in some urban areas. Since right now the total amount of solar and wind power distributed generation is very small and has almost no impacts on frequency. However, utilities may need to improve distribution grid and the wire and voltage control (?).
- Our investigations also showed that even smart micro-grids is a perfect version of city smart grid. But for most of the renewable distributed generation the scheme of active distribution grids is preferable since the prices of the energy storage devices are too high up to now.

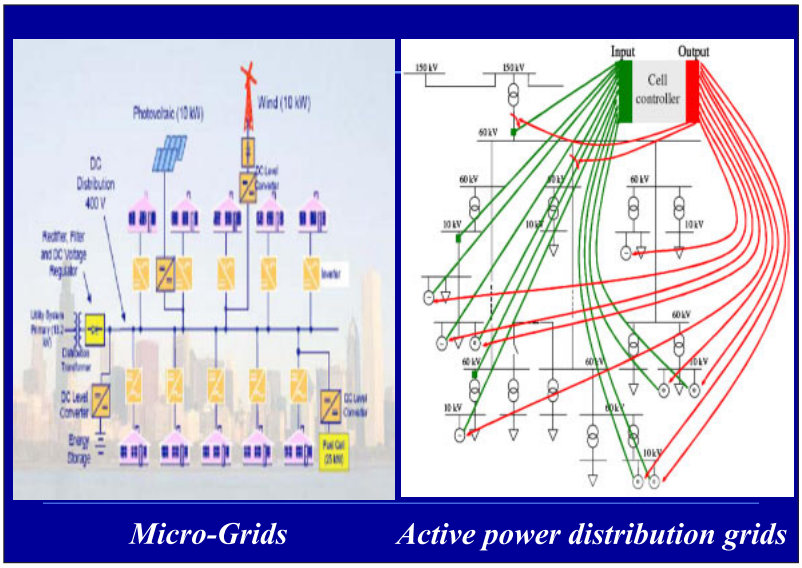


Figure 14

On the left hand side you see Micro-Grids (Figure 14) and on the right hand side active power distribution grid. The additional potential needs and requirements on research and development for integrating distributed generation are as follows (Figure 15 and 16):
First we have to develop standards and a protocol for the equipment performance, communication interoperability, distributed generator, interconnection distribution grid expansion as well as collecting and managing distribution operations data. Second, we have to develop models, algorithms and tools to optimize smart grid capabilities for system planning and operations in the presence of high uncertainty (higher penetration of variable output).

Figure 15

To sum up the above mentioned investigations, we made the following conclusions:
To increase the asset utilization rates, the electricity efficiency, and the reliability of city power grids as well as to integrate the increasing amount of the distributed variable output of renewable resources, city smart grids are needed in China with satisfying the above mentioned requirements.

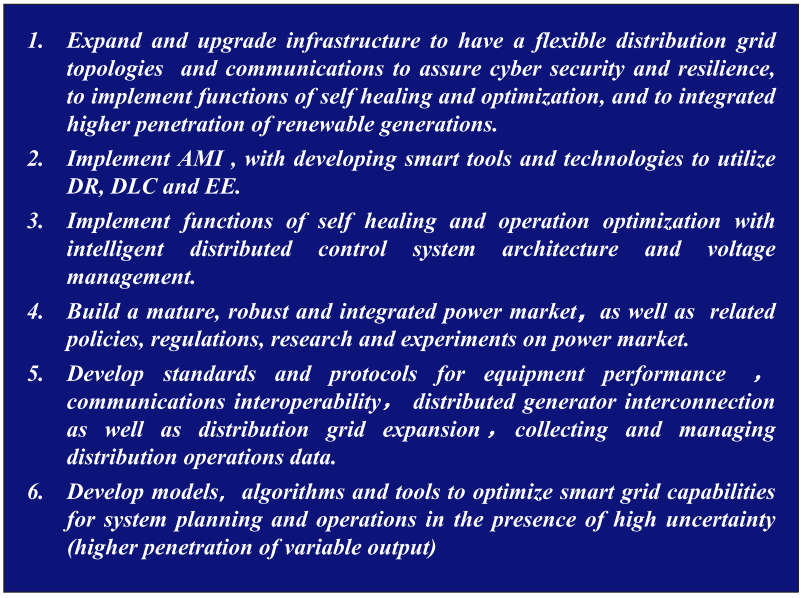


Figure 16

I now come to Part II of my presentation: considerations and implementations on city smart grid in China (Figure 17). While many interests and efforts on advanced transmission operations have been taken, other smart grids components such as advanced metering infrastructure, advanced distribution operations, and advanced asset management are emphasized as well in China.

Figure 17

The following table shows the investments of pilot projects related to city smart grids since 2009 given by the state grid company in China (Figure 18). This company supplies 80 % of the electrical power in China.

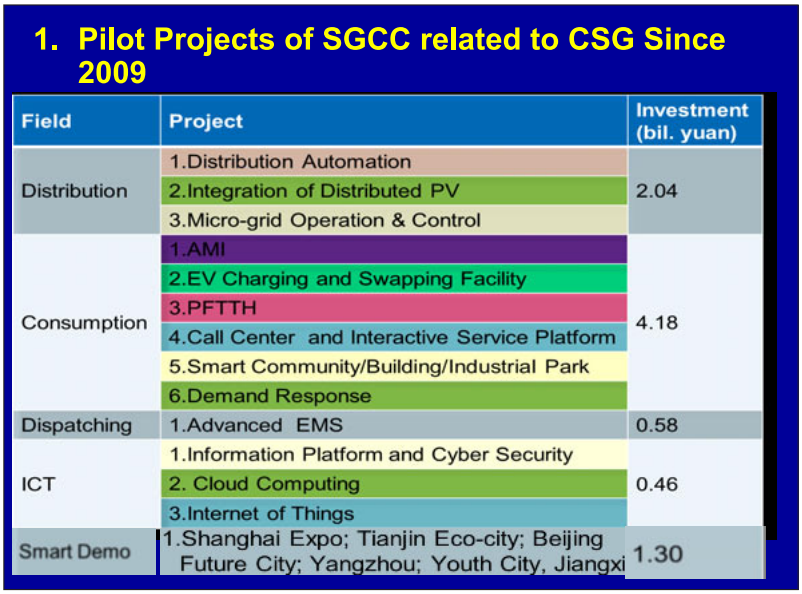


Figure 18

This table shows the pilot projects of the state grid company of China related to city smart grid since 2009 (Figure 18). The first column is the field that includes distribution, consumption, dispatching, ICT and smart demo. The second column shows the project such as distribution automation, integration of distributed PV, and micro-grid operation and control, and advanced metering infrastructure. The last column shows the investments made in billion Yuan. For example, since 2009, 2.04 billion Yuan have been put up for distribution.

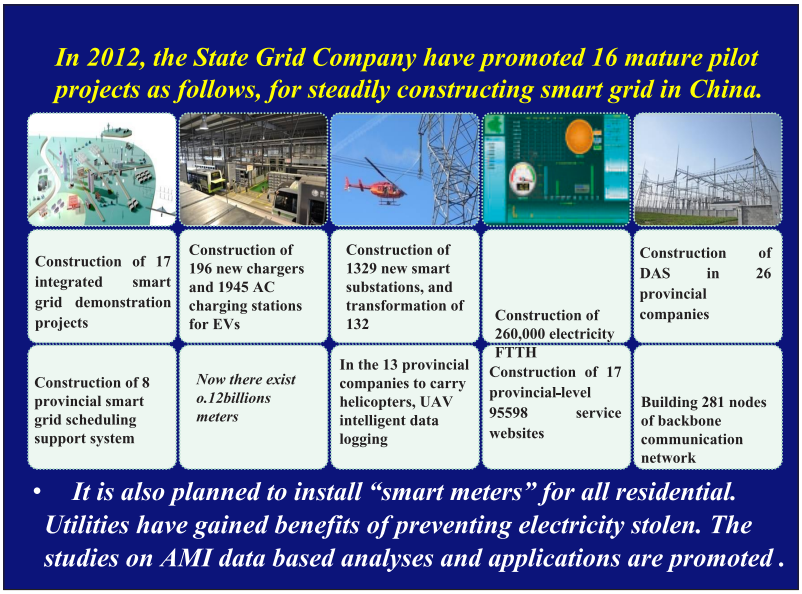


Figure 19

In 2012, the state grid company have promoted 16 mature pilot projects as follows for steadily constructing smart grid in China (Figure 19). They have now, e.g., 0.12 billion meters and it is also planned to install "smart meters" for all residential since utilities have gained the benefits of preventing electricity being stolen. The studies of advanced metering infrastructure data based analyses and applications are promoted.

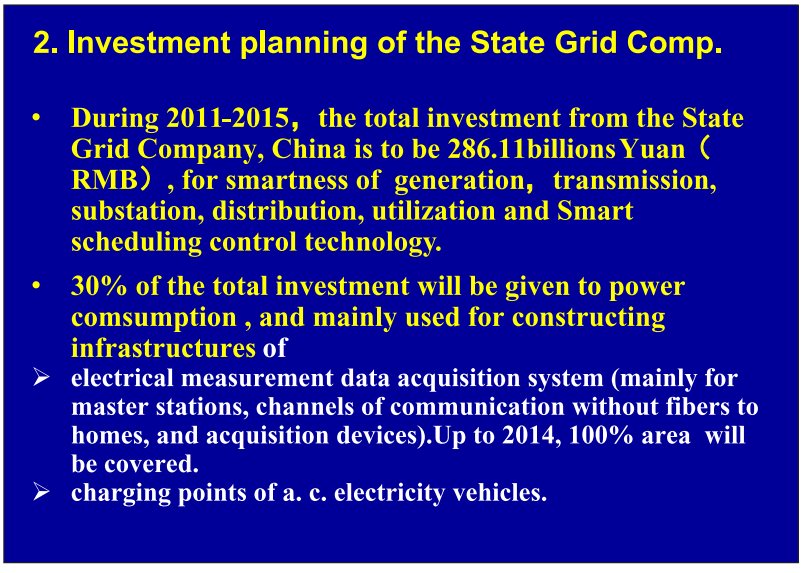


Figure 20

The second point concerns the investment planning of the State Grid Company of China (Figure 20). From 2011 to 2015, the total investment from the state grid company in China will be 286.11 billion Yuan for smartness of generation, transmission, substation, distribution, utilization and smarter scheduling control technology. 30 % of the total investment will be given to power consumption and is mainly used for constructing infrastructures of electrical measurement data acquisition system (mainly for master stations, channels of communication without fibres to homes and acquisition devices). Up to 2014, 100 % region will be covered. And the 30% of the total investment will be also used for the construction of charging point of a.c. electricity vehicles.

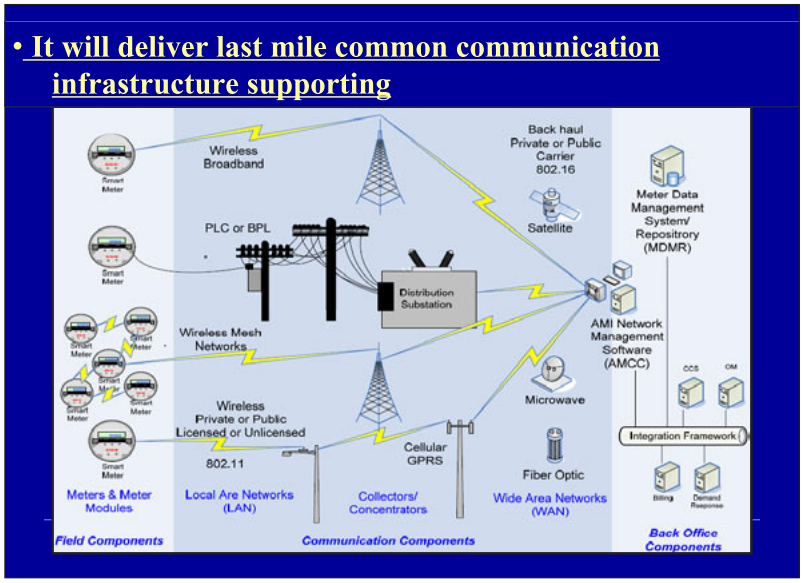


Figure 21

It will deliver the last mile common communication infrastructure supporting (Figures 21 and 22). Both the city smart grid as a whole and its communication system will act as mobility of ICT.

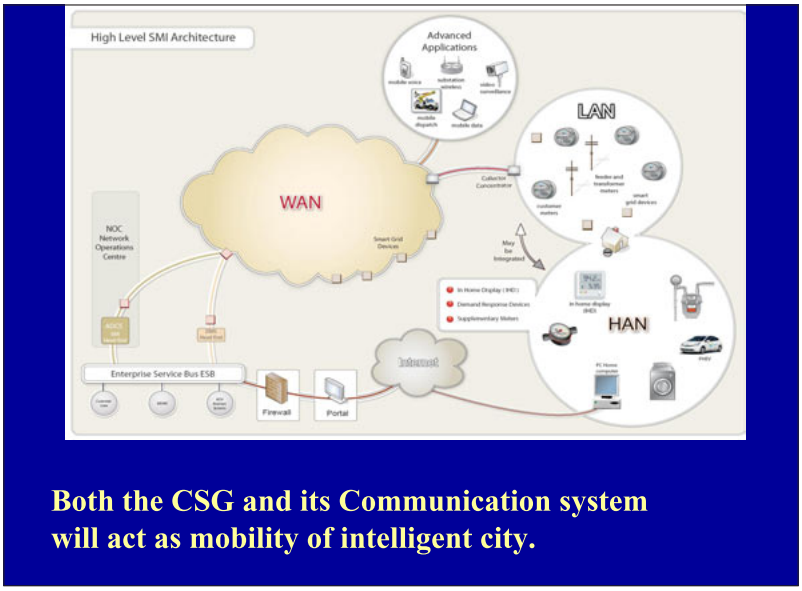


Figure 22

Here are our conclusions: City smart grid has been proposed in China to address those challenges that the existing electric grid is facing, such as increasing distributed renewable energy generation access, low asset utilization and low energy efficiency, a growing demand and reliance on digital applications. Both the city smart grid and its communication system will act as mobility of an intelligent city. The government and utilities have paid more attention to implement city smart grid. However, the emergent issues are to develop advanced markets and to realize the flexible ‘plug and play’.

4 Smart Grids for Smart Regions

Prof. Sebastian Lehnhoff, OFFIS – Institute for Information Technology, Oldenburg

First of all you might notice that I dropped a little bit of "hybrid energy" in the title, which allows me to present the work we have done within the acatech project group 'Hybrid Energy Networks' late last year and wrap this up. So, my presentation is two-fold. I will present the main outcomes, the modelling and the framework we build and set up in that project group. Then I will give you a little bit of an outlook of what we are doing in our OFFIS institute with that framework. Giving you a practical approach to the lengthy papers you would otherwise have to read and ask yourself about its purpose.

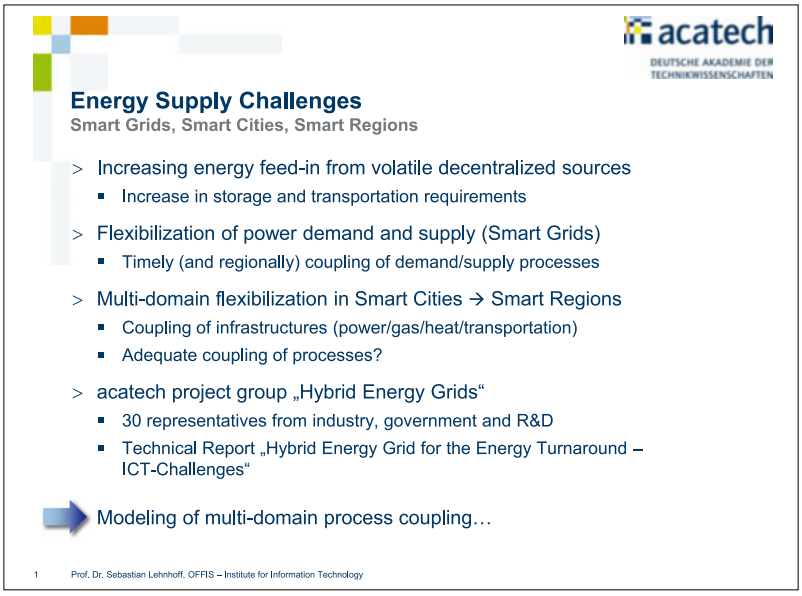


Figure 1

As Mr. Herzog already said, I had the pleasure of coordinating the acatech project group 'Hybrid Energy Grids' last year. Basically, the main challenge when we look at energy supply systems in the context of smart grids, smart cities, smart regions is the decoupling of demand and supply (Figure 1). Due to the volatile generation in such a system we don't necessarily generate the power when we need it, for instance when the sun is shining or the wind is blowing and not even necessarily where we need it. This increases, the need for storage and transportation. One solution of course is to build up storage and transportation systems and expand our transmission systems. The other way of course is to look at how to flexibilize the demand or the generation side.

We are looking at smart grids for a while now and focussing on the potentials of flexibilizing the demand side, how to shift the duty cycles of certain appliances within the industrial sector or the residential sector and aligning it more properly with the generation intervals.

But the question is: can we extend this further to other energy-domains? This is what we call the multi-domain hybrid energy systems. This morning we heard the term multi-modal systems as Siemens is calling it. We want to look at how we are able to couple infrastructures to processes of e.g. power systems and gas systems, gas and heat systems and might even take into account the transportation system as a sector, as a domain for intelligently coupling those processes in order to decrease the need for storage and transportation.

Late last year acatech founded the project group "Hybrid Energy Grids" directed by the acatech member Prof. Hans-Jürgen Appelrath with representatives from industry, government as well as research and development. We specifically wanted to look at the ICT-challenges connected with such a hybrid grid. This is related to a extensive study acatech has published, called 'Future Energy Grids'. Herein, a regulation framework 'Migration paths' have been identified to assess the complexity of the system but at the same time show the paths – the migration paths – in order to make technology decisions on the basis of targeted business and use cases.

The question was: can we – to a certain extend – use that methodology and extend this to further energy domains? How do we assess the complexity? What we first did is we came up with model, which is based on the energy value chain. You see the classic generation consumption storage value chain. How can we assess the complexity of what we want to do? In this depiction of the value chain, we want to achieve the balance of demand and supply as soon as possible. So, starting from a generation point of view we want follow that path and meet the balancing of the power supply and demand. How can we do this? Demand side management, virtual power plants, grouping small generation units into larger and more flexible generation unit or capacity. We have the possibility of integrating storage capacities. We have all those smart grid means and methods in order to decrease or shorten the way along that path/chain, starting from the lower point of generation untill we have a balanced system.

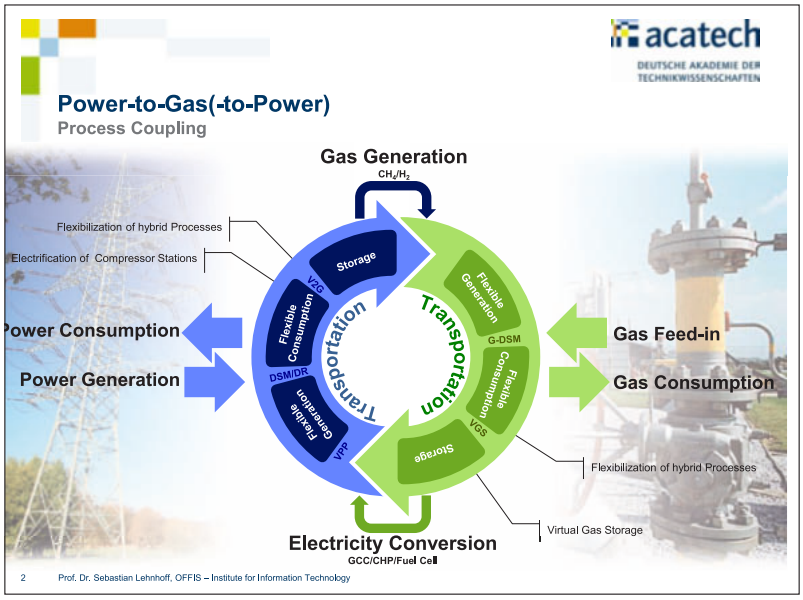


Figure 2

Of course then most of the time – and especially in Germany during high-wind periods – we have to curtail our generation because we do not meet and balance our demand of supply appropriately. What can we do? In Germany, there are several experimental power-to-gas-sites and so the question was (Figure 2): can we use this to connect the power system to the gas sector? Within this very basic example what we have here on the right hand side is the gas value chain. Similarly, in here we can flexibilize the gas demand side. We may virtually couple storages into more flexible gas storage systems. Of course we can go from one domain to the other domain through chemical processes. So, we have the gas generation through methanization i.e. we can produce hydrogen from electrolysis and use this to synthesize methane. Thus, we don't have to stay in side of the circle; we can connect the cycle down there through conversion processes. We can use the gas combined cycle or combined heat and power plants to close that circle.

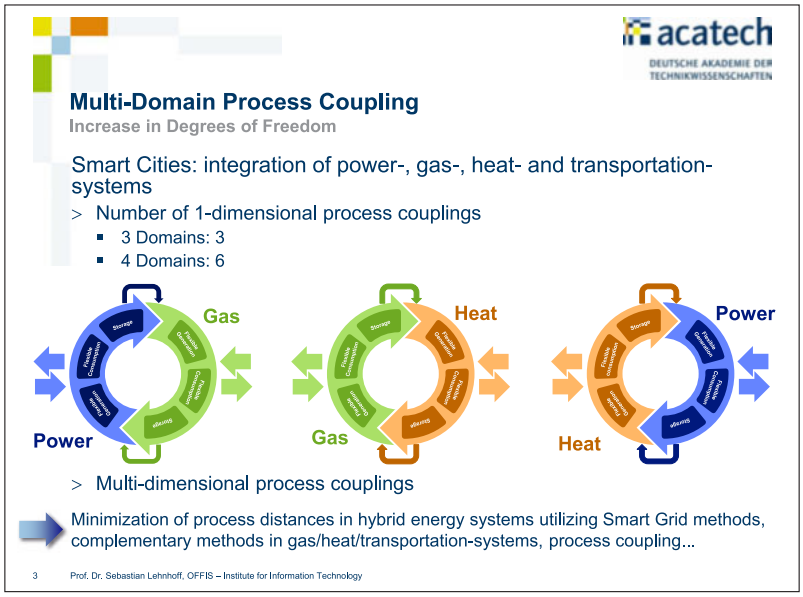


Figure 3

However, what is more interesting than those highly inefficient chemical processes to connect those two domains is what we call ‘hybrid coupling processes’, mainly through flexible industrial or residential processes that allow us to switch from one energy source to another (Figure 3). We looked at thermal industrial processes, melting processes, metal refinery processes. Here it is possible to go from an induction heater to a gas heater, so switch from energy to gas consumption. In doing this, we decrease the demand of the power system and increase the demand of the gas system, which is basically – if you balance it out – a conversion process on its own.

We can find the same thing in the gas system. That was our very first model and a way to assess how can we measure this. And of course we have transportation losses along the way that we somehow have to factor in.

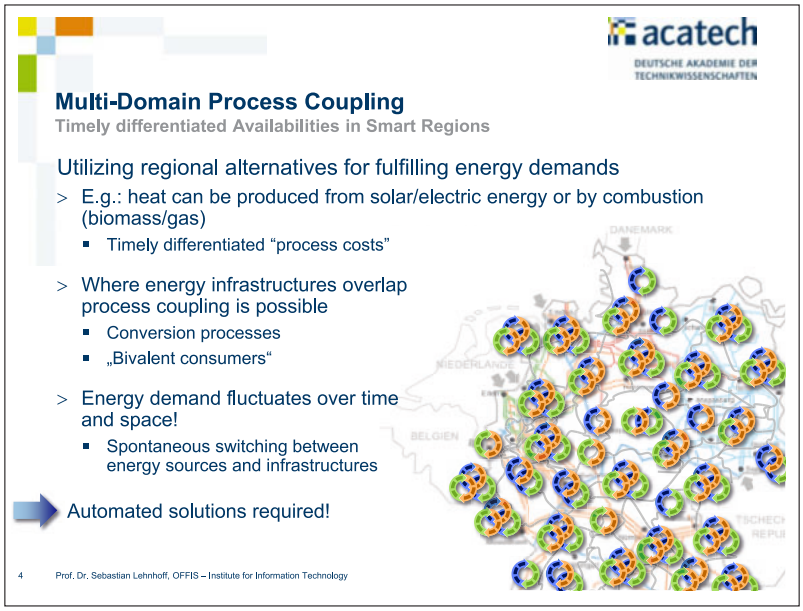


Figure 4

If we now want to incorporate heat and mobility there is of course more than one circle. Of course you could build this up and have a multi-dimensional circle (Figure 4). But I don’t know how that would look like. I brought here three more circles connecting the power to the heat system, the gas to the heat system and so on.

Just to give you an impression of how the complexity of this system increases when you start form the smart grid where you have your power processes, your consumption processes and try to shift them. Now you have flexibilities – degrees of freedom – going from one system to the other one. If we look at three domains we have of course three degrees of flexibility, with four domains we already get six degrees of freedom and so on. This grows over linearly. If we look at multidimensional processes and if we do not connect only two domains through one coupling process, our problem explodes and gets even more complicated. But I want to spare you the details.

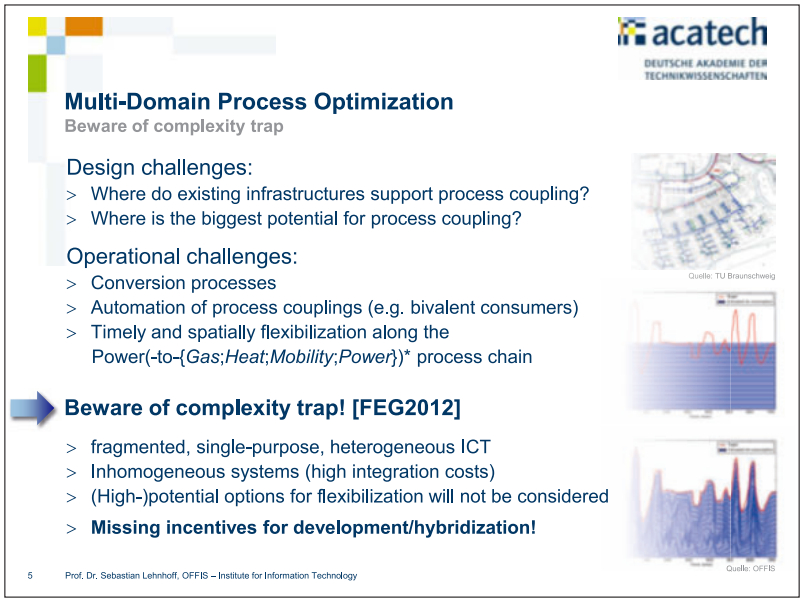


Figure 5

There is a problem in in handling the complexity of the model itself (Figure 5). But we don't just want to model the system we actually want to optimize the system. This morning we heard about operational optimisation but the problem has also a design perspective. First we have to ask ourselves how to assess those process couplings at certain periods of time, at certain places in our environment. We have to take that complexity into account even further. If we look at it this way not every process coupling is available at every place. Everywhere that a gas infrastructure system comes near to my power system doesn't mean that there really is a proper degree of freedom for connecting those two systems. But if we look very carefully maybe there are those thermal industry processes? Or perhaps I have flexible/ hybrid gas compressor stations that can be driven by power or gas and allow me to use those? We require automatic solutions for determining where and when to couple processes and domains.

When we look at the optimization challenges – we have the design challenges of course – where do the existing systems support those process couplings? What is the biggest potential? Then of course I have the operational challenges meaning I have to assess very closely the conversion processes that are already running. And if I have industrial processes I have to assess the flexibility I have connected with a certain industrial process because there has to guaranteed a certain goodness for the industrial process. There has to be product that is probably produced with that process. I cannot simply interrupt that process. I have to assess very closely and product specifically what is my flexibility at hand.

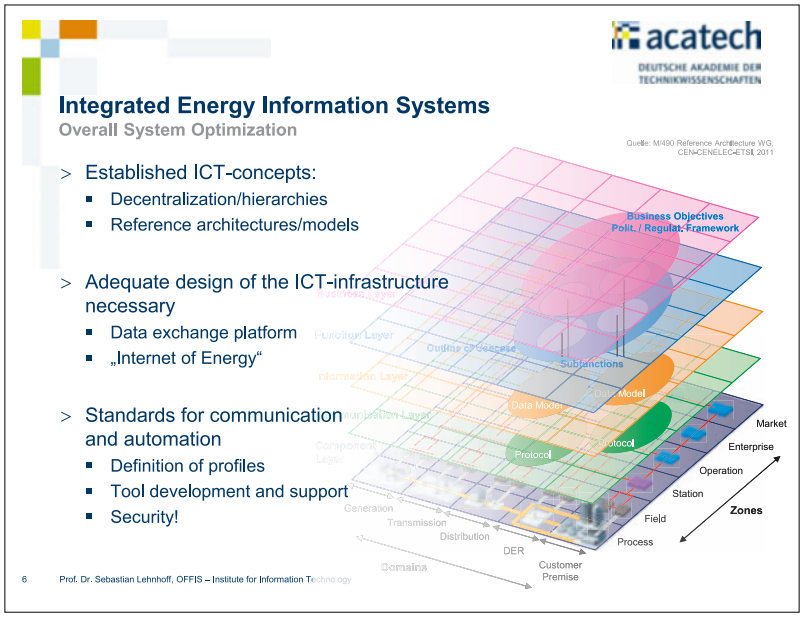


Figure 6

Now I have the time and especially the flexibilization for which I have come up with a model to decide when to flexibilize, when to do what operation within this power to gas/to heat/to mobility/to whatever possibly again connected to the power domain process chain. I already mentioned the future energy grid study. There have been identified several scenarios. This can go in a good way and can work well. But there are also many scenarios where this can take a very bad turn and in the future energy grid study this has been termed the complexity trap. When trying to get a grip or to handle such a complex system you have to come up with a model. You have to be able to compare different use cases, assess business models being able even to map this down to the requirements for your automation system, for standardisation and so on. The threat is if you don't do that we get fragmented, single purpose, very inhomogeneous ICT solutions and ultimately in such a systems you possibly don't consider certain flexibilization options at all because with the models you have you don't see the benefit.

A good model is what you need to assess the business cases, to come up with a solid assessment of the requirements of your automation system. We have something like this already in the smart grid sector. This is a picture of the smart grid architecture model (Figure 6). I won't bother you with any details. This is just to wrap up what it can do. It is able to use formalized use cases from the smart grid domain e.g. those demand side management I told you earlier about and map this through a formalization onto that model. Then you are able to drill down to the single processes and derive your non-functional requirements and basically telling you how efficient, how valuable and – bottom line – how costly your ICT, your automation system must be to support a certain use case. Than you can ask yourself if your business model is able to generate that much revenue to finance the use case you had in mind.

And most of the times this is not the case. But you can use this to overlap and combine certain use cases and then you can find combinations of use cases where suddenly you don't have to build up an ICT infrastructure for each use case but can use for the second use case probably 80% of what you have already in the field. And that makes it beneficial and suddenly the business case flies.

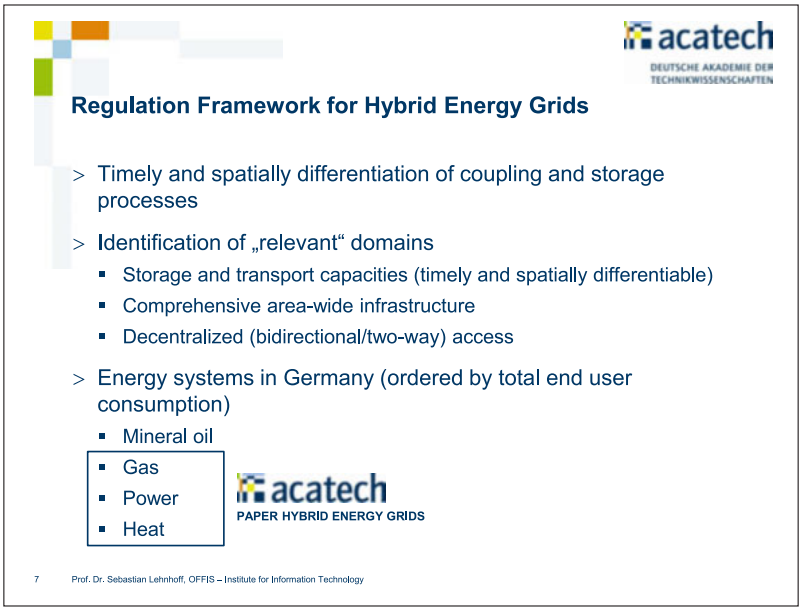


Figure 7

It helps you designing an adequate ICT infrastructure and this is basically what we now want to look at and try to come up with as a solution for the next problem, the even more complex hybrid energy system. It helps you to develop appropriate tools. Of course we need security tools and methods to assess the need for security concepts connected or needed, required for certain use cases.

When we looked within the acatech project group at these models it became clear very early that we basically cannot use the architecture models we have in smart grids for the use in hybrid energy systems because you can already see that basically the bottom level is a fine grained representation of the power system. But there is no heating system. There is no transportation. There is no gas system. So, of course we can come up with a higher dimensional representation of this model. But in my opinion this is complex enough. So, first we have to come up with a more coarse regulation framework to give us the answers we need. That was basically the task we addressed in the acatech project group. First of all we wanted to identify relevant domains. I already mentioned gas, heat, transportations. But of course we talked with people that said, you have to look at water systems, at chemical product systems and other infrastructure-based systems to incorporate these. Of course they are right. But for the purpose of our regulation framework we had clear categories we want to look at. We demand storage and transportation capacities from a domain we want to incorporate in our framework. We want to have a comprehensive area-wide infrastructure and of course we need decentralized bi-directional access to that infrastructure.

Next we looked at what are the infrastructures, the energy networks we have in Germany ordered by total end-user consumption. There at the top is the mineral oil network and infrastructure. When we applied the categories it became clear pretty early that for the purpose of the hybrid energy grid the project group has to focus on the bottom three energy domains.

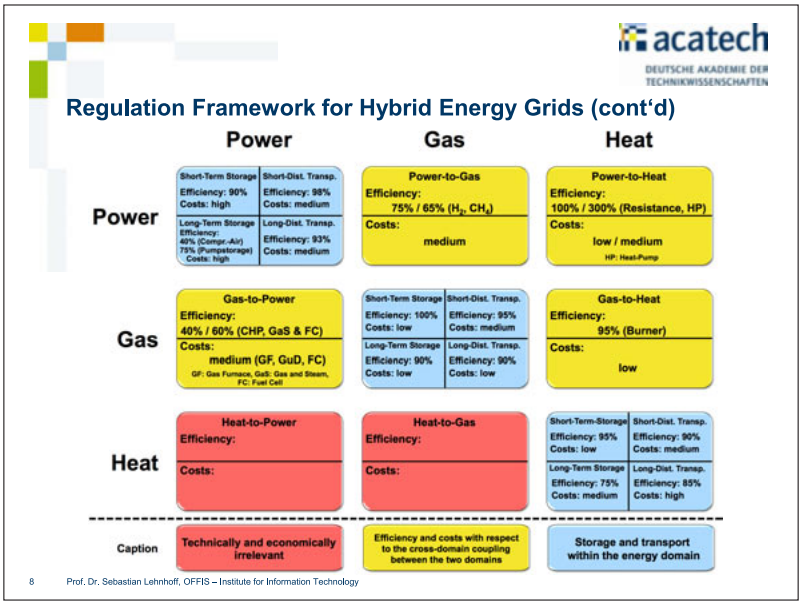


Figure 8

Long things short. What we came up with is a regulation framework where we looked at the conversion processes, the efficiency of conversion processes, the approximate costs of conversion processes and of course transmission and storage costs and efficiencies within each domain (Figure 8). There is of course a drawback because we didn't want to include all those highly experimental lab technologies that are all out there. For being taken into account, we needed at least one experimental site where that technology is being assessed and we can derive hard facts in terms of costs and efficiency from that. Thus, not every technology is in there and the cost matrix is somewhat thinly spread. We have this 'high, medium and low' cost categorisation in here. But now we can for example look at it and see what are the transportation costs in the power domain. If you want to assess a use case where you have this process conversion from the power to the gas domain and want to transport something within the gas domain then maybe couple it back to the heat system, you can come up with efficiency assessments, cost assessments that allow you to identify promising business and use cases.

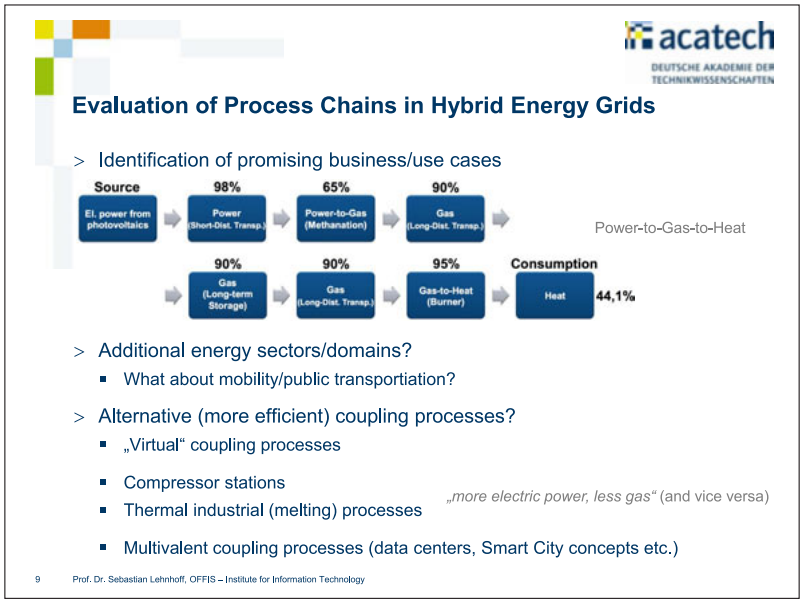


Figure 9

The aim is of course to identify nice efficient use cases that may overlap and come up with a common ICT architecture that if we have 3 or 4 use cases demanding that architecture is a business case that generates enough revenue to meet the investments and the ICT costs (Figure 9). This is a power-to-gas-to-heat example where we come up with an efficiency of 44.1%. What is very nice in the gas-domain is that we have long term storage opportunities in there. This is very efficient in the gas sector. And now we have a use case connecting the efficiencies and the costs from that regulation framework to a concrete use case.

So far we only looked at those three energy domains. What about the other energy sectors or domains? What about the mobility, public transportation, the virtual coupling processes (already mentioned) that are obviously not part of that regulation framework? All the conversion processes are in a sense chemical conversion processes where we talk about power-to-heat, power-to-gas etc. We don't have the industrial flexible virtual coupling processes in there, neither.

What about those multi-valent coupling processes, e.g. the data centres or other more interesting smart city concepts? Those have to be integrated here somewhere. We have ideas how to do that. But what we did here is only this three domain regulation framework, yet, that allowed us to do that.

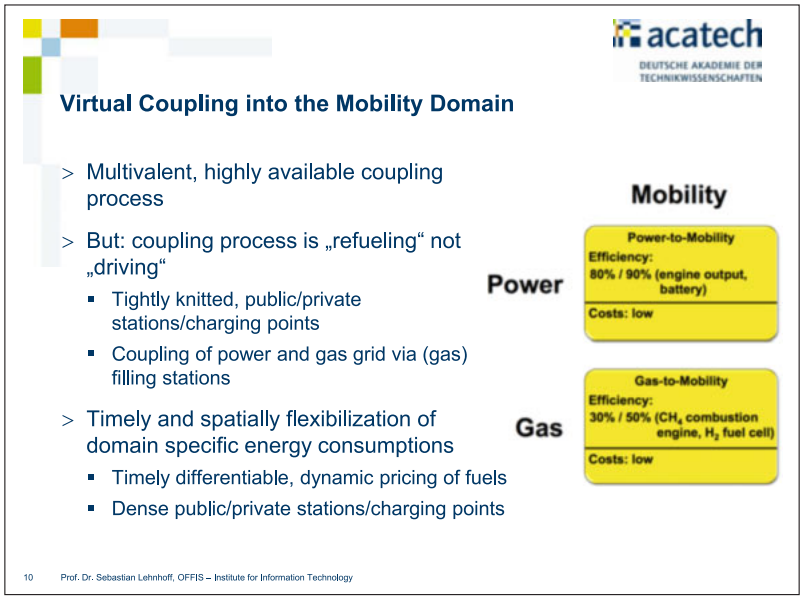


Figure 10

One word on the mobility sector (Figure 10)! Of course if according to the categorization looking at the mobility domain we have a wide area infrastructure offering bi-directional access. With transportation and storage capacities as required categories for identifying adequate domains within that model we have problems trying to map that onto the mobility, the transportation sector. We don't actually see transportation and storage as a viable or efficient use case for the mobility sector. On the other side, if we look at automotive gas as a means of generating energy for the mobility sector we have our fuel stations, which are very efficient and highly flexible process coupling stations between my power system and my gas system. If I look at it, I have a very tightly knitted charging point refuelling station network. Already today, I have timely differentiable dynamic pricing of fuels. And we are also very suggestive to those signals I get send by my fuelling stations and prefer to refuel my car when the price is low. This is something that is already very flexible.

Additionally, I have a very dense network of these stations. So, we identified the mobility sector not as a degree of flexibility for transportation or transmission in storage but as a very highly flexibly coupling process for one of those virtual coupling processes.
Just this one wrap up slide before I have two more slides from our current work at the OFFIS institute.

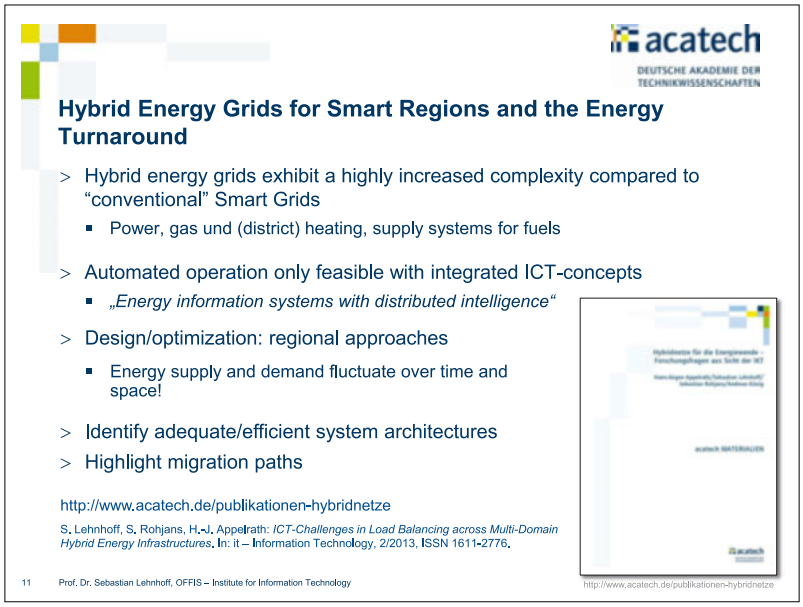


Figure 11

Of course we published this in a working paper (you will find the web address here) (Figure 11). This is obviously only interesting for the German speaking part of the auditory. We translated this and even went a little bit further when assessing certain use cases in that second reference here. So, this is basically to a large extend a translation of that study on hybrid energy system use cases. If our Chinese guests are interested in that I may refer them to the second reference here.

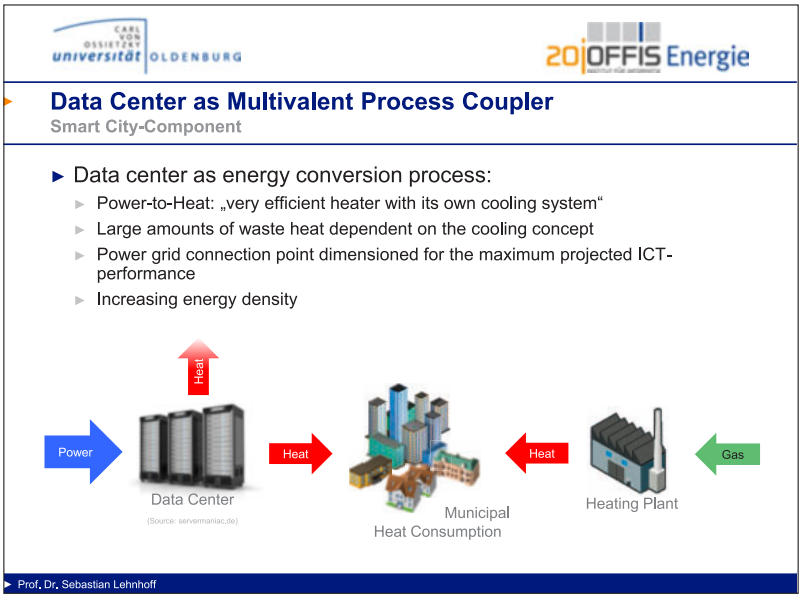


Figure 12

Now I changed the slide master for my second slides because I am changing my hat and I am representing the scientific director of the OFFIS energy division. We want to look at the multi-valent process coupling I talked about earlier (Figure 12). We have a group of researchers looking at the flexibilization and the flexibility potential of data centres as multi-valent process couplers in future smart cities, basically if you look at the data centre you have the most efficient radiator heating system in the world. You don't generate any kinetic energy. What you do is you produce heat. And then you have to address the challenge of getting cooling that very hot radiator very efficiently. So, we have very efficient heaters with their own cooling systems. That still generates a lot of waste heat. We have very high capacity grid connection points because usually those data centres are designed to meet the energy consumption or the energy requirements in the next couple of years. And we know by Moore's Law the energy consumption increases exponentially and so they are actually designed for getting and delivering that energy to their clusters, to their servers for the near future.

Of course a very easy and basic concept is then connecting this to a municipal heat consumption system and closing the gap using the waste heat to meet your heat demand in your smart city and then of course decreasing the need for gas on the right hand side here. We didn't actually only produce those power point slides. We have very fine grained models for the flexibility of these data centres. So, what we did next is we took a look at our surroundings. We are based in Oldenburg, which is roughly a couple of 100 kilometres to the north-west of here. We looked where do we have similar data centres that could be part of our scheme here? We have a data centre there, which is as I specified a very efficient heating system consuming a lot of power, generating a lot of heat and of course generating a lot of cold to cool those systems. We extended the scope and looked even further. We found out that we have a gas expansion site directly next to the data centre. Gas expansions sites are very nice because they produce excess cold. Now we have those very highly automated, very flexible systems next to each other.

We extended the scope even further and found a very high capacity, very high automated industry over there, which is an animal feed drying company. It is a ridiculously high amount of energy that is consumed there for drying animal feed. It is very nice to forecast. They have certain duty cycles. Once they run they have to keep running. They have several heat levels, which they have to reach in order to get their process running. By the way those diagrams are so called Sankey-diagrams. The width of each arrow is proportional to the amount of energy that is consumed there. Usually you use it to visualize process chains with the in-between processors and the sequences. This is a very condensed version to get the main points on this one slide here.

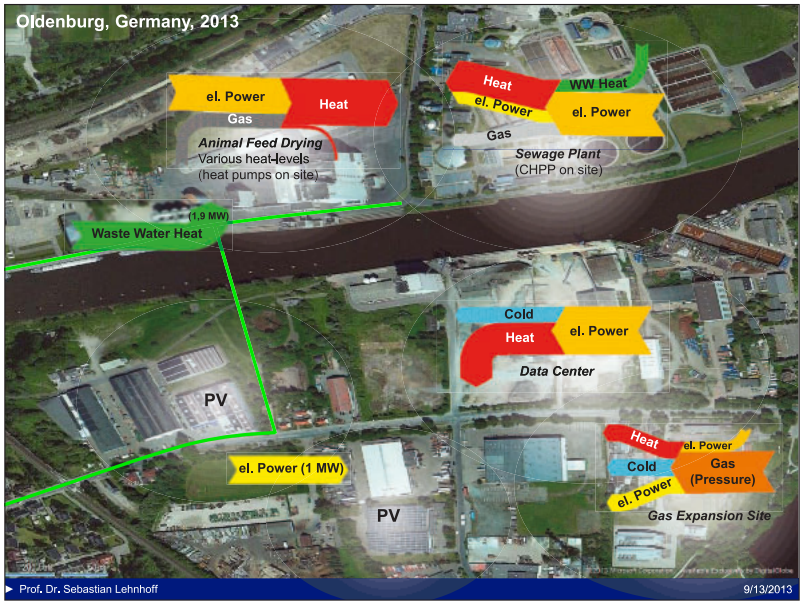


Figure 13

Next we extended the scope again and said: oh, we have a sewage plant there! Of course it needs electrical power, using the waste water heat to a certain extent, generating gas (Figure 13). It even has a combined heat and power plant on site that generates electric power and of course again we have a lot of waste heat directly next to an industrial consumer that needs a lot of heat, that uses basically all the energy being it gas, being it electric power to generate that heat.

Looking even further we have large PV installations and then we have the waste water channel. Waste water recuperation is very popular in Oldenburg. We have several experimental sites where we recuperate through connected heat pumps the waste water heat for residual or housing heating systems. This is something that can also be utilized here.
So basically we have 1 km² of very highly automated very flexible processes that can easily be connected. Of course they have the problem of the Hunte river here that is kind of landmark barrier cutting my otherwise very nice to work with 1 km² site in half. But as you see we have at least the waste water piping crossing the Hunte river and of course we have electrical transmission lines over the Hunter river as well.

What we are currently doing at the OFFIS Institute is modelling, assessing all those processes, getting all the data of the in-between processes, modelling the flexibility and now coming up with an optimization system allowing me to look at this 1 km² tile at a certain point in time and identifying what would be the best process coupling combination of those four, five processes I have on this very combined condensed area and then do what we did with the smart grid architectural model: coming up with an assessment for the requirements, for the ICT automation system to perform a feasibility assessment for such an automation system. We already learnt that if you take two or three use cases and combine them efficiently you get a valid business case. We are very eager and optimistic that this will be possible here. Unfortunately, I cannot tell you more about this because this is work in progress. But this is very feasible and we are convinced that if you use this mapping on other very similar areas you can find those degrees of freedom, those sweet spots for hybridization all over the country.

5 Service Platforms for Applications in Smart Cities

Prof. Chen Junliang, Beijing University of Posts and Telecommunications

It is my honour to make a presentation to you. The title is 'Service Platform and Applications in Smart Cities'. This is the outline of my presentation. The first part of the presentation has already been discussed in the morning session, especially in Prof. Pan's keynote speech. So, I will skip this part directly.

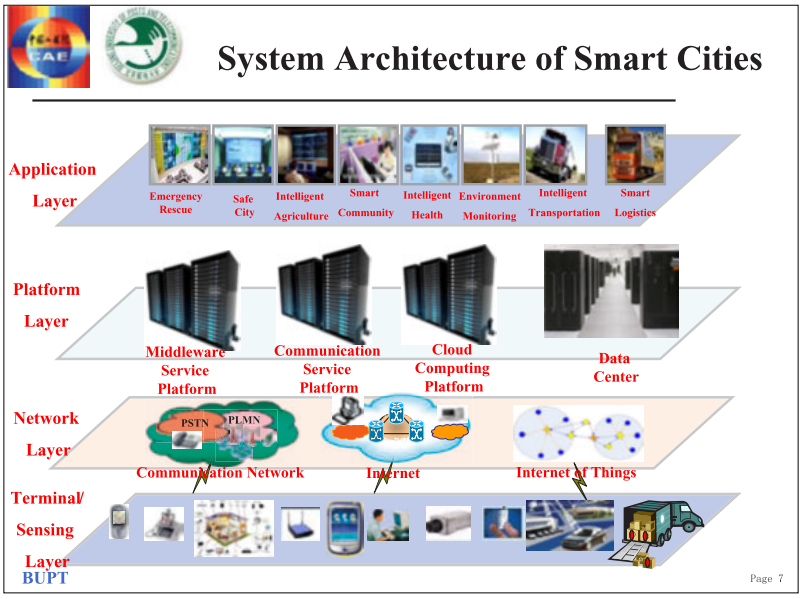


Figure 1

I will go directly to the system architecture of smart cities (Figure 1). From our view point, the basic layer of the smart cities should be various kinds of sensors, sensor networks. Above that is the network layer, which communicates all kinds of sensor networks together and sends them to the necessary or predefined places. The final use of this information is to apply all this information to different kinds of usage, e.g., to agriculture, to the safety of the city, to the intelligent transportation, to logistics and so on. But from our view point, between the practical application and the network layer, there should be a platform layer. The role of the platform layer is some kind of middleware which plays a key role to do all the application because from my point of view most of the applications are software. How to design this software efficiently and in a unified way, this is the key point of the platform layer. This is what I have said before. In the smart cities service platform developed in our university I will describe to you later on.

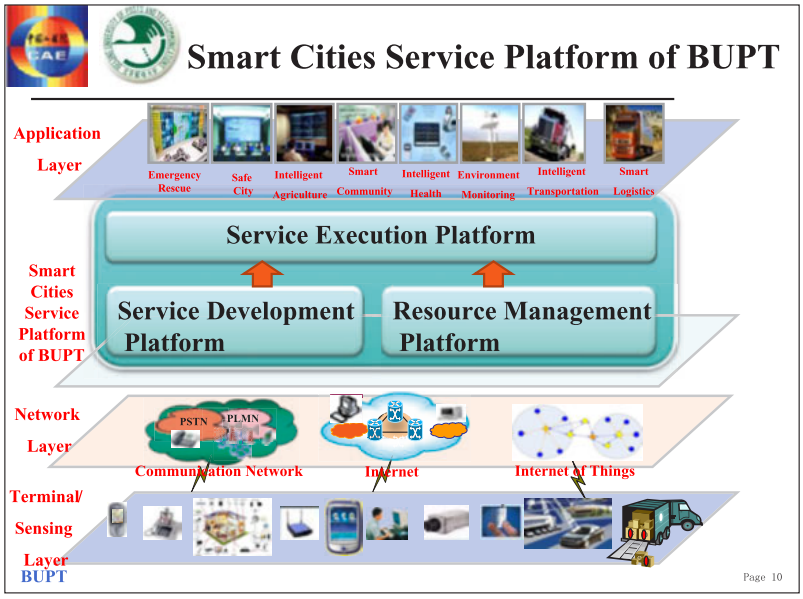


Figure 2

This is the overall plan of the smart city service platform of our university (Figure 2). The basic layer is all kinds of sensors or sensor networks and above it, as I said, is a network layer. And in the other upper layer it is all kinds of applications. The concrete service layer, we propose, is a service execution platform as the centre of the service platform, and we have two support tools. One is a service development platform, the other is a resource management platform because for all kinds of software you have to design the whole system according to the requirements of the software and the resources you use. So, the service development platform is used to implement the service requirements. And the other is a total solution for the resource description.

After that we can execute in the execution platform. By the way, between the service development platform and the execution platform, we just directly move the code to the execution platform. Between them no high level language will be used.

The basic idea of our service platforms is that the ordinary service development platform is based on so called SOA paradigm. This is a usual software development paradigm. But we think that this paradigm is not enough because right now for the smart city, or even internet of things, there are a huge number of sensors, and there are large numbers of processes running concurrently and at the same time there are complex relationships among these concurrently running processes.

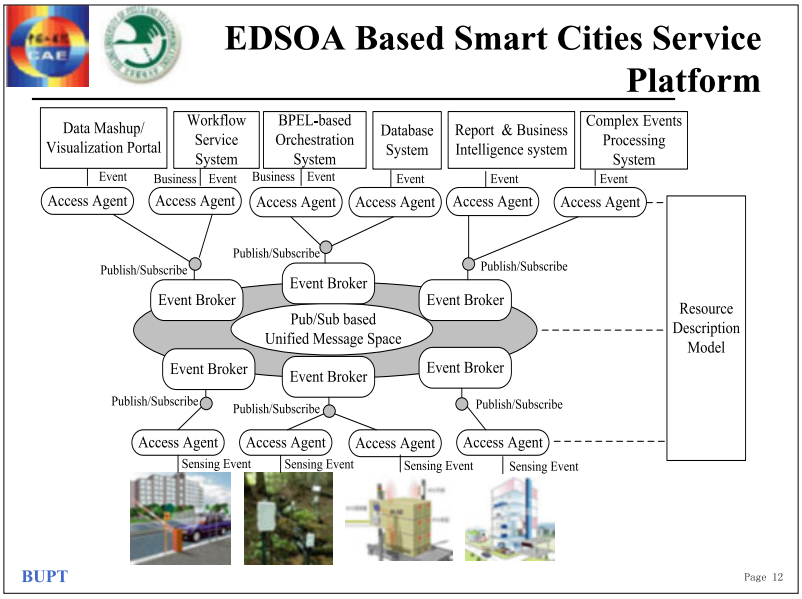


Figure 3

So, only SOA is not enough. We propose a platform with both kinds of basic ideas. First is SOA, the second one is EDA. That is the event-driven architecture. We combined this together to use what we call EDSOA (Figure 3). This is the basic principle of our service platform. Why do we use EDA? Because of the asynchronous interaction among processes and also to make the dynamic collaboration between processes and various kinds of resources. We can do it on real time and we use efficient concurrence. Combining these two principles together is the basic idea of the platform we proposed.

This is the EDSOA based smart cities service platform. At the lower layer are the varables of the sensing system. The above layer different kinds of tools e.g. mashup is commonly used in the service commuting discipline, also workflow service system and BPEL-based orchestration system. The BPEL system is used to describe a single process. It is very useful. Also different kinds of data systems and report system etc. Through these tools and the resources at the lower level and the middle part is our service platform.

This is the execution platform for the whole services. I will later talk about this in detail. Our EDSOA based service department is based on two major steps. First, the relationship analysis of the requirements. For example, you have a huge number of sensors and you have a lot of processes, and there are very complex relationships among these processes. We propose a systematic approach to decompose all these complex factors. Through this approach we can finally get two things. First, a series of individual processes and second, an event table which describes the complex relationships among these processes. From this decomposition, we can get single processes and we can use our single SOA service development tools to process the single process problems.

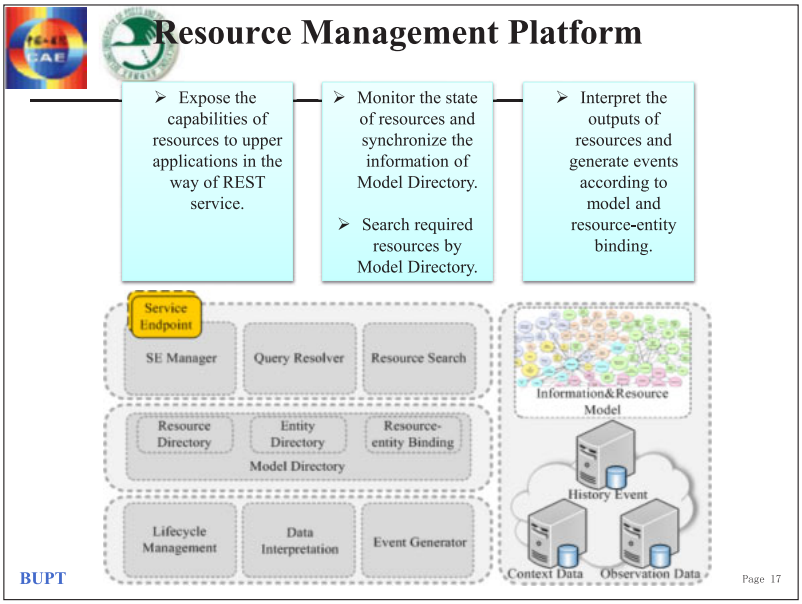


Figure 4

And another way we have to describe different kinds of resources (Figure 4). As you know an ordinary way to design the software is to use the resource directory. In practise, there are a lot of different kinds of resources and then it is of these all kinds of resources we can analyse into categories. Each category has something in common. We try to do a research management framework according to their usage and according to their main purposes. After we have a resource management network, each time for each application you do not have to describe each resource separately. You just look at the framework and find the type of resource you are interested in. In this way you can save a lot of time.

This is our philosophy to unify different kinds of use resources. Finally we have a semantic model for all these uses and according to these semantics you can easily find your resource and put the upper level of this model into your application and with some modifications you can use this kind of resource directly. You don't have to do the detailed description of each kind of sensor, for example.

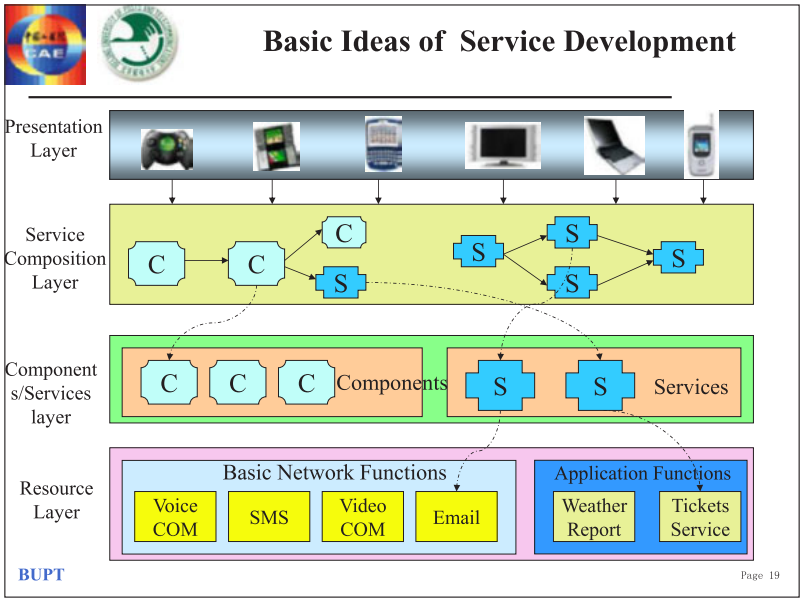


Figure 5

Finally we have resource management platform and each time you use resources from this management platform, you find your suitable resource (Figure 5). All the details, the major features of details, have been described already.

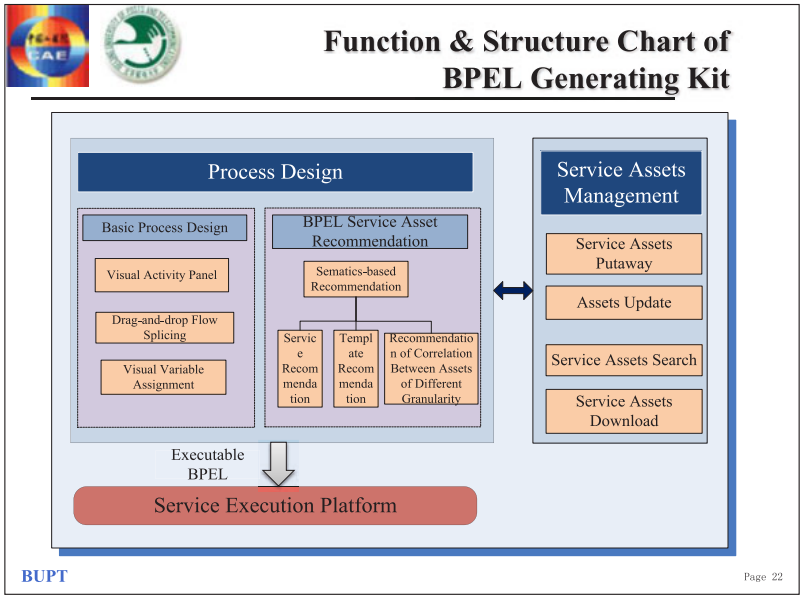


Figure 6

After we solved the problem of resources, we now shift to the single process of service developments (Figure 6). We use it in a BPEL orchestration process. The basic idea of the service development is to compose the service using existing components or existing services or web services. You just combine all these things according to the software requirements. This way of development is quite simple. At this time we shall have two things. One is the assets. The assets include different kinds of services and different kinds of components. Components mean from the granularity, it is a big web service. So, basically they are the same. Your task of designing a software system is just to select suitable components or software web services and to combine them to form a process that you need.

For the SOA development tools, we developed three kinds of tools. The first is a BPEL based service development tool. As many people may know, BPEL is a standard language to describe the industry language, industry workflow, it is a defect standardization developed by IBM around 2002. This is for the automatic process. Another thing is that in all the enterprises or the companies, you have some things to do not totally automatically. You have to use human interactions, e.g. if you want to go on a business trip to other cities, from Munich to Berlin or even to China, you have to get the permission from your upper administration and also you have to get the money to go there. These processes need some human interactions.
Another very useful thing is that for each enterprise, there should be a human interaction call centre. Once your products are complained about by the user and they should be entered in the computer and processed partly automatically, partly manually. You have to combine the human interactions with the processes together. This is the second kind of the tool we developed.

Finally, a mobile terminal service development tool. So, the BPEL based service development tool is mainly composed of two parts. The first part is the service access management. That is you have to collect all kinds of web services, components or templates with different granularities. Another way is that you use the process design according to the software requirements. The process design is a very simple task. You just combine the assets with your automation procedure. This is a web terminal, a computer terminal interface. You have to drag and drop flow designer. You have to use the designer flow diagram (?) actually and use different kinds of assets to drag the assets to the diagram and you can do it quite easily. This is an example as we use this kind of development tools to design a multi-media conference. This is the design process. I will not go into detail.

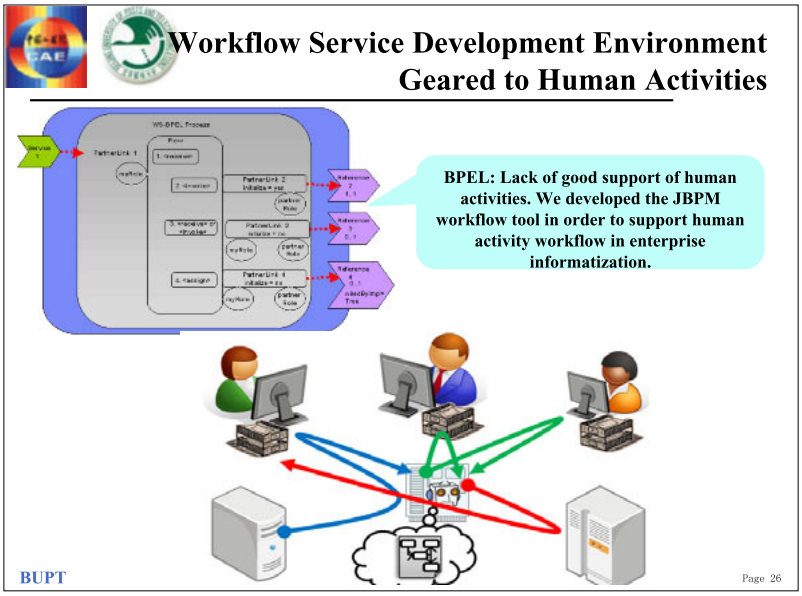


Figure 7

The second tool we developed is called JBPM based human interaction workflow development tool (Figure 7). As I said, many procedures in a company or in an enterprise use human interactions, for example, a call centre or when you have to go to other cities to have a business trip or anything else. They cannot be worked totally automatically. You have to have some human interaction and combine the automatic processing. This is the workflow service development environment geared to human activities. Because of the time limit, I will not go into detail. This is the final result: the computer will interact with some human beings for example the administration people and to process the whole thing.

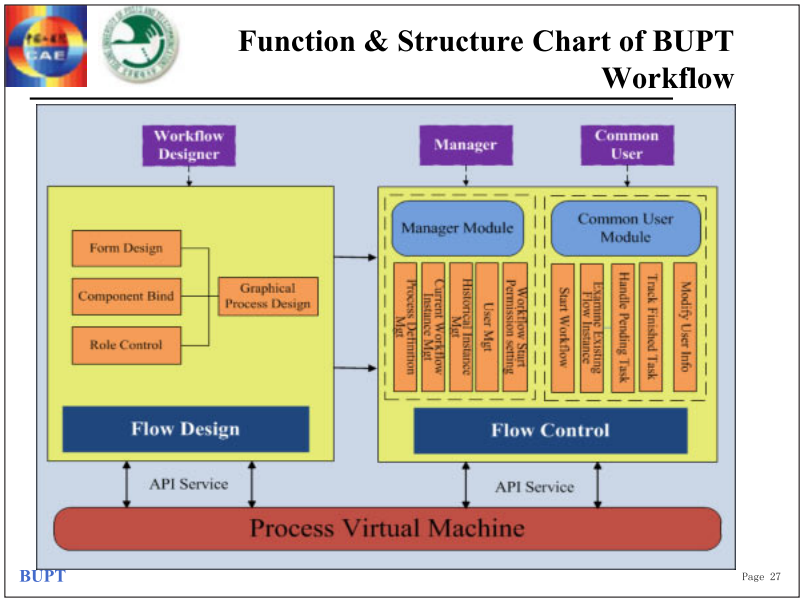


Figure 8

This is the basic structure chart of our workflow tool (Figure 8). The workflow tool is divided into two parts. The first is the workflow designer that is to work out the whole workflow of the whole process. On the other side, we have two main roles in the human interfaces. One is the manager and the other is the common user. The common user, for example, wants to apply to go to any place you need and you have to get the permission from your manager and so on. This is why we developed the whole tool into two parts, one for the manager and another one for the common user.

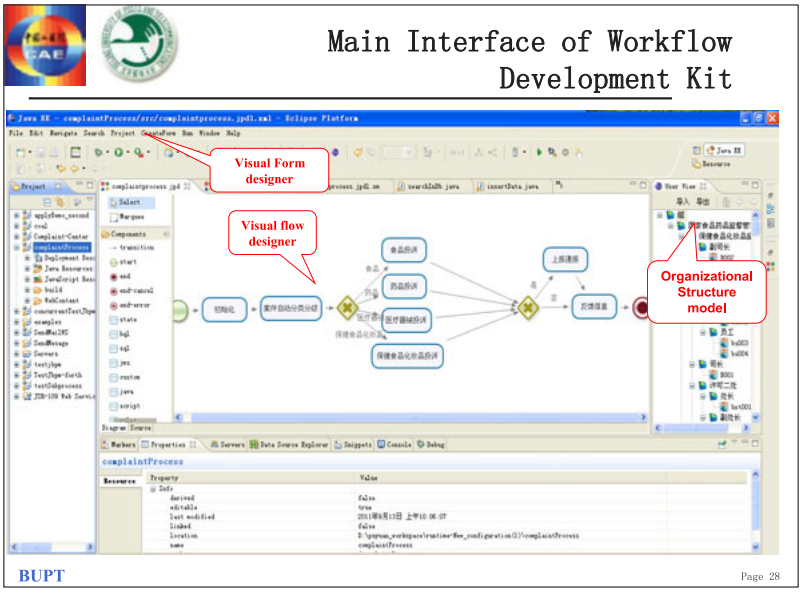


Figure 9

This is a concrete example (Figure 9). To process you see something for a company which produces a refrigerator. His refrigerator has some frost and he has to complain through the call centre and you have to process all these things. This is just an example.

Figure 10

This is the result of the runtime (Figure 10). Because it is in Chinese I will not go into detail.

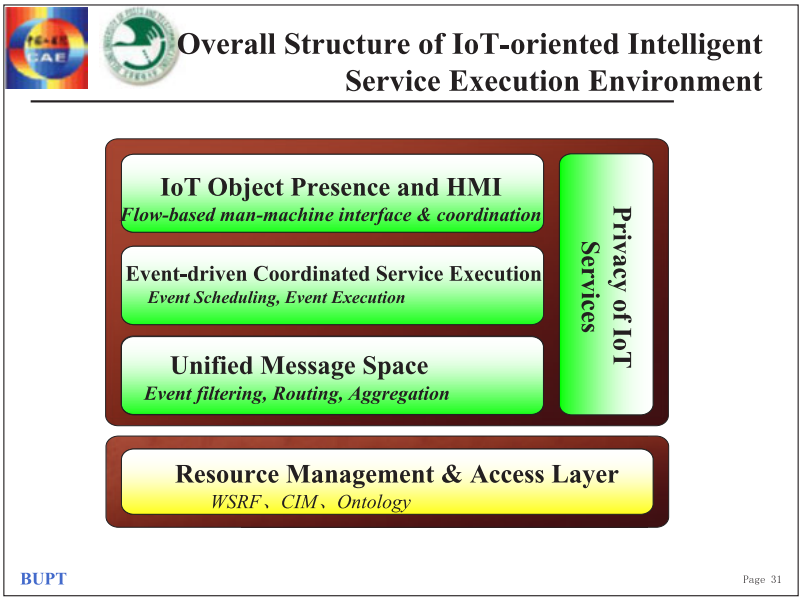


Figure 11

Finally we have the service execution platform (Fugure 11). The service execution platform here is composed of the following parts. The basic part is the resource management. We have to use different kinds of resources. To fulfil the idea of EDSOA – as I said before we combined these two paradigms of software into one – we use a unified message space to fulfil these requirements. Above this execution system, there are service event authorities. This is the human interface and all the designed applied systems. Through event driven coordination, we separated the whole process into two basic parts. One is a series of single processes. It can be easily executed in an ordinary service engine. Another one is a table defining the complex interactions among processes. We have to combine these together into a unified message space.

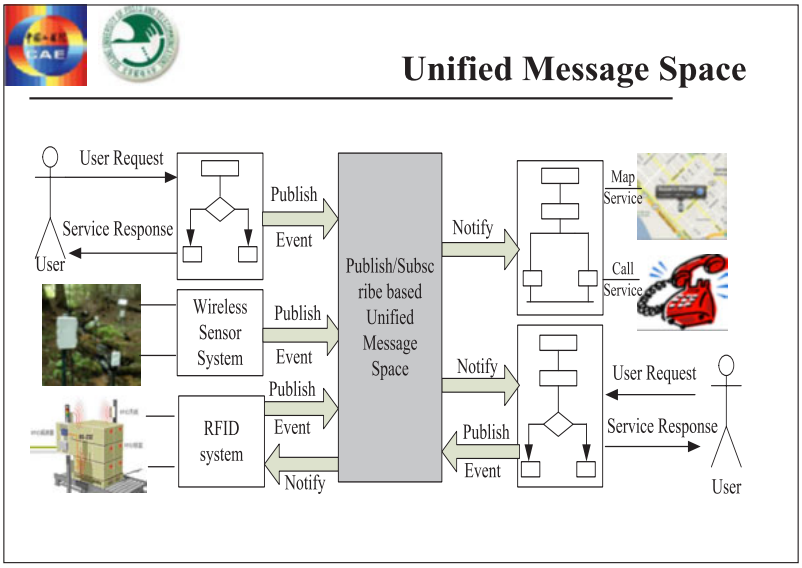


Figure 12

This is about the security of the whole system (Figure 12). It is quite natural. The unified message space is based on distributed systems and subscribed and published systems in networks.

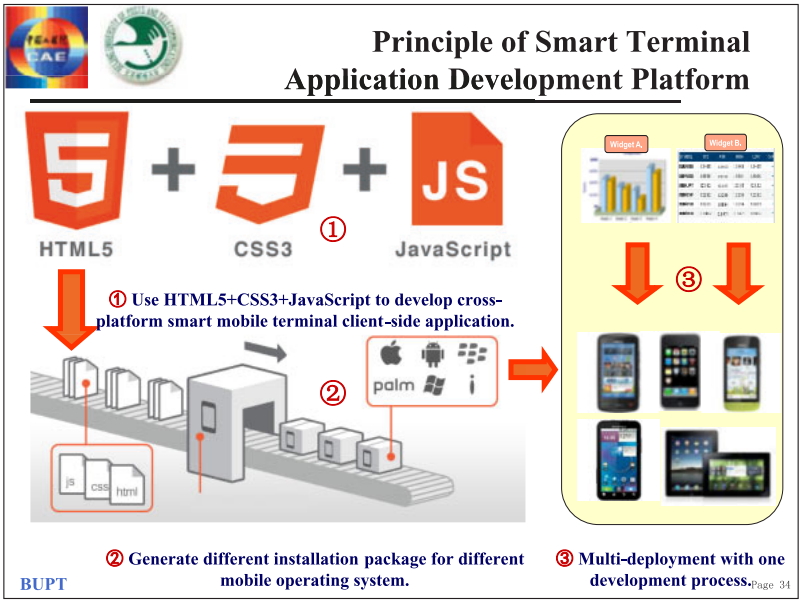


Figure 13

Finally, I want to tell you something about the mobile terminal service development tool and why we have the modification to develop these tools (Figure 13). Three years ago, we got a requirement from an enterprise that is a coal mine manager in Jining city of the Shandong province. The manager of the coal mine wanted all the data that is the real-time data not only displayed on the terminals in his office but also displayed on his mobile phone because he has to go everywhere, outside for a business trip or to go to some conferences and so on. But as you know, human safety is very crucial fact in China because there are a lot of human damages. It takes a lot of lives. From the government, they have a very rigorous to the coal mine owners and to let them at their office at any time they have the responsibility to secure the coal mine. But since they have to do business, they have to go outside, so they want to have all displays on their computer terminals to their mobile phones.

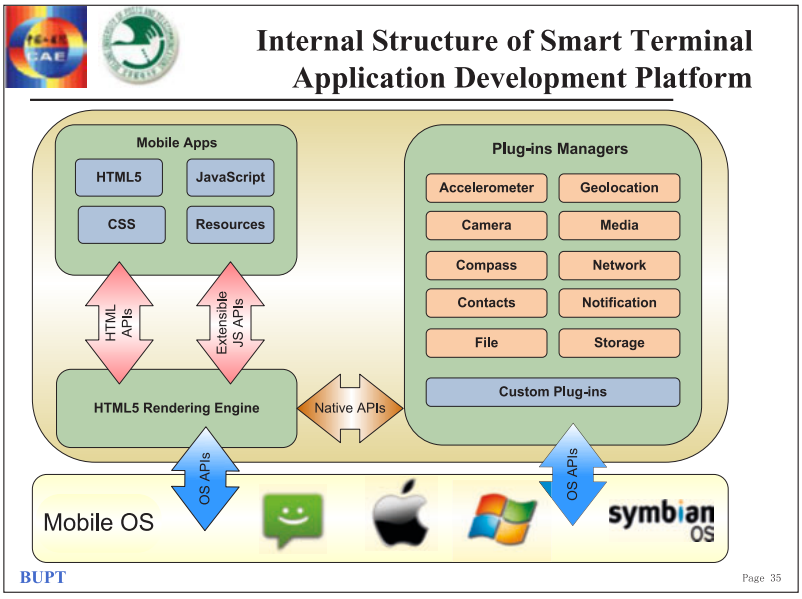


Figure 14

In addition to this, not only real-time data but also all the signal images are captured by all kind of monitors, video monitors (Figure 14). There are around 100 monitors in the coal mine. If the manager or the boss of the coal mine selects any of the 100 video monitors, he can see all the graphics or images on his mobile phone. That's the requirement.

Figure 15

We got these requirements and developed all the displays for their mobile phones (Figure 15). They have at least two kinds of operating systems for their mobile phones. One is Android, the other is iOS. That is for the iPhone. Around 100 figures should be displayed on their mobile phones. So, we developed a system using a lot of manpower. Firstly, we had to learn two kinds of operating systems and their development tool kits. Especially the students developed around 100 figures on their mobile phones. After that we thought that it is very useful, but the method we used was too tedious. It was unthinkable for ordinary people because the task was too big and too tedious for people to develop. How to automate the whole system into at least a semi-automatic tool? Later-on we thought about that and we developed the development tool.

Right now we actually have a production line. The first part is all the resources and the requirements for displaying on their mobile phones. And we use e.g. HTML5 and so on, these basic tools, to organize all these resources.

Most importantly we have something like a gateway. One operating system corresponds to one gateway, e.g. it is an Android gateway and all the materials before that we have organized for using existing languages and so on.

After that, if these raw materials go through the gateway, the product is the downloaded or loadable software package for the Android forms. If you change the gateway to iOS, you automatically use the same materials and you get all the iOS loadable software packages and so on.

This is the whole diagram of the development tools and the development of human machine interfaces. Right know we develop three operating systems for the intelligent terminals. These are really the most important operating services for the mobile terminals. One is Android, the second is iOS, and, finally, WinPhone for the Microsoft operating system.

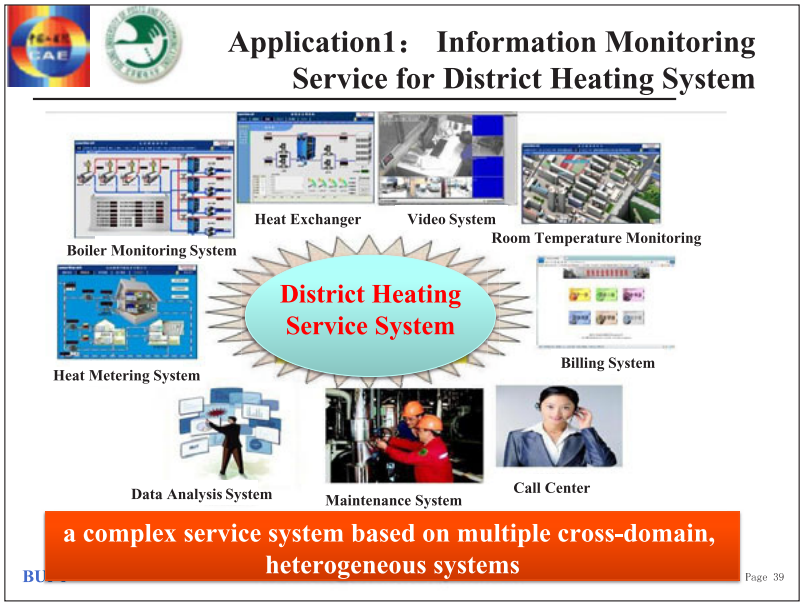


Figure 16

Some development examples: One application is the information monitoring service for district heating system (Figure 16). In Beijing there is right now a new regulation from the Municipality of Beijing that all newly built residences must use the metering to meter the heat they used. Our task is to collect all the data from the resident, from the boiler system, from the pipeline system, and to collect all this information system together to get the best way to heat the boiler and to apply the pressure on the tube system etc so as to run the whole system in the most efficient way, i.e., to fulfil the room temperature determined by the Beijing Municipality and also to decrease the energy consumption. In this way we can reduce the pollution of the whole city.

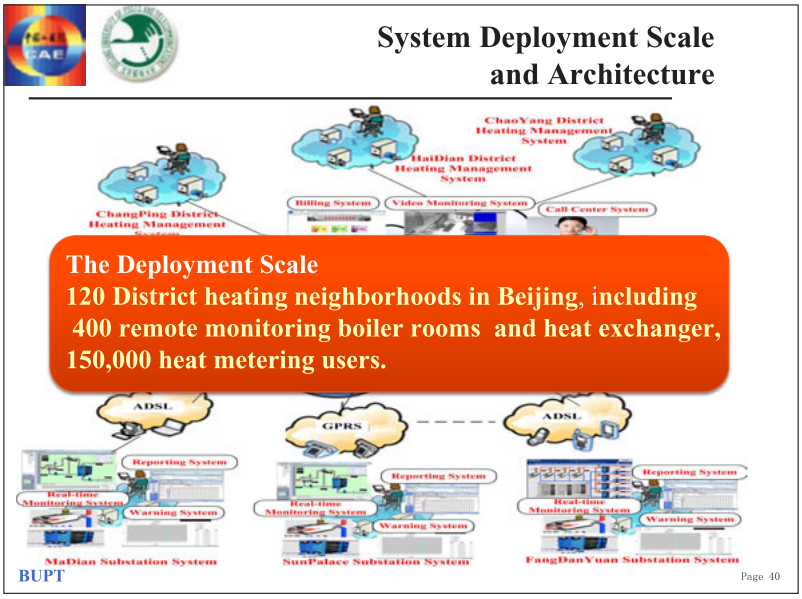


Figure 17

We have worked for more than one year at this system and right now it is on the way to running (Figure 17). This is the whole system of the heating system. The development should still be in 120 district heating neighbourhoods in Beijing including 400 remote monitor boiler rooms and heat exchangers and 150,000 heat metering users. It is quite a quantity. This is the diagram display for the control.

Figure 18

The applications I mentioned for the e-mine mobile information system of Jining in the Shandong Province (Figure 18). This is the final display for the system, and this is a picture from the video monitoring system.

6 SAP Urban Matters: Best Run Cities

Jens Romaus, SAP AG, Walldorf

Thank you very much Prof. Yu Yixin for the nice introduction and thank you very much Prof. Chen Junliang: You have set the scene for me. We use in SAP a similar architecture to develop our solutions. I'm happy to offer you here on stage our collaboration in China if you will.

My name is Jens Romaus. I am responsible for the solution development for public sector globally in SAP.

What drives a company like SAP for an initiative like urban matters? Most of you know that SAP started 40 ago to develop back office functionality, known ERP. At the beginning of 2000 we started to add to this back office solutions front office solutions industry by industry. During the last years we recognized that social networking is changing our lives. One billion people engage in social networking today. What does it mean for a company that comes from the back office, is now in the front office and on the road to become a cloud company? We have 15 billion connected devices into open. Global middle class is growing from two billion to five billion. Business in personal lives have been blurred. That is what I have recognized during the presentations this morning. There are more data in the last five years than in the entire history of mankind. And we have got more mobile devices than people in most of the countries.

What does it mean for a company like us? Years ago we decided to go into the mobile business and bought a company called SYBASE. No we are able to offer solutions to manage mobile networks, offer partners tools to develop mobile applications and make our existing offering mobile. The generation of the people who are 30, 35 years old are all mobile. They expect 24 hours, seven days a week services not just answers from their friends but also from e. g. companies, public bodies and cities.

We have developed our solution portfolio "Urban Matters" with a couple of our customers. The city's business is influenced by e.g. strategy and sustainable development, governance, finance, managing spending and expenditure, neighbourhood, economic development, and education. In terms of education I recommend to have a view to Singapore. The government of Singapore is currently developing an education platform for all citizens.

Cities creating internal and external benchmarks in areas like healthcare, transportation, mobility, public safety and security, infrastructure, traffic, sustainability, culture, leisure etc. In terms of benchmarks and best practise cities do not look just into their country they maintain global networks with other similar cities. An example: Sao Paulo has a very close corporation with Cape Town. Cape Town has done the journey Rio de Janeiro is expecting for the next five years. Cape Town consolidated the suburbs, created a strong governmental structure, cut cost and improved the services for their citizens. These more or less unknown networks are driven by the cities themself.

Together with our city customers we identify core innovation areas also called key solution areas. We use for that design principles some of you may know. It is the design thinking methodology we are using. With that we are creating with each city a tailor-made road map

talking into account the different political environments and programs. Such a roadmap is the guide for the long term planning of each city.

What does it mean for the four main topics in the city? I mentioned to you the importance of an efficient organisation. Estimates are that in 2050 more or less 75% of the world population will live in urban regions. What does it mean for waste, transportation and connectivity? What does it mean to collaborate with your citizens? Economy: 600 cities stand for 60% of the global growth. Just to give you here also an example: Sao Paulo has a bigger CDP than Chile, has more citizens than Chile, is bigger than Chile, but has unfortunately much higher liabilities than Chile.

Cities will use 80% of the global energy, stand for 75% of carbon emission and want do go green. Five billion middle class people will live in cities. What does it mean for education, food, waste, employment? What does it mean to connect, to collaborate, to manage all these people? SAP helps cities to implement good governance structures. We work with cities on engaged communities. That means open transparency, connected collaboration and transparency. Cities all over the world ask us for our advice to improve processes, to empower users, to implement standards and good governance, how to achieve performance efficiency, create sustainable funding, accountability and service innovation. More and more our urban customers are focussing directly on productivity, real-time solutions, and predictive analytics and to provide relevant information and access anytime anywhere.

Some examples on urban innovations:

We worked with the City of Boston entitled “Boston on results”. We built together a city portal and developed a city swot analysis. We collaborated on developing KPIs by engaging and integrating employees from the city government, citizens and politicians. This is an great example for good governance.

With our colleagues from Siemens we built and implemented with the City of Houston a city portal not just to provide information to citizens but also an interactive reporting on sustainable topics like reducing pollution in water and in the air.

The municipality of Pune has faced major issues with the air pollution and wanted that their citizens are more engaged in fighting against pollution. They started an initiative on making citizens responsible for a new tree in the city. We came up with the idea to use our mobile platform, build an application on top of that so that citizens are able to register their own tree, take pictures on a regularly basis to document the progress and their responsibility. The amazing result is that the municipality of Pune has now 200.000 new trees in the city.

With the City of Edmonton we realized the idea of a call centre which is reachable 24 hours, 7 days and cost efficient. The combination of a call centre and an internet based centre where you get automatically generated answers on dedicated questions fulfilled all the desired requirements.

We did the same with the City of Wolfsburg. We used the SAP platform to build a city platform for the City of Wolfsburg, not just as an information tool. Now citizens are able to interact with the city administration. By the way: Citizens can use different devices – fixed or mobile.

The City of Mumbai is one of our long-standing customers. The mayor said to us: If you want to know what the problems are in governments in India, take half a day, sit down in the building of a city administration and just look what is going on. If SAP can help me to improve my processes, to improve traffic, to improve the information I can bring to my citizens then you can help me significantly. One result was to build together with the City of Mumbai a call centre from where the traffic in the city was monitored and managed. You can imagine to monitor, to manage the traffic in a city like Mumbai is a demanding exercise! That means the SAP systems have to manage and analyse big data and unstructured data. With our integrate concept of front office solution, in-memory technology and our open technology platform approach we are currently the market leader in managing big data and unstructured data.

Resilient is another important topic for urban regions. What does risk reduction, early warning for citizens mean? We all have the accident in mind caused by tsunamis. We know what is happening around fire disasters, especially in Australia last year. Earth quakes causing devastation and human tragedies. The problem to solve is how to how to get the relevant information immediately 24 hours, 7 days to my citizens. SAP worked CFA in Australia on implementing an early warning system on fire. With the City of New York we developed an individual and personalized warning system where citizens can receive personalized warnings, if they are for instants close to a building which is under danger of terrorism. Early warning is not just a warning on risk or a help to be rescued. This kind of SAP solution can be used for screening yourself on health problems if you are for instant a smoker or a drinker. People can get an average in their area and receive an indication in case they are in the critical area. The alert will provide people with a couple of offerings how to save their health. Again big data, unstructured data and connectivity to citizens managed by SAP solutions.

This picture gives you an overview how we provide or in which environment we provide these types of services. You see the green one where we are very close to the architecture you have presented to us. This architecture is based on our SAP HANA (High Performance Analytics Appliance) platform which is an in memory platform combined with SAP tools, which are used SAP internally. On top of that we have positioned our analytics solutions. Please remember what I said at the beginning. We acquired a couple of companies to expand our portfolio to meet the requirements of our customers. One of these companies was “Business Objects”, a global leading company in analytics. Now a part of our SAP family.

SAP is porting all solutions on the highly innovative HANA technology. Customers are asking more and more for cloud and hosted services. We just announced a new service to host the SAP Suite on HANA in an enterprise cloud. SAP partners provide to customers dedicated cloud services in private cloud environment too.

SAP’s citizen centric government offering is based on our technology platform, here the green area. On top of HANA we offer a couple of tools for e.g. analytics, data management, applications development and integration. The next level represents the IT management layer with IT infrastructure management, application lifecycle management and IT service management. By using just the technology platform you will be using all SAP internal tools also used by SAP development and partners.

The next levels with procurement, budget and finance, and people and talent management representing our back office functionality. The four blocks 1. Sustainable Government Funding, 2. Delivering on Citizen Needs, 3. Best-Run Cities, 4. Public Security stands for our front office offering.

In the area best-run cities we are putting together all best practises we have developed with customers, partners and different institutions.

The last topic is public security with investigated case management. Interesting what I received this morning. In Melbourne they have implemented the environmental protection authority GS. This organisation has implemented 43 processes of environment protection by using SAP's investigated case management solution. Melbourne wants to reduce pollution in the water (e. g. rivers) and in the air by using sensors in the combination with predictive analytic applications.

Hopefully I was able to give you and overview or just a taste about the new SAP – with applications, technology and moving to the cloud and an incredible good partner network. Our motto: public is a local business, we operate with our partners locally.

7 Evolving T-City: Combining Sustainability with Business through Innovation

Joachim Schonowski, Deutsche Telekom AG, Berlin

In my presentation I am talking about smart sustainable city which is a matter of global need. One important aspect is that Deutsche Telekom has introduced T-City already in 2007. I am coming to that point during the presentation.

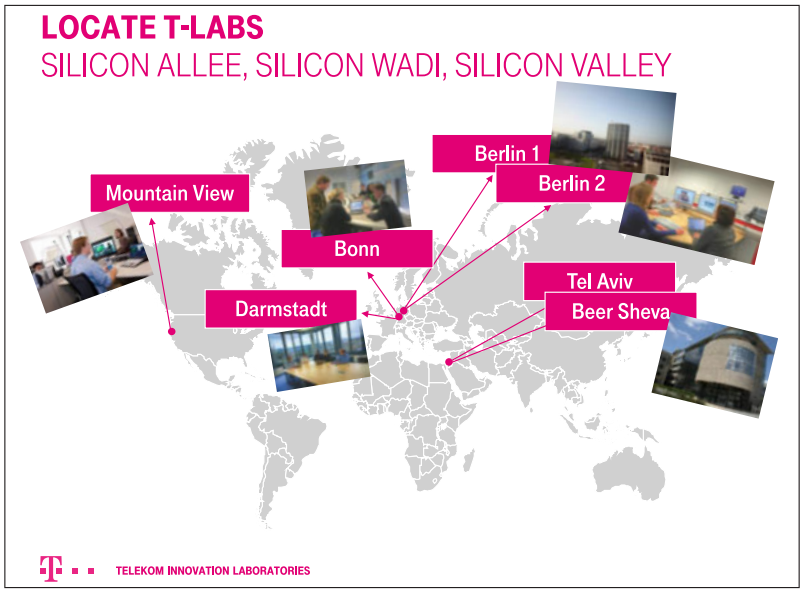


Figure 1

First of all I would like to introduce T-Labs (Figure 1). The T-Labs or Telekom Innovation Laboratories differ from other departments of Deutsche Telekom because, as you can see here, the small team is situated at different locations. As Mr. Dowling said already the headquarter is situated in Berlin, where we have two different housings. In addition we are situated in Bonn, have colleagues working in Darmstadt and other offices in Mountain View, in the Silicon Valley, and in Tel Aviv and Beer Sheva, Israel.

Being situated in these international regions we address the start-up scene within these different countries and in addition we are part of the start-up scene in Berlin because Berlin is right now the start-up capital in Germany.

As you can see here T-Lab is divided in two major areas. In strategic research we work together with Universities in Berlin, e.g. the Technical University of Berlin. The research arm incorporates around 150 high-potential researchers from across the globe. You can see here that we are working heavily on publications, one core aspect of traditional research. In addition they develop patents and one prominent example is our colleague Prof. Anja Feldmann who won the Scientific Leibnitz Award for her work in the area of network domain.

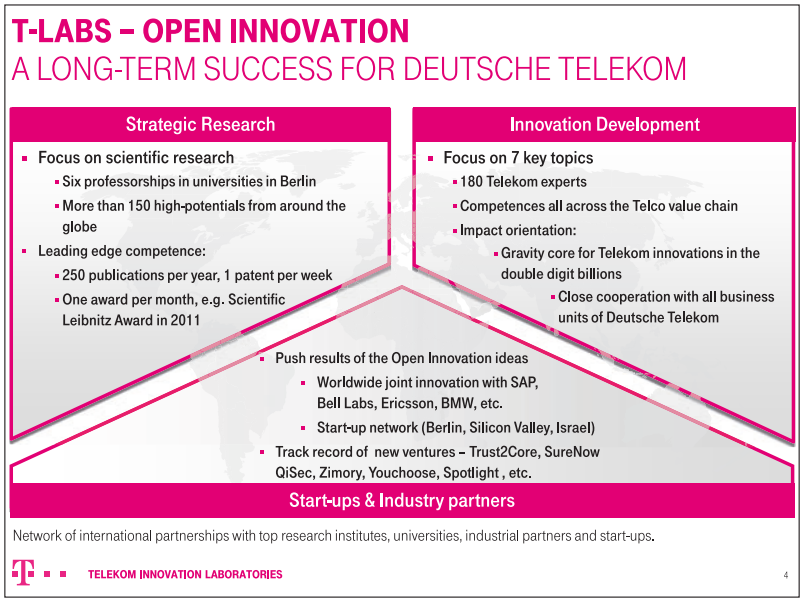


Figure 2

On the other side we have the innovation developments. These are the Telekom experts (Figure 2). We have competences across different value chains of the Telekom operator. I'll come in a second to the 7 key topics. The important thing is that we are providing all the innovations for the huge organisation which also means the specific difference to other departments, dealing with any kind of business development. In this case we are having the chance and opportunity to look forward for more than five years. We even address topics like 2020. So, this is the difference to usual business development departments which are part of with Deutsche Telekom too. Still, we are working very close together with the units of Deutsche Telekom and with the other big unit T-Systems. T-Systems is the enterprise part of Deutsche Telekom.

One key aspect of our work is that we are dealing with open innovation and working together with a variety of big companies and start-ups within the industry. Big names here are e.g. SAP, Siemens, Ericsson. We are also working for the automotive sector together with BMW. And we are dealing with the start-up network in Berlin where we have an incubator which is called Hubraum, being steered from us. In addition we are working very closely together with the Silicon Valley and Israel in the start-up scene.

The department T-Labs have recently done some spinoffs. One of the spinoffs or new ventures we have created is called Trust2Core. The so called secure phone which will be later on maybe used by the German government was created from the colleagues of Trust2Core. This phone has a compartment technology in order to have one aspect which definitely secure and the other one is more public available or usable. Another new venture is SureNow which is tackling new opportunities in the assurance business; others are dealing with smart cloud business and so on. Therefore we have a network of international partnerships and we are dealing with the top research institute too.

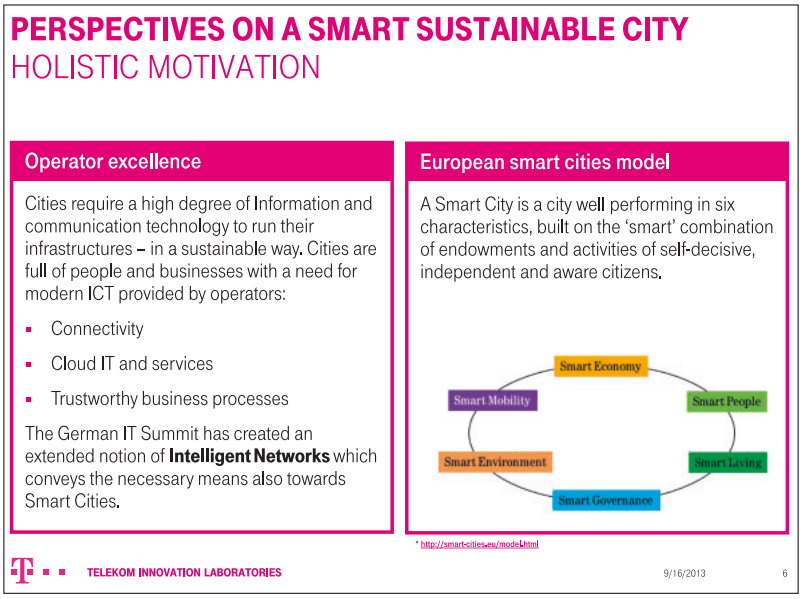


Figure 3

Now I am coming to smart city (Figure 3). Here we are working together in the framework program 7 of the EU. Therefore we are looking with an EU eye on this topic and the ICT view is the view of Deutsche Telekom. In the beginning I would like to talk about the perspectives of a Smart Sustainable City and about the holistic motivation. For me one word is really essential when we talk about smart city and this is the word in the middle 'sustainable'. Sustainability is really important for our planet.

The cities require a high degree of information and communication technologies. This is something like the foundation of it. We need this infrastructure and this infrastructure is required to be very sustainable. Sustainable means in this case it should be resilient and it should be highly secure. One obvious motivation for the topic Smart Cities are the increasing population of Cities.

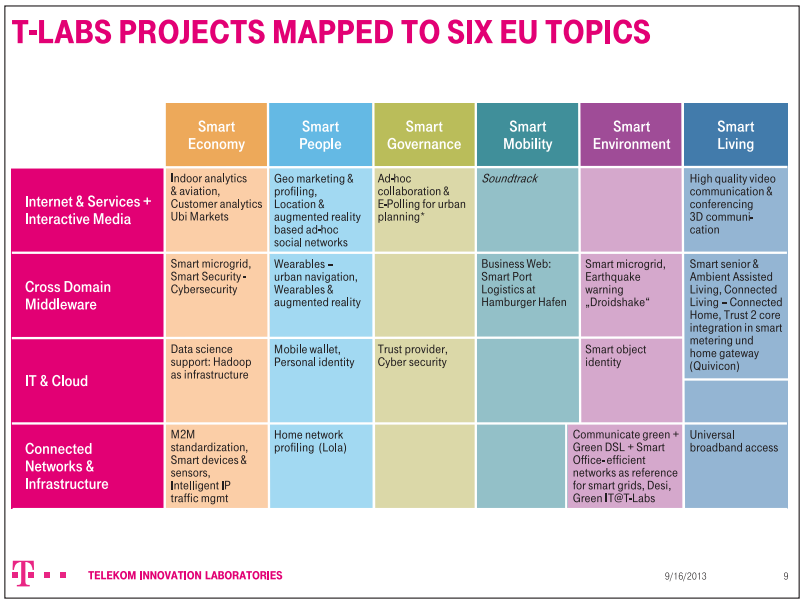


Figure 4

Therefore we need to address these topics from a business but also from an ICT perspective (Figure 4). Looking from an ICT perspective core and essentials aspect are connectivity. Why is that? The second part is the point. Because we are moving more and more things into the cloud and therefore the guaranteed connectivity to the cloud services is essential. In addition to this we need to have these kinds of services which we provide then in a trustworthy way. This also includes the topic of security and resilience.

At the German IT summit there was an extended notion about the topic of intelligent networks. It is essential that we are not talking in the future about networks as we know then, e.g. the internet. We are talking about a different kind of network which is having this intelligent factor.

Let us move from a network driven operator point of view to a more holistic more tangible view: the European smart city model. How is the EU tackling this topic? We see here that the EU is looking at this topic from six characteristic areas. These are smart economy, smart people, smart living, smart governance, smart environment and smart mobility. All of these aspects are the core aspect from an EU perspective, which they address now with work programs. One of these programs is called Horizon 2020, which is part of FP8. We took this structure and I show in the following minutes, how we dealt with it from a T-Lab's perspective.

The other thing I wanted to point out is as I mentioned before the topic of intelligent networks. On the one side we have the network itself so we all know the IP4 network, now IP6 network. We know the broadband access, the internet which we are using. Towards this basic part of the internet we have now add-ons which provide more intelligence to the network, which we require to have. These are the ubiquitous networks. These are intelligent networks, sensor networks. They lead into the area of machine-to-machine communication and also the area of cloud computing.

Both “worlds” business and network operator view we need to address and get together. Therefore these intelligent networks are the important innovation fields from an operator perspective which we need to address in the future.

What we can see on the graphic on the right hand side: We have a huge variety of different contexts in which we have to or can place these different network aspects. We need to address and understand the dynamics which we have, but also the different interests. We need to address the whole topic of intelligent networks not only from a research side but also from a technology and business side. All these kind of things we need to build up across industries.

We heard in the morning about the importance of standardization the colleague from Siemens talked about. With this sentence he stopped my question about interoperability but I just want to point out for you the topic of interoperability which is really important. Therefore we need to have network layers and the whole logics of these networks and the APIs which are then provided in such a manner that they are interoperable.

We see on the right hand side within the graphic on the one side the core which we call the intelligent networks. Surrounding this intelligent networks we have some different areas like traffic, education, administration, energy and health. All of these areas have in addition different groups of interests and also address different parts.

Smart city is here on the right hand side a little bit small. I’ll take it as something like the umbrella topic but we based it here just to fit in. As you see we have a variety of different topics we want to tackle. Let us have a look from T-Labs research perspective and from the Telekom perspective – because we are dealing with the whole organisation. The graphic shows the T-Labs perspective on the six mentioned Smart City core topics defined by EU put together in a matrix with the T-Labs structure of innovation fields. The deepest layer here is the connected networks and infrastructure layer. If we go further up we have the IT and cloud layer. Upon this layer we have the cross domain middleware layer and then the service and content layer. This is the structuring of the T-Labs. If we place now the structuring in the vertical area and have a look from the horizontal perspective – this is the idea of this matrix – we can see that from the different projects and also topics we address a variety of things concerning the Smart City EU logic. This was very interesting when I have done the research within T-Labs because in the first place they thought they were not doing something within the Smart City area. At the graphic showing just some projects, you can see, that T-Labs work on a variety of topics concerning Smart Cities.

There is even a more detailed version with even more projects and topics which are addressed by T-Labs and which are fitting into the smart city context. I just want to point out some examples. As you can see here we are talking a lot about cyber security so we have a group which is only dealing with cyber security. One big aspect they are dealing with is the topic of anomaly detection, e.g. you draw 500 € from your bank account usually per month and suddenly you draw 10.000. This is an anomaly and would be detected by this kind of services. In addition we are working on the area of smart mobility and logistics. We are dealing with logistic services for the port in Hamburg.
In the area around San Francisco we created an application which uses the sensors of the mobile phones to provide an information of a possible earth quake. The name is “Droidshake” based on android.

This is a huge area where we dealt with the topic of smart senior which is very successful running right now. Another area is with the ‘Hadoop’ / map reduce technology of Google

This technology structures the search in packages. Search is than done in parallel using a greater infrastructure and can be used for huge amounts of data. These are the new ways of searching. Here we have the whole area of energy we are dealing with. In this example we are dealing with smart grids but we are also dealing with smart energy solutions internally. I will come to this in a second.

All in all this is part of the T-Labs work but also T-Labs work together with industry partners, especially with units inside Deutsche Telekom.

This is a quick view on lighthouse activities where on the one side we are in a steering manner and are creating the product and on the other side we are supporting initiatives. On the left hand side we were the introductory part of the connected living technology area. We continue to steer this organization, which provides for a platform to connect devices, e.g. in the house and steer them. It goes into the direction of smart home. In addition the EIT ICT Lab is an European organisation in Berlin in the same building as our office and e.g. they have dealt in 2012 with the topic of smart government. This is an EU funded initiative which is supporting also innovative projects from EU universities.

In the middle pillar you see projects we have created. On the one side we have QIVICON which is a smart home solution. The basic idea is from a demographic perspective. The elderly have a longer chance to stay at their homes instead of having to move into senior houses. If we go for smart economy we worked here in conjunction with the industry 4.0 initiative on smart port logistics.

The next lighthouse project was called DESI and is a smart energy project. We tried to have a look for the traffic load on the network and try to adjust the energy requested for the different size for the telecommunication network. I will show you a slide later on to this topic.

On the right hand side you see the different initiatives which are happening in Europe. We are part of the so called the industry 4.0 initiative where we support various projects. On the other side you see the framework programme 7 and this is the framework programme 8 of the EU. Here we were part of the project called FI-WARE which is something like the underlying internet network.

In addition to this project which is providing an extension the Horizon 2020 there is currently another project running which is called XIFI and trying to re-use elements from this FI-WARE internet platform that we have right now. XIFI uses the generic enabler provided by Fi-WARE and develops show cases on five different core nodes across Europe. The idea of these show cases is that if you generate a show case in Berlin the same show case could be transferred e.g. to the city of Barcelona or the city of London. Once developed it can be re-used everywhere across Europe is the idea behind this programme. In addition the programme Horizon 2020 is directed towards one core element. I think this programme will be the topic of smart cities. It is placed on the original programme so the idea is that in Horizon 2020 e.g. based on the initial platform application and services are created.

This is the example of QIVICON, a project which T-Labs developed into a product which is now on the market. The basic idea is that you can address e.g. your washing machine or fridge which is certificated by this consortium and steer it e.g. with your smart phone from wherever you are. The whole logic is placed in a so called home gateway which enables you to steer the different certified devices you have at home.

The other part which I would just like to mention briefly is a huge project which was done together with the colleagues from SAP and T-Systems. This is a logistics project which we have done together with the port authority of Hamburg. What you see here underneath is a port. You see a ship, street, warehouses and all facilities. The problem of the port in Hamburg is that it can't grow anymore. The size is limited because there is simply no space. Therefore the whole logistics there need to be very highly efficient. The project is about how we can provide the logistics in a different way and also e.g. to address one topic we heard this morning about congestion. The idea in this case is that the whole truck- and trailer status information is combined with the traffic and infrastructure information and e.g. with the parking space information. This altogether is then placed into a mobile business cloud.

How does it work? One of the examples which I can briefly show with these different areas which I have mentioned here is that we just think about a transport of highly hazardous fluid. We can take oil as an example. In this case we might need to have a specific truck. The question is in conjunction with the container or the object we want to transport is that the drivers in Germany are only allowed to drive for a limited time. They are allowed to drive for eight hours and after that they have to have a break. Therefore it is e.g. important if we have the situation that the driver has been driving for seven hours he needs to transport this hazardous liquid to some place. The next question is where he can make a stop and sleep. This could be very important to direct this specific truck to a specific parking area where for instance three or four hours later another oil container arrives, which requires this specific truck. Therefore you can optimise now the route. This was one example and many others are there as well.

Another aspect I would like to mention is concerning smart energy and infrastructure of Deutsche Telekom. On the left hand side you can see a sheet with a power usage map of Deutsche Telekom and of the network. When running the network we witness different peak times. What we have done with this project is we tried to see how we can adjust the Telco network which is parallel to a power network. How can we adjust these two in the most efficient way? In brief you can see that we have here a difference between the actually requested power supply and we have on the other side the initially provided power. Due to this project we can now adjust it in a way that we are providing only the requested power. This is the basic idea. We can mediate between the different needs.

Finally we had in 2007 already the initial idea of a smart city. Within Deutsche Telekom we had a competition which the city of Friedrichshafen won. This city was then the lighthouse smart city for Deutsche Telekom and is called T-City. The objectives of this city were on the one side to increase the quality of life with ICT for the inhabitants, connect the city and citizens and on the other side to provide reputation for Deutsche Telekom in terms of the innovative power of Deutsche Telekom.

Within these five years a variety of different areas were tangled. We have touched different needs here too. I remember an online kindergarten which was a very positive service as I heard later on. It really eased up the situation for parents to find a free place in a kindergarten. We have many other examples.

As you can see on the right hand side this was done with a variety of partners and it was really a successful project because on the one side we had a lot of visitors which are not only visitors in a way that they are business customers. You could see a city running. On the other side there was a chance for us that we could have a feedback from the people in the city how they can live within such a city.

We are continuing with the project in normal operation modus and are working very closely together with the local authorities, which is very important in my opinion. We have a combined office between the Telekom partner and the city. We are trying now to make the next level. One of the aspects I know is that we are talking about a smart energy grid which we are trying to create and in order to be more efficient and sustainable.

My conclusion on smart city and telecommunication providers:

It is very important that we have a high-performance intelligent network and a high-performance access. This is especially important when most services move into the cloud. These are essential prerequisites for an operator to provide.

In addition we also need to learn the requirements from a smart city. So, we need to tackle and to address the needs of future smart cities. In addition we need to support the different verticals with such an intelligent network structure and we need to try to get them all in a sense together. In this conjunction I come across the terminology of an a "smart city operating system" so we need to see how we can get all these pieces together, pieces as health, traffic, energy, administration, education, entertainment, production and so on.

We need to provide the user, the citizen with modern communication means to enable participation and encourage them to develop a smart sustainable city together. Very important aspects are the aspects of mobility, real time, security and identity. The latter strongly relates back to the user's needs. So, the user needs to keep control but at the same time intelligently use or work with its own identity Such a city shall be convenient, efficient and sustainable and future development is a combined effort of politics, economy and citizens.

8 Smart Cities—Challenges and Solutions

Kay Hartkopf, IBM Germany, Hamburg

The city represents a rather complex conglomerate of many different systems of people and components. I want to talk to you first of all about the challenges cities are facing and then look at the individual solutions we have developed at IBM to address these challenges.

Smarter cities at IBM: how did we get there? How did we come upon this topic and how did we come to the conclusion that this is something we should put our efforts into and focus on? Worldwide, for example, we are seeing that transportation systems are collapsing and congestion is on the increase. There are traffic jams all over the world and, the necessary productivity is not being provided as a result of the insufficient infrastructure. In France, for example, traffic jams cost roughly 1.5% of the GDP. At the same time, these traffic jams are responsible for 27% of carbon gas emission (Figure 1).

It is, of course, important that this infrastructure is available, and it also has to provide a certain level of safety so that people can use it and so that it can be productive. So, safety is another very important aspect needed for this whole network to work.

Energy has a very significant impact on all of these functions. Transportation needs energy, water needs energy, and telecommunication needs energy. If there is insufficient energy, then something is definitely going wrong. About a year ago, we had a blackout in Germany, and it affected many other areas in Europe. There is a strong dependency between these infrastructures, which is something we need to consider when talking about smarter cities.

Figure 1

When we look at cities from a citizen's perspective, we can identify several domains. In the centre, there are, of course, people. But how people view their cities depends upon which services they consume, which business they follow etc. This is very important to understand. Together, all of these domains make up a functioning city. They have to collaborate and exchange information. The better this happens, the better the city works and, eventually, the smarter the city becomes.

The main domains we are talking about here are obviously transport and mobility, and energy and water. Security and safety is also one of the most important ingredients as are education, buildings, and social services and health care. These need to work together perfectly and that is what smarter cities are all about (Figure 2).

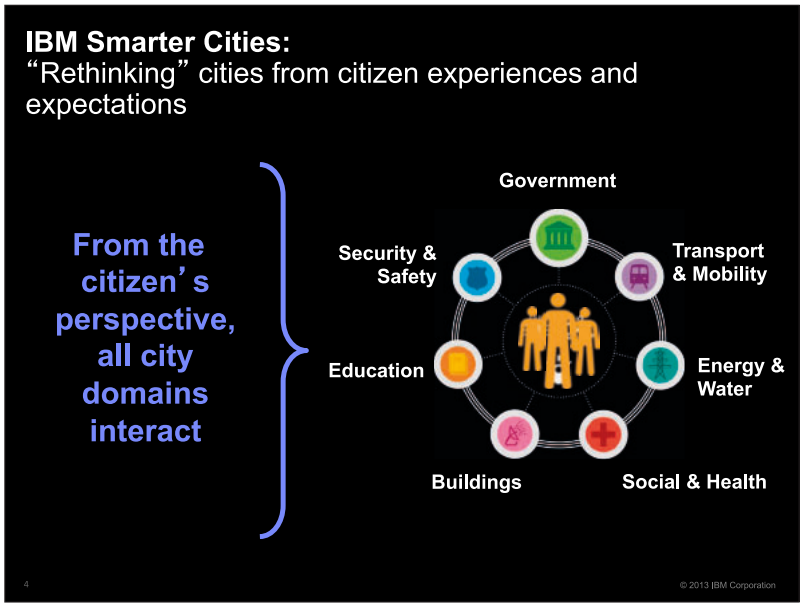


Figure 2

In the recent past, we have witnessed advancing technology allowing us to instrument many things that had previously not been able to do so to collect data and provide this information, for example, small devices such as our mobile phones and smart phones. We are also seeing cars and other devices of use that are all around us being able to provide and capture more information and submitting that information to essential means of processing that require, of course, connections. Deutsche Telekom is a good example of this. Here in Germany, we have quite a sufficient network, which is good as it is very important for the economy and for the economy to prosper in the future. It allows us to collect all this data and information that is out there.

But just rough data itself does not help us a lot. We need to find out what it is telling us, what intelligence we need, and what we need to do to understand how we can improve productivity? How we can improve these services that I have described to work better collaboratively and more productively?

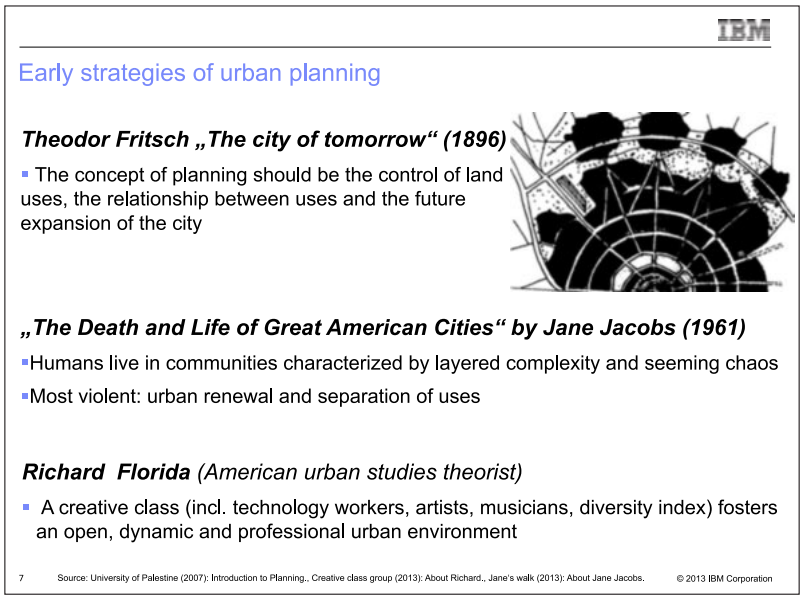


Figure 3

For some time now, people have been thinking about the major challenges involved in urban development and urban planning (Figure 3). Theodor Fritsch, for example, wrote about the city of tomorrow. He said that the concept of planning should be about the control of land uses and the very important relationship between these uses, and, of course, thinking about what is going to happen in the future and to be prepared for that. This aspect of the relationship and connecting things is one of the core elements of a city.

Elsewhere, Jane Jacobs said that humans live in a communities characterized by layered complexity. So, again, complexity is a very important topic here, though it can appear chaotic initially. It depends, of course, on what you think about it. But at the end of the day, there is some structure and some working together and, as we see, the whole system works. Cities are the most prosperous places on earth.

Thought was also given in the past to urban renewal and the separation of uses, which we know is now undergoing changing again. We see people moving into the city again. In former decades, people were leaving the city to live in the suburbs. In the city of Hamburg, for example, new districts are being developed in the centre of the city for living and, of course, working side by side. Technological advances are making this possible.

Finally, Richard Florida posited a theory that the creative class is very important for fostering an open, dynamic, and professional urban environment. This is of course debatable. But at the end of the day, this shows us that there is an extreme need for communication and for being able to connect information and provide that information to the people who work with it. It changes how we work together and how the economy works.

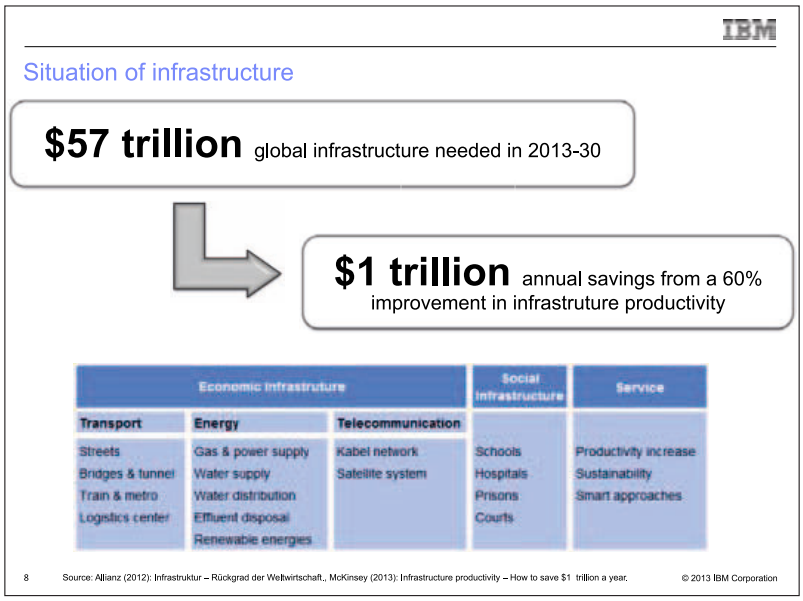


Figure 4

Let's get back to the topic of infrastructure, which is what all these people I've talked about are surrounded by; they of course live in this environment (Figure 4). According to a recent McKinsey study, $57 trillion needs to be invested in infrastructure between now and 2030. That's quite a lot of money! It is 60% more than was spent in the last 18 years, which presents a certain challenge. And it does not even cover the renewal of the present infrastructure. It is just what we need in addition to allow the economic growth we are expecting over the next decades. The table at the bottom of the slide gives an overview of the forms of infrastructure. We see the well known areas of transportation and energy as well as telecommunication. This has become very important, and if we look into the past, we see that it is quite a recent development. Other forms of infrastructure such as schools, hospitals, prisons, courts, are all provided by the government.

Additionally, we need to look into the services that have been built on top of these infrastructures. The services need to be more productive. There is a huge challenge ahead of us and many of you who follow the discussion in German newspapers know that there was a significant lack of spending and investment in the infrastructure here. This creates a great challenge for us and raises the question: what can we do? What can we do to overcome this situation and to help us to spend the $57 trillion, and, in addition, renew the existing infrastructure?

Figure 5

Working harder is not sustainable (Figure 5). We require new approaches here and in addition to this, if you recall the situation with the Hamburg port, there are even constraints that don't allow you to expand, even if you had the money. You cannot expand it; it cannot grow. It's just limited to its size. So you need to be smarter at the end of the day. You require innovative approaches. That's what I want to talk about right now: the solutions!

Figure 6

Let's start with the metro area of Lyon, a city in the south of France (Figure 6). They are faced with the challenge of significant traffic jams and congestion, which affects not only the commuters but also tourists, freight forwarders and other logistics services as well. What can we do about it? Wouldn't it be good to be able to predict what's happening on the roads one hour in advance? We provided Lyon with the technology to help them have this foresight and to really be able to manage their traffic based on the traffic prediction.

It would also be good if the individual commuter and the traveller could know how to get from A to B the best way by combining different modes of transportation. This is where the real-time travel planner comes in. You to select your destination and it tells you which mode of transport you should use and when you should switch to a different mode. And on top of that, freight forwarders and movers can of course also utilize this service when planning tours and directing their trucks.

Figure 7

Rio is quite a different example (Figure 7). Some areas of the world are faced with hazards and natural disasters more than others. The City of Rio was and still is facing significant flooding from heavy rains. This puts them in a very unfortunate situation: at least 100 people are dying each year as a result of landslides induced by the heavy rainfall. What could we do about this? How could we help them?

We implemented a solution called Intelligent Operation Centre. It allows you to connect many data sources and also to include some intelligence such as predictive planning, the prediction of weather, and also the prediction of traffic, so as to be able to plan for such disasters better. Now they are in a position where they can evacuate everybody who could be affected in a very short time. It is also possible to do this very reliably so people aren't evacuated unnecessarily. They know very well when a specific weather situation is going to

happen and when a disaster is approaching the city. This has become even more important since Rio is going to host both the Soccer World Cup and the Olympics in the near future and to be allowed to do so, the city needs to be secure.

Another example comes from one of the key areas of infrastructure we have seen before: energy. We have seen a lot of change in the production of energy and the modes of production. We are seeing an increase in the amount of renewable energy. Predicting the availability of energy is not as easy as it was before. Back then, we had big power plants and could just power up and power down.

Now what you can do to achieve this – and we have glimpsed this in what T-Systems and Deutsche Telekom are doing – is to store some of the load using batteries. We have been doing this for a long time but these batteries still need to be developed further, and so currently we are still struggling with the storage of energy. There are, however, some other means of doing it, for example, refrigerated warehouses. These store a lot of energy. They consume enormous amounts of electric power. The goods in the warehouse do not suffer if they are cooled down more than they actually need to be. They can be cooled down further than needed so that if there is a time when the additional energy is needed from the network so the electric energy can be consumed elsewhere, you can just stop supplying them with energy for a certain amount of time. And it can be quite a long time. As they are very well insulated, they can stay at a low temperature for quite a while without having to be supplied with electric energy. Through this, the network can become more flexible in terms of the energy needs and so you can even out all the spikes and peaks you get out of your supply as well as your demand .

This is a very promising approach, and it can be expanded. Not only does it work with refrigerated warehouses but with every means where energy can be stored. Many sources of energy or even many consumers of energy can act like this refrigerated warehouse. You need an intelligence that brings all of this information together and allows you to manage your network in such a way that it responds accordingly to the supply and demand.

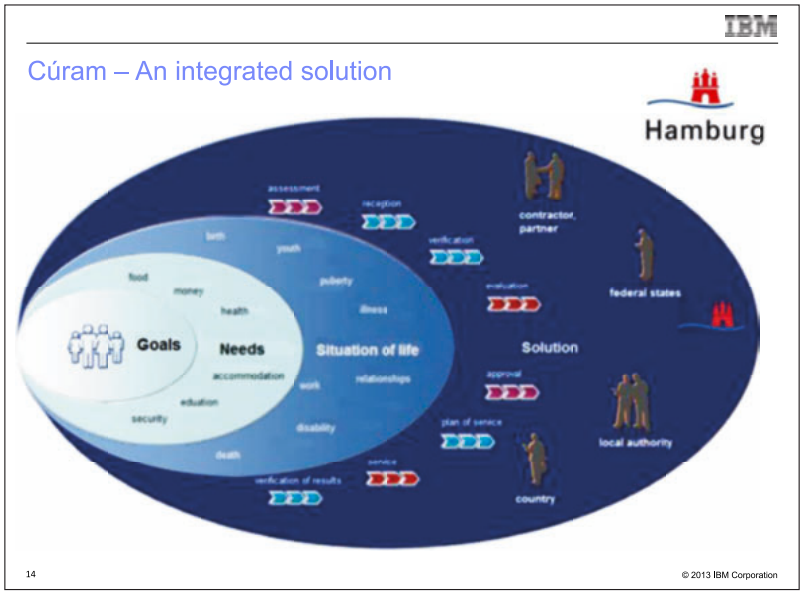


Figure 8

Finally, an example that is very different from those I have already talked about (Figure 8). Earlier on, I mentioned social services. In Europe, and in Germany in particular, the costs for social services and social benefits are rising enormously. We have to find a way to make these services more efficient and more effective. About one and a half years ago, we acquired a company called Cúram, which provides a framework to make these services more effective, to get more out of subsidies and programs, and to make more out of the money available to spend on these kinds of things.

First you look at the goals of the individuals, which puts the individual in the centre of activity. You look at their health, accommodation, monetary, educational needs, and sums them up. Then you look at the situation of life. How are people now positioned, what are their surroundings? Are they divorced? Do they have kids? And then you look at how you can help them and how you can manage that process using contractors and partners, service providers, federal agencies, local authorities, and all those who contribute. A good example of this is Hamburg, which has started on this journey to really transform their social services. The city is doing something new and they have a strong leadership there that is really following these principles and is keen to make it happen.

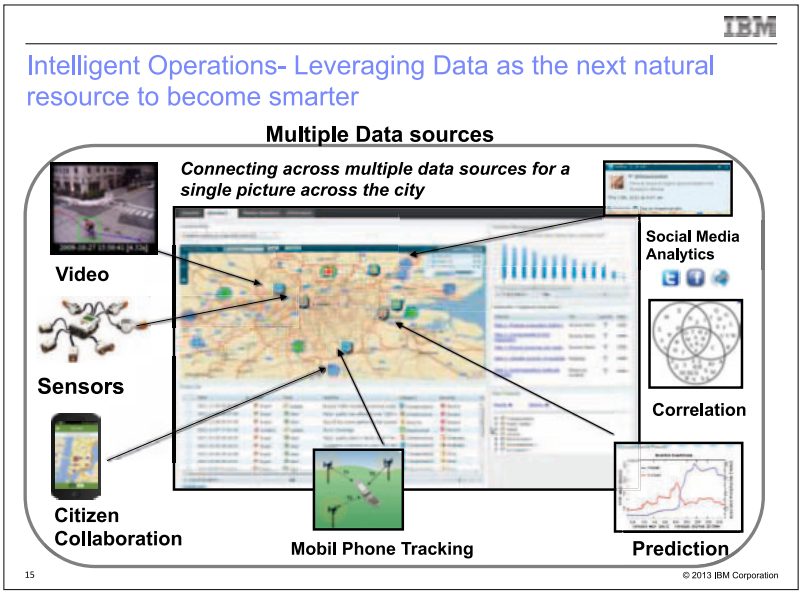


Figure 9

I have really tried to not be too technical, but of course there is a lot of technology behind all of these projects. This is the Intelligent Operation Centre I was talking about before (Figure 9). An intelligent operation centre allows you to really connect all this information and there are different types of these centres available. It can be used for water utilities, electrical utilities, and also for managing traffic, for example, public transport.

As I said before, working harder is not sustainable. We have to think about what else we can do and what we can do is: become more intelligent and put the smarter cities solution in place.

9 Perspectives from the European Union: Smart Cities & Communities

Dr. Colette Maloney, European Commission, Directorate -General Communications Networks Content and Technology, European Commission, Brussels

As announced I will give a overview from the European Union on what we are doing in the field of smart cities and communities. I will start by saying that the perspective I will offer does come from the information communication technology (ICT) side. We have a number of activities around cities and around smart cities in particular. There is an urbanisation partnership with China led by DG ENERGY. There is an EU-China partnership on smart cities, led by DG CNECT, that focuses on the role of ICT in smartening up urban environments.

Figure 1

The outline of my talk today (Figure 1): I will offer a view of smart cities, informed by ICT. I will go through the main actions that we are carrying out at the moment in the area of smart cities.
One of these is the European Innovation Partnership on smart cities. I will mention Horizon 2020 which is our forthcoming research and innovation framework programme from where we will have some funding for smart cities initiatives. And finally, ongoing cooperation that we have with China.

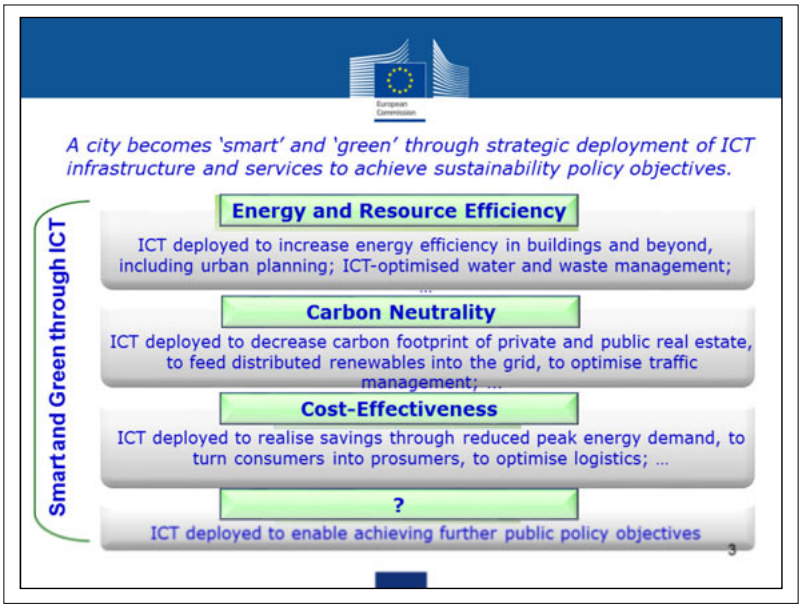


Figure 2

We are interested primarily in the EU in smart sustainable cities (Figure 2). One of the reasons for that is – I am sure all of you are aware – that we have set high sustainability high on our political agenda in the form of the three 20s for 2020 targets:

The first target is around carbon emissions. EU member states have made a commitment to reduce carbon emissions by 20 % by 2020 with respect to 1990 levels. They have also committed to increase the share of renewable energy to at least 20 % by 2020 and finally to achieve energy savings of 20 % by 2020 with 2005 as a baseline. We are doing quite well on the first two. We are doing less well on energy savings. And that's one of the reasons that we are looking at cities because 70 % of our population lives in cities and roughly 70 % of energy is consumed in cities.

We believe that ICT can play a big role in helping us manage our cities better, in terms of achieving energy and resource efficiency, in terms of reducing carbon emissions and also in terms of saving money and engaging citizens and raising awareness amongst them.

So, ICT plays a big role in our smart cities policy. In addition to its potential positive role, we are also conscious of the fact that ICT has its own energy footprint and carbon emissions associated with its use.

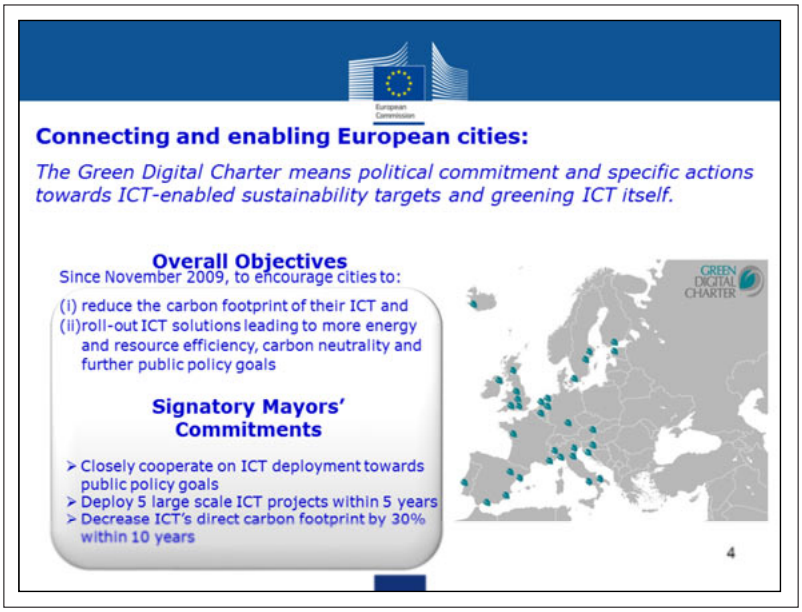


Figure 3

The Green Digital Charter is an initiative that we are running about the use of ICT in cities to help us achieve our energy and climate targets through ICT (Figure 3).

On the right hand side you see a map of cities that have signed up to the Charter. For the moment, 40 cities have signed up. Around nine or ten of them are capital cities in Europe and most of them are major cities or at least well known. It is not a huge initiative in terms of numbers of cities, but it has very concrete commitments that the cities undertake.
Those commitments are basically to use ICT to help achieve sustainability goals. The cities have committed to deploy five ICT projects within five years of signing up to the initiative. They are also looking at the footprint of ICT in their cities and have committed to measuring and to reducing the footprint of ICT by 30 % by 2020.

Figure 4

In order to support this Green Digital Charter -which is a purely voluntary initiative- the EU is funding a support action called NiCE – Networking intelligent Cities for Energy-efficiency (Figure 4). Two things I want to draw your attention to in this initiative.

The first one is the energy footprint of ICT. ICT‘s energy footprint is expected at least to double by 2020. In Europe that means, depending what figures one looks at, between 15 and 20 % of our energy consumption will come from ICT. One of things we are doing within NiCE is providing cities with a reporting tool that they can measure their ICT energy and carbon footprints with, and then set baselines and set targets for energy reduction at the city level. This measurement doesn't come out of the blue. The measurement methodologies are being developed under the International Telecom Union. A lot of ICT companies are participating and cities are also invited to participate in that initiative.

The second is we want to promote more cooperation with China through this initiative and the City of Yantai is a partner in the NiCE project.

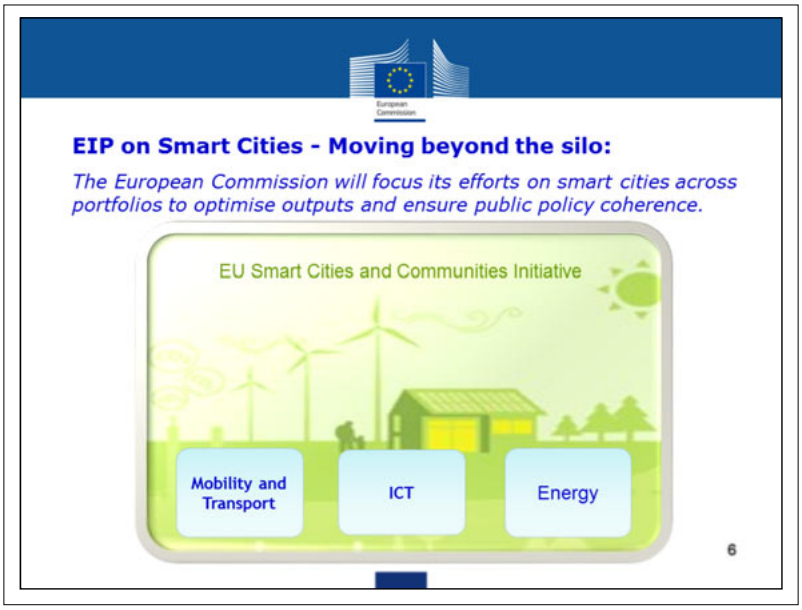


Figure 5

Another initiative that I want to mention is a European Innovation Partnership (Figure 5). This is in scale terms intended to be rather large. It will be the EU's flagship initiative around cities between now and 2020. We are in the process of setting that up.

Three parts of the Commission are coming together to define this initiative. Our own DG CNECT which deals with ICT, DG ENERGY which deals with energy and DG MOVE which deals with transport. One of the big goals of this initiative is to break down silos first of all between energy, transport and ICT. So when we are talking about projects that are taking place in cities we are encouraging the different parts of city administrations to work together and take a holistic view of the needs of and challenges faced by the city. We are trying to do the same in the European Commission.

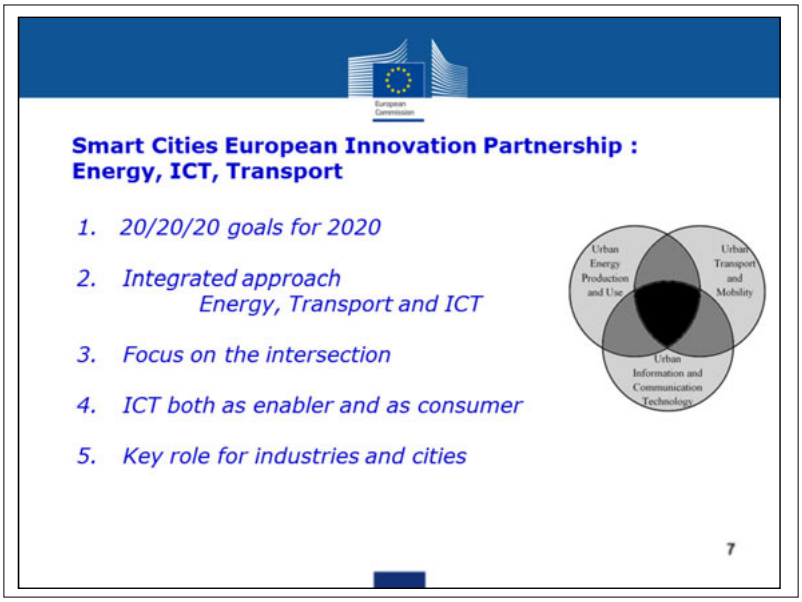


Figure 6

A high level objective of the European Innovation Partnership on smart cities and communities is to speed up delivery on the 2020 energy and climate targets that I mentioned (Figure 6). What we want to do under this partnership is achieve mass market adoption of integrated technological solutions that help us progress on these targets. The situation in many European cities is that lots of pilot projects are ongoing but we don't see much scale up happening.

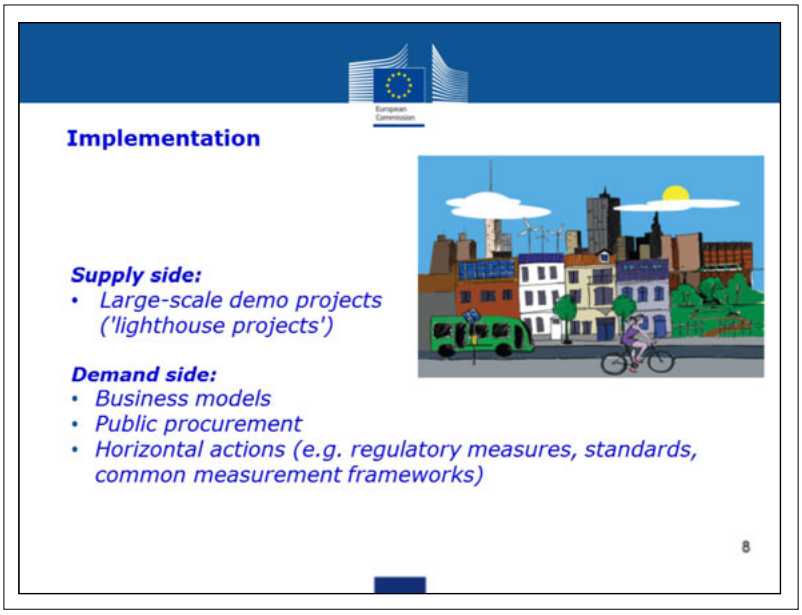


Figure 7

We aim to achieve that in part by supporting so-called lighthouse projects that would be large in scale -possibly some 10s of millions of Euro- and run in partnership by industries and by cities. They would focus on integration of ICT, energy and transport and development of innovative business models (Figure 7).

In trying to achieve scale-up, there will be many challenges to solve. One big challenge is what sort of business models are going to work? What will industry pay for, what will cities pay for, who gets the payback? There are many other questions:

Can we get cities to jointly define their needs and jointly procure technological solutions, also to achieve economies of scale?

Are there regulatory barriers at local level, national level, at EU level that prevent the rollout of technologies?

How can we engage citizens and achieve their buy-in to new services, their participation in new initiatives?

There are many standards for smart cities. The question is which ones are the good ones, which ones should we promote?

And we need to encourage measurement. If we are going to invest so much money into our cities we need baselines, we need to have targets and we need to have tools to measure progress. Common measurement frameworks - and I emphasize the word common – is important because there we need transparency.

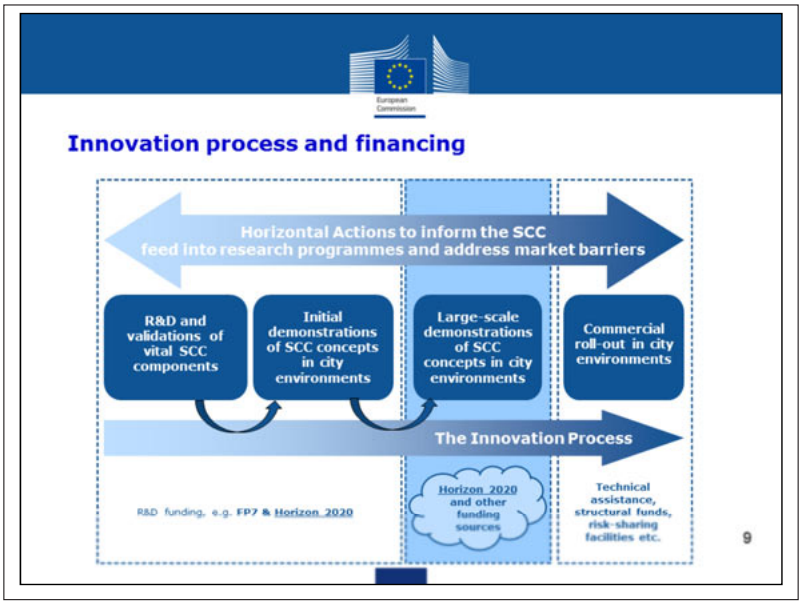


Figure 8

This slide (Figure 8) illustrates the research and innovation value chain. We fund research on the technology building blocks essential to enable cities to be designed, monitored and managed in smart ways cities. We also fund demonstrations of technologies in cities, pilot projects. Such pilots are not very large in scale. What is intended to be new about the EIP lighthouse projects is the aim to achieve scale up and mass market adoption of these technologies that have been developed in Europe.

The EU will contribute from Horizon 2020 to funding the lighthouse projects, but we aim to see them replicated and have that replication paid for through other means of financing. The next step then is commercial rollout. That is the goal: achieve cities that are smart and sustainably so throughout Europe.

Figure 9

Linked to this European Innovation Partnership is a so called high level group -of cities and companies from across Europe- that is charged with delivery of a strategic implementation plan (Figure 9). By the 14th of October this year this implementation plan should be finalised. It goes into more details on issues like I mentioned earlier: procurement, financing issues, issues around data, open data. We are working on setting targets and getting commitments from both the industries and the cities around those targets. There is also a stakeholder platform which brings together close to 2000 stakeholders from around Europe. It allows for information exchange and debate, and for ideas to be injected into the strategic implementation plan.

Figure 10

Under Horizon 2020 we will be having calls for proposals and that will happen by the end of the year for lighthouse projects (Figure 10). A couple of things about the call for proposals. We will set conditions for funding the lighthouse projects. Some of these conditions will come out of the strategic implementation plan or come out of what we have learnt from discussions with both the industry and cities. Just to mention a couple of them: The types of solutions we would support will have to be open solutions. We have talked to many cities who have tried to smarten themselves up in the past and they have ended up being locked into particular vendors or particular technologies. Open data is a key part of the initiative. It will be important to assure accessibility and seek agreement on common formats, common structures, etc for data.

Horizon 2020 has three major components: society challenges; industrial competitiveness projects and scientific excellence. The big part of the ICT funding falls under the industrial competitiveness part though it is present throughout the societal challenges. The lighthouse projects fall under the „secure, clean and efficient energy" challenge where ICT is a substantial component. We intend to publish a first call for proposals on December 11th.

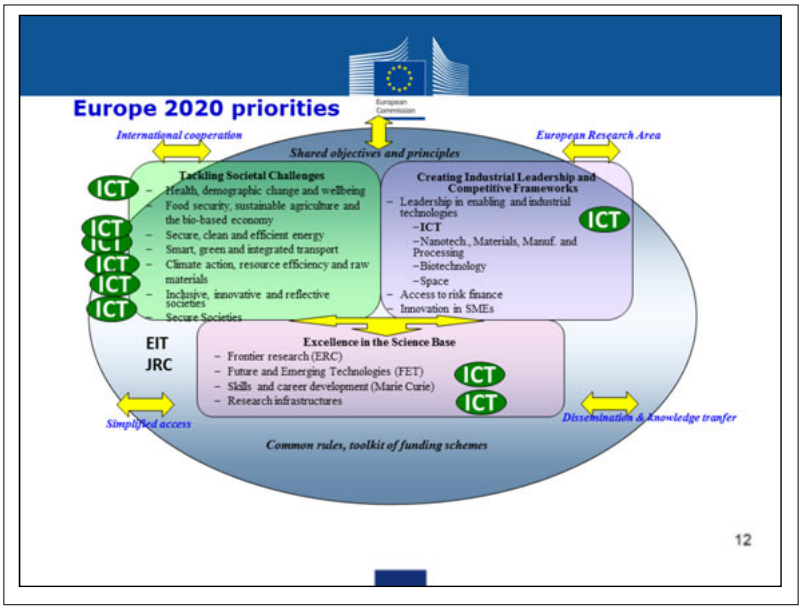


Figure 11

There is cooperation going on between China and the EU. I referred already to the Urbanisation Partnership (Figure 11). This year under the ICT policy dialogue we launched the EU-China cooperation on smart cities. We have set up expert groups and over the summer each side has been selecting 15 cities who are interested to forge cooperation partnerships.

The goals of this cooperation are basically to exchange best practices. Europe and China, both have an interest in cities and both have different experiences from the past, different challenges lying ahead for the future. But both have identified technologies playing a key role in helping solve the challenges that face us, in particular in relation to sustainability - environmental, economic and social. Groups of Chinese cities will be visiting European cities and vice versa. After this exchange we will have a report on what has been learnt and how to move forward. We would expect to eventually see pilot projects established where both parties are involved.

We have now linked this smart cities cooperation into the Urbanisation Partnership. That is important because it is one means of giving visibility in a partnership that has been signed at the highest levels in China and in the EU. The first concrete event we will take place in Beijing this year.

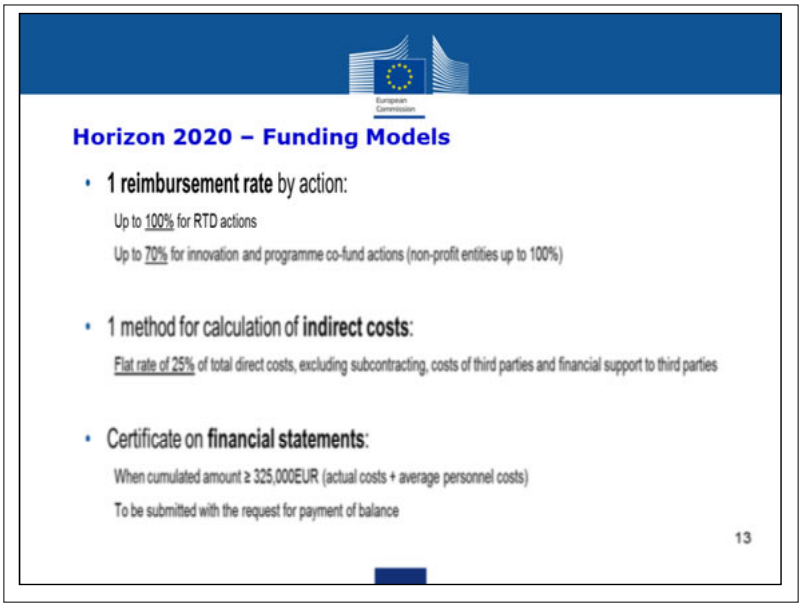


Figure 12

We also plan to establish a follow up to NiCE project again with China as the key international partner (Figure 12, 13). The international collaboration is for now focussed on one country and that is China. We would like to see something equivalent to a Green Digital Charter being set up in China. Important in our view is to cooperate on measurement activities, develop common practices and toolsets, and transparent means of demonstrating costs and benefits of smart solutions.

Chinese representatives can be involved in the EIP stakeholder's platform and the Horizon 2020 programme is open to participation from China, so we would welcome participation coming from the Chinese side in those projects.


Horizon 2020 – Next Steps
1. September-October: Consultations with national experts
2. October-November: Finalisations of WP2014-15
3. November 6-8: ICT 2013 in Vilnius
4. December 10: WP adoption
5. December 11: Publication of first calls
6. Spring 2014: closing of first call
14

Figure 13

10 No Smart City without Smart Government

Dr. Matthias Fluegge, Fraunhofer Institute FOKUS, Berlin

First, let me thank you for the invitation to this event. I think we have already seen quite impressive visions of what makes a city smarter or more intelligent. We have also learnt that a smart city covers many fields of activity that range from mobility over environmental issues to energy, education, safety and many more. When we have a look at the relation between these topics we can see in some cases more and in some cases less interdependencies. However, interestingly all of these topics are somehow related to the city government and to the public sector and the public administration.

Figure 1

This becomes clear when taking a walk through the city (Figure 1). So, I would like to invite you to join me on this walk. Our first stop over is a road construction site. As we have learned mobility is a key topic for urban agglomerations and so it is important to keep the roads in shape. While this may be done by private companies it is the city government that does the master planning for the road infrastructure and it is a public authority - the road construction office for example - that issues the permissions for the road works.

When we go on we enter the shopping area. It is a very nice environment to go for shopping here since it is a very clean and tidy area mainly due to the trash cans that are emptied on a regular basis. This service is provided by the public cleansing service - which again is a municipal organisation.

By the way the air is quite good in this area since it is part of a so called environmental zone. Access by car to these zones is only allowed for cars that comply with certain emission

standards. And again these environmental zones have been set up by a public authority, this time for environmental issues.

After an exhausting shopping trip we decide to relax a bit in a public recreation area which has been established as a result of a local citizen initiative together with the city department for urban development.

Coming back to the initial slide we can see that almost all topics from A like air quality over M like noise emissions to Z are dependent or at least are somehow related to the city government and to the public administration - which brings me to the title of this talk: No Smart City without Smart Government.

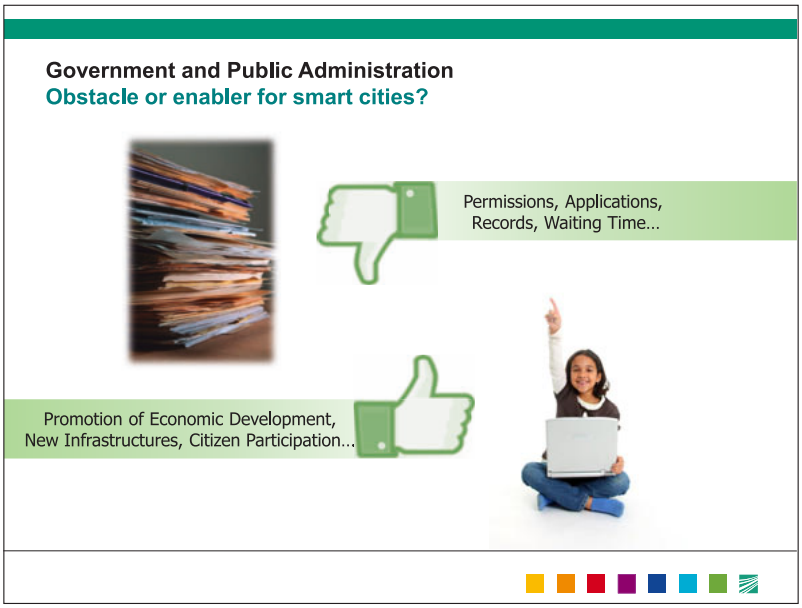


Figure 2

In General one could have two perspectives on the public administration (Figure 2). On the one hand side it can be perceived as an obstacle to smart cities, e.g. when thinking in terms of permissions, of tedious application procedures, waiting time, big records etc. On the other hand it can be also perceived as an enabler for smart cities, e.g. when thinking in terms of promoting economic development, of setting up new infrastructures, also electronic infrastructures of course, of including citizens in making decisions within the city etc. Not surprisingly the German government decided for the second option and the German Federal Ministry of Interior as well as the German Federal States have recognized the importance of a modern government and a modern public administration for economic success. This is why special attention was paid to the use of information and communication technologies - particularly the internet - as a tool to achieve better government. And this is also the definition of eGovernment.

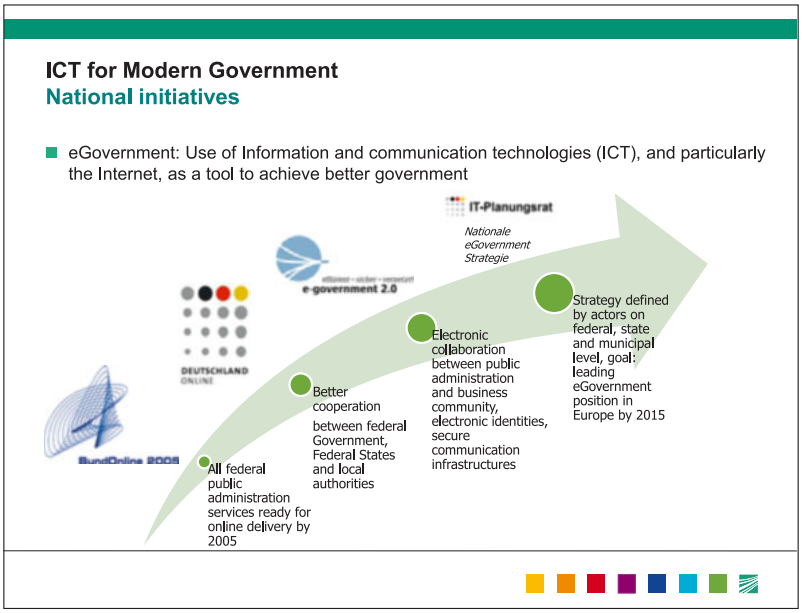


Figure 3

Since the year 2000 there have been several national flagship programmes and initiatives to promote eGovernment on all levels, on the federal level on the state level and on the local level (Figure 3). This started in 2000 with BundOnline 2005 which aimed at making all federal public administration services ready for online delivery by the year 2005. Actually this goal was achieved one year earlier in 2004.

In 2003 Deutschland Online was launched which aimed at a better cooperation among the Federal Government, the Federal States and the local authorities in the delivery of eServices and in the joint definition of standards (Figure 4). In 2006 e-government 2.0 was launched which specifically focused on improving electronic collaboration between the business community and the public administration as well as on electronic identities and secure communication infrastructures.

Most recently the national eGovernment strategy was launched in 2010. It was defined in a joined effort by actors on the federal, the state and the municipal level and it has the overall goal of bringing Germany into a leading eGovernment position in Europe by the year 2015.

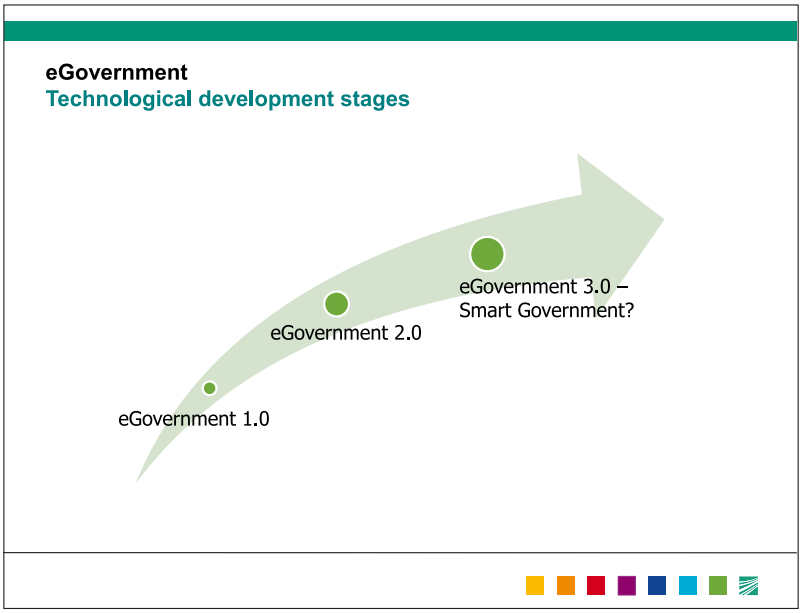


Figure 4

When we look at the technological development instead of political driven initiatives we can mainly see three steps of eGovernment or three development stages of eGovernment in Germany (Figure 4). And maybe the last stage or the most recent stage is something that we can consider as smart government in the sense that it contributes to implement the ideas and the vision of smart cities. I will come back to this later.

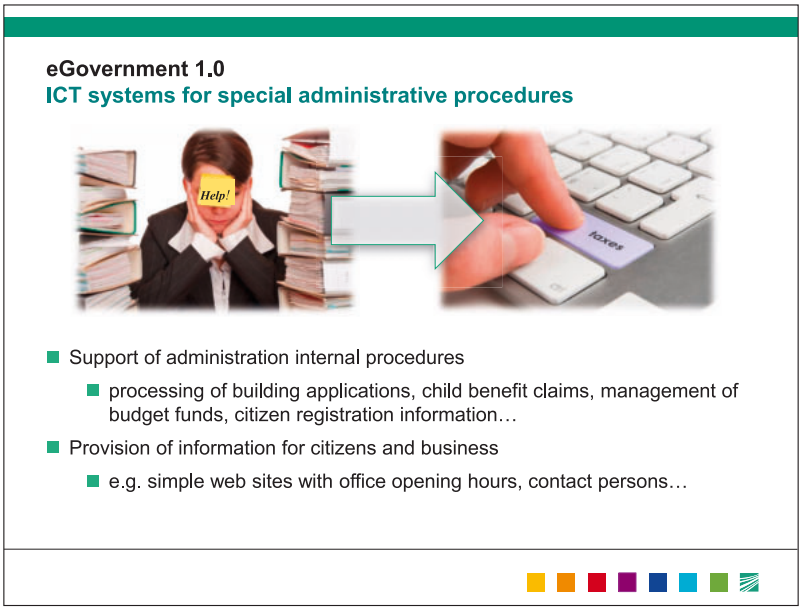


Figure 5

The first technological development stage of eGovernment was actually strongly characterized by ICT systems that support very specific administrative procedures (Figure 5). So, the idea was to relief the civil servant from paper work in applications, such as building applications, citizen registration, child benefit claims etc. This was very strongly focused on administration internal procedures. The ICT systems that have been build at that time were highly individual developments that did not talk to each other, so we could speak of monolithic systems and data silos.

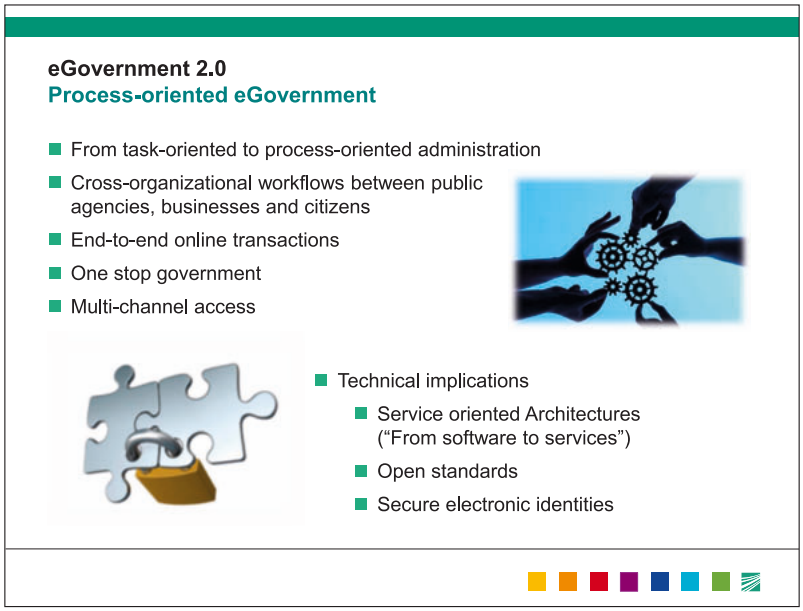


Figure 6

Furthermore the internet and the World Wide Web was discovered by the public sector to provide information to citizens and to the business, very simple information such as office opening hours, contact persons etc. However, at that time this was only considered as a one way communication channel from the public administration to the citizen and not vice versa. This changed with the second technological development stage of eGovernment and this step mainly focused on the shift from a task-oriented towards process oriented eGovernment and process-oriented administration (Figure 6). The basic idea here was to reduce media breaks in order to enable public agencies, businesses and citizens to participate in cross organisational workflows. At that time ICT was not only considered as a means to support existing processes but also as a driver to modernize public administration as such. The idea of process-oriented eGovernment also includes the concept of end-to-end online transactions and one stop government -which is the integration of several public services at a single point of access. Of course such services then should be made available through different channels: web, email, mobile etc.

This shift towards process-oriented eGovernment had several technical implementations. Firstly, ICT systems were more and more built based on the SOA design paradigm, i.e. based on service oriented architectures. The slogan at that time was 'from software to services'. Open standards have been defined for the seamless exchange of data between organisations and between the ICT systems. In the context of end-to-end online transactions secure electronic identities became more and more important.

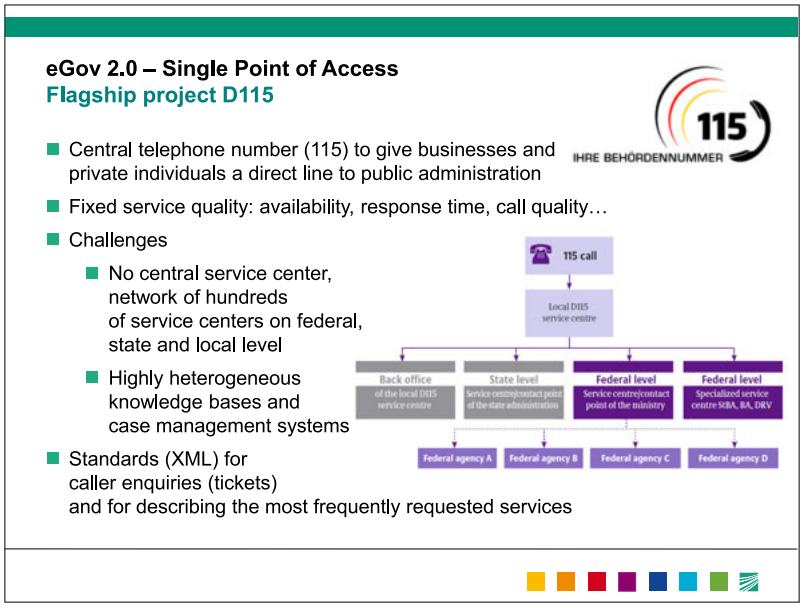


Figure 7

In recent years there have been several flagship and lighthouse projects launched by the German government to promote the idea of process-oriented eGovernment. I would like to briefly introduce some of them to you (Figure 7). One project was the flagship project D115 which is a central telephone number to give businesses and individuals a direct line to the public administration. The basic idea here was that callers would no longer have to figure out which level of government, which authority, which office is responsible for a specific concern. They would just dial the 115 and get an answer. This is why the slogan of this project was also '115 - we love questions'. The interesting thing about this project or this service number is that it provides a fixed service quality regarding availability, response time and call quality which in the end is the time that is needed to fully fulfil the request of a customer or of a caller.

This sounds like nothing special actually. Fixed service qualities – we have heard this quite often. But it becomes very special when considering the fact that the 115 is not provided by a single central service centre but rather by a network of hundreds of independent service centres on all levels, on the federal level, on the state level, and on the local level. All of these call centres come with their own culture. They come with their own ICT systems. They come with their own knowledge bases, with their own case management systems etc. This is why a main focus in this project was to define standards. Standards for the exchange of data between these centres and for describing caller enquiries and most frequently requested services. Today this has a high degree of caller satisfaction. The network of participating service centres is continuously growing.

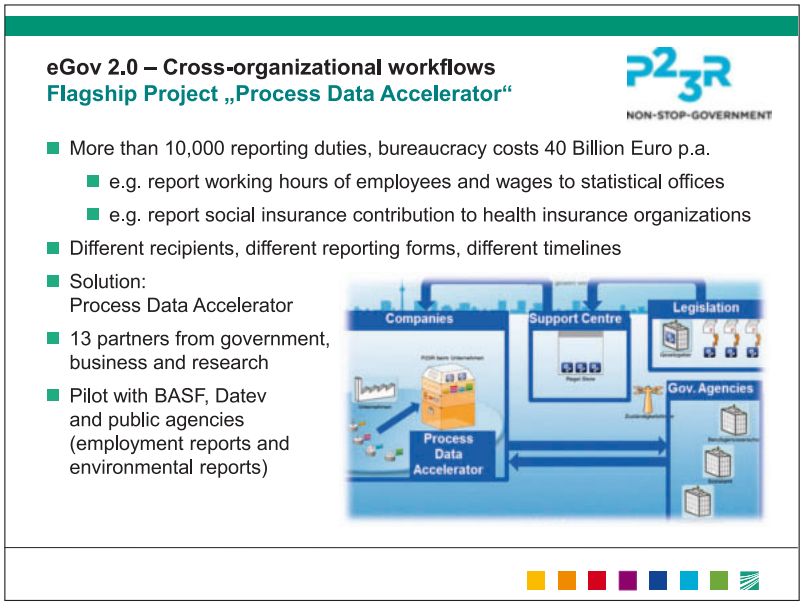


Figure 8

Another example in the context of process-oriented eGovernment - especially focusing on the idea of improving processes between businesses and the public administration - is the so called ‘Process Data Accelerator’ (Figure 8). The Agronom is P23R because in the German translation of Process Data Accelerator there are 23 letters between the P and the R. This project is motivated by the fact that the German legislation defines about 10.000 reporting duties, e.g. companies have to report working hours of employees and wages to the statistical offices of the Federal States. Or they have to report social insurance contributions to the health insurance organisations etc. and many more. Because most of the data for these reports may come from one and the same master data record or from one and the same enterprise IT systems they have to be sent to different recipients, to different public authorities. All of these public authorities require different reporting forms, different reporting contents, different reporting formats and they require different timelines and different reporting periods. This is what makes things really complicated especially for small and medium enterprises. It causes in total bureaucracy costs of 40 Billion Euro per year which is quite a big number. Therefore the Federal Ministry of the Interior initiated this project ‘Process Data Accelerator’ which provides both a technical and an organisational solution for this problem.

The technical solution grabs data from the enterprise IT systems and takes care of two things: for transforming the data, for generating the report that is requested by the public authority and it also takes care of sending out this report within the required period and within the required timelines. The technical heart of this solution is a rule-based transformation engine together with connectors on the side of the enterprise IT systems and on the side of the public administration IT systems.

Furthermore, a support centre - which is part of the organisational solution - continuously monitors the German legislation with regard to reporting duties that might have changed and for new reporting duties in order to adapt this rule base of the Process Data Accelerator.

This project is lead by Fraunhofer FOKUS and is carried out together with 12 other partners from government business and research and we have already conducted quite big pilots with companies such as BASF, Datev and public agencies in the area of employment reporting duties and environmental reporting duties.

Finally, when talking about end-to-end online transactions we have also to talk about secure electronic identities. I guess all of us already have many identities in the internet such as login and password for email services or for web shops. However, when it comes to legally binding transactions we really need trustworthy identities in the sense that authentication is provided for ones identity and also guaranteed.

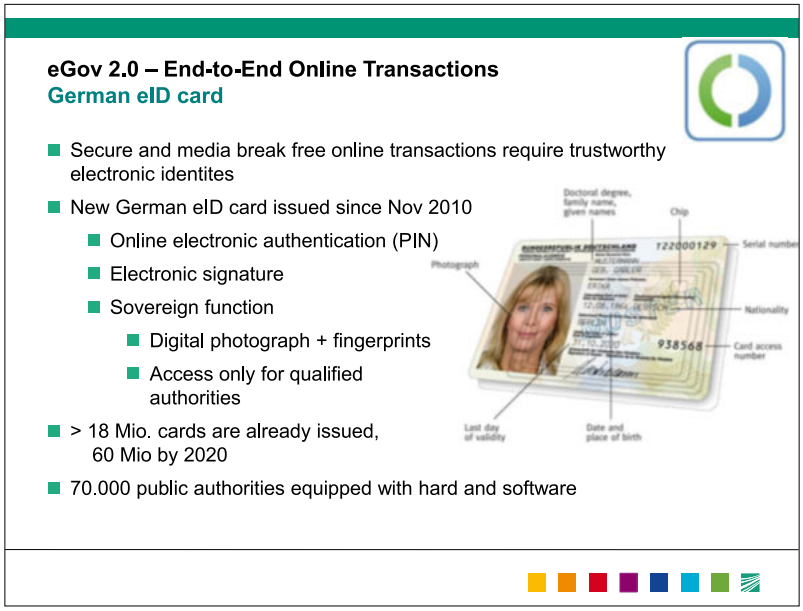


Figure 9

This is why the new German eID card was issued in 2010 and this card provides a number of key functionalities to support secure online transactions, e.g. the online eID function by means of which users can transfer personal attributes to an electronic service provider (Figure 9). In this process not only the user is identified but of course also the service provider has to present an authorisation certificate to access this data. Furthermore it provides an electronic signature to electronically sign documents in a legally binding manner. And it provides a sovereign function that is only accessible for qualified authorities in order to access digital photograph and fingerprints. About 20 Million cards have already been issued and of course in order to use this infrastructure for new public services, also investments by the public sector have to been made. This is why about 70.000 authorities have been already equipped with this infrastructure and with hard- and software for this card.

There are many more examples of process-oriented eGovernment. But I think these projects and these new public services are already quite impressive and they show that despite - or maybe even - because of the complex services structure in Germany and the high autonomy of these levels we have a quite innovative public administration and the ideas of eGovernment are seriously followed.

The basic question is: what comes next? What can we expect beyond of what I just presented as eGovernment 2.0 and how can the government and the public demonstration contribute to implement the ideas of smart cities and to implement this vision? In order to understand this we have to somehow define the term ‘smart’. According to what we have heard yesterday and today and according to many other talks and publications the concept of smart and more intelligent cities is strongly based on the efficient use of resources, on the optimisation of resources and on building on social and human capital within the city. If by ‘smart’ we understand these two things 1- efficient use of resources 2. building on social and human capital then this can be only achieved by the public sector and by the government by strongly involving third parties such as business, citizens and civil society organisations to support governmental tasks and obligations. This is why we strongly believe that in the context of smart cities the city government and public administration will more and more develop from pure service providers that try to do everything on their own to platform providers that set up an environment where third parties can innovate and where third parties can take responsibility in the city.

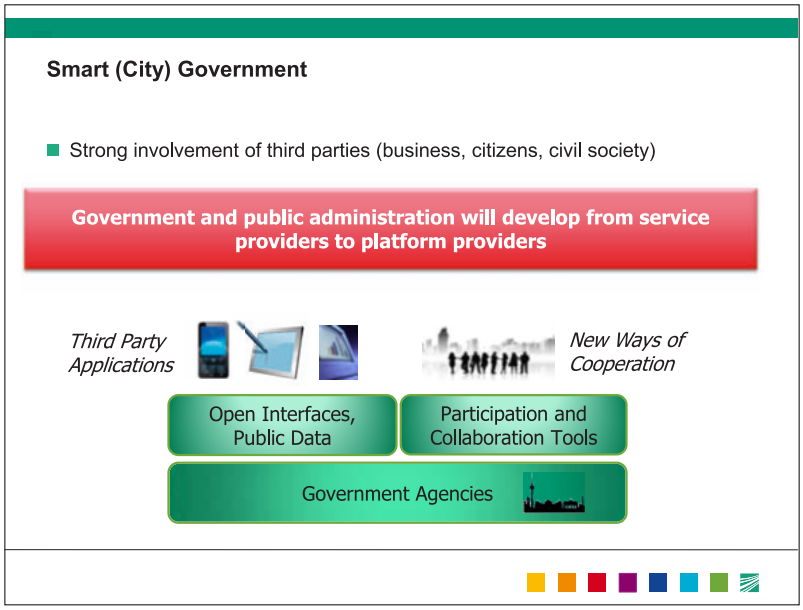


Figure 10

What does this mean in terms of ICT and eGovernment (Figure 10)? It basically means that public authorities will more and more provide programmatic access to public services and public data so that third parties from business and civil society can make use of these assets to develop new innovative citizen applications. Furthermore public authorities will make more and more use of participation and collaboration tools in order to involve citizens in making decisions in the city and in order to engage citizens to support governmental tasks. Of course these new ways of cooperation also require a kind of cultural change within the public administration but we see that step by step in many countries as well as in Germany this cultural change currently takes place.

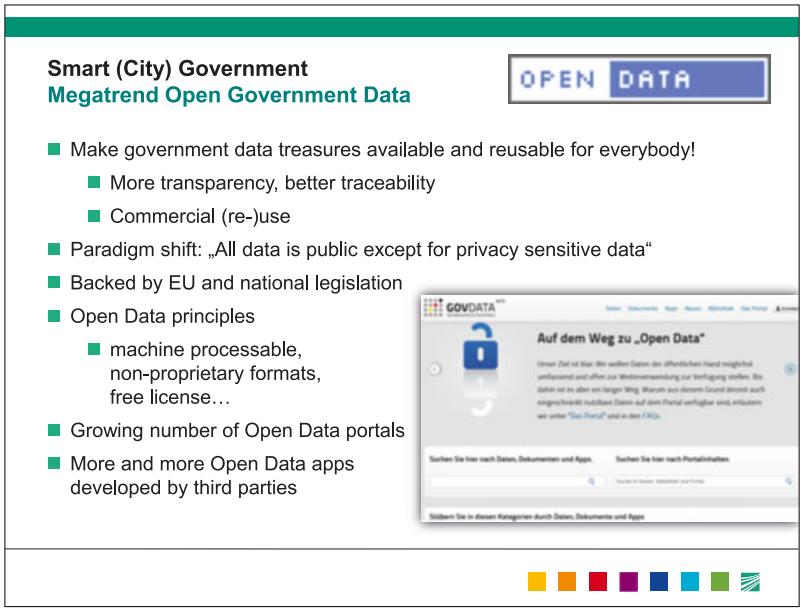


Figure 11

The concept of “government as a platform” was also mentioned by Tim O’Reilly some years ago who coined the term “Web 2.0” (Figure 11). I think it gets clearer when we have a look at concrete examples. One example is not a concrete project but rather can be considered as a megatrend - Open Government Data. The basic idea of this concept is to open up governmental data treasures and to make them available and reusable for everybody. This could be any kind of data, such as for example public transport data, public budget information or statistical employment data etc. The motivation behind this is actually twofold.
On the one hand side the idea is to increase transparency and to provide better traceability for political decisions. On the other hand side however the idea is to support economic development to foster the re-use of these resources by companies so that they can innovate based on this data, and build new business models and new applications.

This is not just a trend but a whole paradigm shift because today all kind of data of the public sector has been considered as private or as closed except for data that has been explicitly requested to be opened. Now - step by step - data is by default being considered as public - except for data that is specifically privacy sensitive and security sensitive. This is not just a weird idea by some activists but it is more and more also backed by EU and national legislation such as the PSI directive, the German eGovernment law or transparency laws t hat we have e.g. in the city of Hamburg,.

There are a number of key open data principles. Public authorities that provide data should do that in a machine processable way in order to simplify the re-use of this data. They should use non-propriety formats and they should put the data under free licenses in order to provide legal certainty and not to constrain the use of this data. There are many more agreed Open Data principles. Along these Open Data principles there is a growing number of Open Data portals that make this data available. On the slide you can see the screenshot of the German national Open Data portal that has been implemented by Fraunhofer FOKUS.

This portal provides ways for public authorities to publish data in a structured manner, to describe this data by means of meta data. And of course it provides means for interested users to find appropriate data and to get information about who maintains this data, who is responsible for it when it has been updated, which license this data is provided under etc.? Along with this growing number of Open Data portals on all levels, on the national level, on the EU level, on the regional level there is a growing number of applications that have been developed by third parties based on this data. This shows the high dynamic city that is behind this movement. I think it is an excellent example for government as a platform, how government can provide better citizens services in a very resource efficient manner and by involving third parties to do this.

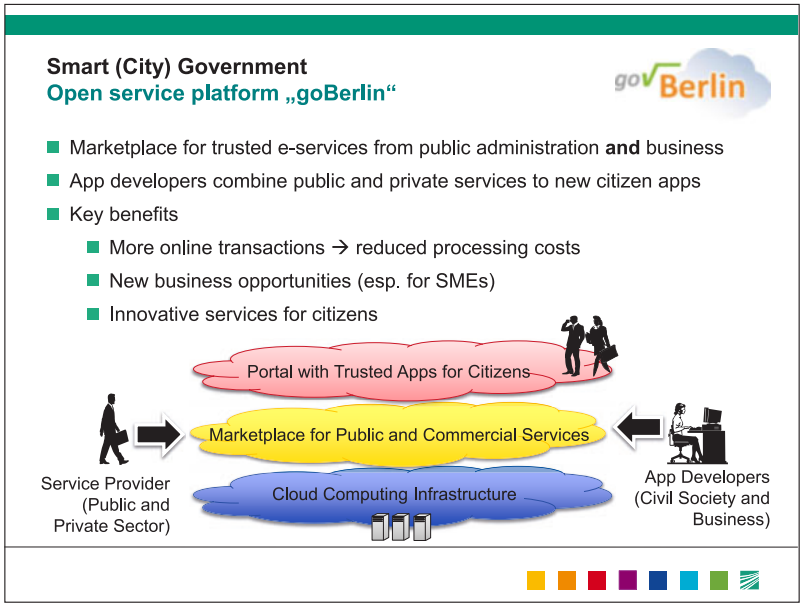


Figure 12

Another example in this regard is an ongoing R&D project called ‘goBerlin’ (Figure 12). In this project Fraunhofer FOKUS together with the City of Berlin and other industrial partners builds a market place for electronic services from public administration and business. This market place is being built on top of the cloud computing infrastructure of the official IT service provider for the Berlin public administration, hence in a trusted environment. The interesting aspect of this market place is that it provides ways for both, for public service providers and for commercial service providers to publish their services on this market place. For example the Berlin public administration may want to publish an online child birth registration service there and private companies may add complimentary services such as services for buying baby clothes or buying baby toys. Then this market place is opened for third party App developers from civil society and business. They can use these services and combine them to completely new application e.g. to the Berlin newborn App.

Figure 13

Another example would be a Berlin re-location App where services for online citizen registration are combined with that of professional relocation companies and transportation companies (Figure 13). In order to support App developers in their work this market place also provides a number of development tools and base services. Then these Apps that have been developed are being published on a portal for citizens. aBefore they are being published they undergo a certification procedure that is carried out by the operator of this market place which is a trusted public entity.

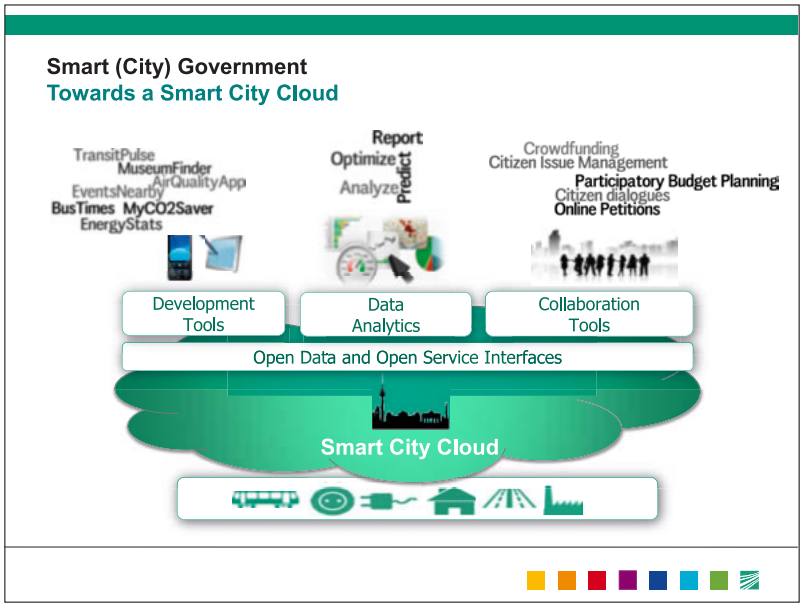


Figure 14

Actually this concept brings key benefits for all of the involved stakeholders (Figure 14). Yesterday we have heard that such models only work when all of the stakeholders benefit. First of course the citizen benefits from completely new services and applications. That means more online transactions and also more online transactions between the public administration and the citizen. On the side of the public administration this reduces processing costs.

On the other hand for businesses, especially for small and medium enterprises, this means new business opportunities. They can act either as a service provider on this market place or they can act as an App developer that combines certain services. This project is being supported by the Federal Ministry of Economics and it is expected to enter in a pilot phase next year in 2014.

Figure 15

In order to support citizens in civil commitment the public authorities may use collaboration and participation tools (Figure 15). One example for such a collaboration tools are citizen issue management systems that can be used by citizens to report local issues to the responsible local authority. That can be issues such as for example side walk parking, broken streetlights, illegal dumping of trash. They can do this very comfortable on the fly when walking by because these platforms also provide mobile applications with which a citizen makes a photo of this issue and the location is automatically detected. Finally, the report is provided to the public administration. There the platform is integrated with the backend systems, a workflow is triggered and hopefully things are getting fixed then.

Again this brings a number of key benefits for all of the involved parties. First the public administration has reduced inspection efforts because now the citizens take the responsibility and inspect their environment. The citizen can track the status of this issue. He can see who is responsible, whether this thing has been already fixed or not. And most interesting is maybe that these tools are also very valuable for political decision makers in the public, e.g. for the mayor of a city because he can see - based on statistical reporting data - which are really the pressing issues within the city. He may also see how effectively his public administration is able to deal with these issues and to handle them. I think this opens up very interesting new opportunities.

Selected cities make already use of these platforms. However, this is just the beginning. In the future we will see these platforms grow together with Open Data portals and with participation tools. For example, at this year CeBIT we have shown a prototype that demonstrates how based on such statistical citizen reporting data a dialogue is launched between the citizens and the government to find a solution for these issues and how this dialogue is automatically complemented by means of suitable Open Data in order to make better decisions.

There are many more examples of how a smart city government may use ICT to build on the innovation potential of third parties, e.g. by means of participatory budgets citizens can decide over a certain part of the public budget and how it is used in the local environment. Governments can use crowd funding platforms to raise additional funds, e.g. for upgrading local playgrounds etc.

Our overall vision at Fraunhofer FOKUS is that of a so called 'smart city cloud' which is a kind of virtually integrated environment that provides open interfaces to public services and public data along with certain value added services. Such an infrastructure is not just a vision but something we are actually working. Such an infrastructure basically provides three main functionalities. Firstly, it is a breeding environment and a development environment for completely new applications as I have mentioned before, applications that are being developed by third parties. It provides data analytics and data foresight tools and methodologies to monitor urban processes and to optimise urban processes. And it provides of course customisable collaboration tools and participation tools to involve citizens in decision making and to support new forms of commitment and civil engagement.

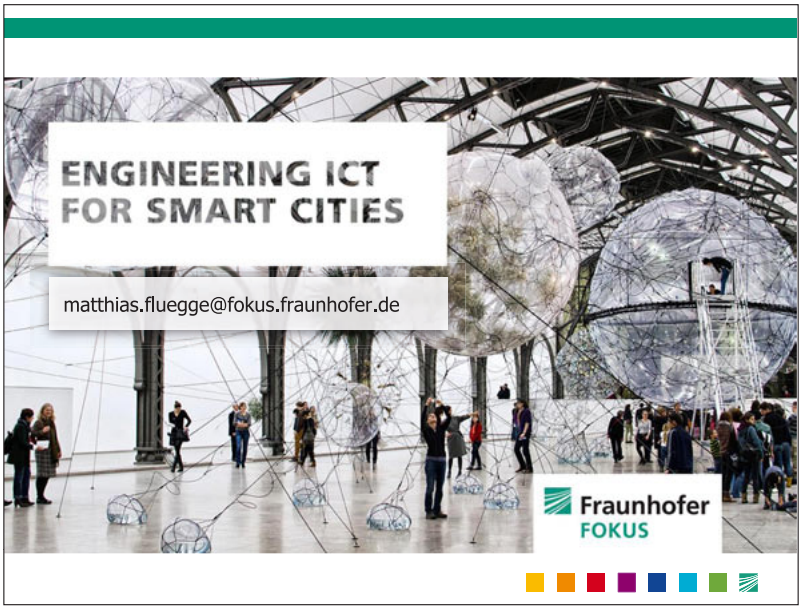


Figure 16

When consequently following the idea of opening up the innovation process in cities and of considering the government as platform provider for such processes, the city government will be more and more perceived as an enabler for smart cities rather than an obstacle. At Fraunhofer FOKUS we support this process by engineering ICT for smart cities (Figure 16).

11 Building an Smart City Highligting Economy and Living: Two Case Studies in Ningbo, China

Chen Bingrong, Ningbo Municipal People's Government

To Build a Smart City Focusing Economy and Living
——2 Case Studies in Ningbo, China

Ningbo Municipal Government, China

Contents

- Introduction of Ningbo City
- Goals, Ideas and Approaches of Ningbo Smart City Development
- Two Case Studies in the Areas of Economy and Living
- Potential Collaboration Opportunities with Germany

Introduction of Ningbo City

Location, Area, and Population

Governing 11 counties(county-level cities, or districts).
The total area is 10,000 km^2, population is 5.77 millions.
Among them, the area is 285 km^2, population 2.26 millions in the central area .

A City of Culture

Hemudu Culture Ruins

The Ruins are Neolithic and world famous, with a history of over 7000 years. They are the one of the earliest formation of the Neolithic Age found in China

Tiantong Temple

The temple was constructed in Jin Dynasty , which is a famous temple of Zen Buddhism, the 2nd temple among the 5 temples of Zen Buddhism. It is with a history of over 1700 years.

Tianyi Pavilion

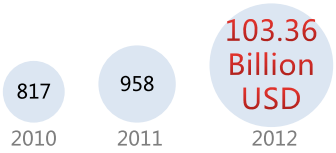
It is the earliest existing private library in China as well as the oldest library in Asia with a history of over 440 years.

A Port to the World

The cargo and container throughput of Ningbo Port reached 453 million tons and 15.67 million standard containers, ranking the 5th and 6th respectively in the world

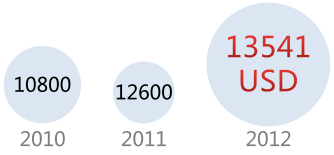
Economic Power

2010-2012 GDP



Ningbo is the economic center of the southern Yangtze River Delta area, ranking at the top in the national economy.

2010-2012 GDP Per Capita



Rapid Economic Growth

The private economic sector in Ningbo is well developed. GDP accounts for 70% of the total.

Ningbo is quite a manufacturing city. Owns 20 out 190 of the national export-brands ranking at the top throughout the nation

Ningbo is an Export-oriented economy city. In 2012, 95% of the economy is externally oriented.

Ningbo is a fast developing city. The rate of urbanization has reached 69%.

Goals, Ideas and Approaches of Ningbo Smart City Development

Urbanization Issues

Economic development mode and industrial structure need to be transformed

inadequate infrastructure

pollution, global warming and unsustainable resources

The quality of the public service provided by government and the administrative efficiency need to be upgraded

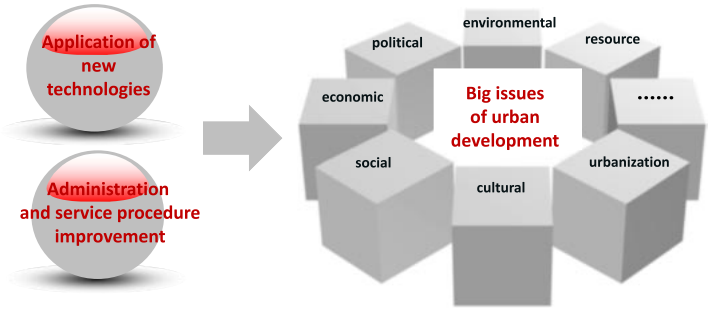
Aspects around social insurance, education, sanitation and safety are far from perfect

Strategy

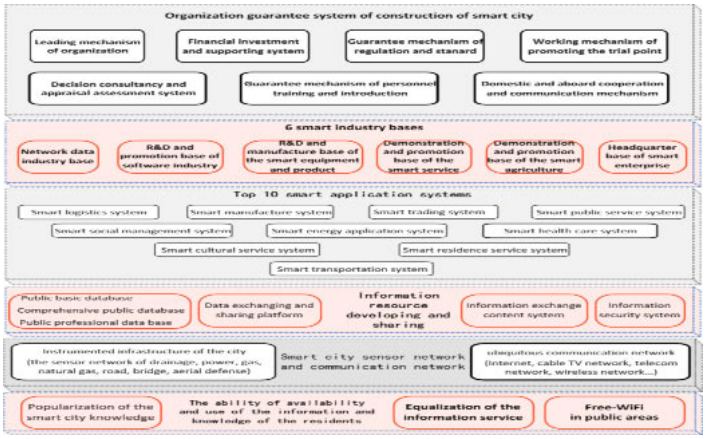
May. 2010	The strategy was raised on the 'Informatization and City Development' forum of World Expo 2010 in Ningbo
Sep. 2010	Ningbo Municipal Government issued the Decision to plan the construction of a smart city.
Feb. 2011	The twelfth Five-Year Plan of Ningbo includes the strategy to accelerate the construction of smart city
June.2011	The issuance of 'Accelerating Smart City Construction Action 2011-2015'

Goals

Relieve and Solve the 'Urban Diseases'



Ideas



Honors

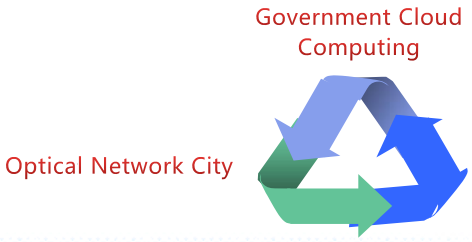
City of Informatization Excellence Achievements China 2011

Leading Smart City China 2011

Top 50 Informatization Cities China 2012
Top 10 Cities Propelling Smart City Development China 2012

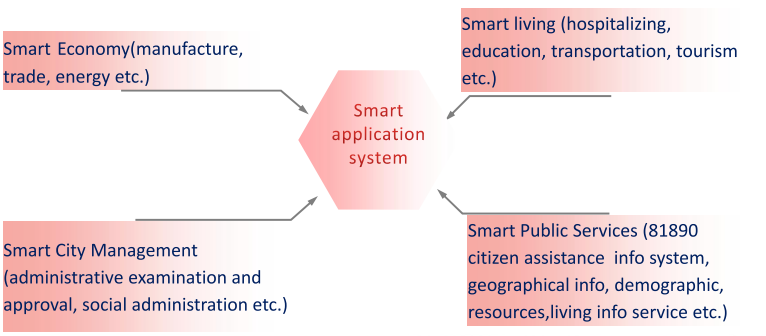
1st , Infrastructure Building

Higher than the national standards, the government has endeavored to improve infrastructure of the internet and telecommunication, enhance the construction of government cloud computing centre and fundamental database, strengthen the co-construction and sharing system of information resources. A framework of 'big internet, big data, big platform and big sharing is coming into being.



2nd, Smart Application System

According to the ideas of setting up experimental units first and then expanding to the entire city, an application system of smart, economic and socially beneficial needs to be built initially.



3rd, Development of Smart Industries

The government introduces and nurtures smart industries based on the idea of mutural propelling and contribution between smart system construction and smart industry development. Governmental, industrial and academic cooperation and leagues establishment have been highlighted.

Smart Industries Development

1. Focus on two major industrial bases

2. Build a sharing platform

3. Advance the merge of industrialization and informationization

Sponsored by:
Ministry of Industry and Information Technology
The State Administration of Radio Film and Television
Chinese Academy of Sciences
Chinese Academy of Engineering
China Telecom Group
China Mobile Group
China Unicom Group
People' s Government of Zhejiang Province

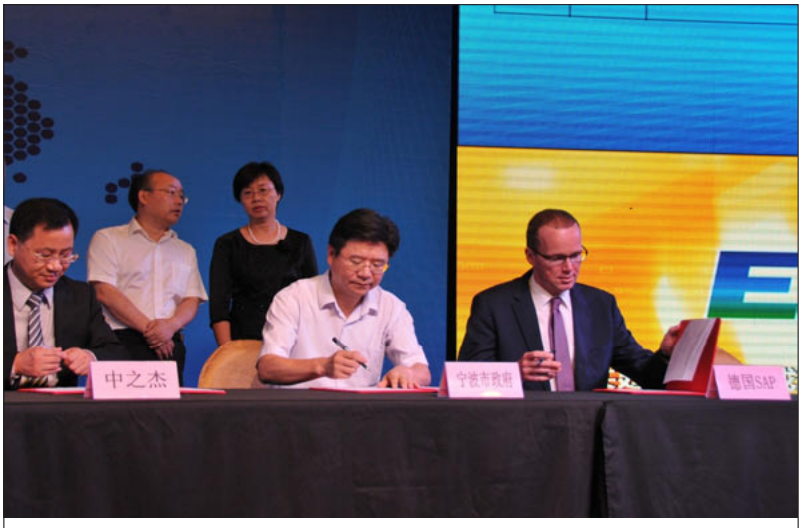
Executed by: Ningbo Municipal Government

Some facts about 2011-2013 China Smart Expo, Ningbo

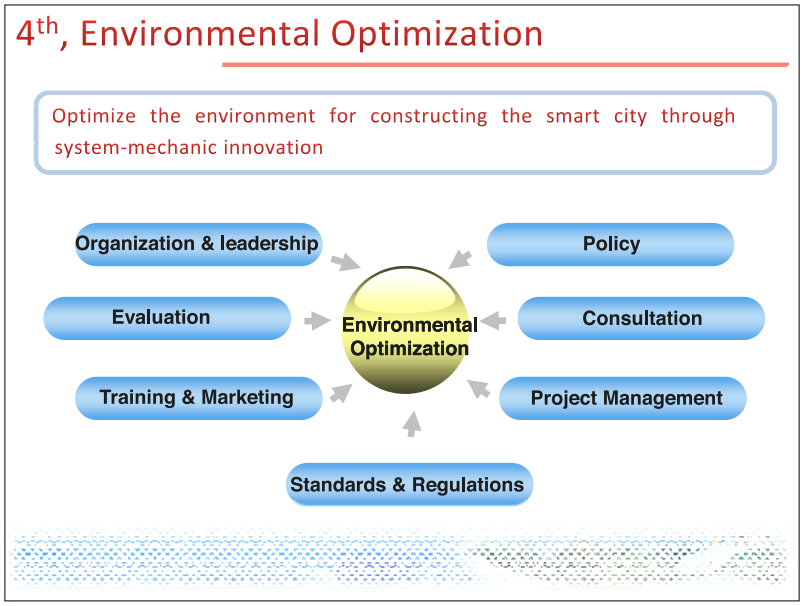
	Cooperation Item	Total signed amount	Enterprise in exhibition	Visitor
1st term	16	1.04 billion USD	310	Over 52000
2nd term	23	1.45 billion USD	300	Over 56000
3rd term	23	2.09 billion USD	310	60000 or so

Opening Ceremony, Smart City Expo. China, 2013, Ningbo.

Prof. Pan are delivering speech on the summit forum, Smart City Expo. China, 2013, Ningbo.



Ningbo Municipal Government are signing cooperation agreement with SAP, on Smart City Expo. China, 2013, Ningbo.

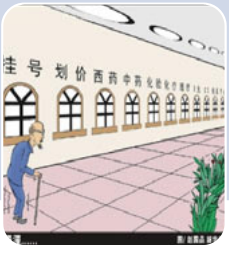


Two Case Studies in the Areas of Economy and Living

Case 1: Smart Health Care System

Background

The Health system cannot meet the demands



Difficult and Expensive to See Doctors

Unequal Resources Distribution

Achievements

1 Save time by online registration

The online hospital registration system in Ningbo gets over 20 hospitals involved, reducing the waiting time for more than 60%.

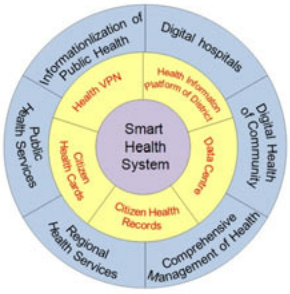
2 Increase the diagnostic level through online consultation

The government has established 37 digitalized community clinics, 8 regional video image system and 3 regional Clinical Laboratory Medical Devices. Ningbo hospitals have established remote joint consultation with famous Hospitals in Hangzhou and Shanghai

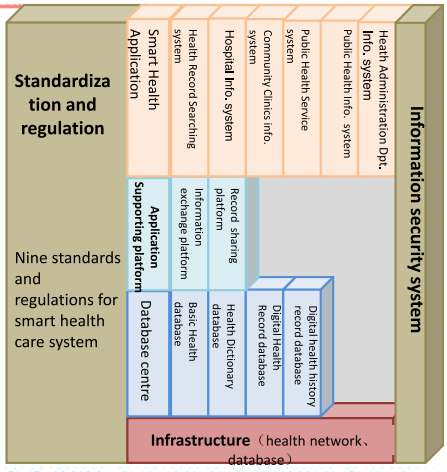
3 Share health records through sharing platform

5 million health records have been built with rate of standardized records over 65%.

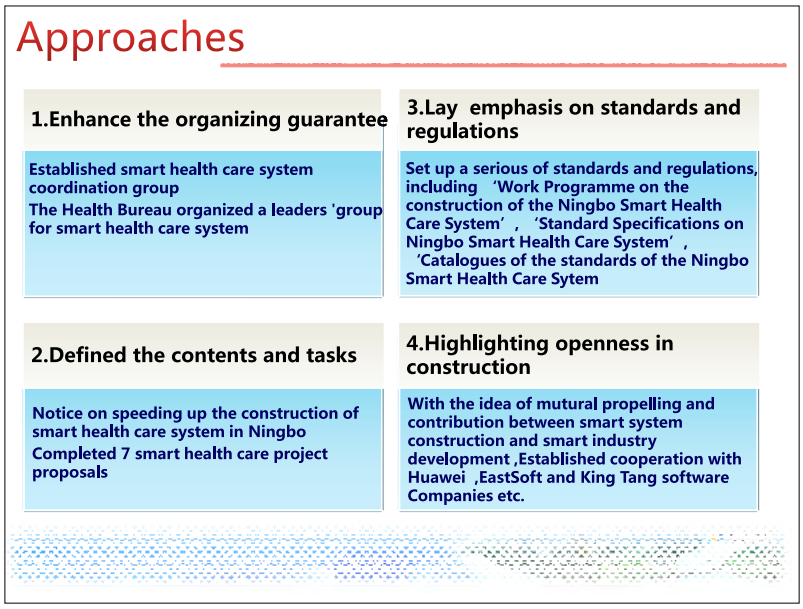
Ideas of Construction



Framework: five integration and six tasks



new progress



Case 2: Ningbo Credit

Background

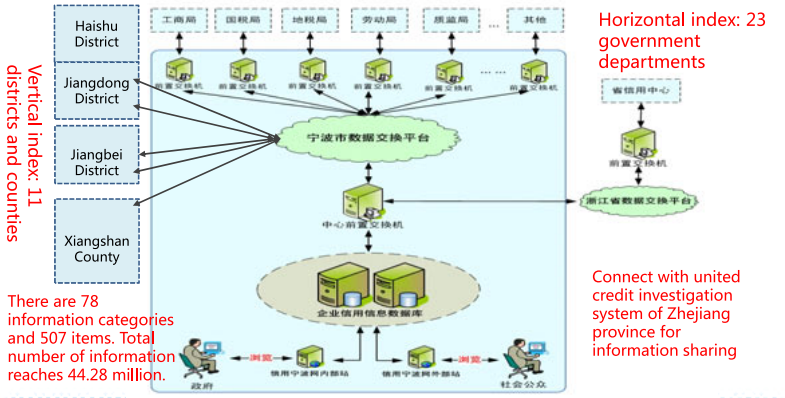
1. The utility ratio of companies' credit information is low due to limited openness.
2. The government cannot fully understand the overall situation of companies credit as credit information has not been intergrated.
3. The credit information of many enterprises is not transparent. The penalty for losing credit is unclear.

Achievements

1 Improve the efficiency of decision making	Real-time receiving of specific information on the industry developments in the entire city.
2 Improve the fairness of tax raising	Local Tax Bureau issued notices to more than 20,000 companies for delayed taxation. It increased the fairness of taxation as well as increased fiscal income for local government
3 Establish joint rewards and punishment mechanism	Established joint rewards and punishment mechanism according to the lowest credit level of the company.
4 Increase the efficiency of examination and approval	Enterprise registration takes less than an hour as apposed to a couple of days before.
5 Improve the government service level	The general public could search relevant information such as basic information, annual check and honors obtained of the company to avoid frauds.

Ideas of Construction

Build up a network for system integration, information sharing and business collaboration.



Horizontal index: 23 government departments

There are 78 information categories and 507 items. Total number of information reaches 44.28 million.

Connect with united credit investigation system of Zhejiang province for information sharing

Approaches

Organization & leadership

Established a leader group consisting of the city mayor and members from 34 relevant departments

Policy guarantee

In 2002, the government promulgated a regulation of 'Enterprise Credit Information Management 'to regulate the collection, publishing, investigation and evaluation of enterprise credit information. In 2012, the 'Enterprise Credit Information Monitoring and Social Responsibility Evaluation Methods' was put into effect

Potential Collaborations with Germany

Potential collaboration

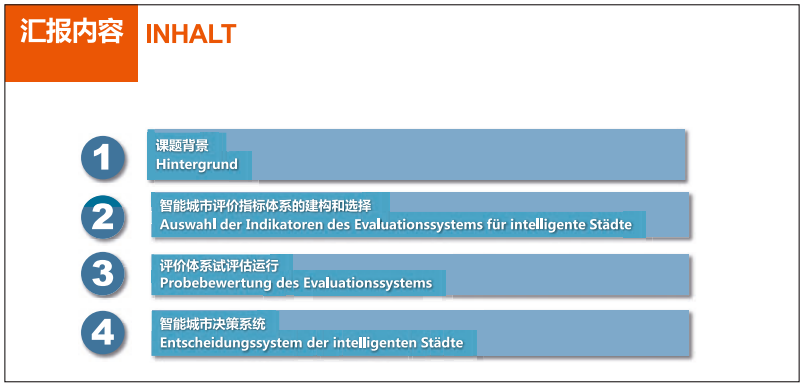
Smart City construction is very complex and sophisticated. Apart from a few achievements, the construction is still on its initial phase.

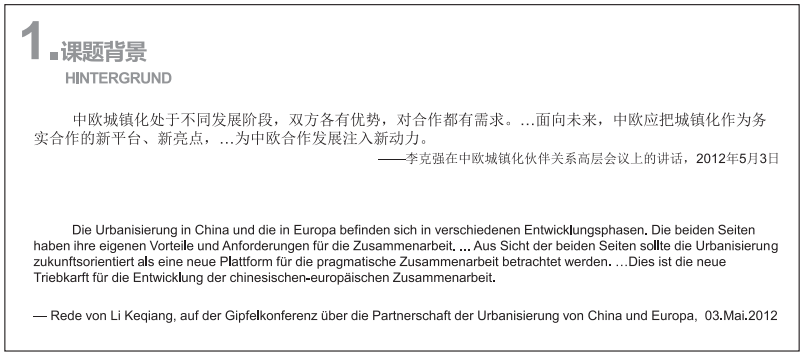
The idea of combining the wisdom worldwide to build a smart Ningbo city, is essential for our success. Stick to openness and cooperation all the time. Have established project cooperation with IBM, MicroSoft, SAP, TATA etc.

We sincerely hope to seek potential opportunities for cooperation with Germany companies and research institutions for building smart city. Welcome to Ningbo Week in Germany held in Dusseldorf next week.

12 Case Study of Intelligent City Evaluation System in China

Prof. Wu Zhiqiang, Tongji University





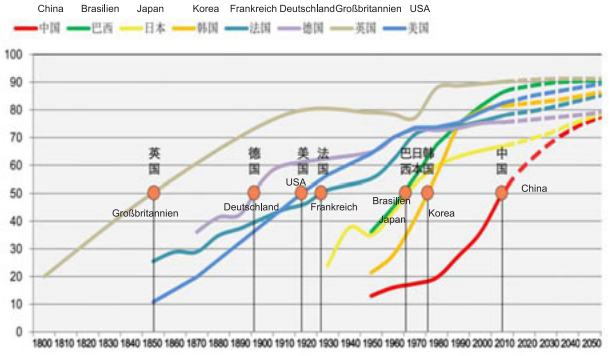
1.课题背景
HINTERGRUND

中国城镇化进入关键攻坚阶段

DIE URBANISIERUNG IN CHINA BEFINDET SICH IN DER ENTSCHEIDENEN PHASE.

8个典型国家：
8 typische Länder：

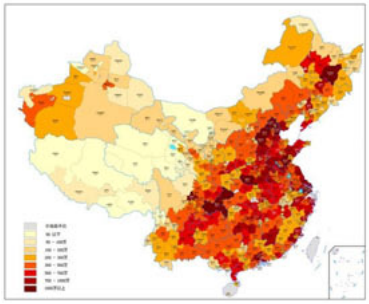
- 英国Großbritannien - 1851
- 德国Deutschland-1892
- 美国USA-1918
- 法国Frankreich-1931
- 墨西哥Mexiko-1959
- 巴西Brasilien - 1965
- 日本Japan-1968
- 韩国Korea-1977



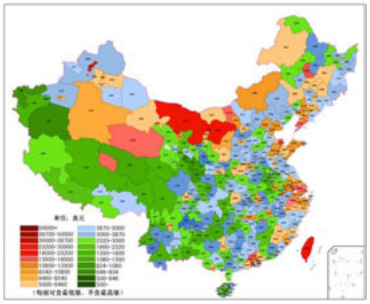
1.课题背景
HINTERGRUND

中国的城镇化发展

URBANISIERUNGSENTWICKLUNG IN CHINA



全国人口空间格局图 Diagramm der nationalen Bevölkerung pro Kopf



全国人均GDP空间格局图 Diagramm der BIP

数据来源：第六次全国人口普查地级市数据，中国统计年鉴2011 Quelle: die sechste nationale Volkszählung, China Statistisches Jahrbuch 2012

城镇化已上升为国家发展战略

Urbanisierung wird eine der nationalen Entwicklungsstrategien

“坚持走中国特色新型工业化、信息化、城镇化、农业现代化道路，
推动信息化和工业化深度融合、工业化和城镇化良性互动、城镇化和农业现代化相互协调，
促进工业化、信息化、城镇化、农业现代化同步发展。”

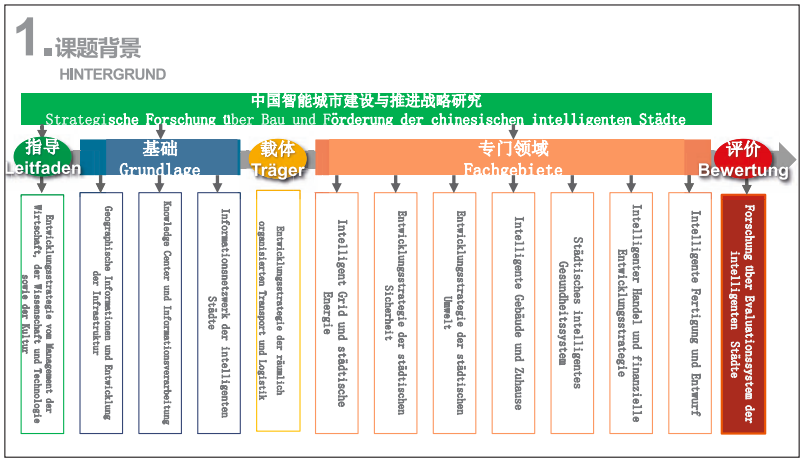
——十八大报告

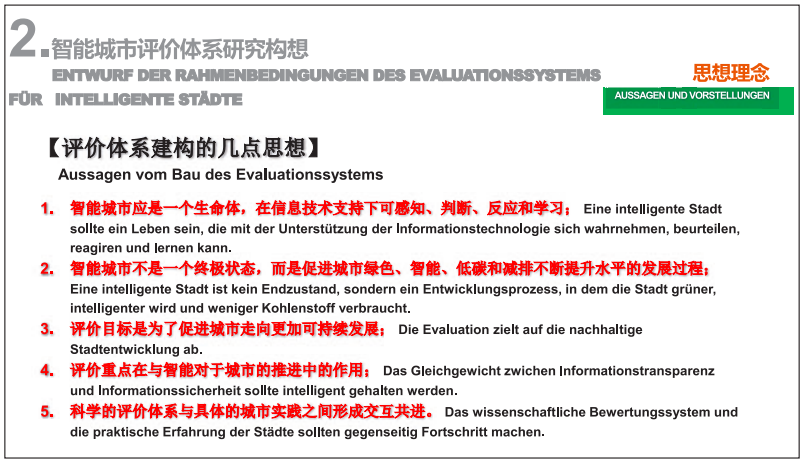
“-Festhalten am chinesischen Entwicklungsweg mit den Eigenschaften der Industrialisierung, des Einsatzes von Informationstechnologien, der Urbanisierung und der landwirtschaftlichen Modernisierung

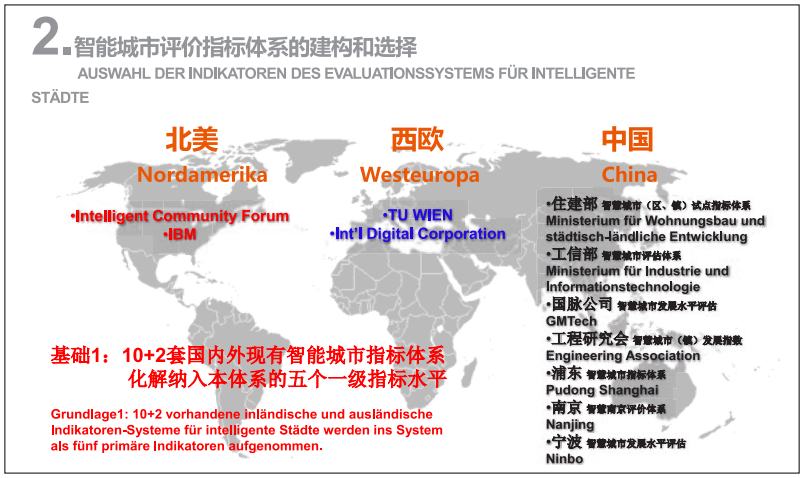
-Förderung der tiefen Integration von der Industrialisierung und dem Einsatz der Informationstechnologie, Verstärkerung der positiven Wechselwirkung zwischen Industrialisierung und Urbanisierung, Verbesserung der Koordination von der Urbanisierung und der landwirtschaftlichen Modernisierung

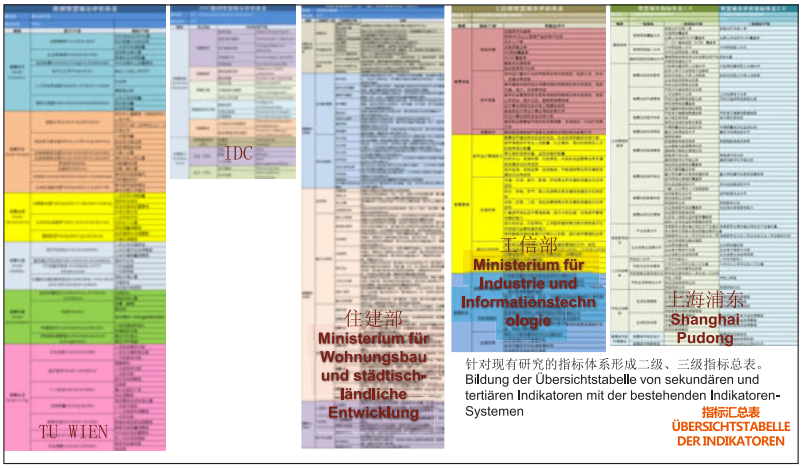
-Förderung der synchronen Entwicklungen von Industrialisierung, Einsatz der Informationstechnologie, Urbanisierung sowie der landwirtschaftlichen Modernisierung”

——aus dem achtzehnten Kongress


1.课题背景
HINTERGRUND
中国智能城市建设与推进战略研究
Strategische Forschung über Bau und Förderung der chinesischen intelligenten Städte
指导 Leitfaden
基础 Grundlage
载体 Träger
专门领域 Fachgebiete
评价 Bewertung
Entwicklungsstrategie von Management der Wirtschaft, der Wissenschaft und Technologie sowie der Kultur
Geographische Informationen und Entwicklung der Infrastruktur
Knowledge Center und Informationsverarbeitung
Informationsnetzwerk der intelligenten Städte
Entwicklungsstrategie der räumlich organisierten Transport und Logistik
Intelligent Grid und städtische Energie
Entwicklungsstrategie der städtischen Sicherheit
Entwicklungsstrategie der städtischen Umwelt
Intelligente Gebäude und Zuhause
Städtisches intelligentes Gesundheitssystem
Intelligenter Handel und finanzielle Entwicklungsstrategie
Intelligente Fertigung und Entwurf
Forschung über Evaluationssystem der Intelligenten Städte

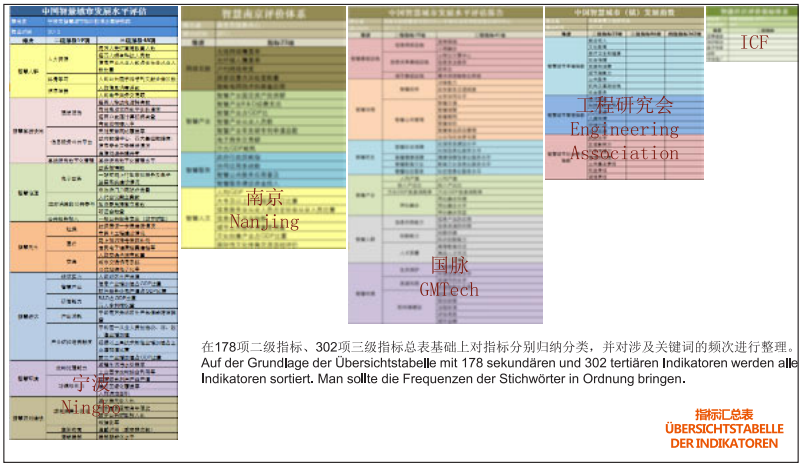

2.智能城市评价体系研究构想
ENTWURF DER RAHMENBEDINGUNGEN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE
思想理念
AUSSAGEN UND VORSTELLUNGEN
【评价体系建构的几点思想】
Aussagen vom Bau des Evaluationssystems
1. 智能城市应是一个生命体，在信息技术支持下可感知、判断、反应和学习； Eine intelligente Stadt sollte ein Leben sein, die mit der Unterstützung der Informationstechnologie sich wahrnehmen, beurteilen, reagiren und lernen kann.
2. 智能城市不是一个终极状态，而是促进城市绿色、智能、低碳和减排不断提升水平的发展过程； Eine intelligente Stadt ist kein Endzustand, sondern ein Entwicklungsprozess, in dem die Stadt grüner, intelligenter wird und weniger Kohlenstoff verbraucht.
3. 评价目标是为了促进城市走向更加可持续发展； Die Evaluation zielt auf die nachhaltige Stadtentwicklung ab.
4. 评价重点在与智能对于城市的推进中的作用； Das Gleichgewicht zwichen Informationstransparenz und Informationssicherheit sollte intelligent gehalten werden.
5. 科学的评价体系与具体的城市实践之间形成交互共进。 Das wissenschaftliche Bewertungssystem und die praktische Erfahrung der Städte sollten gegenseitig Fortschritt machen.


2.智能城市评价指标体系的建构和选择
AUSWAHL DER INDIKATOREN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE
北美
Nordamerika
•Intelligent Community Forum
•IBM
西欧
Westeuropa
•TU WIEN
•Int'l Digital Corporation
中国
China
•住建部 智慧城市（区、镇）试点指标体系
Ministerium für Wohnungsbau und städtisch-ländliche Entwicklung
•工信部 智慧城市评估体系
Ministerium für Industrie und Informationstechnologie
•国脉公司 智慧城市发展水平评估
GMTech
•工程研究会 智慧城市（镇）发展指数
Engineering Association
•浦东 智慧城市指标体系
Pudong Shanghai
•南京 智慧南京评价体系
Nanjing
•宁波 智慧城市发展水平评估
Ninbo
基础1：10+2套国内外现有智能城市指标体系
化解纳入本体系的五个一级指标水平
Grundlage1: 10+2 vorhandene inländische und ausländische Indikatoren-Systeme für intelligente Städte werden ins System als fünf primäre Indikatoren aufgenommen.



针对现有研究的指标体系形成二级、三级指标总表。
Bildung der Übersichtstabelle von sekundären und tertiären Indikatoren mit der bestehenden Indikatoren-Systemen

指标汇总表
ÜBERSICHTSTABELLE DER INDIKATOREN



在178项二级指标、302项三级指标总表基础上对指标分别归纳分类，并对涉及关键词的频次进行整理。
Auf der Grundlage der Übersichtstabelle mit 178 sekundären und 302 tertiären Indikatoren werden alle Indikatoren sortiert. Man sollte die Frequenzen der Stichwörter in Ordnung bringen.

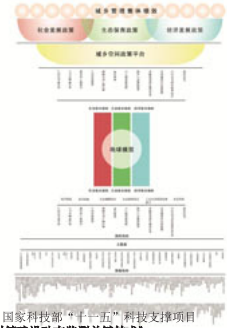
指标汇总表
ÜBERSICHTSTABELLE DER INDIKATOREN

基础2：

Grundlage 2:

1999-2003，国家自然科学基金重点项目
《中国人居环境的评价体系及可持续发展模式的研究》
通过横、纵两个方面多层面地分析了可持续发展人居环境评价体系。

1999-2003, Kernprojekt der nationalen Stiftung für Naturwissenschaften
„Nachnaltige Entwicklung —Evaluationssystem der chinesischen Lebensumstände“
Aus der horizontalen und vertikalen Sichten wird das Evaluationssysten der nachhltigen Lebensumstände analysiert.



2007-2010，国家科技部“十一五”科技支撑项目
《城镇化与村镇建设动态监测关键技术》
以人口、土地、生态、社会、经济、重大设施六大领域的基础数据为城乡发展根系

2007-2010, das „elfte Fünf-Jahrige“ Unterstützungsprojekt vom Ministerium für Wissenschaften und Technologie
„Schlüsseltechnologie der dynamischen Überwachung für Urbanisierung und ländlichen Bau“
Die grundlegenden Daten aus sechs Bereichen, und zwar Bevölkerung, Land, Ökologie, Gesellschaft und wichtigen Einrichtungen, sind die Wurzeln der Entwicklung von Stadt und Land.

3.智能城市评价指标体系的建构和选择

AUSWAHL DER INDIKATOREN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

现有评价体系的评述：
Kommentar über die vorhandenen Evaluationssysteme:

（1）偏重智能（信息化基础），忽视城市（整体可持续）；
Es wird mehr Wert auf den Grund der Informationstechnologie gelegt. Die Nachhaltigkeit der gesamten Städte wird vernachlässigt.

（2）偏重当前状态，忽视发展趋势；
Es wird mehr Wert auf den aktuellen Status gelegt. Die Entwicklungstendenz wird vernachlässigt.

（3）偏重全面性，忽视特性；
Es wird mehr Wert auf die Vollständigkeit gelegt. Die Eigenschaft wird vernachlässigt.

（4）或统一标准，或针对特定城市，缺乏弹性
Die Maßstäben könnten einerseits vereinheitlicht werden, andererseits könnten bestimmte Städte beachtet werden. Es fehlt jedoch die Flexibilität.

3.智能城市评价指标体系的建构和选择

AUSWAHL DER INDIKATOREN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

一级指标 Primäre Indikatoren

指标收敛总图
KONVERGENZDIAGRAMM DER INDIKATOREN

由此形成五个一级维度下的初步筛选的指标体系。

Unter den fünf primären Dimensionen wird das vorläufig gefilterte Indikatorensystem gebildet.

3.智能城市评价指标体系的建构和选择

AUSWAHL DER INDIKATOREN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

二级指标 Sekundäre Indikatoren

关键是如何设计　Im Mittelpunkt steht der Entwurf.

既体现城市可持续发展水平又反映智能水平

Der Entwurf sollte sowohl die nachhaltige Stadtentwicklung als auch die Intelligenz darstellen.

也就是智能手段对城市发展的客观贡献度

d.h. das objektive Niveau der Beiträge von intelligenten Mitteln für die Stadtentwicklung

避免指标体系只测度城市可持续性，或只测度智能化技术应用情况

Indikatoren-Systeme dürfen nicht nur die Nachhaltigkeit der Städte oder die Anwendung der intelligenten Technologie messen.

城市可持续性 Nachhaltigkeit der Städte + 智能硬件水平 Niveau vom Intelligenten Hardware + 城市创新能力 städtische Innovationsfähigkeit

一级维度	二级指标	sekundäre Indikatoren
管理与服务水平 Governance und öffentlicher Dienst	居民需求保障	Deckung der Nachfrage der Bevölkerung
	医疗健康服务	Medizinische Behandlung und Gesundheitswesen
	城市安全	Sicherheit der Stadt
	公众参与	Beteiligung der Öffentlichkeit
经济与产业水平 Wirtschaft und Industrie	投入产出效率	Input-Output-Effizienz
	产业发展	Entwicklung der Industrie
	资本投资比率	Verhältnisse der Kapitalinvestitionen
	信息服务业	Informationsdienste
环境与城建水平 Umwelt und Städtebau	资源使用情况	Nutzung der Ressourcen
	生态环境品质	Qualität der ökologischen Umwelt
	城市污染物处理	Bearbeitung des städtischen Schadstoffs
	建成环境	Gebaute Umwelt
信息化水平 Informatisierung	信息化基础设施建设	Bau der Infrastruktur mit der Informationstechnologie
	信息化人力资源	Human Resources für Informatisierung Human Resources
	信息化技术应用	Anwendung der Informationstechnologie
居民素养水平 Innovation der Bevölkerung	社会教育支出	Soziale Ausgaben für Bildung
	居民教育程度	Bildung der Bevölkerung
	社会公平发展	Soziale gerechtige Entwicklung
	社会多样化	Soziale Vielfalt
	城市创新	Städtische Innovation

二级指标汇总

ZUSAMMENFASSUNG DER SEKUNDÄREN INDIKATOREN

指标整合原则：

Prizipien der Integration von Indikatoren

1.双频次出现 Dual-Auftreten

2.国际可比性 Internationale Vergleichbarkeit

3.智能可持续特性 intelligente Nachhaltigkeit

整合两类指标，初步选定:

Integration von zwei Arten der Indikatoren Auswahl der folgende Indikatoren:

5个维度每个维度3-5个二级指标，共计20个二级指标。

5 Dimensionen mit jeweiligen 3-5 sekundären Indikatoren, insgesamt 20 sekundäre Indikatoren

一级维度	二级指标	三级指标
管理与服务水平	居民需求保障	人均居住面积
		人均收入增长率
		市民对政府满意度
	医疗健康服务	电子病历使用率
		人均医生数
		期望寿命
	城市安全	电子安防系统覆盖
		犯罪率变化率
		食品安全保障
	公众参与	投票率
		公众参与比重
经济与产业水平	投入产出效率	投资GDP产出率
		地均GDP
	产业发展	GDP三产比重
		GDP增长速度
	资本投资比率	外部投资比率
		R&D支出占GDP比重
	信息服务业	信息服务业GDP比重
环境与城建水平	资源使用情况	单位GDP能耗
		人均能源消耗
		人均耗水量
	生态环境品质	可再生能源比例
		污染监测覆盖率
		空气污染物浓度
		单位GDP工业污染物排放变化率
	城市污染物处理	污水处理回用率
		工业垃圾处理回用率
		生活垃圾处理回用率
	建成环境	人均公共绿地面积
		绿色交通出行比重
		城市人口密度

指标汇总表

ÜBERSICHTSTABELLE DER INDIKATOREN

根据上述建构，指标体系包括6个一级维度，以及在其之下的20个二级指标和初步的49个三级指标

Das Evaluationssystem umfasst 6 primäre Dimensionen, 20 untergeordnete sekundäre Indikatoren und 49 tertiäre Indikatoren.

信息化水平	信息化基础设施建设	信息化基础设施投资占比
		家庭高速网络可接入率
		公共空间WLAN覆盖率
	信息化人力资源	信息化人才储备
		信息服务业从业人员比重
	信息化技术应用	移动宽带用户比重
		互联网用户比例
		人均网络信息搜索量
居民素养 水平	社会教育支出	教育支出占预算比重
	居民教育程度	高中入学率
		大专及以上文化程度人口比重
		终生学习参与度
	社会公平发展	失业率变化率
		基尼系数
	社会多样化	外来移民比重
	城市创新	创意产业占GDP比重
		大学和科研院所数

指标汇总表
ÜBERSICHTSTABELLE DER INDIKATOREN

primäre Dimension	sekundäre Indikatoren	tertiäre Indikatoren
Governance und öffentlicher Dienst	Deckung der Nachfrage der Bevölkerung	Wohnfläche pro Kopf
		Wachstumsrate der Einkommen pro Kopf
		Grad derZufriedenheit der Bevölkerung mit der Regierung
	Medizinische Behandlung und Gesundheitswesen	Nutzungsrate der elektronischenPatientenakten
		die Zahl der Ärzte pro Kopf
		Lebenserwartung
	Sicherheit der Stadt	Abdeckungsrate des elektronischen Sicherheitssystems
		Änderungsrate der Kriminalität
		Ernährungssicherheit
	Beteiligung der Öffentlichkeit	Wahlbeteiligung
		der Anteil der Beteiligung der Öffentlichkeit
Wirtschaft und Industrie	Input-Output-Effizienz	Investitionsrate der BIP-Ausgang
		BIP pro Quadratkilometer
	Entwicklung der Industrie	Anteil der tertiären Industrie am BIP
		BIP-Wachstum
	Verhältnisse der Investitionen	externe Investitionsquote
		Anteil der Ausgaben von E&F am BIP
	Informationsdienste	Anteil der Informationsdienste am BIP
Umwelt und Städtebau	Nutzung der Ressourcen	Energieverbrauch pro BIP-Einheit
		Energieverbrauch pro Kopf
		Wasserverbrauch pro Kopf
		Anteil der erneuerbarenEnergien
	Qualität der ökologischen Umwelt	Abdeckungsrate der Überwachung von Umweltverschmutzungen
		Schadstoffkonzentrationen der Luft
		Änderungsrate der Industrie-Emissionen pro BIP-Einheit
	Bearbeitung des städtischen Schadstoffs	Rate der Abwasserreinigung und Wiederverwendung
		Wiederverwendungsquote der Industrieabfälle
		Wiederverwendungsquote des Hausmülls
	Gebaute Umwelt	öffentliche Grünfläche pro Kopf
		Anteil des grünen Verkehrs
		StädtischeBevölkerungsdichte

Informatisierung	Bau der Infrastruktur mit der Informationstechnologie	Investionsrate des Baus der Infrastruktur mit der Informationstechnologie
		Zugangsrate vom High-speed-Internet zuhause
		WLAN-Abdeckung des öffentlichen Raums
	Human Resources für Informatisierung	Talentpool der Informationstechnologie
		Anteil der Beschäftigten der Informationstechnologie
	Anwendung der Informationstechnologie	Anteil der mobilen Breitband-Nutzer
		Anteil der Internet-Nutzer
		Suchbetrag der Netzwerk-Informationen pro Kopf
Innovation der Bevölkerung	Soziale Ausgaben für Bildung	Anteil der Ausgaben für Bildung am Budget
	Bildung der Bevölkerung	Einschulungsrate vom Gymnasium
		Anteil der Hochschulbildung
		Teilnahme am lebenslangenLernen
	Soziale gerechtige Entwicklung	Arbeitslosenquote
		Gini-Koeffizient
	Soziale Vielfalt	Anteil der Zuwanderer
	Städtische Innovation	Anteil der Kreativwirtschaft am BIP
		Anzahl der Hochschulen und Forschungseinrichtungen für Wissenschaften

德尔菲法专家咨询
BERATUNG MIT FUZZY DELPHI-METHODE

形成初步指标后，向项目研究组内部的院士、专家发放了56份问卷（Email：int_city@126.com）对指标进行修正，并通过专家打分初步确定二级指标的权重。

Nach der Bildung der vorläufigen Indikatoren wurden Akademikern und Experten des Forschungsprojektes 56 Fragebögen (Email：int_city@126.com) verteilt, damit die Indikatoren korrigiert werden konnten.

Die Gewichte der Indikatoren wurden mit der Bewertung durch die Experte bestimmt.

2.智能城市评价体系研究构想
ENTWURF DER RAHMENBEDINGUNGEN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

基本框架
RAHMENBEDINGUNG

2.智能城市评价体系研究构想

ENTWURF DER RAHMENBEDINGUNGEN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

【评价体系建构的三点原则】

3 Prinzipien vom Bau des Evaluationssystems

- **可行性** （找得到公开数据以及经过调研可以拿到的数据以及具有国际可比性）

  Durchführbarkeit (Die öffentlichen Daten und die durch Forschung verfügbaren Daten sollten gefunden werden können und international vergleichbar sein.)

- **凝炼性** （不需要重复数据）

  Prägnanz (Die überlappenden Abdeckungen der Indikatoren sollten klein sein.)

- **持续性**（可以持续地评价）

  Persistenz (Die Daten der Indikatoren können nicht nur durchgehend bekommen werden, sondern auch kontinuierlich miteinander verglichen und bewertet werden.)

2.智能城市评价体系研究构想

ENTWURF DER RAHMENBEDINGUNGEN DES EVALUATIONSSYSTEMS FÜR INTELLIGENTE STÄDTE

明确目标

ZIELE

【总体目标】

übergeordnete Ziele

帮助城市政府和市民：

Stadtregierung und Öffentlichkeit können:

- 更全面地理解智能城市的发展状况，

  die Entwicklung der intelligenten Städte umfassend erfassen

- 更真实地了解智能为城市可持续发展带来的贡献，

  den Beitrag der Intelligenz für die nachhaltige Stadtentwicklung erkennen

- 更因地制宜地制订相关计划与行动，

  örtlichen Verhältnissen entsprechende Pläne und Maßnahmen treffen

- 更多元地参与和共享城市的整体发展。

  an der Gesamtentwicklung der Städte vielfältig beteiligen

指标合成

SYNTHESE DER INDIKATOREN

- 一级维度的指标易记、易抓、易控、易显，简明扼要的体现智能城市建设推进的大方面。一级维度由3-5个二级指数合成，各二级指标的权重由研究项目各课题组的专家通过德尔菲模糊咨询法获得。

  $A=r1*A1+r2*A2+\ldots+rn*An$

  (A是一级维度，A1，A2至An是一级维度对应的二级指数，r1，r2至rn是相应二级指数对应的0-1区间权重值)

- 二级评价指数与城镇业务管理机构工作目标相结合，体现相应该维度下指标的全面覆盖性，通过阈值和最大值两种方式进行向上的合成计算，体现各个智能城市发展的重点和特色。

  $A3=Max(a31,a32,\ldots,a3n)+IF((a31-a31v)<0,a31-a31v)+IF((a32-a32v)<0,a32-a32v)\ldots+IF((a3n-a3nv)<0,a3n-a3nv)$

  （A3是一级维度A下的第三个二级指数，a31，a32至a3n是构成A3指数的n个三级指标，a31v，a32v至a3nv是对应n个三级指标的阈值）

- 三级评价指标体系应与城乡居民生活的民生质量相融合，开放性设置引导城镇智能化和创新化发展。

- Indikatoren der primären Dimension sind prägnant und leicht zu behalten, zu ergreifen, zu steuern und zu zeigen. Die primäre Dimension veranschaulicht die Makroaspekte vom Bau der intelligenten Städte. Jede primäre Dimension besteht aus 3 bis 5 sekundäre Indikatoren, die von Experten aus den verschiedenen Arbeitsgruppen des Forschungsprojektes mit Fuzzy Delphi-Methode gewichtet werden.

  $A=r1*A1+r2*A2+\ldots+rn*An$

  (A ist die primäre Dimension. A1, A2 bis An sind die relevanten sekundären Indikatoren. r1, r2 bis rn sind Gewichte mit dem Intervall von 0 bis 1, die den sekundären Indikatoren entsprechen.)

- Die sekundären Indikatoren sind mit den Arbeitsaufgaben der Stadt-Land-operativen und administrativen Institutionen verbunden. Die Vollständigkeit der Indikatoren wird damit sichergestellt. Die sekundären Indikatoren werden in Form von Schwellenwert und Maximalwert in die primäre Dimension synthetisiert. Die Schwerpunkte und Eigenschaften der verschiedenen intelligenten Städte werden veranschaulicht.

  $A3=Max(a31,a32,\ldots,a3n)+IF((a31-a31v)<0,a31-a31v)+IF((a32-a32v)<0,a32-a32v)\ldots+IF((a3n-a3nv)<0,a3n-a3nv)$

  (A3 ist der dritte Indikator unter der primären Dimension A. a31, a32 bis a3n gehören zu den n tertiären Indikatoren, aus denen besteht A3. a31v,a32v,a3nv stellen die entsprechenden Schwellenwerte der n tertiären Indikatoren dar.)

- Die tertiären Indikatoren sollten mit der Qualität des Lebensunterhalts in den Städten und auf dem Land verschmolzen werden. Die Offenheit der tertiären Indikatoren führt zur Innovationsentwicklung der Städte.

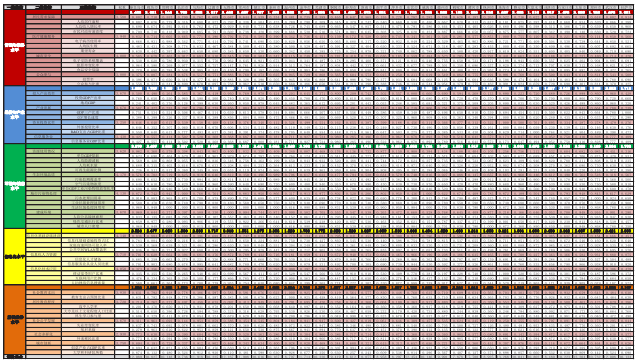
4.评价体系试评估运行
PROBEBEWERTUNG DES EVALUATIONSSYSTEMS

住建部公布首批90个国家智慧城市试点包括：
地级以上城市33个
城区25个
县/县级市20个
镇3个
园区9个
die ersten 90 nationalen intelligenten Pilotstädte nach dem Ministerium für Wohnungsbau und städtisch-ländliche Entwicklung:
33 Städte der Präfektur-Ebene und der Provinzen
25 Bezirke
20 Landkreise
3 Gemeinde
9 Gelände

考虑到统计口径和数据可得性，首先对第一批智慧城市试点名单中的**地级以上33个城市进行试评估。**
Unter der Berücksichtigung von dem statistischen Kaliber und der Datenverfügbarkeit werden zunächst die 33 Städte der Präfektur-Ebene und der Provinzen in der Liste von den Pilotstädten bewertet.

4.评价体系试评估运行
PROBEBEWERTUNG DES EVALUATIONSSYSTEMS

评估评分总表
ÜBERSICHTSTABELLE DER BEWERTUNG



对33个城市的采集数据进行处理、计算和合成。

Die gesammlten Daten aus 33 Städten werden verarbeitet, berechnet und synthisiert.

试评价排名	城市	综合评分	一级上评分				
			管理与服务水平	经济与产业水平	环境与城建水平	信息化水平	居民素养水平
1	珠海市	13.268	2.637	2.695	2.931	3.121	1.886
2	东营市	12.454	1.758	2.590	2.656	3.666	1.783
3	太原市	12.204	2.989	2.182	2.260	2.687	2.086
4	无锡市	12.167	2.402	2.329	2.955	3.018	1.464
5	秦皇岛市	12.089	2.403	1.888	3.279	2.524	1.994
6	武汉市	12.008	2.676	2.652	2.204	2.421	2.055
7	乌海市	11.918	2.512	1.641	3.055	2.335	2.374
8	常州市	11.908	2.657	2.521	3.123	1.951	1.655
9	金华市	11.714	2.678	2.346	2.198	1.783	2.709
10	廊坊市	10.827	2.081	1.747	2.497	2.477	2.025
11	六盘水市	10.802	1.619	2.201	2.676	1.800	2.506
12	郑州市	10.732	1.756	2.335	3.140	1.869	1.632
13	镇江市	10.616	1.767	2.671	2.471	1.279	2.429
14	芜湖市	10.320	1.690	1.858	2.728	1.772	2.272
15	辽源市	10.225	2.017	1.198	2.637	1.717	2.656
16	石家庄市	10.223	1.473	2.043	2.526	2.162	2.018
17	泰州市	10.167	1.499	1.266	3.094	2.366	1.942
18	邯郸市	10.148	1.844	1.309	2.588	2.020	2.386
19	威海市	10.146	1.105	2.366	2.724	1.404	2.546
20	拉萨市	10.134	2.081	1.713	1.793	2.350	2.197
21	雅安市	10.041	2.623	1.620	2.033	1.901	1.864
22	德州市	9.991	1.886	1.837	2.672	1.628	1.968
23	长治市	9.736	2.700	1.595	2.327	1.560	1.553
24	铜陵市	9.419	1.764	2.198	1.992	2.028	1.437
25	南平市	8.958	1.051	1.705	2.524	2.059	1.620
26	株洲市	8.925	2.234	1.177	2.395	1.668	1.450
27	淮南市	8.877	1.673	1.488	1.919	1.827	1.969
28	温州市	8.797	1.592	1.781	1.548	1.823	2.054
29	蚌埠市	8.612	1.620	1.420	1.989	1.526	2.057
30	咸阳市	8.480	0.917	1.627	1.502	2.438	1.995
31	萍乡市	8.297	1.311	1.581	2.153	1.615	1.637
32	鹤壁市	7.878	1.103	1.636	1.550	1.483	2.106
33	漯河市	7.788	2.050	1.598	1.317	1.211	1.611

试评估结果
ERGEBNISSE DER BEWERTUNG

最终得到33个试评价城市的综合评分如表所示。综合评分获得前五位的城市分别是珠海、东营、太原、无锡和秦皇岛，同时，各城市在智能城市方面的表现都有其特征和偏向，呈现多元化的发展状态。

In der Tabelle werden die Gesamtpunktzahlen der Bewertungen von 33 Pilotstädten veranschaulicht. Folgende Städte setzen auf den ersten fünf Plätze: Zhuhai, Dongying, Taiyuan, Wuxi und Qinhuangdao. Inzwischen haben die Städte aus Sicht der intelligenten Städte ihre eigenen Besonderheiten. Diese Städte entwickeln sich diversifiziert.

4.评价体系试评估运行
PROBEBEWERTUNG DES EVALUATIONSSYSTEMS

试评估结果
ERGEBNISSE DER BEWERTUNG

试评价智能城市排名分布图中可以看出，排名靠前的智能城市基本分别在东南沿海，类推向中西部地区递减。

中国智能城市建设现状与中国城镇化发展的状态基本匹配。

Das Ranking-Längsschnitt der intelligenten Städte zeigt, dass sich hochrangige Städte wesentlich an der Südostküste verteilen. Die Anzahl solcher Städte steigt in Richtung Westen ab.

Der Zustand vom Bau der chinesischen intelligenten Städte stimmt sich grundsätzlich mit der Urbanisierung der chinesischen Städte überein.

4.智能城市决策系统
ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE

领导决策桌面
Entscheidungsfindung-Desktop

LBS移动服务终端
LBS mobile intelligente Terminaldienstleistung

通过评价体系的指标，可以把握智能城市建设推进的关键点及其对应的城市部门，将其集成到桌面和移动终端中，形成智能城市决策系统，做到动态监测，及时反应。

Durch die Indikatoren des Evaluationssystems können die wichtigen Punkte und die entsprechenden städtischen Behörden, die den Bau der Städte fördern, kontrolliert werden. Sie werden in Desktop und Terminaldienstleitung integriert und bilden das Entscheidungssystem der intelligenten Städte. Mit diesem System entstehen die dynamische Überwachung un die zeitnahe Reaktion.

5.智能城市决策系统
ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE

技术创新 ——智能化数据决策
TECHNISCHE INNOVATION: ENTSCHEIDUNGSFINDUNG VON DATAMATION

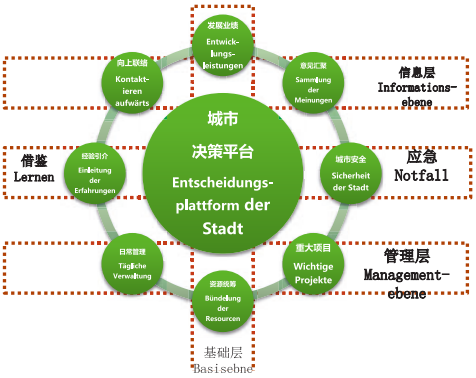
八大功能模块支持智能决策
Acht Funktionsmodule unterstützen die intelligente Entscheidungsfindung.
通过整合城市综合信息的集成及数据可视化分析，为城市决策者服务，服务于可持续的城市未来发展。
Die Integration von der umfassenden Informationen der Stadt und der Data-visualisierungsanalyse dient zu den Entscheidungsträgern der Stadt und der zukünftigen nachhaltigen Stadtsentwicklung.

评估指标体系作为决策数据基础
Indikatorensystem der Evaluation als Datenbank der Entscheidungsfindung
以城市生命体的可持续发展为导向的指标体系夯实科学计算基石。
Die sich an der nachhaltigen Entwicklung orientierteten Indikatoren bauen die solide Grundlage der wissenschaftlichen Berechnung auf.

关键数据挖掘和数据的空间可视化
Data-mining und räumliche Visualisierung von Daten
基于城市大数据，依托先进的软件平台和算法开发以地球模型为代表的多元可视化工具挖掘和展示城市运行数据。
Die diversifizierte Mining der Visualisierungswerkzeuge, die vom Erdmodell vertreten wird, basiert auf Stadtdaten und wird durch moderne Software-Plattform und Algorithmen entwickelt. Die Betriebsdaten der Stadt wird auch angezeigt.

用户需求为导向的进化更新
Bedarfsgerechte Entwicklung und Aktualisierung
推进理性主义决策方法，以数据化决策革新管理模式，促进管理方式和架构与大数据技术工具相适配。
Rationalität der Entscheidungsfindung zu fördern,
Management mit den techinischen Wergzeugen der Daten übereinzustimmen

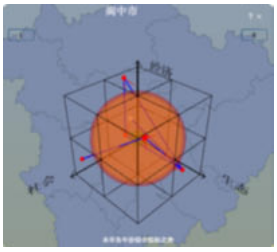
4.智能城市决策系统
ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE



八大功能模块支持智能化决策
ACHT FUNKTIONSMODULE UNTERSTÜTZEN DIE INTELLIGENTE ENTSCHEIDUNGSFINDUNG

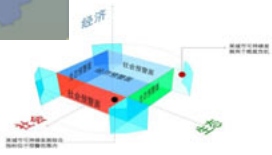
4.智能城市决策系统
ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE

指标体系评估作为决策基础
INDIKATORENSYSTEM DER EVALUATION ALS ENTSCHEIDUNGSGRUNDLAGE



地球预警分析模型智能计算可持续预警区间，使城市决策者能够全面掌握城镇化进程的阶段性和问题。
Erdformiges Modell der Frühwarnanalyse kann die nachhaltige Warnintervall intelligent kalkulieren, sodass Entscheidungsträger die Phasen und Probleme der Urbanisierung in vollem Umfang begreifen können.

异构数据整合技术
Integrationstechnologie heterogener Daten
关键警情识别技术
Anerkennungstechnologie wichtiger Notsituation
数据智能优化技术
Intelligente Optimierungstechnologie von Daten
海量数据存储技术
Speicherungstechnologie von massiven Daten
多系统影响模拟分析技术
simulationstechnologie unter Effketen vom Multisystem



Maßgebliche Indikatoren

4.智能城市决策系统
ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE

数据的空间可视化
RÄUMLICHE VISUALISIERUNG VON DATEN

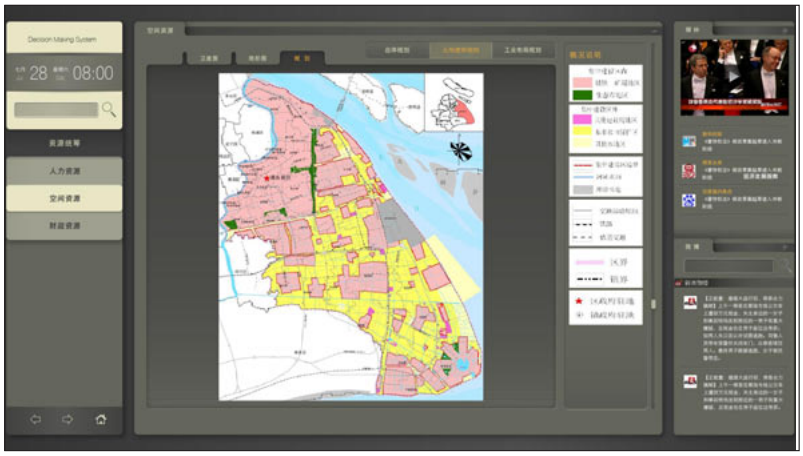
简便　高效　机敏　联动　高扩展性
handlich, effizient, findig, zusammenhängig, hoch erweiterungsfähig


Decision Making System
28
08:00
30°C


Decision Making System
28
08:00
发展全域
经济子系统
社会子系统
生态子系统


Decision Making System
28
08:00
发展全域
经济子系统
社会子系统
生态子系统

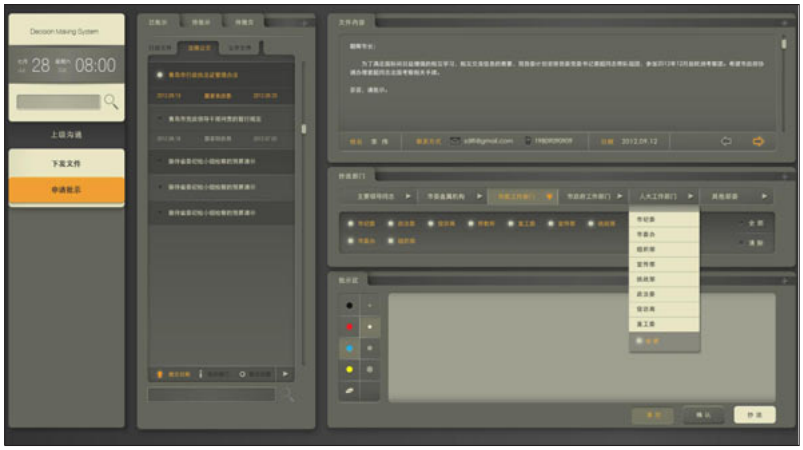

Decision Making System
08:00
资源统筹
人力资源
空间资源
财政资源


Decision Making System
08:00
资源统筹
人力资源
空间资源
财政资源


Decision Making System
08:00
资源统筹
人力资源
空间资源
财政资源


Decision Making System
08:00
上级沟通
下发文件
申请批示

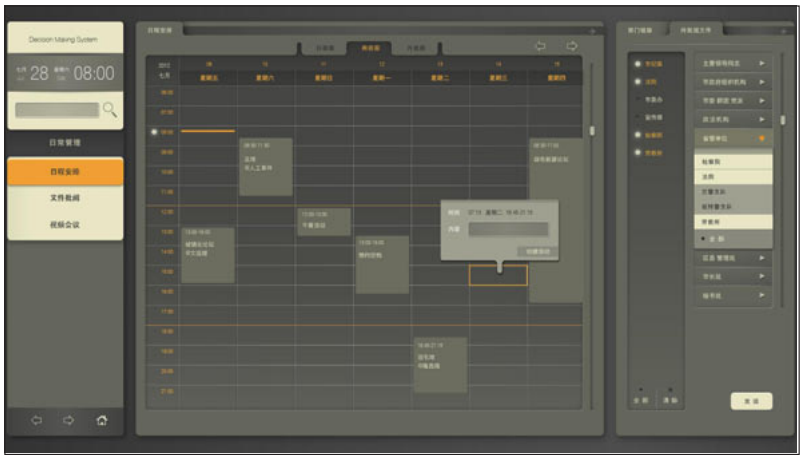

Decision Making System
08:00
资源统筹
人力资源
空间资源
财政资源

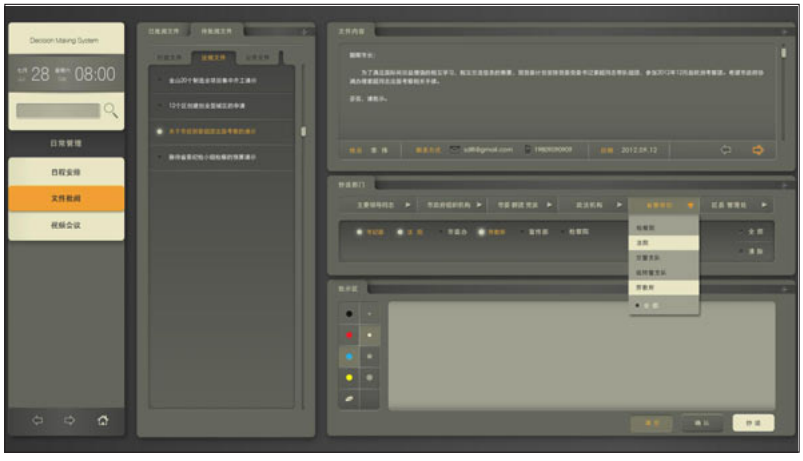

Decision Making System
08:00
上级沟通
下发文件
申请批示

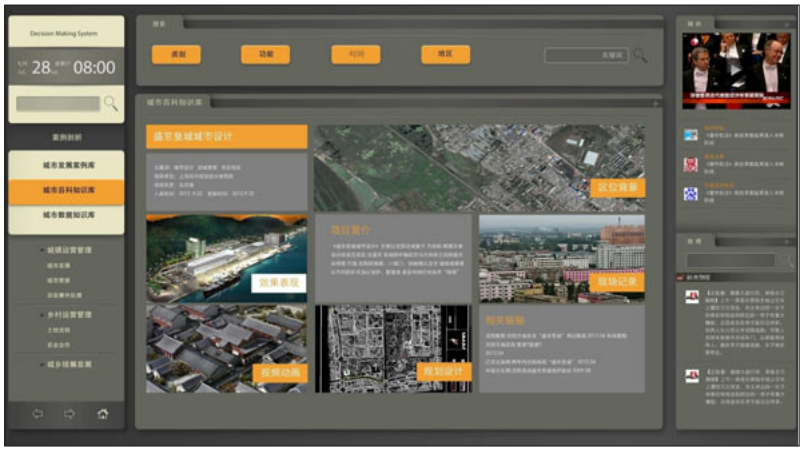

Decision Making System
08:00
重大项目
执行全局
策划支撑


Decision Making System
28
08:00
突发事件
自然灾害
事故灾难
公共卫生事件
社会安全事件


Decision Making System
28
08:00
突发事件
自然灾害
事故灾难
公共卫生事件
社会安全事件








11:15
30°C
视讯会议
任务提醒
信息动态
资源全维
突发事件


突发事件
Forbes

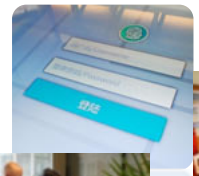
4.智能城市决策系统

ENTSCHEIDUNGSSYSTEM DER INTELLIGENTEN STÄDTE

用户需求导向的平台更新进化

BEDARFSGERECHTE ENTWICKLUNG UND AKTUALISIERUNG

2013年4月瑞典哥德堡市市长Anneli Hulthén女士一行来访参观
der Besuch von Frau Anneli Hulthén, der Bürgermeisterin von Göteborg, Schweden, April 2013



2013年4月瑞士驻沪总领事馆副总领事Pascal Marmier来访#
der Besuch von Herrn Pascal Marmier, dem stellvertretenden Generalkonsul vom Generalkonsulat der Schweiz, April 2013

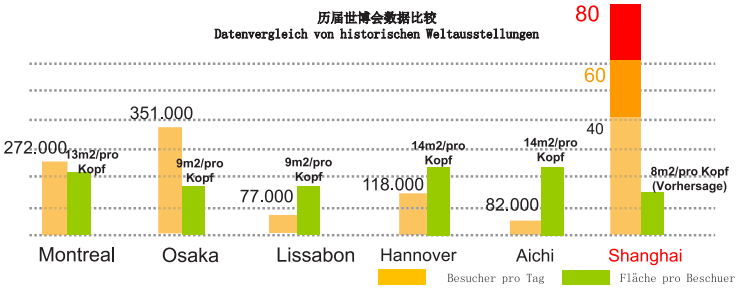
2012年12月奥地利维也纳市长Maria Vassilakou 女士一行来访磋商维也纳试点项目
der besuch von Fau Maria Vassilakou, der Bürgermeisterin von Wien, Österreich, um die Pilotprojekte in Wien zu konsultieren, Dezember 2012

上海世博会规划中的智能决策

INTELLIGENTE ENTSCHEIDUNG BEI DER PLANUNG VON SHANGHAI WELTAUSSTELLUNG

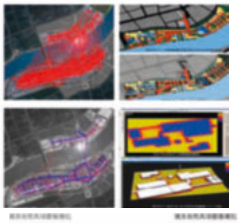
2010上海世博会参观总人数超过7000万人次，平均日客流量40万人次、高峰日客流量60万人次、极端高峰日客流量80万人次。

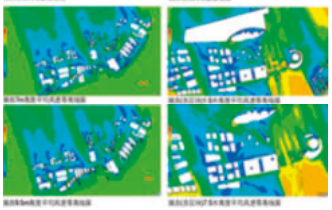
Mehr als 70 Millionen Menschen Shanghai Weltausstellung 2010, mit einem durchschnittlichen täglichen Verkehr von 400.000 Menschen, mit einem täglichen Verkehr von 600.000 Menschen an den Spitzentagen bzw. 800.000 Menschen an den äußersten Spitzentagen.



科学模拟

WISSCHENSCHAFTLICHE SIMULATION





方法创新

1. 复杂人流参观流线的动态模拟方法
2. 超大规模人群的时空分布模型建构方法
3. 室外空间热舒适度评价方法

Innovation von Verfahren

1. dynamisches Simulationsverfahren der komplexen Besucherströmung
2. Modellierungsverfahren der zeitlichen und räumlichen Verteilung von ultra-large-scale Besucher
3. Thermisches Behaglichkeitsverfahren von innen und außen

技术创新

1. 城市规划设计方案的安全性诊断技术
2. 城市尺度的数字风洞边界设定与风场数值模拟技术
3. 方案场景模拟仿真及优化的集成技术

Innovation von Technik

1. diagnostische Technigen der Sicherheit vom Stadtplanungsprogramm
2. digitage Einstellung der Windkanalgrenze der städtischen Scala sowie die numerische Simulation vom Windpark
3. integrierte Techniken zur Simulation und Optimierung der Szenario

6.上海世博会规划中的智能决策

INTELLIGENTE ENTSCHEIDUNG BEI DER PLANUNG VON SHANGHAI WELTAUSSTELLUNG

危险点预判

VORAUSSAGEN DER GEFAHRENSTELLEN

基于人流离散选择模拟，重点分析了极端高峰规模日世博园区运营特征，指出了十大高危场所

Aus der Simulation der diskreten Auswahl von Menschen werden die Betriebsbedingungen innerhalb des Expo Parks am äußersten Spitzentagen spezifisch analysiert. Zehn hoch riskante Stellen werden gezeigt.

场地设计增设引导警示标识系统，为运营管理提供预警信息和人流有序疏导建议

Schildsystem zur Leitung und Warnung wird zusätzlich bei der Stellenplanung eingestellt,um Frühwarninfomationen und Vorschlag zur geordneten Umleitung von Besuchern für die Operation anzubieten.

经验主义的城市规划——理性主义的城市规划

Empiristische Stadtplanung——rationalisitsche Stadtplanung

可视化决策平台

OPTIMIERUNG DER RÄUMLICHEN LAYOUT

技术运用1：空间布局优化
Technikanwendung 1:
Optimierung der räumlichen Layout

技术运用2：热点场馆调整
Technikanwendung 2:
Anpassung heißer Stellen

技术运用3：外溢空间预埋
Technikanwendung 3:
Vorbedacht vom Außenraum

技术运用4：
优化高位预警场地
Technikanwendung 4:
ptimierung der Hochriskanten Stellen

技术运用5：服务设施匹配
Technikanwendung 5
Anpassung vom Dienstleistungseinrichtungen

技术运用6：馆前广场拓展
Technikanwendung 6
Platzausbau vor der Galerie

6.上海世博会规划中的智能决策

INTELLIGENTE ENTSCHEIDUNG BEI DER PLANUNG VON SHANGHAI WELTAUSSTELLUNG

可视化决策平台

VISUALISIERTE ENTSCHEIDUNGSPLATFORM

城市规划设计方案安全性诊断技术

Technik der Sicherheitsdiagnose von der Stadtplanung

在可视化决策模拟仿真平台中，按照前期参观行为模型布局参观人流，直观表达40万、60万和80万乃至100万参观者条件下的世博园区人群分布状态。在短短的30个月内必须完成从世博规划到建设及试运营，这一超大规模长达180天的高密度人流集聚项目，其成功实施必然高度依赖高效率和高质量的规划建设决策。通过可视化决策平台的模拟仿真结果，调整部分重点场馆的高度、位置和体量大小。

In der visualisierten, simulierten Entscheidungsplatform werden die Bescuher anhand des Verhaltens in der vorherigen Periode positioniert. Die Menschenverteilung innerhalb der Expo-gelände bei 400.000, 600.000, 800.000 sogar 1.000.000 Besucher wird anschaulich gezeigt. Innerhalb der kurzen 30 Monaten muss man mit der Planung, Konstruktion und Probefahrt von der Expo fertig sein. Der Erfolg von diesem umfangreichen, massiven, 180 Tage dauernden Besuchersammlungsprojekt hängt wesentlich von der effizienten und hochqualitativen Planungsentscheidung ab. Die Hohe, Stelle und Größe von einigen wichitgen Gebäuden sind anhand der Konsequenz aus der Entscheidungsplatform zu adjustieren.

谢　谢

并期待您的宝贵意见！

Vielen Dank!
Wir freuen uns auf Ihre Kommentare!

13 Smart as the New Green? – Reflections on the International Debate about Eco-Cities

Prof. Dr. Bernhard Mueller, Leibniz-Institute of Ecological Urban and Regional Development, Dresden

Growing interest in eco-cities

The discussion about eco-cities is not at all new. What started in the mid-seventies as a reaction to the unsustainable development patterns of cities that had evolved already during the decades before, has become a worldwide movement. Whereas the first approaches towards eco-cities were mainly ecology based, smart technology has increasingly intruded more recent modern concepts. But can we therefore say that "Smart" is the "New Green" in urban development? This article attempts to shed some light on this question and tries to provide some answers.

If we look – let's say – at Masdar City in Abu Dhabi, one of the most prominent contemporary examples of eco-cities worldwide, we can find many arguments for calling smart the new green. The city was projected by Lord Norman Foster as a zero-carbon- and zero-waste-city on a area of 700 hectares with mainly residential and commercial uses for an envisaged population of about 40.000 inhabitants. The city is less a green island than a high-tech development hub providing not only latest technology in urban development but also international high-tech oriented research facilities. The initial cost estimate was 24 billion US $ or 600,000 US $ per future inhabitant. Meanwhile rising cost has forced some undertakings to be stopped, and the pace of development has considerably slowed down. The initial timeframe for completion was until the year 2016. Meanwhile it has been extended to 2025. The initial transport concept has been partly shelved. And the cost forbids repeating the project in other areas on larger scales like in China where according to government plans, 230 million persons are to become urbanized within the next 20 years.

Nevertheless, if we look around we can find a lot of similar projects where eco-city development is closely linked with technological progress: for example in China, the United States, Canada, Europe, as well as in India and in other countries. Moreover, new concepts have evolved focusing different levels. On the one hand, eco-districts are discussed, focusing mainly the neighbourhood level within cities. On the other hand, eco-regions are designed. They are conceptually linked with regional production chains, endogenous development and more locally and regionally oriented lifestyles.

For many years, eco-cities have been much under debate. There are at least two lines of discussion: One promotes urban green areas and ecological issues. The other one emphasizes technology and promotes innovation oriented and ICT-based development. Does this indicate a divide between nature and technology in urban development? Or should the fact that there are differing starting points be regarded as different facets of the same, i.e. contributions to a more sustainable urban development? In any case, we can assume that "Smart" at least plays a role in the discussion about the "New Green" in urban development, and eco-cities have become urban laboratories for innovation in order to create a more sustainable world.

Based on these considerations we shall first have a closer look at the ambiguity of the eco-city concept in the following. Second, we will reflect about the relation between the eco-city

and sustainability. Third, we look into certification schemes. And finally, an answer shall be given to the question of whether "Smart", i.e. the technology driven city, is the "New Green" in future urban development.

Ambiguity of the eco-city

According to an article by Mark Roseland from Vancouver in 1997, the term eco-city is relatively new but it is based upon concepts that have existed for a long time. And indeed, if we go back in history, lets say to the late 19th and beginning 20th century, we can identify garden cities as very early eco-cities, or as their promoters marketed them: cities of tomorrow. „Yesterday living and working in the smoke, today living in the suburbs and working in the smoke, and tomorrow living and working in the sun", was the motto of the sales promotion for Welwyn Garden City north of London, one of the first garden cities in England founded by Ebenezer Howard. Here and in many others cases principles of a more eco- and human-friendly urban development were applied.

50 years later, Richard Register from Berkeley only had to take up the earlier ideas when he promoted the eco-cities movement in the 1970s. He wrote a book on "Rebuilding cities in balance with nature" in which he emphasized the walkable and mixed-use city together with an abundance of natural, green areas as important prerequisites for facilitating a better urban life. Was Ebenezer Howard's approach a reaction to the early industrialisation and its detrimental environmental and human impacts, so was Richard Register's approach a reaction to sub-urbanization, and its impact on central cities' decline and disappearing inner-urban life.

Nevertheless, as Simon Joss from Westminster University in London put it in a publication in 2010 considering the experience of about 80 eco-cities worldwide, eco-cities have moved from a relatively loosely defined concept with only few, mainly experimental pilots to a multitude of concrete practice led initiatives. This is supported by the timeline of eco-cities worldwide which he provided in a recent article: Whereas he identified only less than 30 eco-city initiatives until the year 2000, the number of eco-cities skyrocketed since then reaching almost 200 by now. This rise can be to a large extent attributed to China, where the concept of eco-cities has spread enormously, and a number of more than a hundred, some speak of even several hundreds of new eco-cities, is under discussion at the moment.

With this evolution, the face of the eco-city has tremendously changed. In the 1970s eco-cities were mainly understood as green cities, and the first eco-city world summit in 1990 was still very much oriented towards ecological principles of urban planning and development. Later, authors like the Australian David Engwicht, widened the discussion by bringing in issues like calming down traffic and promoting place making. And if we look at the principles for creating eco-cities as published in Urban Ecology in 1996, we can see that technological issues were not a topic of discussion yet.

The principles read as follows: (1) Revise land use priorities to create compact, diverse, green and vital mixed communities near transportation facilities; (2) Revise transportation priorities to favour bicycle and foot over autos; (3) Restore damaged urban environments (creeks, wetlands); (4) Create affordable, safe, convenient and racially and economically mixed housing; (5) Nurture social justice and create improved opportunities for women, people of colour and disabled; (6) Support local agriculture, urban greening projects and community gardening; (7) Promote recycling, innovative appropriate technology and resource conservation while reducing pollution and hazardous waste; (8) Work with business

to support ecologically conscious economic activity; (9) Promote voluntary simplicity and discourage excessive consumption of material goods; and (10) Increase awareness of the local environment and bioregion through activist and educational projects.

Only during the early 2000s, with the discussion about peak oil, energy, and climate change technological issues of urban development and the "smart" eco-city became more prominent. New city developments like in Masdar City or within Vancouver's "Greenest City" approach supported technological thinking related to the eco-city. Only lately it became clear that there may be a rather large overlap between eco-cities and "smart cities", and that the two debates should not strictly be separated. And the 10th Ecocity World Summit in Nantes in 2013 put much more emphasis on technological solutions for sustainable urban development, though still very focused on energy problems, than any of the world summits before. The following five themes were discussed: reducing the ecological footprint, addressing the energy challenges of the city, strengthening solidarity, organizing the sustainable city, and mobilizing enabling factors. Summing up it can be stated that, although technological issues do not play the most prominent role in the discussion yet, the eco-city has become much more multi-facetted during the last two decade, and the nature only oriented eco-city is a model of the past.

Eco-city and sustainability

Why do we talk about eco-cities at all? Wouldn't it be much better to simply promote sustainability approaches in urban development like in some countries this seems to be the case? To answer these questions we shall have a closer look into the discussion about sustainable development and its relation to the eco-city. I would like to make special reference to Germany here.

Sustainability has made it to the stage of international debate since the late 1980s and early 1990s. However, the principles of sustainability are much older. For example, they were formulated already at least 300 years ago by a practitioner, Hans Carl von Carlowitz. He was since 1711 the Chief Mining Officer in Saxony, which is nowadays a state of Germany bordering Czech Republic and Poland. In this function he was also responsible for forestry, i.e. the sustained supply of wood for mining, as well as for industry and production. In a book about the "appropriate cultivation of trees" he formulated for the first time principles of sustainable development, i.e. not to use more natural resources than nature can offer and regenerate. These were almost exactly the principles which were much later formulated by the Brundtland-Commission in 1987 and the Rio Conference in 1992: to use resources wisely and not at a higher speed than they are produced.

Two years after the Rio Conference, the Aalborg Charter formulated principles for sustainable urban development and a framework to act for municipalities. The Urban 21 Conference in Berlin in the year 2000 and then the Leipzig Charter on Sustainable European Cities in 2007 were further cornerstones for a more sustainable urban future. However, eco-city developments did not play a role. For example, the Leipzig Charter focused on two goals: (1) to make greater use of integrated urban development policy approaches and to foster implementation oriented participatory integrated urban development programs, and (2) to give special attention to deprived neighborhoods in order to promote social cohesion and integration. Regarding the first goal, the following strategies for action were formulated: (a) to create high quality public spaces, (b) to modernize infrastructure networks, (c) to improve energy efficiency, and (d) to promote proactive innovation and educational policies. And in the second case it was recommended (a) to pursue strategies for upgrading the

physical environment, (b) to strengthen the local economy and local labor market, (c) to develop proactive education and training policies for children and young people, and (d) to promote efficient and affordable housing.

In Germany, sustainability found its way into the constitution, the Basic Law, in 1994, and it became a major principle for spatial planning and development through its inclusion in the Building and Spatial Planning Laws in 1998. In 2001, a 15 members National Council of Sustainable Development was created, and in 2002, the National Sustainability Strategy was first elaborated. A respective monitoring system is in place since 2006, consisting of bi-annual Assessment or Indicator Reports. Some of the goals reflect issues related to urban development, especially those referring to new ways of energy provision, resources efficient construction, and the reduction of "consumption" of space for urban development and transportation. However, the indicators are relatively vague. Innovative technological and ICT driven development approaches do not play a role.

We can see a similar tendency if we look at the many contests for sustainable urban and regional development which were initiated in the 1990s by the federal government. Issues such as land management, mobility, environment, housing, and economy were considered while developing a set of sustainability goals and indicators while others like those used in the "classical" eco-city discussion were not under discussion. This is also especially true for technology-based urban issues.

Similar observations can be made concerning attempts on the state level to develop and implement sustainability indicator systems. The German Federal and State Governments developed indicator systems to measure urban sustainability and recommended them to be applied by municipalities. However, their response was more than poor as they either did not find them useful for their own development purposes or they did not want to give government a chance to interfere in their own municipal affairs and to challenge their rather high independence and autonomy. As a result we have to realize that such indicator systems were hardly taken. For example, in the state of North Rhine-Westphalia two thirds of the municipalities did not have any sustainability indicator system at all in place until recently.

This shows that the sustainability debate does not always become a driver towards a more eco-oriented urban development. This is especially true if we consider that sustainability in German planning is very much defined as a task to balance ecological, economical and social issues. And even less it promotes technology solutions in an eco-urban context. Nevertheless, there are a few German examples where sustainability and eco-city development have worked hand in hand. The city of Freiburg in south-western Germany is recognized as a hub of sustainable urban development and an eco-city at the same time. This reputation is based on long standing efforts by several city governments over a longer period, but it is also especially grounded on the development of Freiburg-Vauban. The area was formerly used by military forces. After the German unification it became clear that they would leave, and a local initiative was formed in order to redevelop the area in a sustainable way. Strong emphasis was put on goals such as car reduced mobility, the creation of a neighborhood of short distances, the installation of local heating systems, social integration, as well as giving priority to private and cooperative groups over investors. Thus, a true eco-city was created, and Freiburg-Vauban has since then become a remarkable success story. It can be considered as one of the cases where sustainability has been operationalized, and been made a political guideline in overall municipal decision-making.

Eco-cities: From concept to operationalization

The eco-city discussion has tremendously gained focus and operationalization through different indicator systems for sustainable urban development which were developed over the years. However, a real breakthrough was made only with the development and the increasingly popular application of respective certification schemes. In Germany we can see that a decisive step forward was made through the creation of the German Sustainable Building Council, the Deutsche Gesellschaft für Nachhaltiges Bauen, DGNB, which was initiated only in the mid 2000s by a small group of stakeholders from the real estate and the building sectors. Now it has around 1200 members, and it understands itself as a unique knowledge platform. DGNB has developed a certification system which is quite remarkable. It takes up ICT and technology issues, and brings them together with eco-development approaches.

The indicator system for new and already existing but rather recent development areas which is applicable on both, building and neighbourhood/urban district levels, is built around five key aspects of sustainable building: environmental quality, economic quality, socio-cultural and functional quality, technical quality and process quality. Each of these is specified by a set of criteria, among them criteria such as IT and communication infrastructure, energy technology, and quality of transport systems. According to the criteria which a project fulfils and the level of accomplishment, bronze, silver or gold certificates are awarded. During the past years, a high number of urban development projects have been assessed and certified by DGNB nationally and internationally, and the certification scheme has managed to find its place among other international certification schemes, such as LEEED and BREEAM. For example, the DGNB certification scheme was successfully applied in several development projects in China.

The DGNB scheme follows a very broad approach, and it goes far beyond of what municipalities are doing or have done before. Private sector initiative and involvement has proven to be a strength as the scheme has become highly attractive for investors as well as for real estate owners. Moreover, also municipalities have shown increasing interest in certifications. Nevertheless it may still be too early to assess the success or failure of the scheme, especially with regard to its international application.

And one more aspect needs consideration: the DGNB certification scheme is mainly applicable and applied to rather new buildings and urban districts. This causes a bias in the overall assessment approach, and it poses a severe limitation to the scheme's ability to assess the sustainability of a whole city or region. At least in Germany and in many European countries, most of the buildings and urban districts of our future cities already exist today.

Conclusions

We have started with the question of whether "Smart" can be regarded as the "New Green". We have argued that elements which characterize smart cities have intruded eco-city approaches only slowly and late. We also saw that for along time there was an ambiguity in the debate about eco-cities. Approaches ranged between purely nature oriented green urban development on the one side, and mainly technology driven city futures on the other side. It was further argued that it may not be advisable to fully subsume the eco-cities debate under the discussion about sustainable urban development as many sustainability approaches, especially on the local level, lack clarity and traceability regarding their progress. And finally, it has been shown that with the more recent certification schemes, such as the DGNB system in Germany, technology is becoming an integral part of eco-city

development. Therefore the answer to the above question is definitely not that “smart” is substitutes “green”. In fact, it is more and more playing a complementary role.

Technology and ICT-based approaches may become even more important if we think in new challenges, i.e. through climate change and demographic change. Mitigating climate change requires intelligent approaches, e.g. regarding energy systems, and adaptation policies are dependent on smart solutions, e.g. for making our cities more resilient. Demographic change, and especially aging sensitive urban development concepts will more and more be in need of technological solutions, e.g. in the fields of ambient assisted living, transportation, and medical care. Eco-cities can thus be suitable laboratories for smart technologies, and we should take this possible symbiosis much more actively up. Moreover, there may be large market potentials and opportunities, among others regarding advanced manufacturing and Industry 4.0. We are entering a phase where everything is connected, from health care to transportation, from design and production to logistics and marketing. Therefore it is not the eco-city or the smart city alone anymore which we should aim at, but the “eco-tech-city”, t he city which gives room for both, nature and technology.

However, new questions arise here: Do we want to create eco-islands even if they are not linked with their hinterland, where biodiversity or pollution does not matter? How can we avoid new types of segregation within our cities, functionally and socially? Who is going to live in which part of the segregated city? How do we link the more modern, high-tech oriented “smart” parts of cities with the backward and retarded ones? How do we create a bridge between the technology affine population and the less affine one? How can we avoid that the “innovation cheetahs” in our cities of today become the technological dinosaurs of tomorrow? Which new (data) security requirements come up and how can we achieve the highest possible resilience of critical infrastructures? Will the rather inflexible and slow infrastructure development be able to keep pace with the fast innovation cycles of techno-logy- driven urban development? Are we able to finance and mentally cope with the necessary transformation processes? Should we continue to produce showcases of “eco-tech-cities”, or do we have to more strictly observe principles of reproducibility? How can we avoid that our dreams of today turn into burdens or even horrors of tomorrow? Which forms of participation and governance are best suited? We can easily see: More questions than answers. Thus, the search goes on.

14 Environmental Solutions for Smart Cities in China

Prof. Hao Jiming, Tsinghua University

Outline

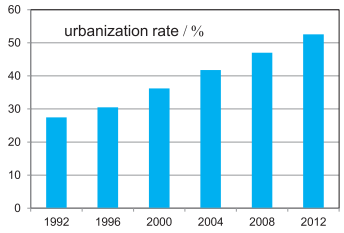
1. China's Urbanization
2. Urban Environmental Issues Caused by China's Urbanization
3. Urbanization Concept for Harmoniousness between Environment and Development
4. Environmental Solutions for Smart City in China

China's urbanization

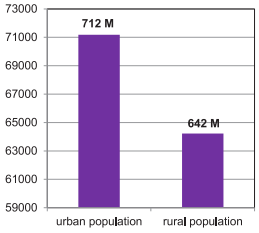
"Revolution of new technology and China's urbanizing process are expected to be the two big events that will affect humankind in the 21st century", predicted by Joseph E. Stiglitz, former World Bank Vice President and also Nobel winner in economy, in 1999 when he came to China to participate in a symposium on urbanization

China's urbanization

- China's urbanization rate reached 52.57% in 2012, with an annual 1.2 percent increase from 26.41% as for 1990
- Urban population increased 15 million annually
- By the end of 2011, China has 657 cities. There were 30 cities with urban population more than 8 million, of which 13 cities more than 10 million



China's urbanization rate



China's urban and rural population distribution in 2012

China's urbanization

China's urbanization will aim at building World-Class City Group

✓Three national city groups: Beijing-Tianjin-Hebei Metropolitan Region, Yangtze River Delta Region, Pearl River Delta Region

✓Seven city groups growing up with a certain scale

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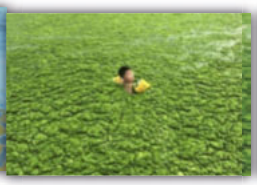
Urban Environmental Issues Caused by China's Urbanization

- Urban Water Environment
  - Eutrophication of water body
  - Waste discarding
  - Industrial wastewater discharging

Chaohu Lake, Hefei



Offshore sea, Qingdao

River outside the forbidden city

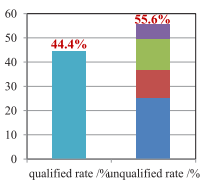
Urban Environmental Issues Caused by China's Urbanization

- **Urban Atmospheric Environment**
  - Vehicle source
  - Industrial source

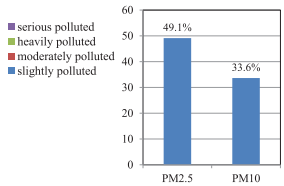
Haze, Beijing

Tiananmen Square, Jan. 29, 2013

Late January in 2013, **more than 143 square kilometers** in middle-east China were covered by heavy haze, mainly Beijing, Tianjin, Hebei, Henan, Shandong, Jiangsu, Anhui, Hubei, Hunan, etc.



Urban air quality of 74 cities in the first quarter of 2013



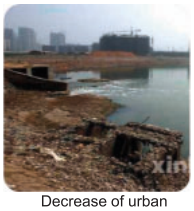
Average **unqualified rate** of principal air pollutants of 74 cities in the first quarter of 2013

Urban Environmental Issues Caused by China's Urbanization

- **Urban Ecosystem**
  - Deterioration of the ecosystem
  - Decrease in biodiversity

Sensitive species disappeared

Deterioration of natural habitats



Decrease of urban wetland

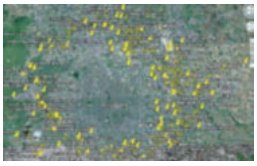
Destroy of urban forest

Urban Environmental Issues Caused by China's Urbanization

- **Urban Contaminate Sites**
  - ➢ Factory relocation
  - ➢ Land reuse

Urban Environmental Issues Caused by China's Urbanization

- **Urban Solid Waste**
  - ➢ Disposal difficulty of municipal solid waste
  - ➢ Industrial solid waste stockpiling in huge quantity
  - ➢ Illegal discarding of hazardous waste



Garbage siege

Protest of MSW incineration

Illegal discarding of chromium slag

Stockpiling of red mud

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Urbanization Concept for Harmoniousness between Environment and Development

Green Low-carbon Ecological

- Humanistic Beijing, S&T Beijing, green Beijing had been the developing strategies for Beijing after Olympic Games
- National Development and Reform Commission launched pilot construction project of low-carbon cities (totally 36 cities) since 2008
- Eco-city becomes a new target for most cities after ecological civilization proposed in 2012

Urbanization Concept for Harmoniousness between Environment and Development

Better City, Better Life

- Space conflict, cultural friction, resource shortage and environmental pollution were inevitable results from high-density urban living
- As the inconsistency between environment and development become more and more serious, sustainable development concept emerged
- "Better City, Better Life" is the theme of Shanghai World Expo, in order to enhance the urban solutions to achieve harmoniousness between human and nature, human and human, spirit and material, etc

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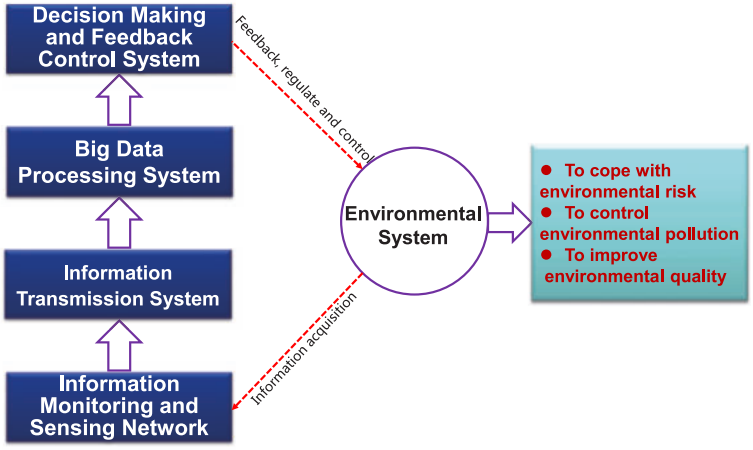
National developing strategy

- To solve the key environmental issues caused by China's urbanization
- Focused on intelligent perception, intelligent processing, and intelligent application of environmental information to establish a smart environmental management system for cities
- Aiming at making the urban environment be sustainable and harmonious with economy and society development through the change of environment protection mode
  - ✓ From pollution source control to environment quality improvement
  - ✓ From targeted pollutant quantity control to environment capacity control
  - ✓ From passive emergency management to positive risk management

Architecture of Smart Environmental Management System



Information Monitoring and Sensing Network

- **Automatic monitoring system of the key pollution sources**
  - **356 monitoring and control centers in province and city levels had been built in China**
  - **Automatic and online monitoring had been enforced on more than 15000 enterprises by the Internet of Things (IOT)**


code


RFID


satellite


sensor


camera

Information Monitoring and Sensing Network

- **Automatic monitoring system of urban atmospheric quality**
  - **Automatic monitoring network with 1500 monitoring stations for atmospheric quality will be built in cities at prefecture level or above in China by 2015**
  - **As well, 96 regional air quality monitoring stations will be built**

Information Monitoring and Sensing Network

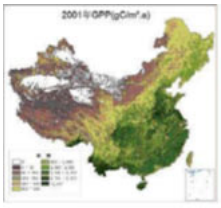
- **Automatic monitoring system of urban water environment quality**
  - Water environmental quality risk assessment and early warning platforms had been built in Beijing, Chongqing, Shenyang and other cities by the foundation of the national water project during the 11th five-year plan
  - Automatic monitoring system with 88 water quality monitoring stations had been built to monitor and sense 81 drinking water sources in real time in Zhejiang Province

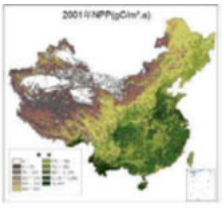
Surface water quality of Beijing, Jan. 2013

Information Monitoring and Sensing Network

- **Automatic monitoring system of urban ecosystem**
  - The first provincial ecological environment monitoring center had been founded in Jiangsu Province in September 2011
  - A national ecological monitoring network will carry out biodiversity monitoring in wetlands, ground and soil environment in the ecological vulnerable areas and important ecological preservation areas during the 12th five-year plan

Ecosystem monitoring system

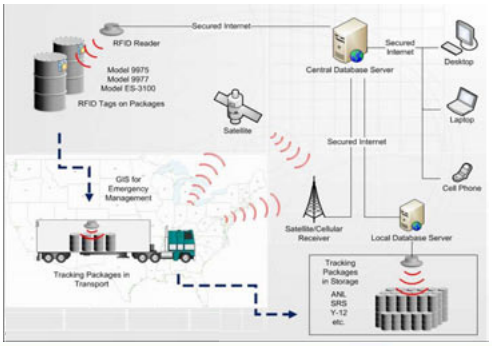




RS monitoring of carbon cycle of terrestrial ecosystem

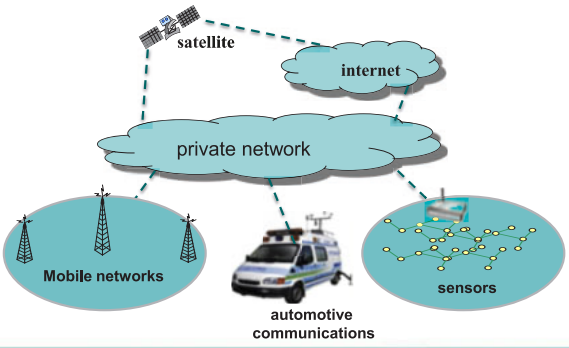
Information Monitoring and Sensing Network

- **Monitoring of solid waste**
  - **IOT was widely used in the monitoring and tracking of hazardous waste and medical waste**



Information Transmission System

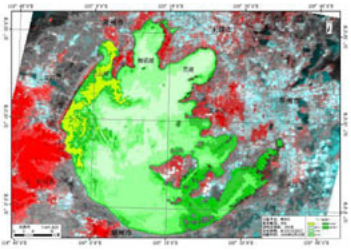
- **Urban environmental information transmission system for full coverage and all time can be built by wireless transmission networks(GSM, Remote sensing, GPS, Internet, etc）**



Information Monitoring and Sensing Network

- Application of hyperspectral remote sensing technology in environmental remote sensing

Haze distribution in RS image

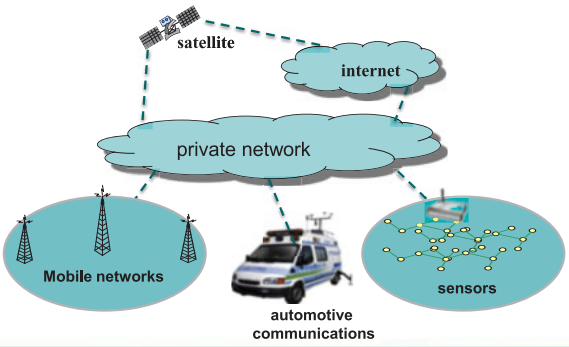


Chlorophyll a concentration distribution in RS image

The first high-resolution remote sensing satellite was launched in April 2013

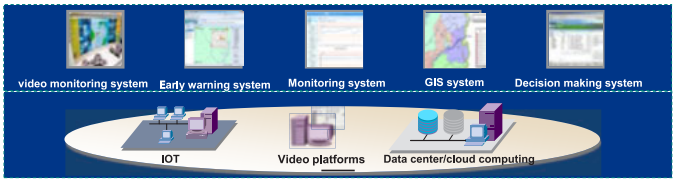
Information Transmission System

- Urban environmental information transmission system for full coverage and all time can be built by wireless transmission networks(GSM, Remote sensing, GPS, Internet, etc）



Big data Processing System

- **Big data of environmental information processing system by cloud computing technology**
  - **Big data of environmental information sharing system**
  - **Unban environmental information processing system and evaluation models**
  - **Big data of unban environmental information simulation platform**

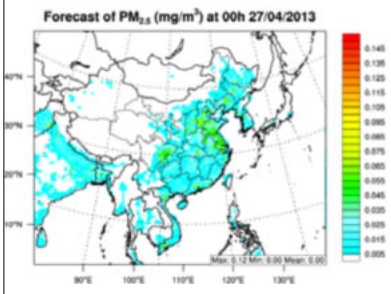


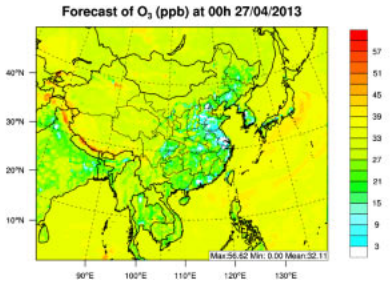
Decision Making and Feedback Control System

- **Pollution source management**

Decision Making and Feedback Control System

- **Forecasting and warning**





Numerical forecasting of air quality

Decision Making and Feedback Control System

- **Forecasting and warning**

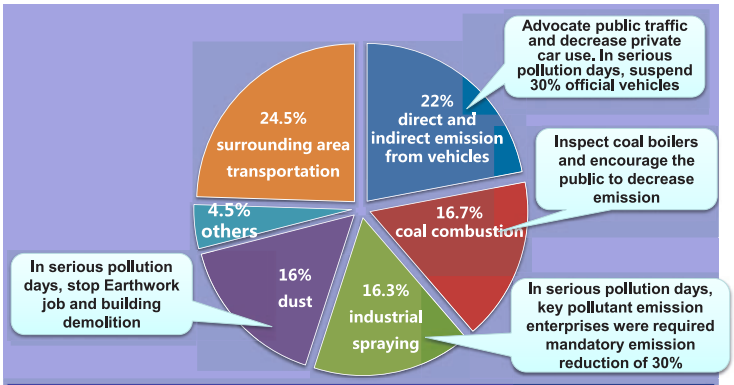
Digital basins can forecast and warn the water environment by monitoring and simulating the pollutant release process of potential sources and water quality evolution process of lakes and rivers

Automatic water quality monitoring system of Huaihe River Basin

Quantity and quality management for water diversion project from Yangtze River to Taihu Lake

Decision Making and Feedback Control System

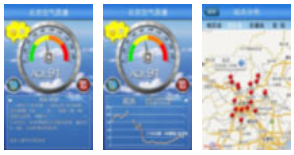
- Emergency Countermeasures



Sources of PM 2.5 and its emergency countermeasures in Beijing

Decision Making and Feedback Control System

- Information disclosure



"Beijing Air Quality" Mobile Client Software

Self-service terminal

Smart environment development in Jiangsu

An environmental monitoring and early warning platform covered 13 cities had been built to manage environmental information intelligently in Jiangsu province.

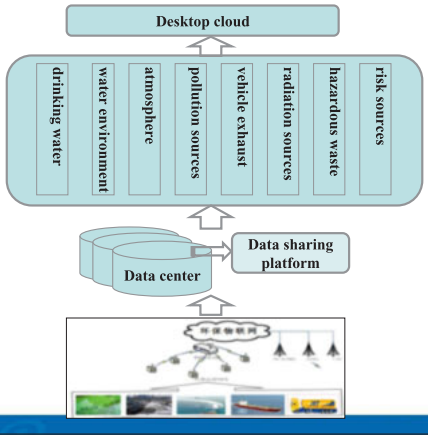
Desktop cloud
- 54 applications

Information processing
- 8 monitoring systems

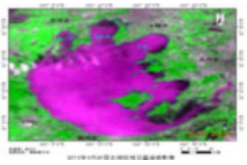
Data center
- All environmental data in one map

Private networks
- 127 private networks

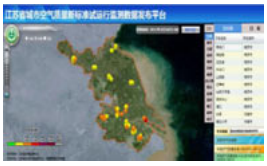
Environmental IOT
- Advanced IOT applications



Smart environment development in Jiangsu



Daily published monitoring image of blue-green algae in Taihu Lake



Publishing platform of air quality monitoring in Jiangsu

Publishing platform of water quality monitoring of sections in Jiangsu

Real time publishing platform of urban air quality index

Summary

- Urban environment improvement, prevention and protection must be a prominent and prior task due to a series of environmental issues caused by China's urbanization
- Based on high levels of city informationization, ubiquitous real-time environment service system will be built, including dynamic perception, integration, processing, decision-making and service of urban environmental information
- The intelligent environment strategy was expected to achieve urban environment sustainable and harmonious with economy and society development, of which information disclosure is an essential breakthrough
- Sharing and integration of big data including environment, land, forestry, and water conservancy will further improve the environmental management level of smart cities

15 Digitalization and the Future of Work in Germany

Prof. Dr. Arnold Picot, University of Munich

In this presentation I am going to give an overview on several aspects that have been touched before. I want to focus on the implications for the working people, the humans who work in cities and how their live might change under the influence of ICT.

Of course I can only point to some trends within this ongoing process. I assume that deep changes will come up in the working world and organisation of work in our societies. How is work going to change and what kind of influence is this going to have on the structures of our cities?

If one talks about the organisation of work and the nature of work one has to keep in mind that technology has always shaped the way we work. Looking through history we can distinguish at least for the last couple of centuries several phases of industrial revolutions.

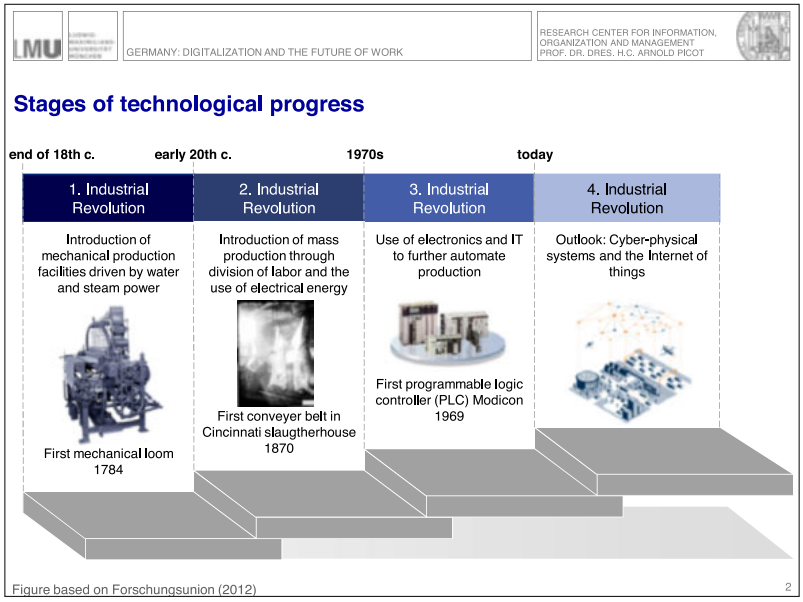


Figure 1

The last two Phases are mainly influenced and shaped by IT, digitalisation and IT driven technology (Figure 1). I think this is the interesting point that we have to keep in mind. What's going on there? It's an unprecedented increase in performance of key technologies such as computers, especially the processing power of computer chips, storage capacity for electronic information, and transmission capacity in electronic networks, i.e. bandwidth. This increase in performance is taking place in an exponential way which can be seen on the vertical axis and at the same time it's going on for quite some time already. Specialists and experts tell us that this will continue for a couple of years to come - some say ten years, some say twenty years. Anyway, this is very important because every one to two years the performance of these technologies doubles more or less and if it doubles the next two,

three or four years again and again then of course the potential that these technologies put in place increases tremendously and this changes a lot. However, this wouldn't be that exciting if not on the other hand the costs for the functions that these technologies provide go down at the same pace more or less.

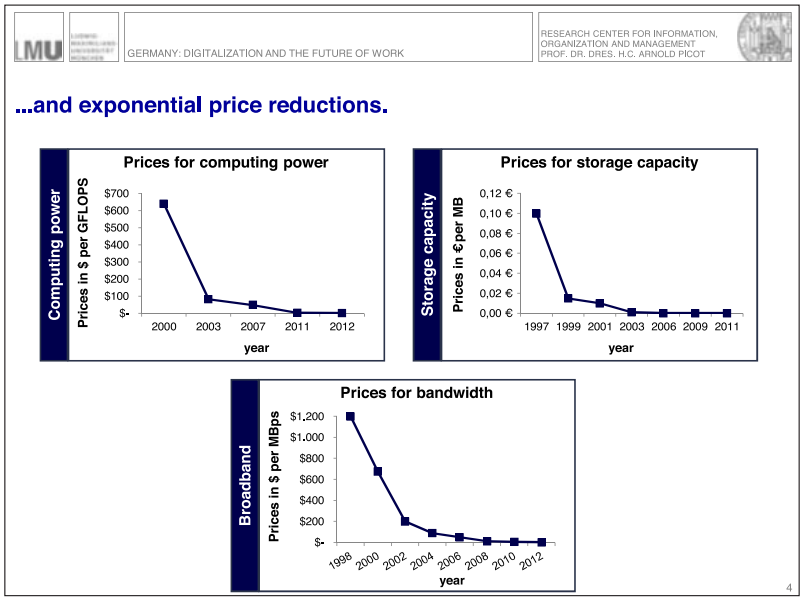


Figure 2

For all three technologies, prices on a unit basis really rapidly decreasing, so that you nowadays get these functions on an unit base for prices near nothing (Figure 2). This changes a lot because if you get this kind of functionality for very few money than of course people invent many things in order make use of these technologies' potential and to facilitate their lives and work or to improve industrial work processes.

If one wants to understand how important these changes are one can compare what kind of performance you get – measured in number of electronic calculations per second - if you invest 1000 $.

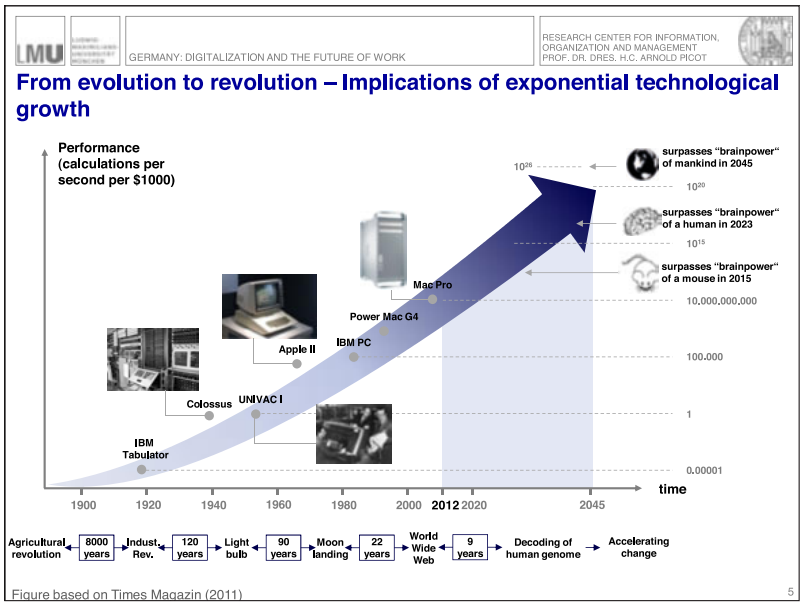


Figure 3

If you take this as a unit observation then you see that this is going up tremendously and that in the near future you get for this price the capacity of the brain of a mouse or even the brain of a human and later on even the brain of the entire mankind (Fig. 3). Of course, nobody knows whether this will take place in future according to this slope. But it shows that a tremendous potential of computing and transmission and storage power is available and becomes more and more available at even lower prices. This will be used in order to automate and to facilitate many processes in our world. This development is linked at the same time to an ever increasing miniaturization of working and production tools of all kinds leading to a more or less weightless economy. Of course this again changes the way we work and offers unprecedented mobility and flexibility potentials.

As I mentioned at the beginning technological progress has always influenced the organisation of work in the time of mass production which started in the early or middle 19th century.

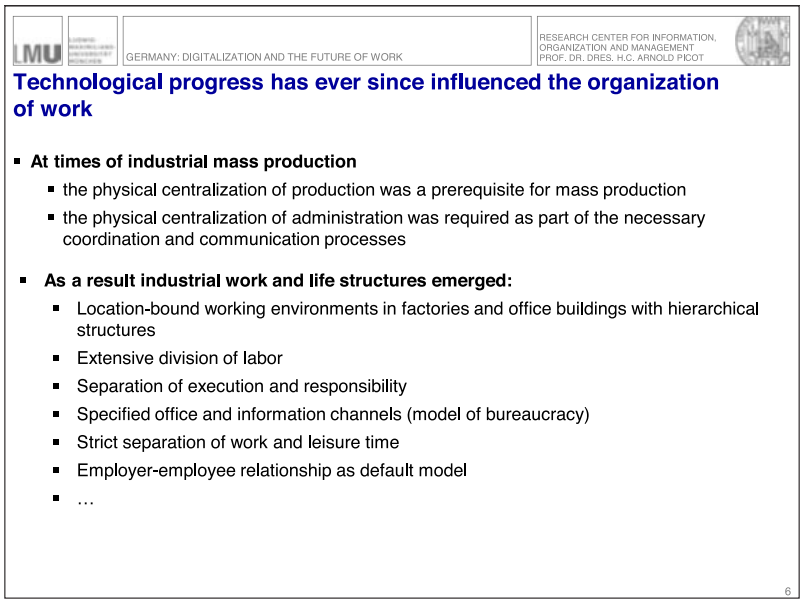


Figure 4

The physical centralisation of production was a prerequisite and precondition for mass production (Figure 4). So, the plants, the factories and the office centers were created where people had to work in order to carry out their productive activities. Before they mainly worked at home or near home. The physical centralization of administrative functions was required as well in order to coordinate activities and to facilitate communication.

The industrial work in factories has emerged a picture of work itself and so we got used to location bound working environments and to an extensive division of labour, separation of execution and responsibility and similar structures that seem to be self-evident. However, with the newly changing technology new ways to carry out work emerge.

I don't want to go through all the details of the next slides, but if we take these potentials that are coming up together with the third and fourth revolution that I mentioned at the beginning we more and more get near to the possibility of real-time management, of dispersed value networks.

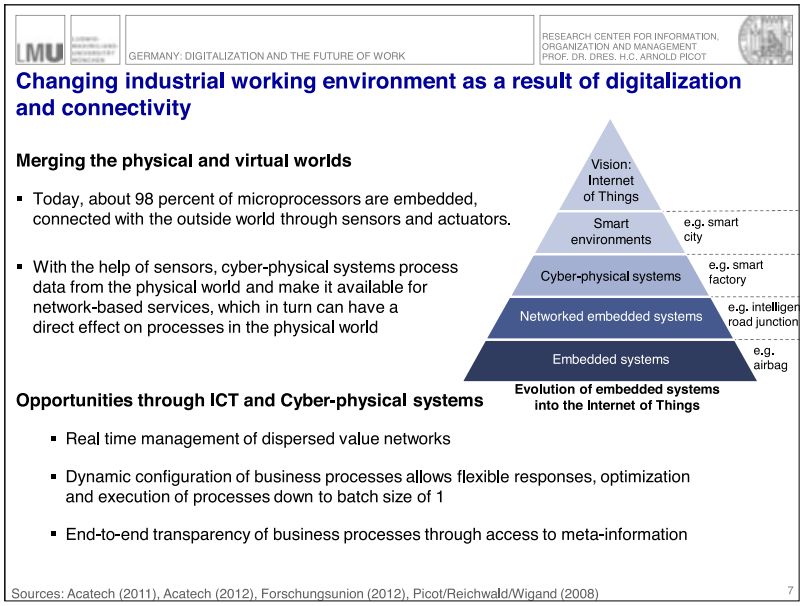


Figure 5

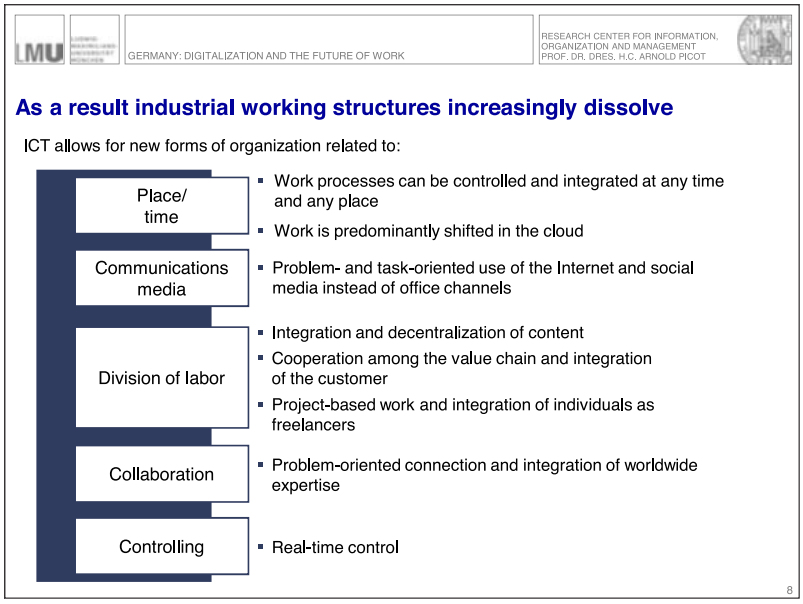


Figure 6

Thus, we can coordinate spatially dispersed activities almost on a real-time basis which is very new for the mankind and will chang a lot (Figure 5 and 6). We also can dynamically configure business processes and can coordinate and call in expertise and specialists from all over the world if we want to. We can also flexibly design our work processes even to the individual level of a batch size of one. This again is a trend that outweighs the traditional

mass production situation. The transparency of all these processes increases due to the availability of meta information through sensor networks and other means.

As a result we can foresee deep changes in the way we work and we combine work and everyday life. Work processes can be controlled and integrated at any time and any place. Work results and work related data are predominantly shifted in the cloud. Project-based work and flexible integration of individuals as free lancers really increases rapidly, even today. We can tap expertise worldwide and all this in a more or less in a real-time fashion. How is this reflected in the development of cities or of settlements and what kind of trends can be observed right now already?

At this point I would like to draw your attention to a recent study that has been carried out by Münchner Kreis and a consortium of companies and organisations.

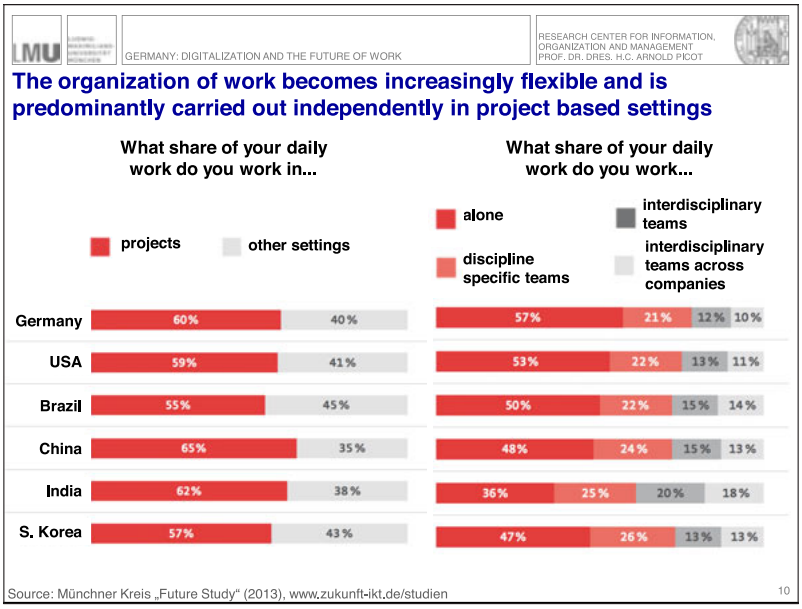


Figure 9

This study among other aspects did field research in the countries listed and compared these countries in their attitudes towards situations and experiences regarding work (Figure 9). But also many other aspects were covered.

One interesting result is that project work already covers more than half of the work forces. So, we no more have the picture of work being something that is done in a linear and sequential way but it is a more project-oriented and flexible and this demands for new ways to organise work compared to the former times. This is quite similar in all the countries covered which is remarkable. Especially in China we had even a higher percentage.

If one looks at the way how this project work or current work is being done then quite some of this work is still done alone in a single work fashion. But some is done in teams or even in inter-organisational teams, teams that cross company boundaries.

Another aspect which seems to be interesting also for the development of cities is that people less than before can distinguish between a private life and work life and also that they don't want to distinguish as clear cut between these two fields as they used to do.

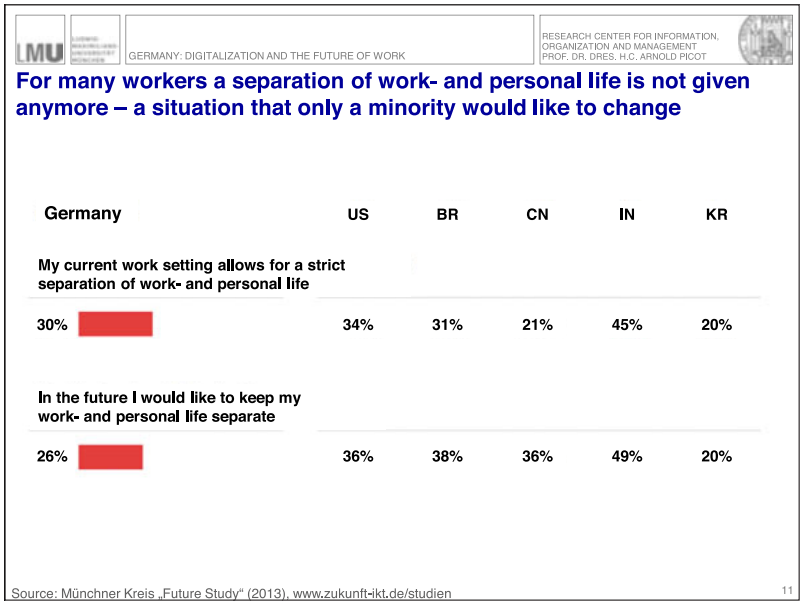


Figure 10

Only 30 % in Germany say that their current work setting allows for a strict separation between work and private life (Figure 10). In the other countries it is not very different. India seems to be an exception. If one asks: in the future I would like to keep my work and personal life separate, only 26 % in Germany said that they would like to have this separated. This was a surprise to us. And in the other countries there is not so much of a difference. We see that this strict separation between work and life which also characterised so far our cities and our settlements might be something of the past.

As one implication the office as a specific place for our professional lives is becoming less important leading to a diminishing need for down town office centres.

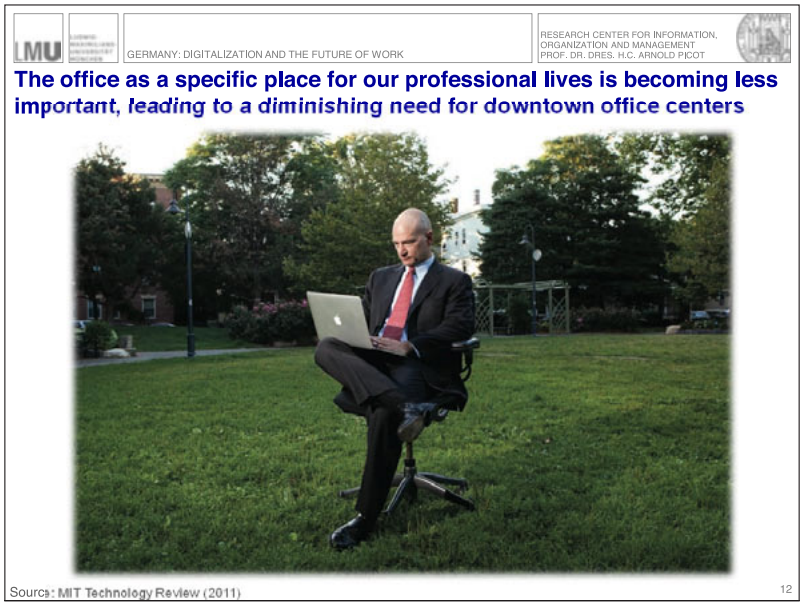


Figure 11

Of course we will need office centres still in the future but they must not grow at the same pace as population and jobs grow in a metropolitan area (Figure 11). Real estate people already report on this trend .

Of course, people, who work flexibly, do their work from any place and at any time. In an earlier study that we did two years ago with Münchner Kreis in a similar consortium fashion - all these studies can be downloaded from the Münchner Kreis website (www.muenchner-kreis.de) by the way - we found out that by 2024 at the latest over 75 % of office workers in Germany will regularly use a home or mobile office.

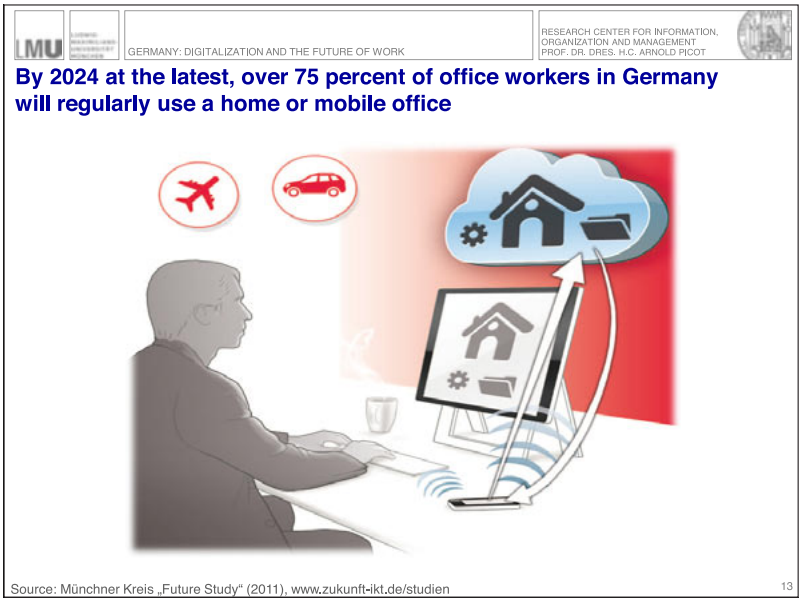


Figure 12

So ¾ of the work force will regularly work at home, from a mobile office or from office sites next to their home. This is important for our cities (Figure 12). Of course you need connectivity in order to enjoy the advantages of flexibility. Your data is stored somewhere in the cloud and you have to be able to tap the data anyplace and anytime. Therefore, high performing connectivity is a very important precondition. In this respect Germany at least, I think many countries, are still under- developed.

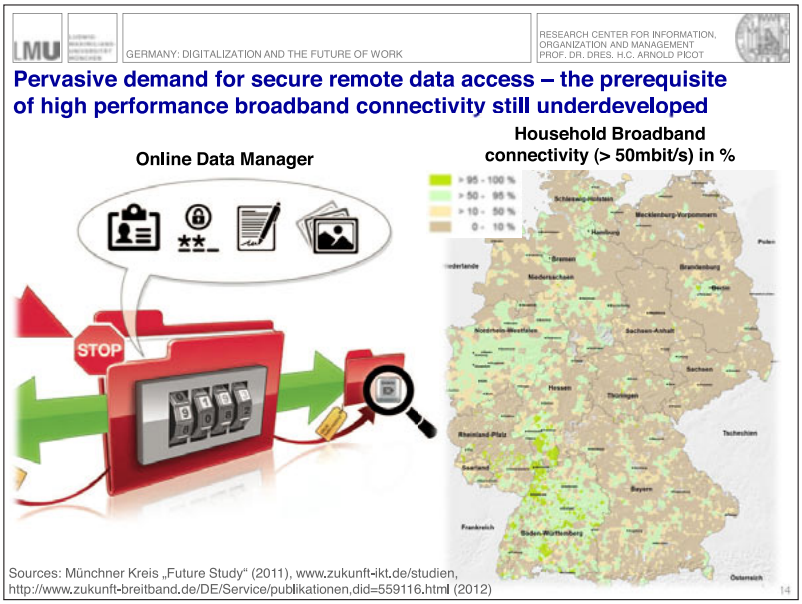


Figure 13

Looking at this official map from the German government you see that those parts of the country where you have access with a bandwidth of more than 50 mbit/s are rather sparse (the green areas) (Figure 13).

If you want to de relevant work in a really flexible and mobile fashion then you have to have at least this level of bandwidth, perhaps even more. Therefore connectivity, especially high performance connectivity, is key and will have to be developed. Some countries are already ahead, they invest a lot into high performing broadband infrastructure (especially in fibre). Germany will have to dedicate considerable resources to this purpose. Challenges coming up with ubiquitous workplaces have to be kept in mind.

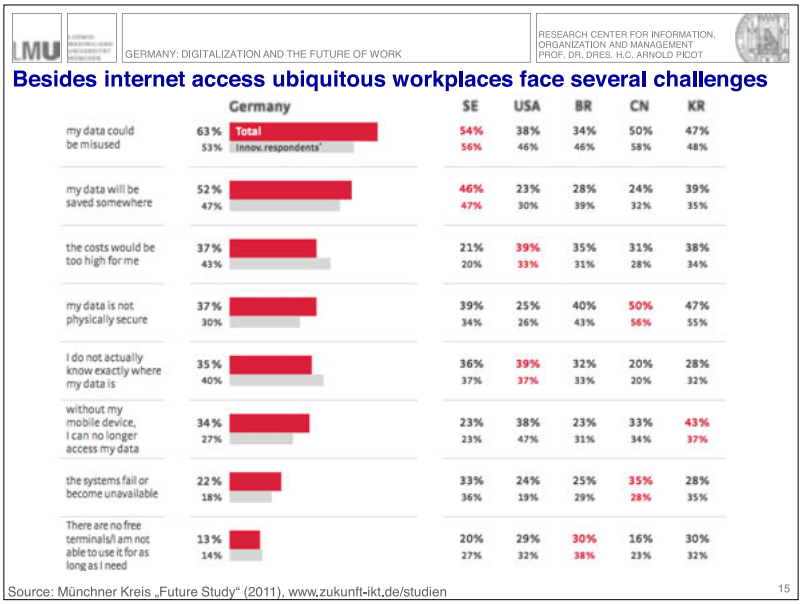


Figure 14

Even if people work from home of from remote places there is the need to gather in person und to communicate face to face from time to time (Figure 14). There is also for those whose private homes do not have the necessary space or equipment to have a centre with special technology and other facilities near your home. This calls for the requirement of so called smart working centres that are being discussed for quite some while already.
Even the political level has drawn attention to this aspect.

Figure 15

In Germany in the year 2011 we could count something like only 72 so called smart working or co-working centres where people can gather and use equipment but also work together, have project meetings, share resources etc. (Figure 15). Of course these working centres also have a positive impact on the various dimensions of city life.

South Korea has made the development of smart working centres a priority, a top priority and they have even installed I think a sort of Minister for Smart Working in South Korea on a very high level government position.

Figure 16

Korea has a plan to enable at least $^{1}/_{3}$ of all employees in the public sector to work from home or from so called smart working centres (Figure 16). The private sector then has to follow this kind of strategy. In 2012 only two smart working centres were realized in South Korea but 12 public ones and 50 private ones were to follow later in 2012. And until 2015 the goal is set to have 50 public and 450 private smart working centres.

The Netherlands also have laid down a policy which would cover the country with smart working centres, so does Estonia. European countries also have discovered this need. Telecommuting or working from near home has a lot of beneficial effects. The following slide shows effects of telecommuting that were calculated for the US.

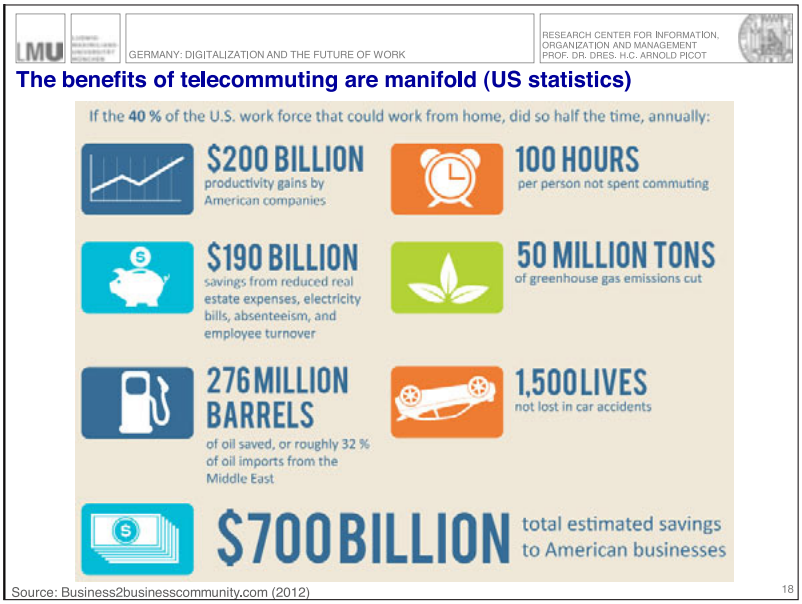


Figure 17

Here If 40% of the US work force that could principally work from home did so half the time what would happen (Figure 17)? This provides an idea of how telecommunication could impact the environmental and health situation and many other aspects.

We know that despite all remote work etc commuting cannot be abolished and travel as well as transport of goods will still needed. People have to meet in person in cities. What people expect is the seamless experience of travelling; they demand the intermodal easiness to travel and to smoothly use different means of transport.

Figure 18

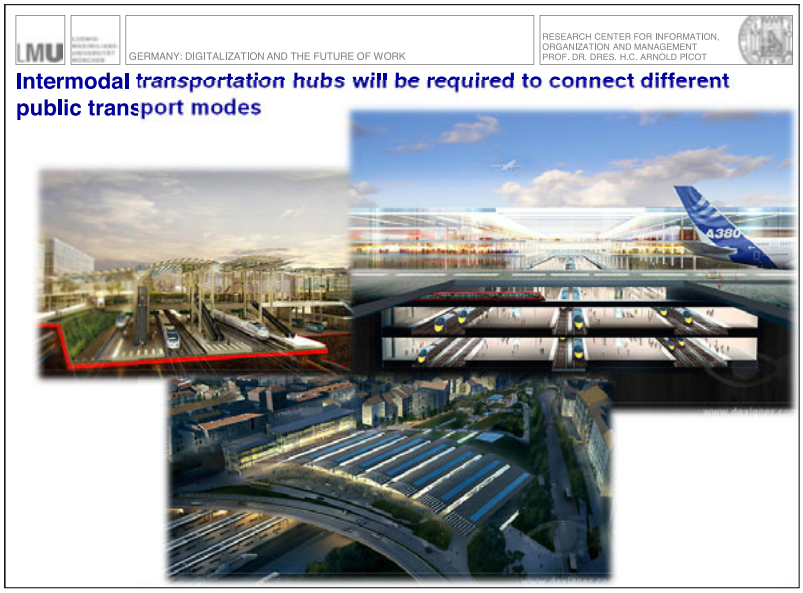


Figure 19

Figure 20

This need is, thus, an increasing requirement for city planning (Figures 18, 19, 20). Intermodal transportation hubs in cities are recommended, of course virtual hubs and platforms but also real hubs where you can physically change the traffic means. One needs systems to plan and to integrate these travels nodes. This is not yet very far developed, but s badly needed in metropolitan areas.

In contrast to office work, industrial mass production, i.e. production of more or less identical physical goods in very high quantities, will also in future be highly centralized. One should expect that this takes place in industry parks and economic development zones outsides cities. Though the individual and decentralized production will increase mass production will continue to play an important role. Due to the space needed this mass production cannot take place within the cities. So, one has to take care for real estate where one can place and develop these factories. This is another challenge for the city development and for the transportation and traffic situation of course.

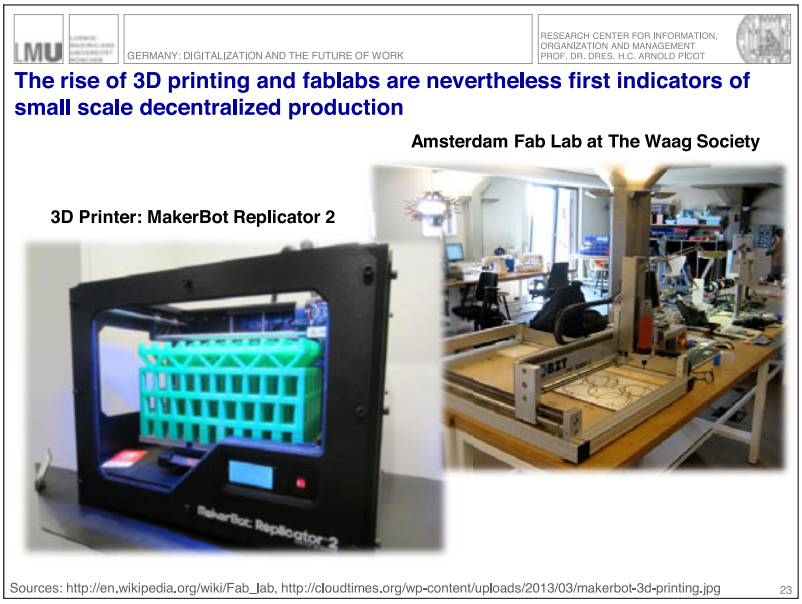


Figure 21

On the other hand the rise of 3D printing and so called fables is a first and strong indicator of new ways of highly efficient and flexible small scale and decentralized production (Figure 21). This enables physical production to move back close to residential quarters and neighbourhoods or even back into private homes. We will definitely see much more decentralised production which is carried out near the homes and which – due its digitized and software driven functions - operates very efficiently in provisioning a variety of physical goods. This trend is only starting right now but has to be reflected in future city development.

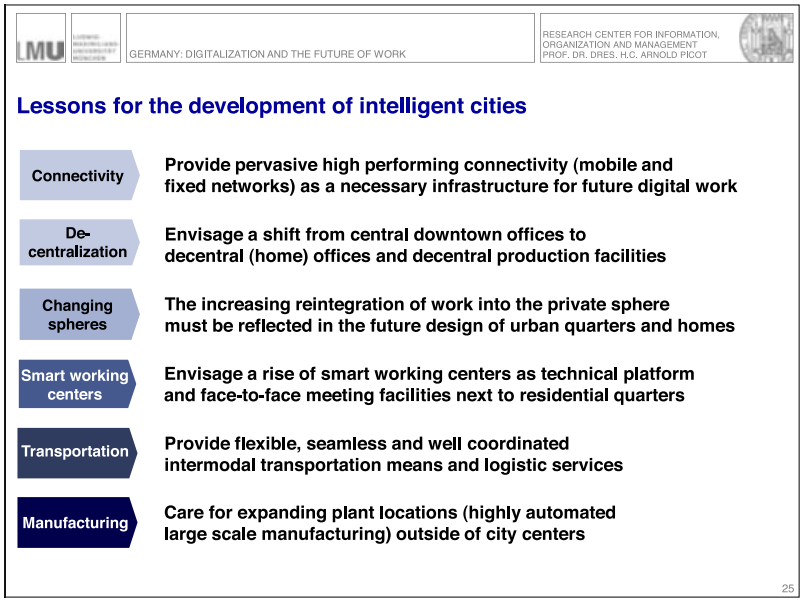


Figure 22

To conclude: what are the first takeaways that one should draw from this short presentation. I would like to wrap up in six points (Figure 22).

Figure 23

Connectivity: Provide pervasive high performing connectivity. Mobile and fixed networks as a necessary infrastructure for future digital work in the cities.

Decentralisation: Envisage a shift from central downtown offices to decentralized home offices and decentralized production facilities. This would considerably change the structure of cities.

Changing spheres: The increasing integration of work into the private sphere must be reflected in the future design of urban quarters and homes. So, the special situation of private homes must also take into account the need for space, for office, or production work or at least one has to organise this in the very near environment of these quarters. For some cities this prerequisite for beneficial future development might not be easy to realise. Smart working, technical platforms and face to face meeting facilities next to residential quarters will be much more in demand. Transportation: Provide flexible, seamless and well coordinated intermodal transportation means and logistic services for transportation of goods or messages within the city manufacturing: care for expanding plant locations for highly automated large scale manufacturing outside of city centres (Figure 23).

List of Speakers and Chairs

Chen Bingrong
Ningbo Municipal People's Government
91 Jiefangbei Road
Ningbo 315010
P.R. CHINA
247756901@qq.com

Prof. Chen Junliang
Beijing University of Posts and Telecommunications
No. 10. Xitucheng Road, Haidian District
Beijing
P.R. CHINA
chjl@bupt.edu.cn

Prof. Dr. Michael Dowling
University of Regensburg
Innovation and Technology Management
93040 Regensburg
michael.dowling@wiwi.uni-regensburg.de

Prof. Dr.-Ing. Joerg Eberspaecher
Technical University of Munich
Communication Networks
Arcisstr. 21
80333 München
joerg.eberspaecher@tum.de

Prof. Dr.-Ing. José Luis Encarnação
Technical University Darmstadt
Informatics – GRIS
Mornewegstr. 28-32
64293 Darmstadt
jle@gris.informatik.tu-darmstadt.de

Dr. Matthias Fluegge
Fraunhofer Institut FOKUS
Kaiserin-Augusta-Allee 31
10589 Berlin
matthias.fluegge@fokus.fraunhofer.de

Prof. Hao Jiming
Tsinghua University
Department of Environmental Science and Engineering
Beijing
P.R. CHINA
hjm-den@tsinghua.edu.cn

Kay Hartkopf
Smarter Cities Leader DACH
IBM Deutschland GmbH
IBM Sales & Distribution
Beim Strohhause 17
22117 Hamburg
kay.hartkopf@de.ibm.com

Klaus Helmrich
Managing Board
Siemens AG
Corporate Technology, External Cooperations
Otto-Hahn-Ring 6
81739 München
klaus.helmrich@siemens.com

Prof. Dr. Otthein Herzog
University of Bremen
TZI – FB 3
Am Fallturm 1
28359 Bremen
T 0421 218-64003
herzog@tzi.de

Prof. Dr. Henning Kagermann
President
acatech
Hauptstadtbüro
Unter den Linden 14
10117 Berlin
kagermann@acatech.de

Prof. Dr.-Ing. Sebastian Lehnhoff
OFFIS – Institute for Information Technology
Escherweg 2
26121 Oldenburg
sebastian.lehnhoff@offis.de

Dr. Colette Maloney
European Commission
Directorate Sustainable & Secure Society
Head of Unit "ICT for Sustainable Growth"
Brussels
BELGIUM
colette.maloney@ec.europa.eu

Dr. Roland Mertz
Bavarian State Ministry for Economy,
Infrastructure, Transport and Technology
Prinzregentenstr. 28
80538 München
ronald.mertz@stmwivt.bayern.de

Prof. Dr. Dr. h.c. Bernhard Mueller
Leibniz-Institute of Ecological and Regional
Development e.V.
Weberplatz 1,
01217 Dresden
b.mueller@ioer.de

Prof. Pan Yunhe
Chinese Academy of Engineering
No.2 Bing Jiao Kui Hu Tong
Beijing 100088
P.R. CHINA
panyh@cae.cn

Prof. Dr. Dres. h.c. Arnold Picot
Ludwig-Maximilians-Universität
Research Center for Information,
Organisation and Management
Ludwigstr. 28
80539 München
picot@lmu.de

Jens Romaus
Senior Vice President
Global Head of Public Services
SAP AG
Dietmar-Hopp-Allee 16
69190 Walldorf
jens.romaus@sap.com

Joachim Schonowski
Deutsche Telekom AG
Telekom Innovation Laboratories
Ernst-Reuter-Platz 7
10587 Berlin
joachim.schonowski@telekom.de

Prof. Wu Cheng
Tsinghua University
Beijing
P.R. CHINA
wuc@tsinghua.edu.cn

Prof. Wu Zhiqiang
Vice President
Tongji University
1239 Siping Road
Shanghai
P.R. CHINA
prof.wus@gmail.com

Prof. Yu Yixin
Tianjin University
School of Electrical Engineering
and Automation
92 Weigin Road, Nankai District
Tianjin 300072
P.R. CHINA
yixinyu@tju.edu.cn