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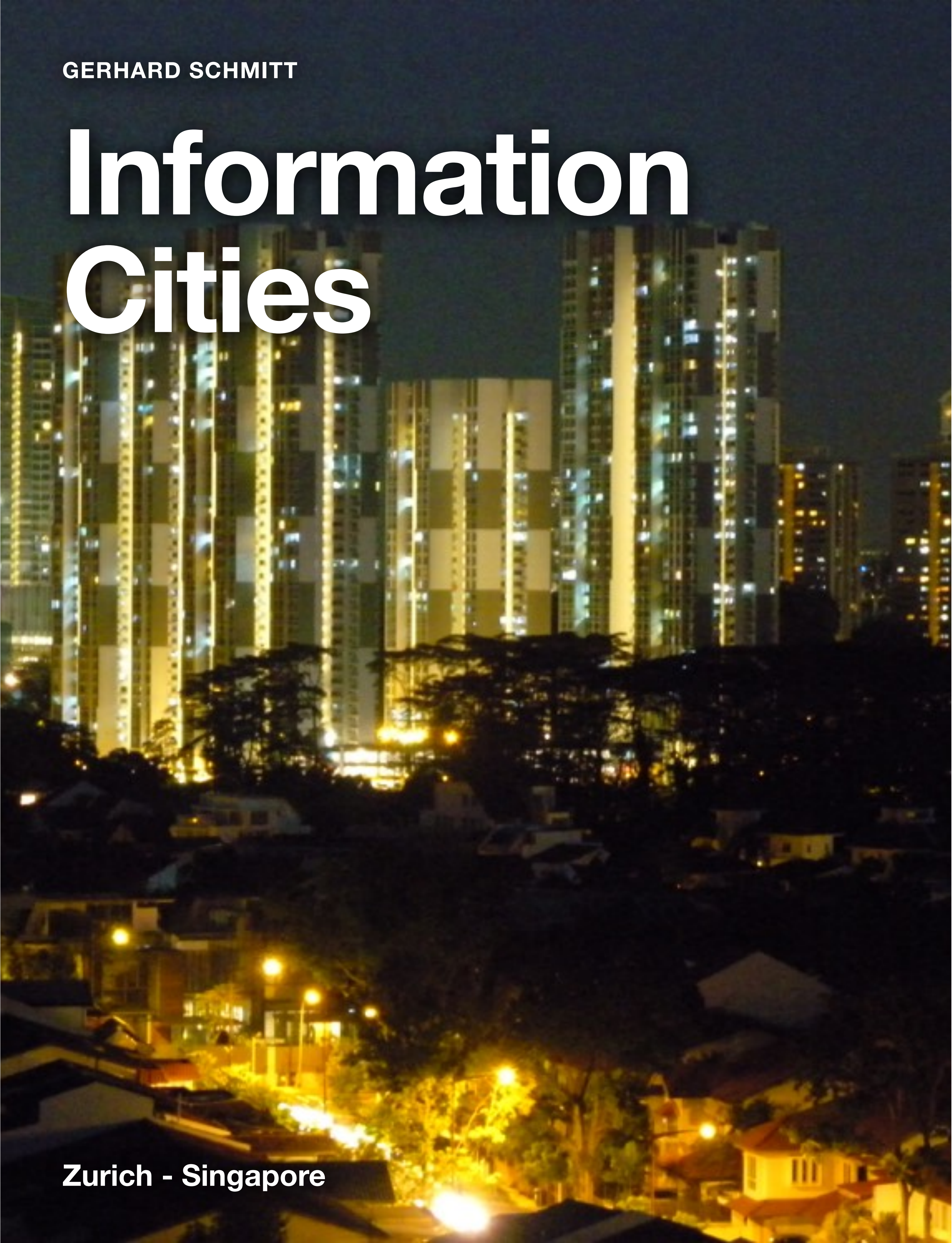
Information Cities



Zurich - Singapore

Future Cities Preface

Abstract

What is a city? What is an urban system? Do we understand these most complex man-made artefacts in their entirety? Why do people move into cities? When do they prefer to stay in rural areas? Do cities need skyscrapers? Are there cities without density or are there dense settlements without being a city? Some cities are liveable for the majority, others just for a few. As we enter the first urban century, we start to realise that today's cities are not sustainable, no matter from which side we look at them. Prerequisites for their transformation towards **liveability**, sustainability and resilience are better knowledge and ability to change. Understanding the city and knowledge about the city should be the base for change. As we begin to realise that cities are not neutral objects, but that people define the city, the mobile citizen gains a central role in the definition of the future city.

With regard to cities, the development in different parts of the world is moving in radically different directions. Cities in the tropics will grow strongly in the coming decades: overall, the number of new inhabitants is expected to increase by 3 times the population of Europe today in the next 30 years. But who is planning those cities? To enable people to do so, it is necessary to develop new University programmes which in an integrated and holistic way will transmit the knowledge to understand the city, to transform it, to plan it, to design it, to build it, to manage it and to constantly adapt it. The **Future Cities Laboratory** in Singapore and Zurich is conducting fundamental research into this area and also prepares concrete proposals to change existing urban structures towards a higher level of sustainability.

A new understanding of the city: The Future Cities Laboratory

At the beginning of the second decade of the 21st century, networks of urbanised centres are the predominant framework of life in Europe, the United States, South America and Oceania. While in Africa and Asia a majority of the population still lives in the non-urbanised countryside, the urban population is growing much faster, through higher birth rates and internal migration, and is expected to exceed the rural population by 2050. Thus, the urban framework of living will dominate the coming centuries. As a consequence, the urban theme has moved to the top of the agenda of elite universities, industries, and agencies. Governments such as the one of Singapore have made the future of the city, in particular the future of the liveable city, one of the **national central themes**. Global Think Tanks, such as the **Santa Fe Institute** in New Mexico, explore the topic of the city as a complex system in-depth.

The urbanisation of the rapidly emerging countries of the 21st century, as societal and scientific phenomenon, urgently needs fundamental research. This is the main reason why **ETH Zurich** has founded in 2010 the Future Cities Laboratory, as an integrated and multidisciplinary design and research centre in Singapore and Zurich. The Future Cities Laboratory is looking for realistic approaches, techniques and methods to increase the sustainability of cities. It integrates research results from fields of science that are crucial for the next generation of city planners, city builders and city managers to know about.

In order to better understand the city, theory, experiment, and simulation need to work hand-in-hand. *Theory* entails research on the reality, the planning, and the implementation of the city; *Experiment* includes the conduction of Design Research Studios, with the city as a living laboratory; **Simulation** is needed to make the invisible visible and to test and visualise future scenarios.

Three years after its launch, the Future Cities Laboratory in Singapore and Zurich operates with more than 200 people from 31 nations. Among those are 50 Ph.D. students, 25 Postdoctoral Researchers, 13 Principal Investigators, 35 Design Research Studio Master Students and 5 management involved persons, as well as the academic partners of the **National University of Singapore** (NUS) and the **Nanyang Technological University** (NTU). All together, these researchers are beginning the development of a new **city science**, by the combination of theory, experiment and simulation.

Building on the model of the urban metabolism, on the stocks and flows approach and on complex systems theory, the Future Cities Laboratory, in addition, explores experimental possibilities, such as pre-specific modelling and a **quantum city** approach. The research operates on 3 integrated scales: small – building and building technology; medium – neighbourhood and city; and large –hinterland and territory. 10 research modules and 3 assistant professors work on the influential and decisive parameters water, material, energy, design, capital, landscape, density and information.

Context versus universality

Throughout the entire book, there will be a distinction between universally accepted facts and context-based information and facts. Universally accepted facts and methods can be transported without causing confusion or damage between cultures, countries, and climates, as they apply to all cities and urban systems. They are only a few. Context-based information and facts refer to a specific location, in a specific climate and must be used with great care as a base for design decisions in other places. Cities and buildings are not context-free objects and therefore must not be just copied (Platt, 2012). The boundary between context-based and universally applicable theory is not rigid, and as our knowledge about cities increases, we will be able to expand both the set of universally accepted design support theories and facts as well as the locally important information and knowledge. The universally applicable information is depicted by the global symbol.

New ways to plan the city

City planning means different things in different parts of the world. And many of the fastest growing cities even evolve without planning in the traditional sense. While the development in Europe and the United States is stagnating, the cities north and south of the equator are expanding as rapidly as European and North American cities did 150 years ago. Yet since then, the world's population has grown by a factor of 6, and the global networking amongst the urban centres has increased significantly. The interactions between cities are massive, compared to those in Europe and North America in the 19th and 20th century. Asian cities, such as Singapore, have recognised and developed city planning, as a crucial part of the development of the entire nation. The idea is to become the leading centre in Southeast Asia, with the highest satisfaction of the inhabitants. In 2012, the Singapore Minister of Trade and Industry **Lee Yi Shyan** asks: "How can we urbanise while maintaining harmony – socially, economically and environmentally? How do we balance short-term needs with long-term demands? How do we ensure that we can go on building cities, while retaining a healthy environment for our children and grandchildren?"

The Future Cities Laboratory looks at city planning from different perspectives. On the territorial scale, the architects and urban designers **Marc Angélil and Franz Oswald** conduct research on the symbiotic relation between cities and their regional and global Hinterland, in Brazil and Ethiopia. Territorial Architect and Designer **Milica Topalovic** concentrates on the interconnections between Singapore and its Hinterland, which includes Malaysia and Indonesia, but which, in reality, is global. Also in a territorial scale, transportation planner **Kay Axhausen** simulates the effects of **mobility** and the increasing number of cars and other vehicles, as well as the emerging links between mobility and urban design. In the neighbouring Jakarta and along the Ciliwung River, the landscape architect **Christophe Girot** and the hydrologist **Paolo Burlando** try to understand and plan for the territorial importance and the local functions of water as natural and development elements. The urban sociologist Christian Schmid works with comparative methods in the rapidly growing urban centres north and south of the equator to discover common phenomena and solutions for the densification of cities.

New ways to build the city

Cities, seen as physical expressions of urban systems, consist of people, buildings, infrastructure, and moving parts. The urban system extends above and below ground. Above ground, buildings are the objects that are most associated with cities. Every single building in a city contributes to its future success or failure with regard to sustainability, and therefore the building physicist **Hansjürg Leibundgut** and the architect **Arno Schlüter**, concentrate on **Low Exergy** housing and office buildings for the tropics. Architect and building technologist **Sacha Menz** compares housing typologies in Switzerland, Singapore, and China. To construct these buildings in the future with high precision and longer life cycles, **Fabio Gramazio and Matthias Kohler** teach their students how to program robots for the automatic, non-standardised digital production of high-rises. Building scientist and preservation specialist **Uta Hassler**, and her group, focus on material flows, on historic aspects of quarters originating in different times and on the development of the city of Singapore. Expanding this team, the urban planner and architect **Kees Christiaanse** leads another team that deals with the revitalisation of city quarters and also explores the new role of the airport as an integrated part of the new city. With the explicit goal of saving valuable resources and reducing CO2 output in the production of building materials, **Dirk Hebel** introduces regional material, such as bamboo, which in specific parts of the world could partially become, under certain conditions, a substitute of concrete in construction.

New ways to manage the city

Cities consist of more continuous parts and more dynamic parts. In the constant development between continuity and change, it is necessary to build innovative methods and instruments for a dynamic city management. Already the master plans for a city and the resulting buildings should be seen through the eyes of the city life-cycle management, and the city administration has to be composed in a way that it can implement well-founded requests from the population. Rules and building regulations will play an important role in the future to manage the city. **Alex Lehnerer** is planning a centre for urban rules, that could formulate planning guidelines for the new city. As interaction environment for those who are participating in the building and the management of the city, as well as for the safe deposit of all information related to a city, the **Simulation Platform** of the Future Cities Laboratory with the Value Lab Asia represents the technical foundation. Information originates from data. This data stems from historical records, but also nowadays increasingly from real-time and online sources, crowd sourcing and social media. Integrating them carefully in the Simulation Platform will lead to context sensitive knowledge databases for the management of future cities.

Future cities

It is already clear now, that the future city will not be designed and built based on hierarchies, formalisms, or mathematics, but will originate from a dynamic system including global relations and local force fields. This view of the future city is already reflected in the organisation of the Future Cities Laboratory, which closely networks on the one hand in-depth disciplinary research and on the other hand disciplines like design or sciences. Depending on the topic, the leadership of emerging synergy projects will rest with the research module that has the highest competence in this field of interest and might change throughout the project. The first example is the common work on the historic Rochor quarter in Singapore, where tradition and future are at stake. A second example is the Jakarta Ciliwung project, in which several research modules of the Future Cities Laboratory cooperate with the University of Jakarta on the concrete redevelopment of a Kampung, in order to improve the situation of the slums in a sustainable way. A third example is the design and construction of the city of Nestown in Northern Ethiopia. All three examples have in common that research, development and implementation are closely working together in the rapidly growing regions around the equator, with the common goal to achieve urban sustainability.

The cities of the future will differ from each other much more than those of the present, because they emerge in a globally networked consciousness and with having the knowledge of the importance of sustainability. They will increasingly take into account the participation of people as well as the climatic and economic context. This requires that the teaching of city planning and urban design needs to be revisited and renovated fundamentally, and must be adjusted to the degree of knowledge that has been created from the research related to the city. To this end, the Future Cities Laboratory develops a new curriculum for those students, in different parts of the world, who will lead the planning, the construction, the redevelopment and the management of future cities. The new curricula will influence education in the West, but possibly even more education in Asia and Africa, because these curricula will hopefully eliminate the discrepancy between the needs of cities in those continents and the solutions that were traditionally offered in the West.

At the beginning of the 21st century, the majority of the fastest-growing cities are in Asia and Africa. In the very near future, the majority of the population in the world will not only be housed in cities, but in Asian and African cities. As a result, the knowledge of the development of cities and of urban-rural systems is crucial for students worldwide.

The patterns and recipes of the past will be replaced by new patterns and blueprints that are under development in the Future Cities Laboratory in Singapore and Zurich. Those blueprints will differ significantly from city to city even in similar climate zones. They will differ even more from cooler climates to tropical climates.

Section 1

How to navigate

QUICK GUIDE

You are interacting not really with a “book”, but with a multi-dimensional “information space” that you can access from different perspectives and levels of knowledge.

1. **If you are interested in an overview, read the short summaries on the first page of the chapters**
2. **If you are interested in the definitions underlying the chapter topics, read the page following the chapter summary**
3. **If you want to know why this chapter is relevant for designing, planning or managing cities, read the section on “Relevance for the city” in each chapter**
4. **If you know more or read incorrect statements, please use the feedback section to improve the book for all future readers.**

Overview

All Chapters in the book are relevant for the understanding of cities, and if you are in the position of or have interest in designing, building or managing a city or its parts, these chapter overviews will give you a brief introduction. Do not worry about expressions you might not know - if they are highlighted, a click on them will provide an explanation.

Definitions

The first page after the chapter introduction contains the definitions and gives access to the next level of understanding. The more formal approach is meant to establish access to the relevant literature and reports in the particular field of urban design, construction or management knowledge. Here you will also meet the people who most prominently work on and define the cutting edge research in this area.

Relevance

In some cases you may wonder how a particular chapter or section is relevant to city design, construction and management. The “relevance” section should give the reasons in cases that this is not obvious and also establish the correct links to the related chapters.

Chapter 1

City Planning in History

Cities are the most complex artefacts that humans have created in history. Highest respect goes to those who made it possible to create an environment for thousands and later millions of people to live together. This chapter is not about the complete history of city planning, but as a reference and introduction to the future of city planning.

Section 1

City Planning in History

CITY PLANNING IN HISTORY

City learning is an art that has developed continuously over more than three millennia. While the origins of planning are not entirely clear, the object of planning - the city and the urban system - have become increasingly complex.

Organising and providing for the living together of large amounts of people, while securing continuous water and food supply as well as protection from enemies, has been the objective of city planning throughout history, independent from climate or culture.

In the development of cities, there is a continuous increase in the role of information and data, at the expense of the role of durable materials. While this development has begun with industrialisation, its recent acceleration has led to changes in the art and science of city planning that will grow at the same pace as the expanding role of IT and Big Data.

The history of cities is long and strong - and surprisingly fluid during history. Even their origin is disputed - most scientists agree that people invented or developed them after the rise of agriculture, but even that assumption is not unchallenged, as the urban theorist Jane Jacobs argues (Jacobs, 1969). Her view is particularly meaningful for future cities, as it points to the multifunctional character of this type of human settlement, which is always good for surprises and can drastically change the appearance and liveability of the city.

As much as the origin of cities is not entirely certain, the reasons for their development, demise, or even disappearance are unclear as well in many cases. As we try to explain the reasons for growth or decline of cities from today‘s point of view and always with a specific cultural background, the real reasons will only become visible once a true science of the city has formed. This city science should be able to analyse the development of cities over time, and to a degree predict their future.

Independent from the kind of origin, functioning cities need communal decisions and organisation. They need urban design in the sense that the construction and management of urban systems require decisions, the result of which are in the future. Independent from culture, climate or geography, this was particularly true for the first cities, which had no precedents to look at and no best practice examples to take ideas from. But even today every design and planning decision is a marker placed into the future with no guarantee that the city will reach this goal entirely or in part. It is this gap between idea and realisation that requires design and organisational leadership.

City planning in history is characterised by a process between two extremes: on the one hand, there is a decision maker who decides and orders a particular city design, based on suggestions by a planner or a group of planners working for the leader. On the other extreme, there is the total communal decision-making process that leads to the design and construction of the city. Both extremes normally do not work in the long run, and cities and urban systems that want to be sustainable and resilient over long periods of time need to be designed and managed more by communal decisions rather than by an individual or by ideology. The chapters on City Projection and Urban System Design describe two more recent historic approaches of city planning.

Up until the middle of the first decade of the 21st-century, city dwellers were a small minority of the entire population which grew over millennia at a relatively slow pace. Small cities grew over a longer period of time and their performance could be observed by other cities. Yet as rapid city growth and industrialisation go hand in hand, the 19th and 20th century have made professional city planning a necessity.

The increase in the choice of materials and the decrease of energy and transportation costs led to an extreme diversification of materials, shapes, details, services, colours, building heights and urban spatial organisation. With the rapid increase of the world population and the constant rise of the share of urban population compared to the entire population, this process will not only continue, but accelerate. The process is moving at different speeds throughout the world. The industrialised countries have reached urbanisation degrees of more than 80%, and their population begins to stabilise or decrease.

City planning in history was also characterised by relatively slow development and a high value of physical materials. Cities and their infrastructure were planned and built to last for centuries. Even today, physical infrastructure and the land it occupies represent the majority of a country‘s assets.

Yet with the increasing dematerialisation of value creation in modern societies and with the limitation of physical material, information slowly takes on the role that physical material had in the past. Therefore, information plays a crucial role for the development of today‘s cities and for the design and management of future cities. This is also the reason, why this book places specific emphasis on information as a central concept and virtual material for the future city, on the particles that information is made up of – data – and on the elements that information can be developed into: knowledge, Architecture, cities, and territories. Data, information and knowledge are crucial for understanding and designing future cities.

Chapter 2

Information Architecture

In the realm of the built environment, Information **ARCHITECTURE** visualises the information inherent in a building and thus makes the invisible visible. In the realm of the virtual, **INFORMATION** Architecture serves as a metaphor to structure the vast amount of data produced in modern society. We define **INFORMATION ARCHITECTURE** as the necessary framework to understand architecture, urban systems and territories in the knowledge society.

Section 1

Data, Information, Knowledge

INFORMATION ARCHITECTURE COMPONENTS

For physical architecture, we use physical materials. For information architecture, new types of material are needed. Data, information, and knowledge could be those materials. Abstract in nature, they need structure, space and interfaces so that we can use them for design support purposes. Other disciplines, such as medicine, are constructing their body of knowledge with the same elements to come to a better understanding of the functioning of the human system.

With regards to urban design, the realm of data is expanding faster, followed by the amount of derived information, that can be used to build design knowledge.

Three important words

Data and information are often used interchangeably, but as they are at the core of information architecture, they deserve a special consideration. Wikipedia, for example, suggests that "**Data** is another word for information". We see data as the smallest entity of information and as a necessary foundation for building knowledge.

The transformation from data to information and knowledge is one of the most important activities in every society. Even though it might appear that this activity applies only to the post-industrial societies, yet it was and still is important for the preindustrial and the industrial societies, too. With regard to the city as hub for collection, storage, and transformation of data into information, knowledge, and finally built architecture and other physical and intellectual structures, this activity is crucial. It requires the capacity to abstract, to order, to give structure, and to design. Therefore, the architectural curriculum is a good foundation for information architecture.

Since the middle of the 20th century, a development in computer science, with roots even more than 100 years ago, laid the foundation to represent and work with data in a standardised format. This standardisation of data and information has had a significant impact on human society until today.

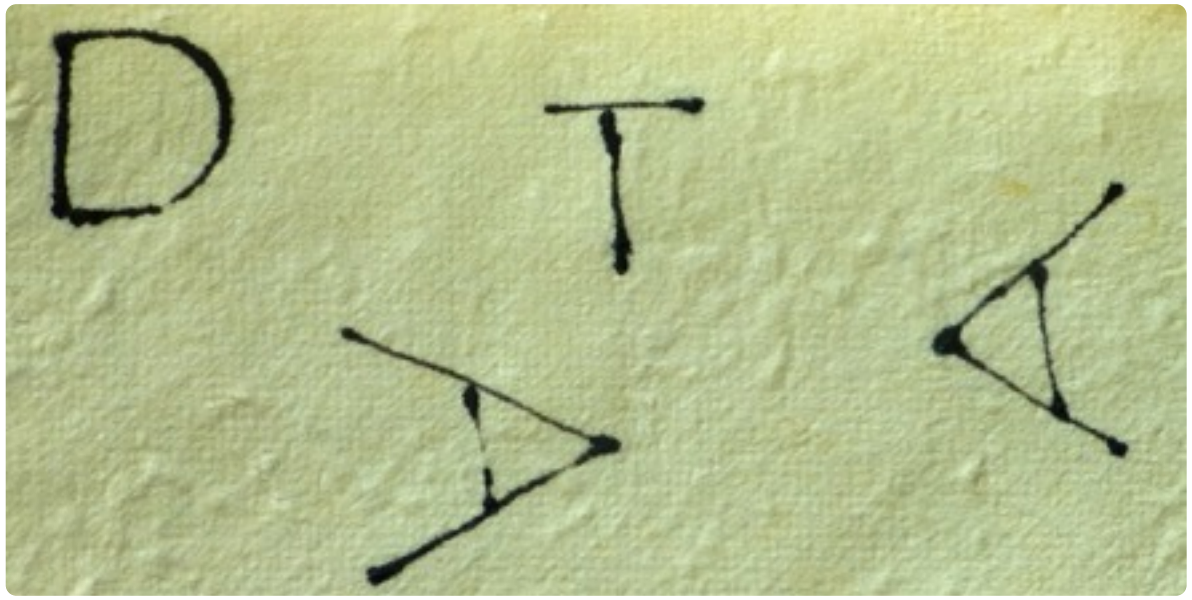
Data

The Romans used the word **datum** to express “that is given”. In the context of the city, we refer to data as the smallest entities of information, as values given to objects, expressions, functions or properties. Examples of data are numbers, colors or other simple descriptions. To better describe objects, expressions, functions or properties we need data and connections or relations - we call the result information. Important to remember: Data do not completely describe objects, expressions, functions or properties, but they are an indispensable ingredient.

Information

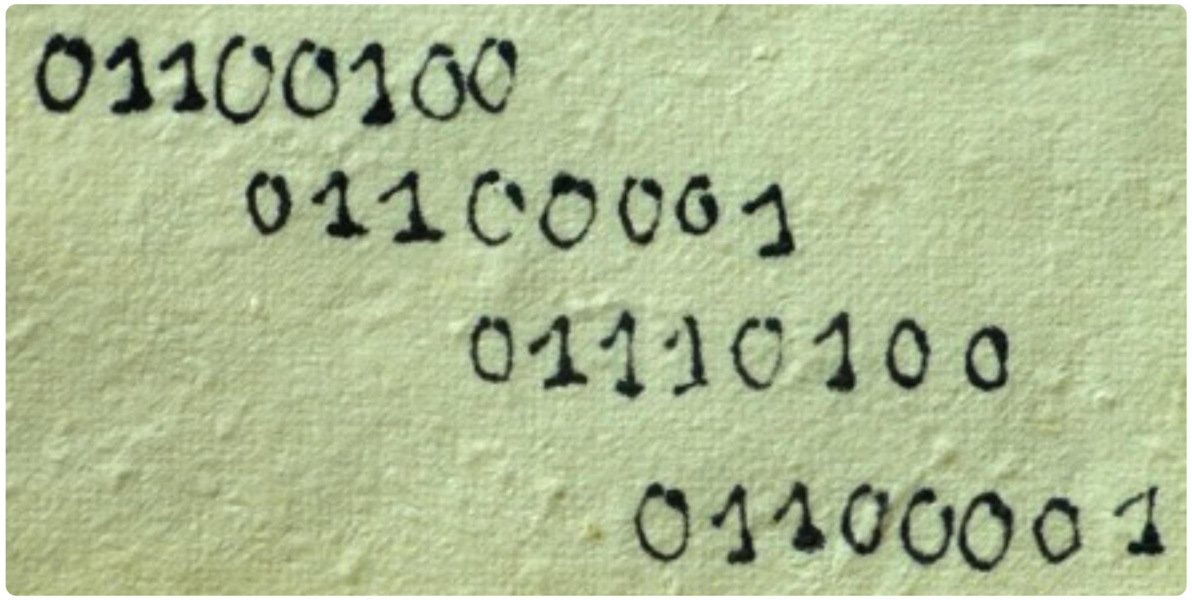
Information sets data in relation to each other, it consists of data and connections. The word has also Latin roots: *informatio*. There was the stone age, the bronze age, the iron age, or the nuclear age. We consider information as a virtual material, and one of the most important ones for the information age and for the information society. Important to remember: Information does not completely describe society, but it is an important abstraction.

Gallery 2.1 Examples for data



Schmitt, J. 2013. *Letters of the alphabet as data.* [Ink on paper]

Gallery 2.2 Examples for information

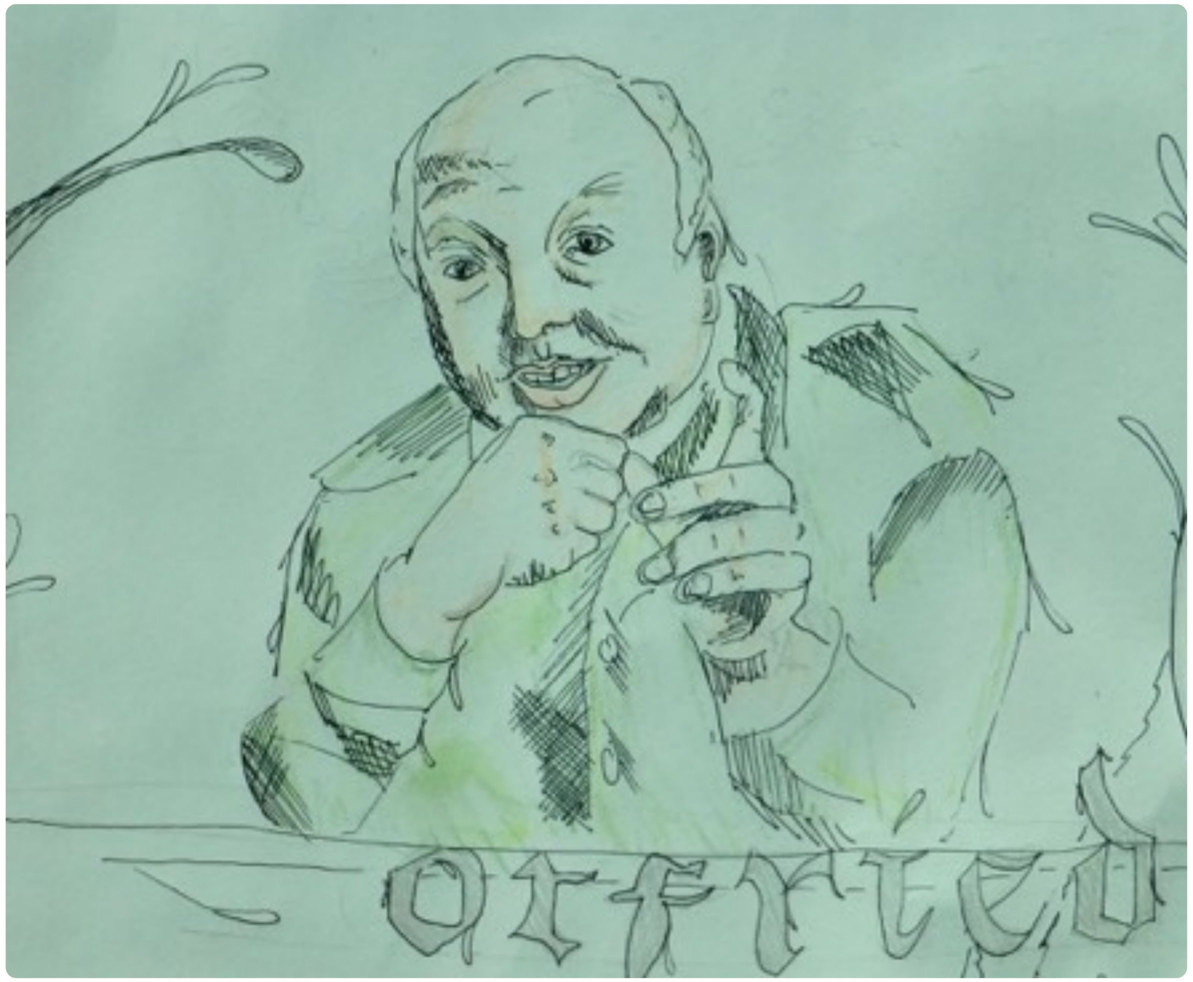


Schmitt, J. 2013. *Binary code of the word «data».* [Ink on paper]

Knowledge

Knowledge is a result of connecting data and information. It is not entirely clear how data and information are combined in the cognitive process into knowledge, but in any case domain knowledge and domain independent knowledge build on data and information.

Gallery 2.3 Containers of knowledge



Schmitt, J. 2013. *The knowledge of the writer Otfried Preußler, author of the book Krabat.* [Pen on paper].

Section 2

Information ARCHITECTURE

DEFINITION

Information ARCHITECTURE stands for making the invisible visible in the form of digital information extracted from and applied to physical architecture, to better understand and design physical architecture.

Information is a central property of architecture, as it is defined by data and their relation, and at the same time is a crucial ingredient to build and maintain architectural knowledge. We can think of information as the building blocks of future architecture. Looking at such a building block, we can decompose it into its facts (data) and into the relations connecting the different facts. Looking at knowledge, we can decompose into information and into the relations connecting the different sets of information. But it is much more difficult to reverse this process.

Information ARCHITECTURE describes the information IN architecture.

Architecture and information

Far too often, we take built architecture for granted. We are satisfied by looking at the surface of a building, of a city, or of a landscape. For those who want to merely enjoy and experience architecture, this may suffice. But for those who want to design buildings, urban quarters or territorial structures, this is not enough. We need information to understand and design architecture, and as we shall see later, we need the architectural metaphor to understand and design information. But what is information? And what is the relation between data, information, and knowledge?

Think of a simple brick wall: in the distant past, it was sufficient to know about the bricks ability to protect and to bear loads. In the information age, the brick wall can tell us an entire story: the origins of its materials, the process of their transportation to the production site, the production of the bricks and the mortar, the transportation to the building site, the construction process, the position of each brick in three-dimensional space, the thermal properties of the wall, its colour, its acoustic properties, its health related qualification, and many other invisible, yet existing properties. In fact, the wall informs us of the entire history about its life-cycle. If we know all these properties and also how to handle them, it should be possible, in the future, to design and build new architecture, which fulfils its specifications much better than today.

Data in ARCHITECTURE

All scientists need data, and all architects need data. Often, we see the value of data only when we have no access to them. As history is an important aspect of architecture, historic data are valuable and the precondition for many design decisions. Future data – which by definition cannot exist – come from architectural simulation and design exploration.

Information in ARCHITECTURE

Looking at architecture, we see the obvious. But there is more invisible information in architecture than meets the eye. Consider, for example, of the past, present, or future temperature of the room; the weight of the wall resting on a floor; the age of the wooden beams in the ceiling; the hidden pipes and cables behind the plaster; the acoustic properties of materials surrounding you; the cost per square metre or per cubic metre of the space you look at; or the CO2 embedded in the material and the energy needed to heat and cool the space.

Gallery 2.4 Data in ARCHITECTURE

Lim, K. 2011. *What do these numbers mean? This data might be important, but make no sense without knowing the context.* [Photograph]. Science Park 2, Singapore.

Gallery 2.5 Information in ARCHITECTURE

Schmitt, G. 2010. *Old or new? Original or reconstructed? We need historical information to decide.* [Photograph]. Vicinity of Riyadh.

Knowledge in ARCHITECTURE

Combining information, experience and insights can lead to architectural knowledge. This knowledge is necessary to design new buildings that fulfil certain properties; and it is necessary to understand the function and meaning of buildings in the first place. Knowledge is associated with people, in this case with architects. Knowledge increases with the experience of architects in their practical and theoretical work.

Gallery 2.6 Knowledge in ARCHITECTURE

Schmitt, G. 2011. *The Architect Franz Oswald in Singapore as Leader of the Future Cities Laboratory.* [Photograph].

Data, information, knowledge, architecture

The design of architecture is built on knowledge, knowledge is built on information, and information is derived from data. Yet there is no straight and automatic way from data to information, to knowledge, to architecture. The structures, frameworks, hierarchies, ontologies and mechanisms that relate those entities are mostly interesting for research. One of these structures we refer to as models. Models in architecture, urban design and territorial planning are an abstraction of the real object with its functions and behaviours. Models are also the base for simulation, an activity and abstraction that includes the important parameter of time.

Information ARCHITECTURE uses simulation for more than creating images or artefacts based on geometric constraints, rules, or cases. Rather, non–geometric factors such as light, energy, structure, behaviour or systems knowledge become available for integrated direct modeling. Information Architecture helps to formalise and generalise design principles.

Few design principles in architecture, urban systems or territorial planning are context-free. Those are the ones based on known constraints, such as gravity, temperature ranges, or material properties. Most other design considerations depend on the context.

Modeling in ARCHITECTURE

When we think of architectural models, physical models of proposed designs or existing buildings come to mind. Yet in the context of information ARCHITECTURE, **modeling** builds on abstractions of physical architecture that explicitly show the connections between the parts and the whole. This normally involves simplification and formalization. To simulate a building's cooling demand, for example, we apply a formalised physics model to a specific, yet simplified geometric model.

Simulation in ARCHITECTURE

Simulation in Architecture requires the existence of a model, representing the most important characteristics of the proposed solution. In the past, the words «model» and «simulation» were often used interchangeably in architecture, i.e., an architectural model was seen as a design scenario for a given time in the future. Increasingly, the factor time and with it the dynamic aspects of design proposals become important parts of simulation in architecture.

Gallery 2.7 Modeling in Architecture

Schmitt, G. 2010. *Physical models of buildings in Singapore.* [Photograph]. URA Gallery.

Gallery 2.8 Simulation in Architecture

Chair of Information Architecture. 2009. *Simulation of future buildings and land use in the Value Lab Zurich with Antje Kunze and Jan Halatsch.* [Photograph].

Projection in ARCHITECTURE

Projections are a special type of information ARCHITECTURE. They either project images that have nothing to do with the content of the projection area, or – more interesting – they project abstractions of information of functions or events that occur behind, in, or in front of the projection surface. This way, facades can become large information displays. The chair of information architecture has established a tradition in projection exercises with Christian Schneider. He started with projecting complex adaptive code generating geometries onto facades, respecting the particular qualities of each facade in terms of openings and proportions. He then began using infrared cameras to detect people and heat emitting objects, as they were moving in front of the building, resulting in dynamic changes in the projections.This was a convincing example of making the invisible – in this case sources of heat – visible. Lukas Treyer extended the experimental exercises towards dynamic design projected on more complex geometry. Students learned programming and at the same time gained experience in visualising information in previously unthinkable ways.

Gallery 2.9 Projection in Architecture

Treyer, L. 2012. *Architectural projection by Lukas Treyer on the facade of a parking garage.* [Photograph]. City festival of Baden, Switzerland.

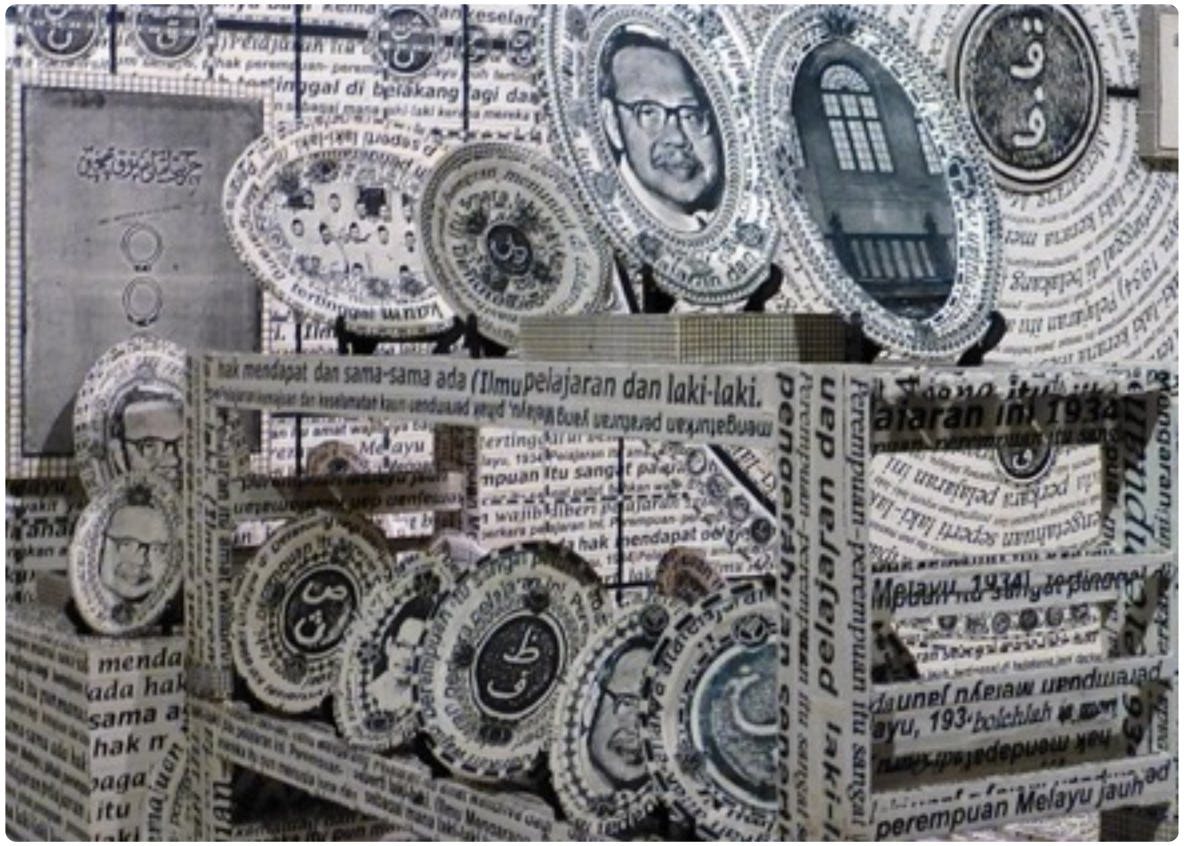
Movie 2.1 Projection in architecture

Treyer, L. 2012. *Video of the architectural projection by Lukas Treyer for the Stadtfest Baden, Switzerland.* [Video].

Art Information ARCHITECTURE

In art, architectural spaces and furniture can be used as information carriers. Most of the time, spaces are used as an empty shell in the background, to allow art to be perceived separately. Information can also be displayed from furniture and other surfaces, giving the impression of interaction between the viewer or user of the space and the art installation.

Gallery 2.10 Art information space



Schmitt, G. 2013. *The shaping of cultural memory by historical texts. Zulkifli Yusoff, collage embossed dye printed on canvas.* [Photograph]. Exhibition in the Singapore Art Museum.

Curricula in ARCHITECTURE

Architectural education is about integrating data, information and knowledge with the ability to design and to arrive at buildable, affordable, and sustainable architecture. The same applies to urban design education and territorial planning education. Each architectural curriculum represents the present view of what the institution in charge considers to be necessary for the education of architects, urban designers and planners. Over the years, courses covering topics from other disciplines and sciences are added to and dropped from the curriculum, with the ultimate goal to improve the final product, be it architecture, urban design or territorial planning. Every addition of a new topic and every elimination of an existing topic cause heated discussions in faculties and among students. Yet as the total time for education is limited, and as the body of knowledge of architecture is growing exponentially, this process is necessary and unavoidable. Rather than merely dropping and adding courses, it is worth looking at a higher level of abstraction to find out if some topics could be combined into one, and if there is an underlying structure, grammar and language to these topics. Data, information, and knowledge might be a first step in this direction.

Section 3

INFORMATION Architecture

DEFINITION

INFORMATION Architecture describes metaphors and principles of physical architecture applied to digital data and information, to create an architecture of information, with the use of information as raw material.

INFORMATION architecture describes the architecture OF information.

In the Internet, **INFORMATION architecture** describes the organisation and the labelling of websites, online communities, and intranets. But there is the potential to organise and structure not only the obvious, but the entire information space. The key to these possibilities is the understanding of the architectural metaphor.

The architectural metaphor is an abstraction that is used in various fields. Think of expressions such as computer architecture, financial architecture, security architecture, or political architecture. In each case, the word architecture is meant to describe a structure and an order, and not the physical construct itself. These expressions and descriptions use the abstract power of architecture and apply it to other fields.

Richard Saul Wurman is the person who originally used the term information architecture. As an architect and graphic designer, he clearly broadened architectural concepts into the world of information with the intention to make it better understandable to everyone. He also invented the Technology, Entertainment and Design (**TED**) conferences.

INFORMATION architecture is very powerful in placing emphasis on certain information by using the architectural metaphor. It is, at the same time, also a dangerous instrument, as it might lead to overlooking other, less structural prominent pieces of information that might be essential.

Architectural and planning metaphors shaping the structuring of data

Even in the digital age, everybody knows a stack of books, or a stack of dishes. Placing a book on top of the stack or taking a plate from the top of the stack are activities in a building that we perform almost daily. In computer science, a **stack** is described as an abstract data type or collection with one main operation: to add one entity to the collection, described as push, or to remove one entity, described as pop. With the stack,the connection between the physical world and the abstract world of computation is still visible: the most recent item is pushed on top, and it will also be the first to be retrieved. One can almost feel the effect of gravity in this description, although it is a completely virtual analogy in information space, were the metaphor of the physical stack is helpful to describe a particular ordering principle.

Moving closer to the building, computer science uses the expressions of **barriers** and **fences**. Fences are used as metaphors and stand for guaranteeing that storage and cache have the same state. In analogy to an animal herd, fencing in computer science can also describe the process of separating entities from the rest. In computer science, this is necessary when nodes or sense of nodes in large computational clusters feel and need to be isolated to protect the overall performance of the system.

Sounding similar, but not necessarily related is the expression of computer farms. In an analogy to physical farms, usually in the hinterland of urban systems and supplying them with food, computer farms have specialised meanings. There are the **server farms** or server clusters, tying together logically and physically dozens, hundreds, thousands or even millions of individual computers. These server farms are the core of most operations in the Internet today. The analogy to farming does not stop here: the individual servers are usually stacked on top of each other in metal racks, which evokes the analogy to vertical farming. They also generate large amounts of heat as a result of the significant electricity consumption. As a matter of fact, server farms and the associated storage devices become so significant in terms of electricity requirements and cooling loads, that in temperate climates can be used to heat entire buildings, and in hot climates need to be placed faraway from the city – in previous farmland – to avoid the overheating of the urban environment. In some cases, the analogy goes even further, in that gigantic server farms are placed directly in the vicinity of huge cattle farms, to make use of the electricity generated by burning biogas. A special type of computer farms are render farms, in which several thousand CPUs are connected to produce the animations for the movie industry.

The function of a **firewall** in architecture is well known: its main purpose is to protect from a threat, specifically to prevent the spread of fire. In computer science, firewalls will most likely not protect from the spread of fire, but they are designed to prevent unauthorised access to information. Today, this software concept is installed on almost every computer we carry around, but nobody seems to be aware of this particular irony. It does however clarify the absolute virtual character of the “firewall” expression.

Further expressions in computer science, using the architectural metaphor are: Roof-line model, Data vaults, Data warehouse, Data highway, Data mining, Portal, Software architecture (Mary Shaw, CMU), Windows, Control plane, Back pressure, Pipeline, Staging, Tiling (so that data fit in the cache), B-trees, quad trees, oct-trees, grids.

Section 4

INFORMATION ARCHITECTURE

DEFINITION

INFORMATION ARCHITECTURE describes objects and buildings that are both expressions of information and at the same time use the architectural metaphor or the architectural object itself to bring structure and order into information.

INFORMATION ARCHITECTURE is architecture built for data and information gathering, storage, display, access, and experience.

A good example for this type of information architecture is the **Jantar Mantar** in New Delhi. The structures are not only architecturally attractive, but serve a specific scientific purpose. They are a perfect merger of form and function. Although construction started in 1724, they still form an impressive information architecture park in the centre of the capital.

Certain cathedrals and temples could also be considered INFORMATION ARCHITECTURE. The condition would be that the physical architecture rationally supports and enhances the information to be conveyed. This applies particularly to the use of orientation and windows to guarantee particular lighting effects at given times of the year. Sound enhancing interior space quality, achieved by geometry, surfaces and material, enable the transmission of sound information to the listeners with emotional effects in mind. Text integrated on the wall, on the floor, or on the ceiling, as well as sculptures conveying messages, are additional pointers. As such, the pre-calculated effect of light, sound, written, painted and sculptural information is a indication for INFORMATION ARCHITECTURE.

In general, also buildings that successfully convey messages (intended, not by accident) and were designed for this purpose, can be considered as INFORMATION ARCHITECTURE. Examples are light towers, old bank buildings, hospitals, skyscrapers or Apple stores.

Example Atacama telescopes

INFORMATION ARCHITECTURE is probably the easiest way to explain the relation between information and architecture in a practical sense. There are structures, whose only purpose is to collect data. Those could be telescopes in Atacama desert, displaying fixed and dynamic parts. The fixed parts are the outer shells of the building, the dynamic parts follow the instructions given by scientists around the world.

Gallery 2.11 Architecture built for gathering information

Schmitt, G. 2007. *One of the 1.8m diameter auxiliary telescopes, mobile on tracks, working in synchronization with the large telescopes.* [Photograph]. Paranal, Chile.

Example libraries

Libraries have the purpose to store, protect, display, and provide access to data and information, mostly in printed form.They have developed over the centuries in all cultures, and form, if successful, communal and social centres in urban systems. Their status and media content is constantly changing in the society, especially in the digital society, yet the inexplicable connection between architecture and information remains.

Gallery 2.12 INFORMATION ARCHITECTURE

Schmitt, G. 2008. *A place to store and access information.* [Photograph]. Library in the Collegium Maius, Krakow.

Example stores

It appears unusual that digital companies need physical stores. Yet it has become a successful business model to build attractive stores selling digital and information technology equipment directly to consumers in prominent locations in the city. The desire of clients to explore the product together with well-trained personnel makes those stories commercially successful.

Gallery 2.13 INFORMATION ARCHITECTURE

Schmitt, G. 2012. *Store that sells digital instruments for accessing digital information.* [Photograph]. Apple Store in Sydney.

Example churches

Churches are good examples of information architecture. The structure is optimised for light and sound impact, in order to support both contemplation and festive celebrations. Strong symmetries and spatial hierarchies in plan and spatial realisation suggest analogies to the organisation of the church. Walls and windows are additional places to display data and information – or leave free space for projections.

Gallery 2.14 INFORMATION ARCHITECTURE

Schmitt, E. 2012. *The Catholic Cathedral in Ho Chi Minh City.* [Photograph]. Vietnam.

Chapter 3

Information City

Information in digital representation will be a major component of the future city. We propose the term Information City to differentiate it from the present city and to emphasize the importance of information, its creation, handling, storage, mining and its refinement into knowledge for the city of the future.

Section 1

Information city

DEFINITION

Information city describes the extension of information architecture to the urban scale. In analogy to information architecture, information city has two main meanings: (1) making the invisible visible on the scale of a city and thus helping to understand the functioning of an interaction between components of the city, and to design new cities; (2) information city might become a metaphor for the structuring and ordering of vast amounts of data, created increasingly by the city's inhabitants and its infrastructure.

With information city we do not mean the various InfoCities projects that focus on the seamless integration of information and communication technologies. We also do not mean completely virtual cities.

Increasingly, cities seem to take on personalities of their own. They are labelled as megacities, industrial cities, green cities, liveable cities, rich cities, smart cities, innovative cities, tele cities, info cities, or future cities. These properties of the city are sometimes related to the society they are positioned in. It is therefore surprising that the information society or the knowledge society has not produced an equivalent adjective with regard to the city.

We therefore put forward the suggestion that the information society is increasingly living in **information cities**. Cities and urban systems have for a long time been the place where societies accumulated and stored their information. More importantly, they made this information available to the general public in the form of libraries and exhibitions. Yet the information displayed in libraries had been mostly static and describing the past.

New today is the ability of any person using computational devices to generate large amounts of data, and in particular of real-time data. The storage and display of this information cannot occur in traditional libraries any more. Instead, the entire city becomes an information organism that at the same time generates data, turns it into information, and displays information in real-time. The visualisation of this information creates new knowledge about the city and is fundamentally different from previous knowledge, as it is able to make the invisible visible.

City information, visible

Like in buildings, a great amount of city information is visible, but not all. Coming to a city, we take photos of the obvious information: people, buildings, traffic, parks. At night, other information becomes visible: Lights in buildings, streets, and parks. It may give less 3D information, but more activity and occupancy information.

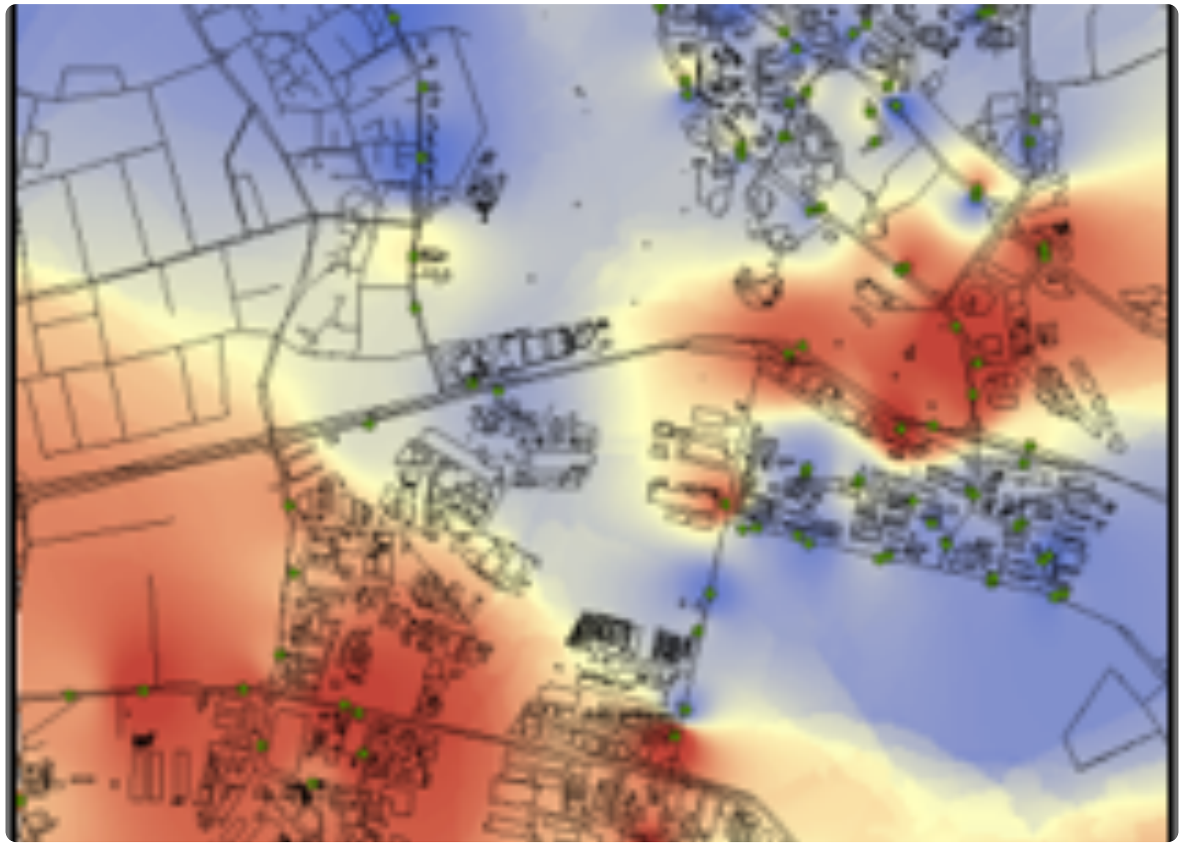
City information, invisible

The inhabitants of the city produce a constant flow of data. They can be visualised, admired, and taken as a basis for observation or future decisions. The first step is to derive a connection between data, activities, and locations in a meaningful sense by deducting relations between data. **Chen ZHONG** has performed pioneering work in this area, in that she is able to clearly relate the use of buildings and travel behaviour.

Gallery 3.1 City information

Bettschart, M. 2010. *Lights in buildings and cities as indicators for activities.* [Photograph]. Marina Bay Sands, Singapore.

Gallery 3.2 City information



Zhong, C. 2013. *Interpolated probability of working places - red: highly probable, blue: less likely.*

Coming to a city, we may sense the areas where poor, middle class or rich people live. This information is normally invisible, the building and streets are not labelled this way. This information is normally contained in the census data of a city. But how do we sense it? It is a combination of observations that leads to the categorization. **Comparative Urbanism** is developing tools to gather and visualize this information.

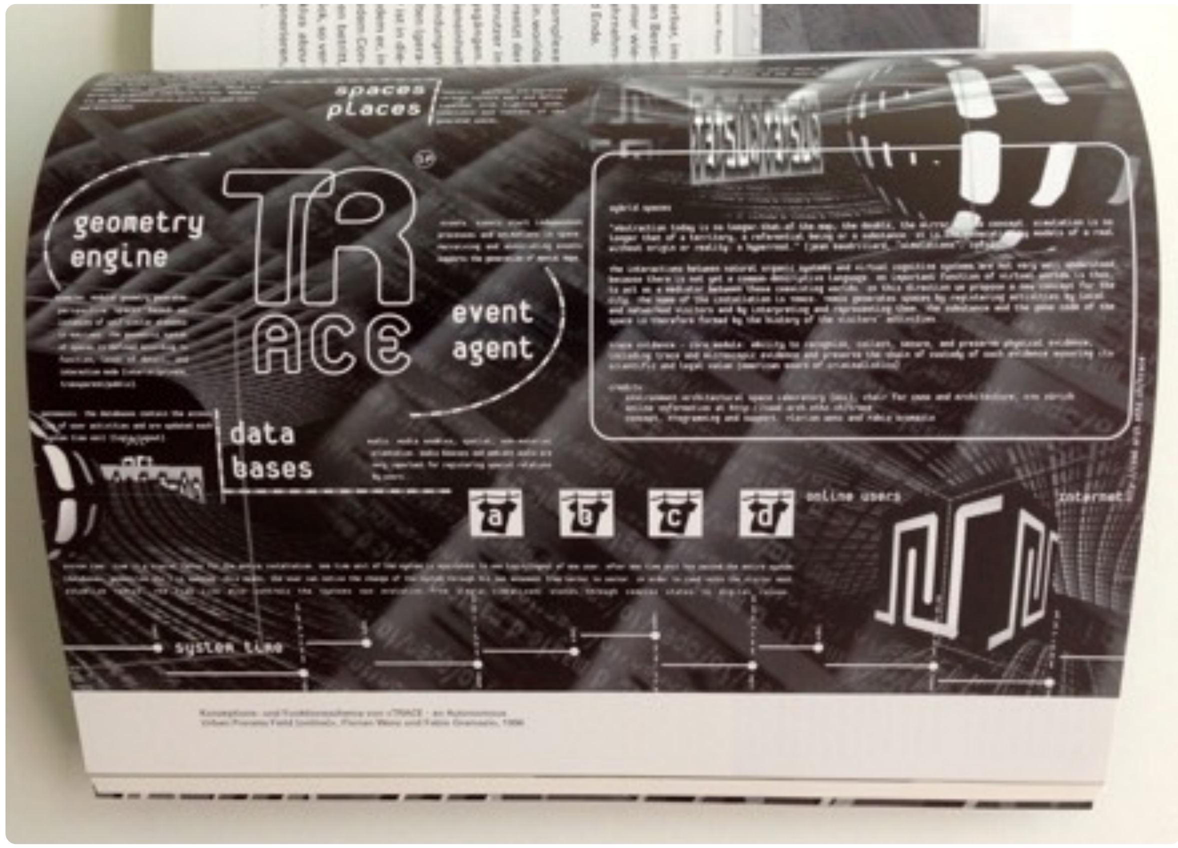
Gallery 3.3 Information city

Schmitt, G. 2013. *Making invisible information visible: comparing cities.* [Photograph]. Meeting of the comparative urbanisms group at the Future Cities Laboratory.

Archaeology of the future city

The plans of today, using information Architecture to depict a possible future, are the historic documents of tomorrow. Seen from the future, they are archaeological items. This view produced the title of an exhibition in Tokyo in 1996, the «Archaeology of the Future City» by Takashi Uzawa (Takashi, 1996). It demonstrated the power of combining Architecture and information in the sense of information as the new building material.

Gallery 3.4 Archaeology of the Future City

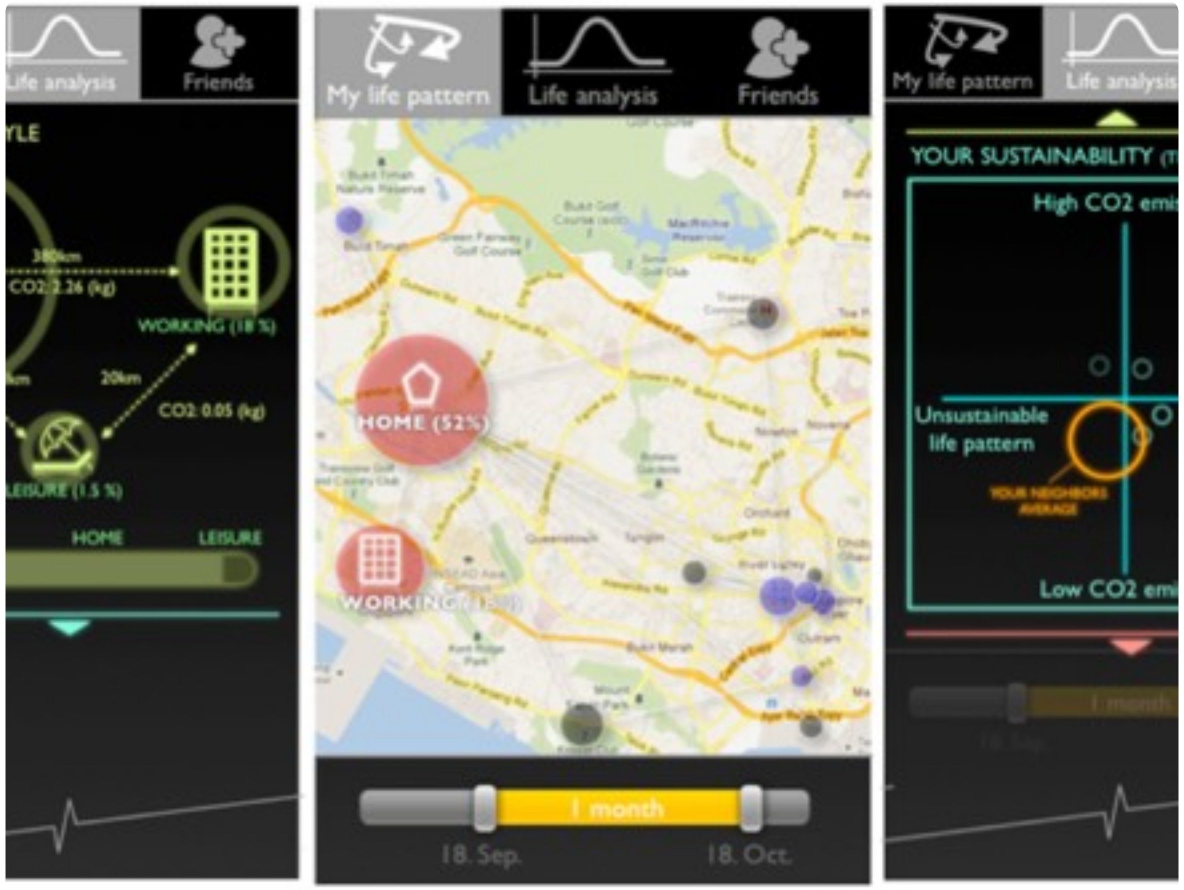


Wenz, F. 1996. *«TRACE» installation by Florian Wenz in the exhibition «Archaeology of the Future City» by Takashi Uzawa.*

Crowdsourcing

The name **Crowdsourcing** appears around the middle of the first decade of the 21st century, with **Second Life** as a precursor. Many platforms now support the input of volunteers that contribute information to open calls. Particularly interesting are participatory planning exercises, that are made possible by the extensive use of crowdsourcing This way, a growing number of persons can direct the development of the planning or the transformation of communities

Gallery 3.5 Crowdsourcing in the City



Shin, D. 2010. *CITYing, a crowdsourcing application that records movement types of people based on smartphone acceleration data.*

The Urban Observatory

The **Urban Observatory** was created by the combined effort of researchers who came to the conclusion that understanding precedes action. It encourages cities to contribute their own data and maps, to make them comparable with other cities of the world. The result is an unprecedented view on cities and their properties at the same scale over time. The Urban Observatory was created by Richard Saul Wurman, Jon Kamen and Jack Dangermond.

Gallery 3.6 The Urban Observatory

Schmitt, G. 2013. *Mansour Raad (ESRI) explains the Urban Observatory at the Santa Fe Institute.* [Photograph].

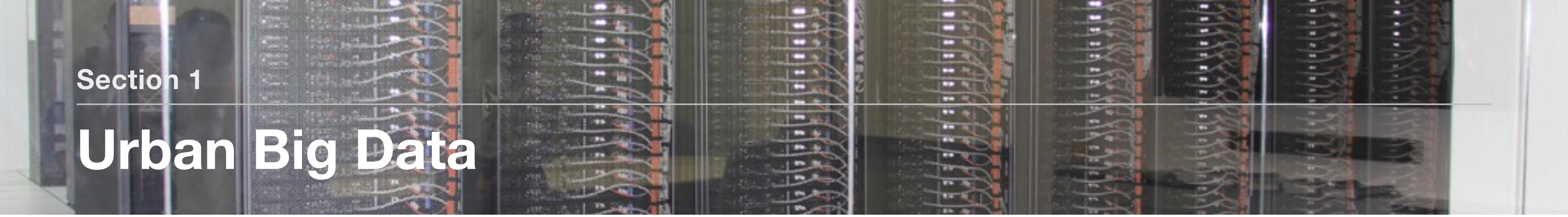
Senseable city lab

The research group focuses on the visualisation of real time data. The **Senseable City Lab** of MIT observes, gathers and visualises the multitude of data and data streams available in various cities of the world. The themes of its exhibitions range from “Data Drives” (2014), “Road Frustration Index” (2013), “Local Warming” (2013), “Senseable Rio” (2012), “Live Singapore” (2011), “Trash Track” (2009), to “Real Time Rome” (2006).

Chapter 4

Big Data City

As more than half of the world's population lives in cities, the total amount of data generated in cities and by citizens is far greater than 50%. As the production of Big Data increases from gigabytes to terabytes, to petabytes, to exabytes, to zettabytes, the derived information grows much slower, and even smaller is the increase of production of knowledge from this information. Yet this Big Data can be helpful for the design, construction and management of future cities.



Section 1

Urban Big Data

DEFINITION

Big Data is an expression of the first decade of the 21st century. Data are components of information, and information is a building block for knowledge. As such, data can be seen as the raw material for future architecture. The amount of data available for urban planners, city governments, and the general public is exploding. In fact, all of these groups generate data in rapidly increasing amounts. The challenge, thus, shifts from producing data to organising and extracting data in meaningful ways. The overwhelming majority of data refers to the past. The carefully collected, structured, verified, and stored data generated by trained specialists of the past are increasingly supplemented by less structured, less verified and cloud based data generated by millions of people and billions of sensors.

Today's planning attempts are hindered by the non-availability of data respectively by the difficulties to analyse this data. This often leads to the abandoning of the necessary integration of data into the planning process, or to the sometimes arbitrary selection of data based on their availability. We propose to accept the fact that organisations, agencies, private collectors and others have reasons not to give access to the data they selected based on measurements, surveys, and data mining in the past. Yet we are convinced that there is a fast approaching paradigm shift towards the useful and effective mining, selection, and recording of relevant data.

For future design, sensing and measuring techniques used in engineering for specific purposes will form an important supplement to volunteered data originating from crowdsourcing, smartphone locations, transportation and other data that are released voluntarily by the persons collecting them. To the combination of all this data we refer to as Big Data.

Big Data City

Big Data City is an interdisciplinary project, with the central idea of an urban design method based on advanced data analytics. By closing the gap between urban sensing, data analytics and design, this project provides the basis for the coupling of urban planning with smart cities management, thus increasing the urban data security and the resilience of the city. Big Data City contains several sub projects that might closely interact with High Density Mixed Use City and Urban Environmental Resilience. The scope of the project allows for interdisciplinary as well as cross-cultural research.

Urban planning decisions must derive from facts and from the best possible decision base. The reasons for decisions should be knowledge, meaningful information, and exacting data. Today and in the future, so-called Big Data is expected to provide an exponentially growing source for high-quality decisions. Unlike approaches that employ Big Data only to analyse existing situations, we transcend that retrospective view by integrating advanced data analytics into the urban design and planning process. Thereby interactivity will be maintained to avoid entirely data driven designs.

From Data Analysis to City Design

Designers of the content of a library need to select from the available books and media, and only this selection makes the library special, as compared to the total availability of all books by other means. In analogy to this,

- The Big Data City project collects (and creates) only designs that contain knowledge that is generalizable to be used for other planning projects.
- The (dynamic) Big Data City library can be customized immediately for new projects (only aspects/books that are relevant are used).
- Big Data City provides a framework for such a new library (based on the Simulation Platform of the FCL).

The responsibility of the Big Data City design researchers thus shifts from the careful selection of data for a specific purpose towards designing the algorithms to extract meaningful data from a multitude of sources with less controllable sparse and heterogeneous data quality.

Big data design methods

In order to make data analytics available to design, the main task shifts from data collection to extracting relevant information and knowledge from data and in addition to use the extracted information for actual design decision-making, thus switching from analysis into synthesis. The primary methodological steps are the following:

- Analysing, categorizing and formulating different data types as urban design decision-making elements.
- Defining and implementing visual interaction techniques that allow applying the decision-making elements in the design process.
- Test and iteratively improve above techniques with existing datasets.
- Integrate the techniques in a real-world design scenario for validation (e.g. through a Design Research Studio or an agency/industry collaboration).
- Synthesis of informed planning

Big Data City will investigate the forces influencing the urban geometry and the correlations of urban functions with properties of this geometry by the workstreams (WS) listed in the following:

WS 1: Flows and design. Urban flows analysis and their integration towards design, data mining on Big Data, applying findings from logistics, transportation, economics and material flows analysis. High-end dynamic design support visualisations.

WS 2: Security and design. A fundamental human need is to live in a secure environment. In highly networked cities, security aspects expand to other important areas such as energy and data security. The development of strategies for the design of resilient centralised/decentralised networks and related aspects is a crucial issue for future cities.

WS 3: Energy and design. Shifting from centralised energy supply towards a mix of decentralised and centralised energy generation and supply will create a wealth of data that must form the basis for future design and its interaction with the geometry on the urban scale and on the building and architectural scale.

WS 4: Governance and design. The impacts of governing bodies, election results, opinion leaders, decision leaders, people‘s reactions to government decisions, people’s evaluation and usage of their environment on urban form and development become filtering mechanisms for Big Data and for urban planning.

WS 5: Health and design. Evidence of interdependencies between the city’s form and the health of its citizens has been gathered in the past in an anecdotal way. By using larger data sets, a big enough cohort can be created to derive ‘proper’ facts.

Ordering this evidence and using it as one input for future design is a necessity.

WS 6: Transportation and design. Readily available transportation data is expanding in volume rapidly and will form the basis for analysis and design input. Clarification of the close relation between transportation and planning will be a result.

WS 7: Planning and Big Data. The basis of a computational evidence informed planning (CEIP) are quantitative methods, which allow the generalization of insights from the analysis of existing cities or districts. This makes these results available for future planning, respectively for the computational evaluation of planning proposals based on past studies.

Urban Big Data Design Team

- Urban planner and designer
- Sociologist
- Economist
- GIS specialist and spatial statistician
- Software engineer
- Social Scientist
- A Generalist who connects all work streams

Chapter 5

City Models

City models are structural abstractions of cities. The purpose of these models is to simplify the components, the properties, the functions and the structure of the city to a degree that projections into the future become possible with acceptable effort. City models are increasingly mirrored in computational representations which open the path towards rapid generation of alternatives. City models are also precondition for urban simulation.

Section 1

City Models

DEFINITION

Models describe an abstraction of the real. They are not the real object and should never be confused with it. But they can extract and describe important features of the real object. Good models also describe the interaction between those features and functions of the real object.

Cities in their entirety are the most complex objects humankind has created, and are constantly expanding. The city changes with and through its observation by the people living in it. Therefore, any model of a city must respect the dynamics of the habitat.

In this chapter, we shall look at historical, present and potential future models of the city. This is an open ended search for definition, yet necessary in a similar way as medicine needs a model of the human being, even if it is not perfectly describing the entirety of human.

During the sixth decade of the last century, a young scientist wrote an influential book with the title “A City is not a Tree”. Christopher Alexander, the author, had previously published his “Notes on the Synthesis of Form”. While the first book could be seen more into edition of “form follows function”, “A City is not a Tree” is a strong hint that modeling a city might not be that easy.

The two books are interesting, because they describe positions that were extended to the extremes in both directions. On the one hand, the perception of the city as a mechanism that can be easily explained, measured, and extended, which may result in a single number describing the essence of the city. On the other hand, the perception of the city as the uncontrollable, messy, constantly changing, unpredictable, and in its entirety, indescribable organism made up of people, infrastructure, thoughts, money, water and sewage.

Neither the search for the ideal city nor the virtualisation of the city have led to tangible results that would increase the sustainability of a city. Restricted to plans and spreadsheets as their only instruments, many city governments in developing and emerging countries are struggling to provide the appropriate infrastructures for the growing number of people streaming into the cities. On the other hand, because of the emergence of instruments which take advantage of big data and the increasing capacity of information technology to simulate complex systems, the need for city models is obvious.

Overview

The following is an excerpt from "Spatial modeling issues in future smart cities", published on "Geo-spatial Information Science" by the author (Schmitt, 2013).

"Early architecture and urban design examples are based on fundamental geometric shapes: point, line, circle, square and rectangle. Besides the purity of these forms, they have the advantage that they can be constructed easily with simple tools. They could straightforwardly be assembled into grids, thus providing the footprint for the basic organization of urban services and separating public from private areas. For the arrangement of these shapes and infrastructure networks, city planners defined simple rules and instruction sets which, in combination with the shapes, would form a design description that could be easily taught to others.

The rule-based approach

Gallery 5.1 Changdeokgung Palace in Seoul

Schmitt, G. 2011. *Changdeokgung Palace in Seoul from 1405: geometry as the driving force underlying the design.* [Photograph].

Gallery 5.2 Marina Bay Sands complex in Singapore

Schmitt, G. 2011. *The Marina Bay Sands integrated resort complex in Singapore by Architect Moshe Safdie from 2010.* [Photograph].

With the growing complexity of settlements into urban centers and denser cities, the simple instruction sets became less effective and could in fact diminish the overall performance of the city or hinder it from achieving its defined goals. The definition of those functional goals became priority and geometry had to follow. The geometric pattern of the city was brutally altered accordingly, as the example of the redesign and reconstruction of Paris in the 19th century demonstrates. In this and other cases, geometry was put into the service of other, for example military goals, rather than being the generative driver of city form. Yet the planning intentions and the results of interactions between basic geometry and political or private goals were still visible.

The stocks and flows approach

With growing sophistication of societies, politics, technology and economy, cities changed their geometry again. Linear transportation systems such as freeways, train tracks and suburban private roads gained in importance and reshaped the design of cities. Economics, transportation and the separation between living and working areas became dominant factors. With less limitations in materials and increased freedom in design, driven by a temporary abundance of cheap energy in the 20th century, the geometric expression of the city became increasingly a result of the various stocks and flows that determined city life, leading to sometimes ordered, but sometimes seemingly chaotic conditions of a city's geometry.

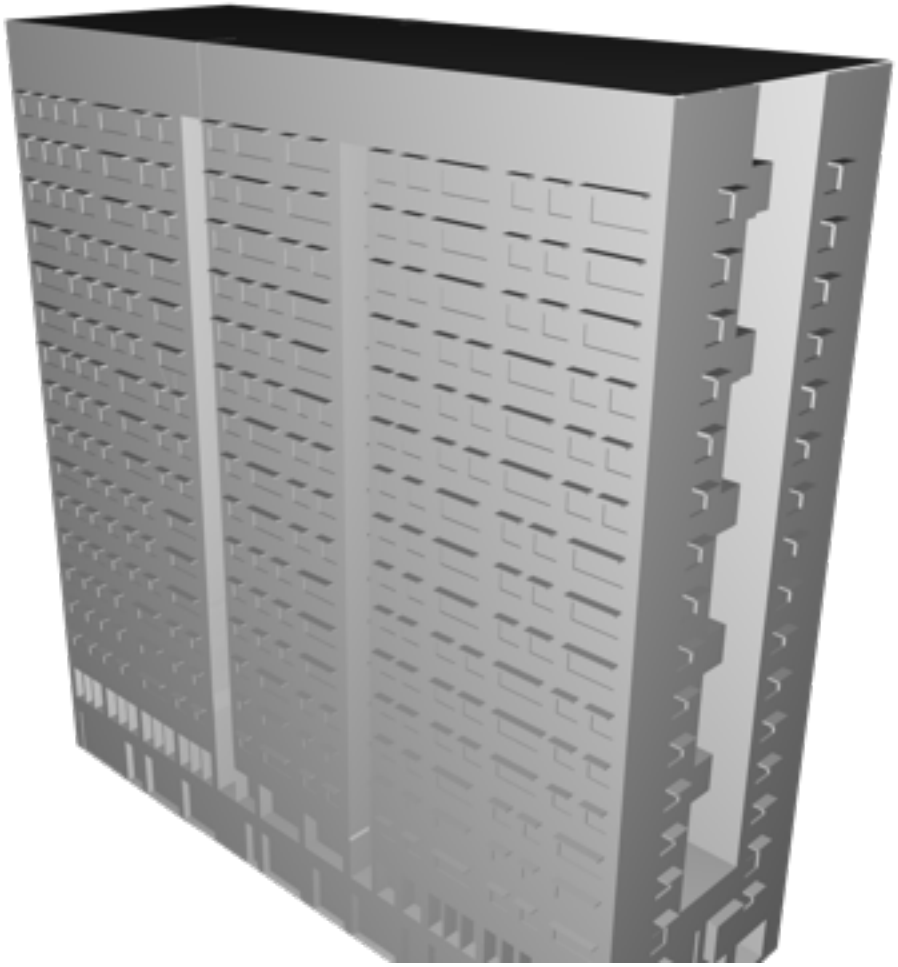
The complex system and quantum city approach

With the beginning of the 21st-century and the globalization of city stocks and flows, the dependence of the city on its direct hinterland decreases, and even national networks of cities for the exchange of goods and services lose their dominance. The forces that cities are exposed to start to shift rapidly, thus making them in their development increasingly the result of changing force fields – force fields in the sense of rules governing the balance of the complex system of the city. This leads to metaphorical analogies with quantum theory and thus to the proclamation of the quantum city, as proposed by Ayssar Arida (1) or Ludger Hovestadt (2). At this stage, geometry takes on a new role, but it still is and will be decisive for the positioning of any physical manifestation of city stocks and flows and force fields."

Geometric Models

Geometric models are the most accessible representation of complex cities, as they create a direct link between visual perception and digital model. In fact, geometric models serve well as the anchor for other properties of a city, which eventually can mostly be pinpointed to a geometric location in space and time.

Interactive 5.1 interactive 3-D model derived from UAV data



Fang, W. 2013. *Graduate student residences at the University Town in Singapore, ETH CREATE.* [3-D model].

Chapter 6

Stocks and Flows

The concept of stocks and flows helps to bring some order into the complexity of a city. Even though the concept of stocks and flows was not invented in or for architecture, but in economics, it constitutes a useful way of inspecting and abstracting parts of the urban system. The chapter on city models places it in its historical context.

Section 1

Stocks and flows

DEFINITION

The stocks and flows concept originated in economics in the 1960s. Best known today is the stocks and flows concept of finances. Stocks are quantities that do not move, whereas flows are quantities that move. Flows are measured quantities per time. This differentiation between statics and dynamics makes the principle applicable to architecture, urban design and territorial planning. The stocks and flows we are most interested in are those of people, water, material, energy, density, and information. Stocks and flows are also basic building blocks of system dynamics.

This chapter offers an overview, while in-depth descriptions and applications of the individual stocks and flows appear towards the end of the book.

The Irrawaddy river in Myanmar and the ecosystem it creates are good examples of **stocks and flows** in architecture, urban design, and territorial planning. The river changes its volume drastically twice a year. The water it brings from the mountains carries sand and other sediments that settle in the large areas it floods. Once the water level recedes, the river has already deposited a small stock of material in the form of fertile earth on its banks that can then be used for a few months. People move in and erect temporary housing and shelter: a stock of material and low-density settlements emerge for a few months. Animals accompany the peasants and deposit fertiliser, becoming another contributor to the stocks and flows of the land. Information on the usability of the land and on the best places to settle is transferred via mobile telephones, creating a flow of information. Farmers grow vegetables and bring them to the market, creating that way a small flow and possibly stock of finances. The entire landscape changes over the years and, as a result, creates a stock and flow of landscape elements such as land, bodies of water, trees, and other vegetation. Yet the example also shows how a single stock and flow cannot be isolated from the others. The water mixes with the material and the sand deposits. Later, people use the clay to burn pots, and they harvest the sand and ship it to the city to construct buildings. In Europe, the ice age deposited large amounts of materials in the path of the glaciers, thus creating the present landscape (stock) in a slow, yet dynamic process (flow).

Stock and flows of energy

Every country and every city has a specific way to acquire, transform and distribute energy. The chapter on infrastructure will describe the physical necessities to transform and transport energy. In this chapter, we are interested in the different sources and uses of energy.

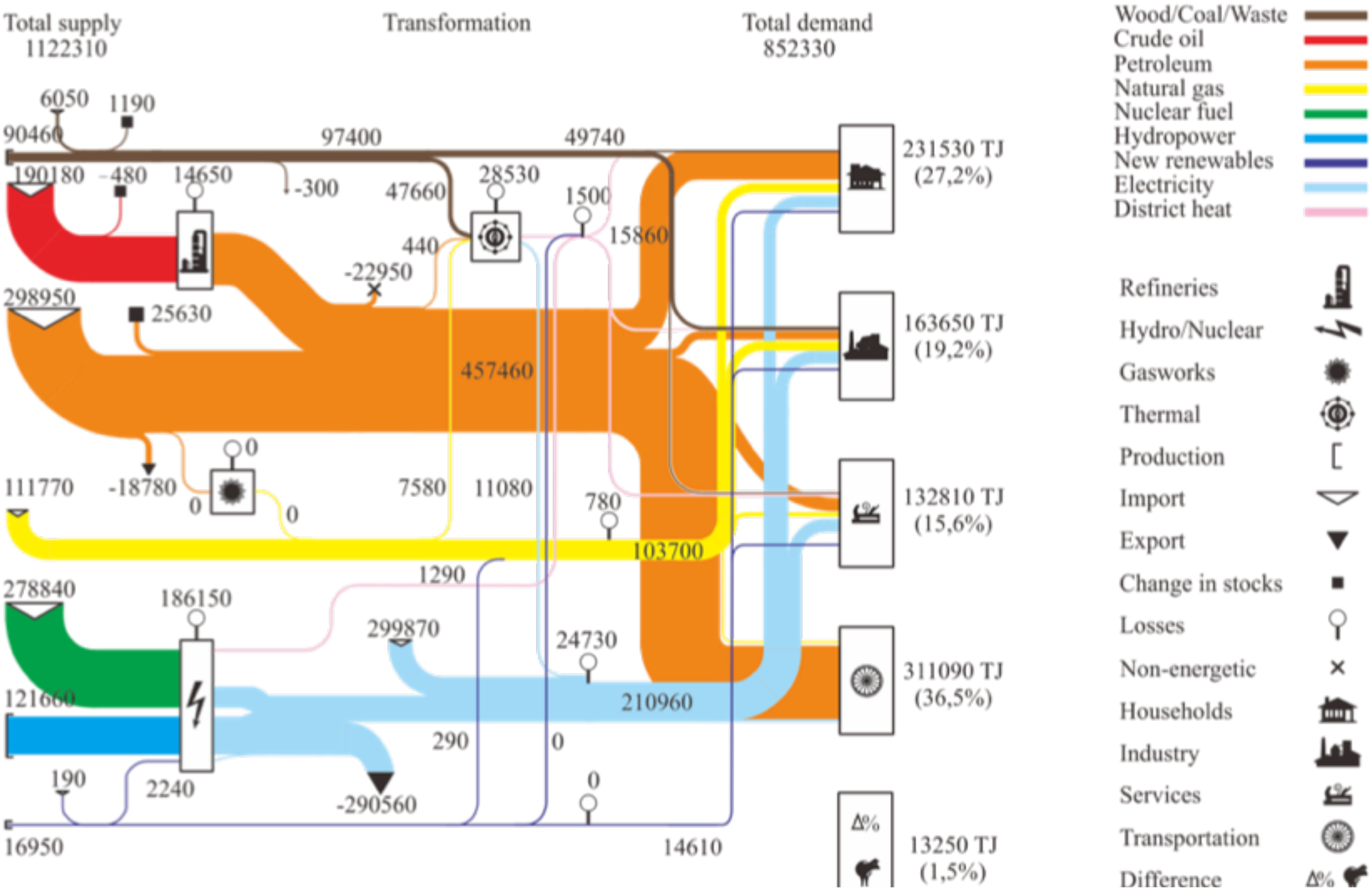
A comparison between Switzerland and Singapore reveals significant differences. While Switzerland has a broad mix of different energy sources or supplies, ranging from hydropower to gas, crude oil, nuclear and biomass, Singapore relies mostly on natural gas and crude oil. As a result, Switzerland's electricity production is almost carbon free, whereas in Singapore there is almost no carbon free electricity production.

The uses of or demands for energy are also different in the two countries. In Switzerland a large percentage of the energy is used to heat residential buildings, offices and factories, whereas the need for heating fuel in Singapore is zero. Instead, electricity is needed to cool factories, residential buildings and offices. Large differences are also visible in transportation. While Switzerland is a mountainous country with a multitude of centres, Singapore is a small island with short paths and no mountains. As a consequence, the per capita energy use for transportation is smaller than that of Switzerland.

The storage of energy is also different. In Switzerland, artificial lakes with dams in high altitude serve as energy reservoirs and energy buffers during times when excess energy can be generated. This water can later be used to generate electricity that can be produced exactly when it is needed. The water in the reservoir is at the same time a stock of water for drinking purposes, but also for energy storage purposes. The flow of water for drinking purposes is normally from higher elevation areas into the lakes, whereas the flow of water for energy storage purposes can be reversed, which means that large amounts of water are pumped from lower situated lakes into higher situated ones.

The stocks and flows of other energy sources may not be as spectacular, but they are also interesting. For example, the stock of wood is growing in forests. After harvesting, it turns into a stock of heating materials. The stock and flow of oil begins its cycle as a stock in the subterranean caverns of Saudi Arabia, flows into tankers or pipelines, ends up as temporary stock in oil tanks, and is finally transported as a flow into the individual heating appliances.

Gallery 6.1 Stocks and flows of energy



Berger, M. *Energy supplies, energy transformation, and energy demand in Switzerland in 2012.*

Stocks and flows of materials in the city

Concrete is a good example to explain the concept of stocks and flows of materials in a city. The components of concrete are mixed with water, concrete is then poured, hardens and becomes a stock. This is almost a literal translation of the stocks and flows principle. What happens with concrete after the lifetime of the structures in which it has been used expires? In an era when recycling was neither an ecological nor an economical necessity, it was exploded, torn down, crashed, and dumped in the city itself or, more often, in its hinterland.

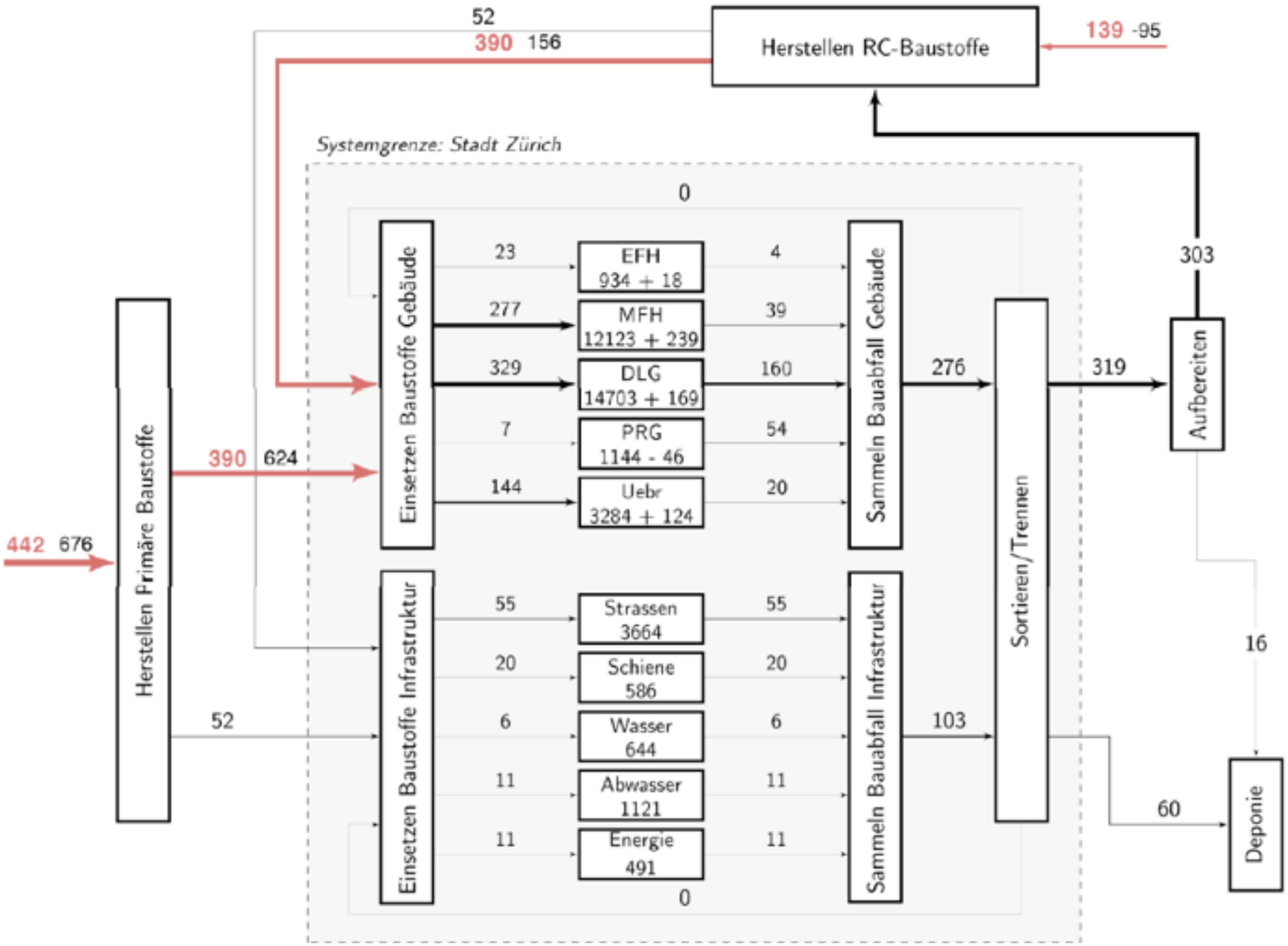
But concrete is a very valuable material with high energy embodiment and thus a major cause for greenhouse gas emission during the production of its components. When a city is being built or expanded, the need for concrete is immense. Every emerging economy and country shows this extensive need. At the beginning of the 21st-century, this is the case in Asia, Africa, and South America, while in Europe and North America the need for concrete has decreased.

Recycling of concrete is a relatively new concept and describes the decomposition and crushing of a stock of concrete to prepare its parts for reuse in another context. If a city is not growing very much any more, such as in Europe, the recycling of concrete makes very much sense for ecological and also economic reasons. In the new emerging cities in China that grow from a few hundred thousand to several millions inhabitants within a few decades, there is no possibility to recycle, because the stock of material does not exist beforehand. In other cities, such as Singapore, where there is a consistent scarcity of building materials, especially sand, there is a high economic incentive to recycle every tonne of concrete when a building is torn down or a broken infrastructure is renewed.

A concrete example might show dimensions of the stocks and flows of concrete in a city. The first step is to define the system boundary within the observations and the measurements that are to be made. In Zurich, for example, this would be the city boundary. Looking at a particular year, in this case 2005, researchers from ETH Zurich have analysed the stocks and flows of concrete precisely. They found that 676,000 tonnes (t) of concrete gravel flowed into the city and that 379,000 t of concrete material left the city boundaries. Almost half of the inflow, approximately 329,000 t, went into new office buildings, which at the same time produced with 160,000 t also the highest outflow. The present increase of population of Zurich is reflected in 277,000 t of concrete flowing into the city for apartment buildings, and only 39,000 t from demolished apartment buildings leaving the city. At the same time, only 7000 t of concrete went into the construction of new factory buildings, while 54,000 t of demolished factory buildings left the city.

This glimpse of material flow in and out of the city shows how closely related it is to the history of the city.

Gallery 6.2 Stocks and flows of concrete material in Zurich in 2005



Schneider, M., Rubli, S. and Gugerli H. 2010. *Entwicklung einer Ressourcenstrategie für mineralische Baustoffe für die Stadt Zurich.* [online] Available at: <https://www.stadt-zuerich.ch/hbd/de/index/hochbau/nachhaltiges_bauen/veranstaltungen.html#veranstaltungen_in2010>

Stocks and flows of water in the city

There is no city without water. Water decides on the survival of a city, and always did. In ancient times, water was transported in aqueducts over large distances, when the city's internal water resources dried up or were not sufficient any more. In the city, water is used as a stock in lakes, drinking water reservoirs or in individual water tanks on, in and below buildings. Water is a technical, an artistic, an architectural and a landscape architecture element.

Gallery 6.3 Stocks and flows of water in the city

Schmitt, E. 2013. *The Marina Bay Singapore, previously open sea, now a freshwater reservoir.* [Photograph].

Stocks and flows of wood in the city

Wood used to be a crucial stock and flow contributor in early cities. It was at the same time construction material and heating resource. Its overuse around cities might have caused climate changes in the cities and in some cases led to the demise of the city. Wood is prone to fire and was therefore replaced, when possible, by more fire resistant materials. It has a comeback today as a construction and heating material. Wood stores CO2 in large quantities.

Gallery 6.4 Stocks and flows of wood in the city

Schmitt, G. 2011. *Wooden Royal structure in Mandalay.* [Photograph]. Myanmar.

Stocks and flows of food in the city

Food used to be grown directly around buildings. With the growth of cities, its production moved further away from the centre. Today, food in almost every city comes from global sources. This causes high levels of CO_2 during its production, its processing, and its transportation. In Singapore, more than 96% of the food needs to be imported. As "Urban Farming", food in the city is making an important comeback in cities that had completely lost their direct relation with food production.

Gallery 6.5 Stocks and flows of food in the city

Schmitt, G. 2011. *On the way to the market in the morning.* [Photograph]. Mandalay, Myanmar.

Stocks and flows of capital in the city

There is no city without capital, and the stocks and flows of capital are a decisive factor in the development of the urban system. As capital is a virtual entity, it has a different effect on the shape, size, and liveability of a city than material stocks and flows, such as concrete or water. Yet there is a strong relation between the location and the spatial quality of the city, and the flows and stocks of capital.

Gallery 6.6 Stocks and flows of capital in the city

Schmitt, G. 2013. *Hotel and convention centre in Moscow, constructed after the end of the Soviet Union.* [Photograph].

Stocks and flows of land in the city

Land appears to be a stable stock at first sight, with little flow possible. Yet if we take a closer look at any of the ancient or newer cities, we will find significant flow of land, either to increase the buildable area into the sea or into a lake, or from natural accumulation of material which leads to vertical growth of land. Singapore, for example, has increased its land area by several hundred square kilometres, but also Zurich has claimed land from the lake of Zurich.

Gallery 6.7 Stocks and flows of land in the city

Bettschart, F. 2012. *Artificial land made in Singapore. The entire Marina Bay area is reclaimed from the sea.* [Photograph].

Stocks and flows of people in the city

It is not correct to place people in the same category as other stocks and flows in the city, but there are similarities. Areas of the city, for example, which have been inhabited for a long time by generations of people from similar backgrounds, could be called to represent a stock of people. The flow of people is characterised by those who newly came into the city from the outside and by those who leave the city or die in the city.

Gallery 6.8 Stocks and flows of people in the city

Bettschart, F. 2012. *People, cars and motor scooters mixing as a stock and flow in the street.* [Photograph]. Ho Chi Minh City.

Stocks and flows of density in the city

It appears surprising at first to list density or space under the stocks and flows characteristics of the city. Yet the concept becomes immediately clear if we imagine the difference between a mediaeval Italian city, such as Siena, and a suburban sprawl area in Phoenix Arizona. The example of Detroit in the beginning of the 21st century demonstrates that density does not remain a stock for ever, but that rapid changes of density can happen within few years.

Gallery 6.9 Stocks and flows of density in the city

Schmitt, G. 2013. *Different planned densities in the city of Moscow, seen from the tower of Lomonosov University.* [Photograph].

Stocks and flows of information in the city

In the information city, stocks and flows of information are almost as important as water or materials. A stock of information is any library or data warehouse. The flow of information is ubiquitous and continuously increasing in all cities of the world. In many places, the storage of information has led to its own infrastructure, which is increasingly consuming space and energy and thus influences the other stocks and flows of the city, as the chapters on information architecture and information city show.

Gallery 6.10 Stocks and flows of information in the city

Schmitt, G. 2013. *Architecture to foster the flows and stocks of information.* [Photograph]. Lomonosov University, Moscow.

Stocks and flows of used material in the city

In the mid-term future, there will be no waste. Waste is a temporary product that exists in times and places of surplus, but rarely in times and places of scarcity or in sustainable communities and societies. Progress in science and in the understanding of the composition of materials has helped to reduce the amount of landfills, which is common in industrialised cities, and has led to a much more intelligent and value creating recycling – something known since antiquity.

Gallery 6.11 Stocks and flows of used material in the city

Schmitt, G. 2009. *University of Addis Ababa. Re-use of transport containers as exhibition space.* [Photograph].

Stocks and flows of pollution in the city

Pollution of any kind – be it noise, aerosols, smoke, smog, haze, oil spills or unclean water – reduces the quality of life of the city, its livability, its attractiveness, and most importantly, the health of its inhabitants. With progress in turning waste into resources of new products, pollution will automatically decrease, but it will remain a major problem, for many years to come, in cities that do not have a holistic view of the urban system as an organism.

Gallery 6.12 Stocks and flows of pollution in the city

BBC News, June 19, 2013. *Singapore haze and its impact on the economy.* [Sreenshot].

Chapter 7

System: Urban Sociology

Urban sociology plays a key role in understanding the city. It is a field of growing importance for the designing and redesigning of urban systems. While some fundamental observations are consistently true for all cities around the globe, each city displays considerable sociological specialties.

Section 1

Urban sociology

URBAN SOCIOLOGY

Urban sociology describes the study of human life and the interaction with urban systems from a sociological standpoint. Urban sociology is sometimes used to provide input for city planning and urban design. While the analytical findings of urban sociology are necessary to understand the functioning of urban systems, the inverse use of these findings as guides of design is rarely possible.

While urban sociology is an active research field in Europe, the United States and the Anglo-Saxon language space, it has started recently as a locally grounded and locally driven science in those countries where most of the cities are emerging in the 21st-century. It is rarely existent in the poorest countries of the world.

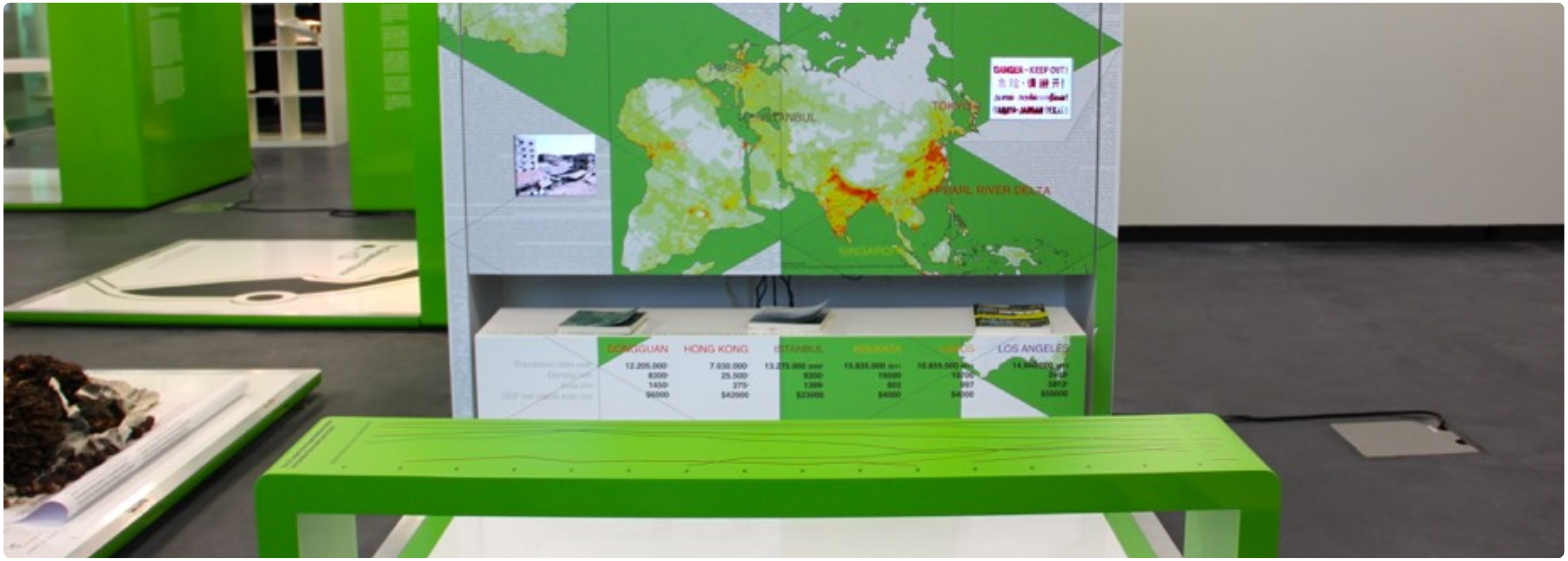
The history of urban sociology goes back to the early 20th century and to the Chicago School of Sociology. More recent research areas are gentrification, globalisation and global cities.

At the ETH Future Cities Laboratory, Professor Christian Schmid and his group lead the research on **urban sociology** and comparative urban studies between 2010 and 2015. They describe their topic as “Building a comparative typology of global urbanisation processes, analysing the mechanisms that generate urban uniformity and difference, and proposing appropriate urban development models” under the title “Global Urbanisation in a comparative Perspective”. They summarise:

“The last two decades have seen a sharp increase in the speed, scale and scope of urbanisation that has fundamentally changed the character of urban areas. Transcending physical borders, political jurisdictions and social spheres, urbanisation has become a truly planetary phenomenon. While it is often assumed that this phenomenon leads inexorably to uniform and undifferentiated cities, evidence shows that it also gives rise to surprising forms of difference, diversity and variation within and between urban areas. This simultaneous proliferation and diversification of urban forms has important implications for urban planning and design. In the first instance, it demands a more supple conceptual framework that can both hold the processes of planetary urbanisation and remain sensitive to the diversifying local manifestations. While many urban studies have examined particular cases in this emerging situation, a comparative and synoptic approach that captures both global and local dimensions is still lacking.

This module aims to redress this lack. It not only analyses the emergence of new urban forms, but elaborates the processes of urbanisation to explain how general tendencies are materialised in specific places. Methodologically, the module is structured around comparative analyses of patterns and pathways of urbanization. Nine metropolitan areas are examined as case studies: Tokyo, Hong Kong/Shenzhen, Singapore, Kolkata, Istanbul, Lagos, Paris, Mexico City, and Los Angeles. There are three major research objectives: first, to develop a methodological framework for comparative analysis; second, to analyse the mechanisms and differences of planetary urbanisation and to establish a typology of contemporary urbanisation processes; and, third, to examine the range of possible urban development models and their practical implications. Special attention is given to the analysis of urban potentials and the framing of possible strategies for a sustainable urban development.

Gallery 7.1 Urban sociology



Schmitt, G. 2013. *The display booth of the Urban Sociology research module at the Future Systems Laboratory.* [Photograph].

The comparative approach has already allowed us to systematically analyze the diversity of responses to many of the common challenges posed by contemporary urbanization, such as urban sprawl, housing for the poor, renewal of old housing stock, the maintenance of public spaces and monuments, in terms of their effectiveness, their unintended consequences, and their ramifications for the quality of everyday urban life.

In our bottom-up approach we started with the specific processes on the ground. For each of our case study cities our individual researchers have taken a stock of the variety of urban processes that define the territory. Based on that, we produced detailed maps that display the relationship between distinct urban configurations for each metropolitan region. This allows us to propose a first set of meso-level categories, namely "comparables", for a comparison of urban processes." (Future Cities Laboratory, *Urban Sociology*, 2013)

Extraction and inequality

While this book is about designing, planning, and managing cities, it is nevertheless important to be clear about which are the most destructive influences on the development of cities. Independent from the time or geography, from the culture or the country, **Acemoglu and Robinson** have identified societal inequality and extractive institutions as two of the most dangerous developments.

Inequality, especially social inequality, means that large parts of the population are treated differently from those who are in charge of running the country, the economy, the city, or the social systems. In a wider sense, it also means that minorities are not part of the political and social systems, that they have no voice, and cannot express their opinion for fear of repression or personal safety.

Extraction describes the situation that a person, a group, a company, a part of the population or a ruling party render such power over the rest of the population that they can force them to work for them at a cost below the value of their work or deprive them of their human rights. History is full of such examples: South America before and after the arrival of the Spanish, Africa before and after the occupation by the Europeans, parts of Asia before the arrival of the colonial powers. Extraction occurred in the process of colonisation, but could also be observed in the Republic of Venice, which changed from an inclusive society towards an extractive society towards the end of the 13th century. As observed before in the Roman Empire, this change was the beginning of the final decline of the republic.

Inclusion and equality

While extraction and inequality are the situations which should be avoided under all circumstances in a country and in a city, inclusiveness and equality are the qualities which are necessary for long-term success. They are not, however, guarantee for the sustainability, the resilience or for the longevity of an urban system. They might even cause misunderstandings, complaints about inefficiency, and prolonged discussions about seemingly unimportant details.

Social equality describes the situation, when the difference in income and political influence between the richest and the poorest sections of the urban population is small. A low **Gini coefficient** is a positive measurement and its rise signifies that inequalities in society are increasing.

Inclusion is perhaps the most important factor to guarantee the longevity, sustainability and resilience of urban systems and cities. It implies that all members of the population, including minorities, migrants, and those who might be unwilling to participate in the normal democratic process are invited, respected and encouraged to participate in the definition of urban life and development.

Urban systems and countries which are built on inclusion and equality have consistently shown a higher quality of life, income, and resilience. Good examples today are Denmark, Norway and Switzerland.

Growth in extractive systems

Acemoglu and Robinson claim that growth can occur both in inclusive and in extractive systems, and just by observing the effects, it is not easy to detect the underlying system and motivation. As the example of the Roman Empire after the end of the Roman Republic demonstrates, the gradual shift from an inclusive to an extractive system led to a loss of political influence for the majority of the population, the forming of the elite, but also in the beginning to an unprecedented expansion of the Roman Empire up to Brussels, despite the loss of its economic power.

However, Acemoglu and Robinson, among many others, claim that there was not, is not, and will not be sustainable growth based on extractive systems. They use the example of the Soviet Union, which after the death of Lenin in 1924 established an extremely extractive system, accompanied by an impressive industrial growth until the 1970s, from which observers drew the conclusion that the Soviet Union would surpass the United States before the end of the 20th century. Yet it collapsed in 1991.

The city state of Venice was at one point the richest city in the world, supposedly as a result of an inclusive political system that switched to an extractive one. Of course that meant that for a few years it could reap the results of the previously positive inclusive system. Yet after the characteristics of the extractive system took root, the decline was inevitable. “La Serrata” of February 28, 1297 is seen as the decisive switch from an inclusive to an extractive system.

Growth in inclusive systems

We often hear that inclusive systems are boring and cannot lead to advancement because too many people need to be listened and decisions cannot be taken in due time to get ahead of the competition. Yet looking at historical evidence, this judgement is incorrect. Swiss cities, Vienna, Munich, Vancouver, or Copenhagen are consistently rated among those cities with the highest quality of life. All of those cities show a high level of inclusiveness in making decisions. Not even a single city that does not have a decision making and planning process based on an inclusive system appears in the top 10 of the most liveable cities worldwide. No business hub, no gigantic tax generator, no top-down planned city in dictatorships has ever won the title of the most liveable city.

It is therefore a fact, that inclusive systems can lead to growing, prosperous, and liveable cities. This also means, that cities with inclusive systems are potentially sustainable and resilient, and that all of them could survive and prosper for many years. It can therefore be argued that inclusiveness is perhaps the most important ingredient when planning a new city or redeveloping an existing one, if sustainability and resilience are the long-term goals. It is therefore important to focus on how inclusiveness and equality can be guaranteed already in the design and implementation of new cities. The chapter on Urban System Design provides practical hints.

Existing and Potential Future Liveable Cities

By following the link below, you get access to the map of "Existing and potential Future Liveable Cities". This webmap reflects the present situation regarding today's most liveable cities and the fastest growing mega-cities in the world. On the one hand the map shows the most liveable cities in the world according to four official rankings (Monocle´s Most Livable Cities Index, The EIU´s Liveability Ranking and Overview, Mercer Quality of Living Survey, The Global Liveable Cities Index), where liveability is defined by a number of criteria, the weighted sum of which in the end characterizes a city as liveable or not. On the other hand, the fastest growing mega-cities are also presented on the map. This way, the user is able, through many interactive elements, to explore, identify and study these cities and their characteristics, and detect the differences among them, derived from the comparison of their liveability characteristics. Additionally, the user can recognize which of the fastest growing mega-cities can eventually become liveable, and how this goal can be achieved.

Later on you can compare the official surveys with the answers of the students of ETH, given during the course "Information Architecture of Cities", taking place in Autumn Semester 2013.
To explore the map, click the link below:

Map of Existing and Potential Future Liveable Cities

Gallery 7.2 Criteria of Liveability - Student choices

Students Choice (Criteria of Liveability)	Total	Gkonos, C.	Korfiati, A.	Loganes, E.	Ariza Gracia, D.	Marmy, P.	Zeller, M.	Decramer, H.	Dubuis, O.	Aske, D.	Dimitriou, M.	Fitz, R.	Aniruddh, J.	Elsadek, M.	Raess, T., N.	Kündig, R. and Christophe, N.	Jaboyedoff, C., C.	Lo Priore, S.	Zaghloul, M.	Coucopoulos, P., A.	Rosset, Q.	Massacci, A.	Julen, J.	Wälti, S.	Gyllengahm, I.
Transportation Infrastructure	18		1	1		1		1		1	1	1	1	1	1	1	1		1	1	1		1	1	1
Culture	16		1	1		1		1	1		1	1		1	1	1	1	1	1	1		1			1
Safety and Security	11	1	1							1			1	1	1	1			1		1		1		1
Education	10	1	1					1	1						1			1	1	1	1		1		
Climate	9					1	1	1	1	1	1				1							1			1
Economics, Prosperity, Working Conditions	8	1							1	1	1							1		1		1			1
Nature	7			1	1		1	1													1	1		1	
Healthcare Services	7	1	1								1								1			1	1		1
Location	7				1				1		1		1							1	1			1	
Stability, Justice, Governance	5	1						1	1				1										1		
Environment	5		1			1	1										1	1							
Freedom	4					1						1		1						1					
Atmosphere	4				1					1														1	1
Social Life	4					1					1	1										1			
Architecture, Housing and Urban Design	4						1					1					1				1				
Size of the City	3			1			1																	1	
Cleanliness	2													1		1									
International Connectivity	2						1														1				
Proximity	1																1								
Purchasing Power	1			1																					
No Stress and Chaos	1			1																					
Density	1				1																				
Pollution	1				1																				
Tranquility	1															1									
International Integrity	1												1												
Availability of technology	1												1												
Bicycle Network	1																	1							

Gkonos, C., Korfiati, A. 2014. *In the Fall Semester 2013, students of the Information Architecture of Cities course at ETH Zurich described their criteria for their choice for the most liveable city.* [Table].

Gallery 7.3 Most Liveable Cities - Student choices

Students Choice (Most Liveable Cities)	Total	Gkonos, C.	Korfiati, A.	Loganes, E.	Ariza Gracia, D.	Marmy, P.	Zeller, M.	Decramer, H.	Dubuis, O.	Aske, D.	Dimitriou, M.	Fitz, R.	Aniruddh, J.	Elsadek, M.	Raess, T., N.	Kündig, R. and Christophe, N.	Jaboyedoff, C., C.	Lo Priore, S.	Zaghloul, M.	Coucopoulos, P., A.	Rosset, Q.	Massacci, A.	Julen, J.	Wälti, S.	Gyllengahm, I.
Zurich, Switzerland	22	1		1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Vienna, Austria	9		1	1				1			1		1			1		1	1				1		
Munich, Germany	7				1		1	1	1		1		1										1		
Paris, France	6	1	1			1		1											1			1			
Copenhagen, Denmark	6					1			1				1		1	1					1				
Stockholm, Sweden	5				1	1								1	1										1
London, United Kingdom	4	1	1										1											1	
Geneva, Switzerland	4		1					1													1		1		
Tokyo, Japan	4						1						1	1	1										
Bern, Switzerland	4								1			1									1			1	
Berlin, Germany	3					1		1																1	
Lausanne, Switzerland	3					1											1				1				
New York, USA	3									1			1							1					
City of Luxembourg, Luxembourg	2	1	1																						
Rome, Italy	2				1					1															
Helsinki, Finland	2												1					1							
Amsterdam, Netherlands	2												1										1		
Toronto, Canada	2																	1		1					
Boston, USA	2																		1	1					

Gkonos, C., Korfiati, A. 2014. *In the Fall Semester 2013, students of the Information Architecture of Cities course at ETH Zurich described their criteria for their choice for the most liveable city.* [Table].

Other student choices with one vote include the cities of Salzburg, Edinburgh, Trieste, Istanbul, Lisbon, Warsaw, Hamburg, Barcelona, Sao Paolo, Campinas, Cologne, Gent, Frankfurt am Main, Thessaloniki, Cochabamba, Vancouver, Victoria City, Sion, Sydney, New Delhi, Melbourne, Stuttgart, Athens, Cagliari, Dublin, Luzern, Skelleftea, Bratislava and Beijing.

Map of Existing and Potential Future Liveable Cities

By following the link below, you get access to the map of “Existing and potential Future Liveable Cities”. This map gives you the possibility to explore and get informed of both today’s most liveable cities and the fastest growing cities in the world. On the one hand the map shows the most liveable cities in the world, according to four official rankings (Monocle´s Most Livable Cities Index, The EIU´s Liveability Ranking and Overview, Mercer Quality of Living Survey, The Global Liveable Cities Index), where liveability is defined by a number of criteria, the weighted sum of which in the end characterizes a city as liveable or not. On the other hand, the fastest growing mega-cities are also presented on the map. This way, the user is able to detect the differences among these cities and the previous ones, derived from the comparison of their Factors of Liveability characteristics, and in the end recognize which of these cities can eventually become liveable, and how this goal can be achieved.

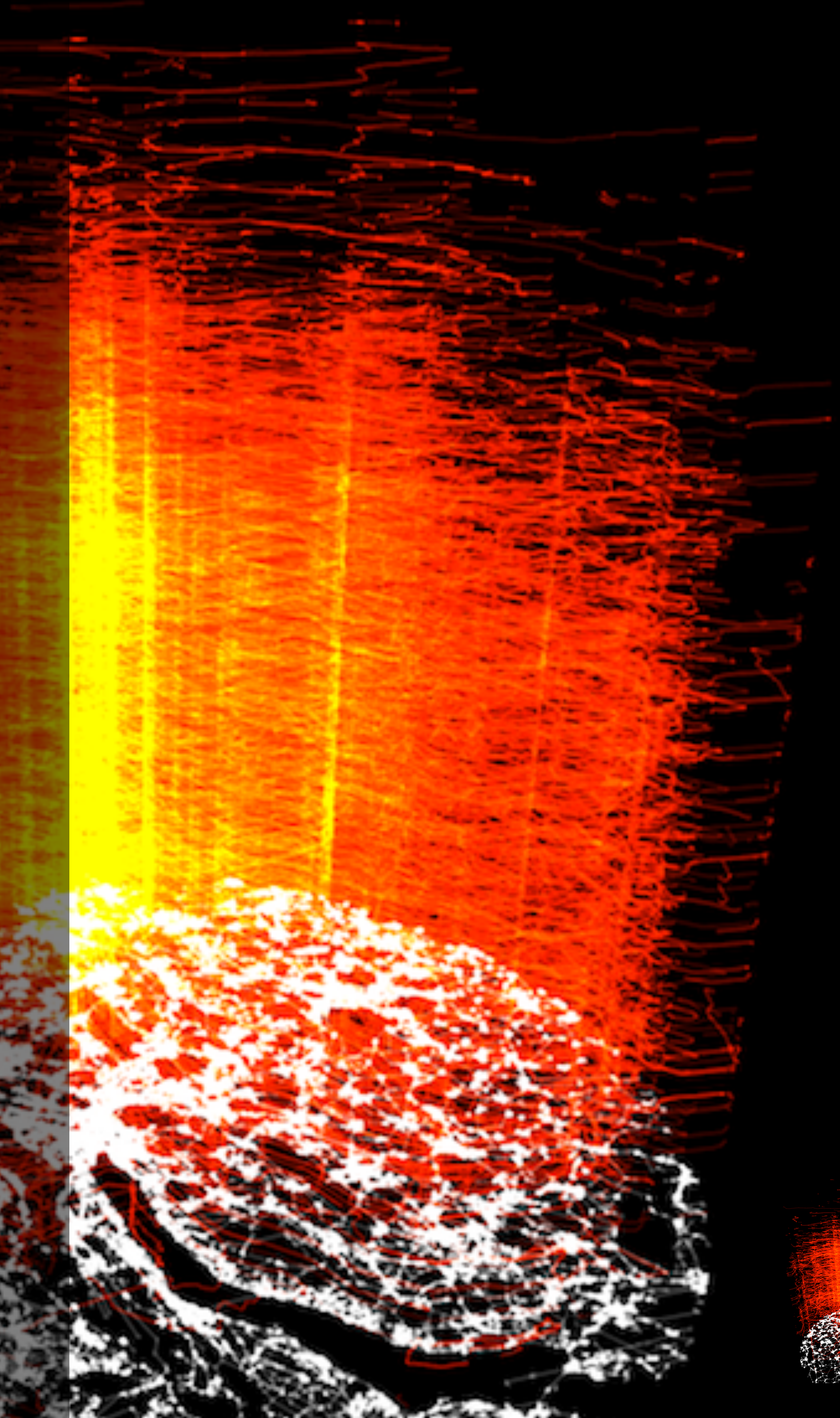
The final product of this project is a web-map that reflects the present situation regarding today’s most liveable cities. It gives the user the chance, through many interactive elements, to explore, identify and study these cities and their characteristics. It visualizes at the same time and at a single map all these information that can only be found from different sources, which is a time consuming process. At the same time the user can explore and identify the fastest growing mega-cities on earth, study their respective characteristics in terms of liveability, and further understand their potential and capabilities.

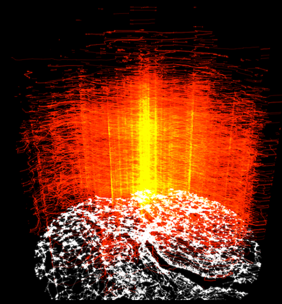
Map of Existing and Potential Future Liveable Cities

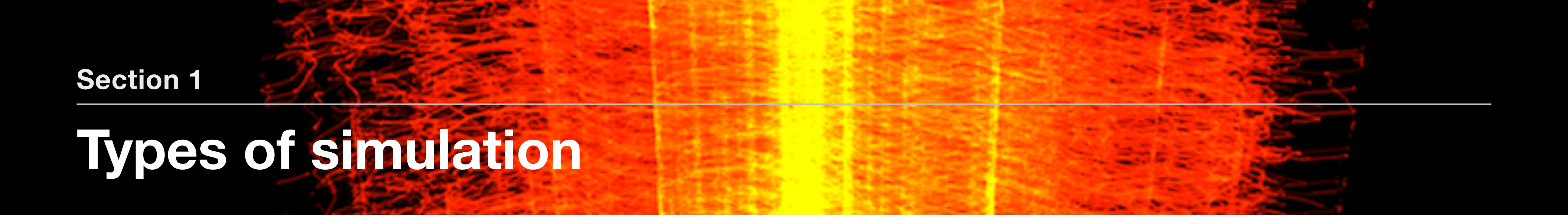
Chapter 8

City Simulation

Simulation is the imitation of the operation of a real-world process or system over time. In science, simulation is becoming an important method in addition to theory and experiment. In architecture, simulation has been used for decades, mainly to predict structural behavior, energy consumption or life cycle cost. In urban design, simulation is gaining importance in exploring future scenarios in pedestrian movements, vehicle mobility, or land use alternatives. In addition, in territorial planning, simulation helps to predict the functioning of large-scale operations in transportation or energy supply.







Section 1

Types of simulation

SIMULATION

Simulation in Architecture, urban design, and territorial planning is evolving rapidly. In Architecture, it is often used synonymously with visualization. In more technical terms, it includes energy use simulation of buildings, evacuation simulation, or interactive exploration of a virtual model of a building. The factor time, which is important in simulation, becomes more apparent on the urban scale: simulation of transportation and mobility, of land value changes, of densification, or any other changes over time. On the territorial scale, simulation is used to depict the growth of city networks, migration of people, or flows of material and information across continents.

Students study Architecture or urban design to design buildings and cities. Design is at the centre of their attention. They devote most of their time in education to design. Technology, information technology and other technical fields may appear as unwelcome constraints to the freedom of design. Thus, design and **simulation** are in constant competition. They compete for the student‘s attention and time, but in the end, design wins. Who wants a building that performs well on quantifiable criteria but is ugly or has no appeal, except for being efficient with regard to low-dimensional criteria?

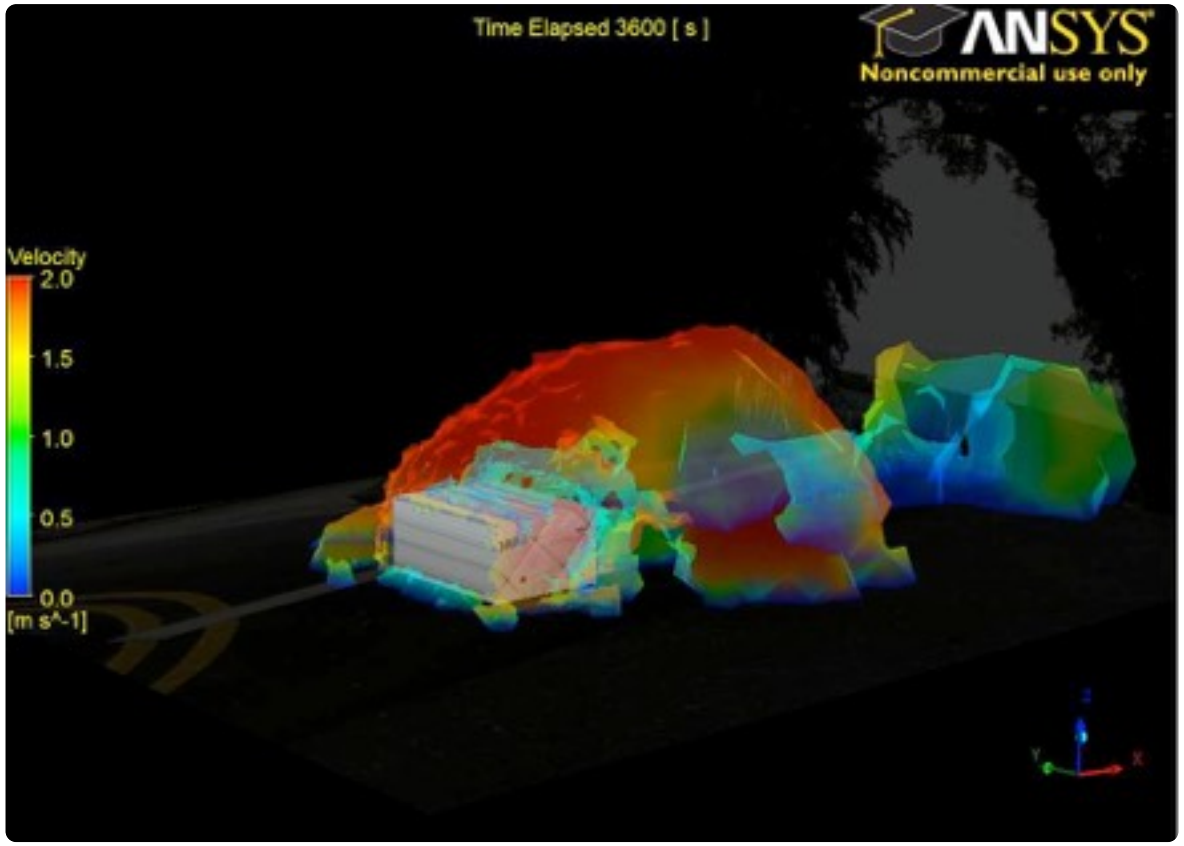
In the practice of building single buildings or complete cities, especially in the design and decision making phase, institutional clients require simulation more often than private clients, mostly because they are investing in high-tech buildings with significant maintenance cost. For this purpose, simulation seems to make sense. Sometimes during this phase, simulation is used to confirm wishes or anticipated results, which can be questionable.

In the construction and maintenance phase of a building or part of a city, simulation becomes more popular, perhaps because there are less undefined parameters to observe and the accuracy and reliability of the simulation result increases. In this phase, the role of the architect is reduced compared to the early phases. Yet these phases in the life cycle of buildings and cities are of high interest, as they have produced highly valuable data and information.

Building simulation - wind

Simulation is only possible to form phenomena that we are able to quantify and to understand. The same is true for building simulation. Examples could be the wind flows around the exterior of the building, the air movement inside the building, or the stream of occupants entering or exiting buildings. It could also show the flow of energy and temperature, light and sound inside the building.

Gallery 8.1 Building simulation



Papadopoulou, M. and Vernier, D. 2011. *Simulation of wind velocity surrounding the Future Cities Laboratory.* [BubbleZero experimental installation].

Building simulation – energy

The projected use of energy of a building was one of the first quantities to be simulated. Early simulation programs go back to the 1960s. The University of California at Berkeley and the Lawrence Berkeley Laboratory were eminent research locations that developed computer programs such as **DOE-2** which are still the basis for todays energy simulation programs, such as **Ecotect**.

Building visualisation

The visualisation of 3D models of planned buildings is often called building simulation. As the parameter time is often missing in these visualisations, it is not entirely correct to label them as simulation. However, virtual walks through and around these buildings could be accepted as visual simulation of future designs. This will change soon, with the dynamic aspects of architectural design gaining importance rapidly.

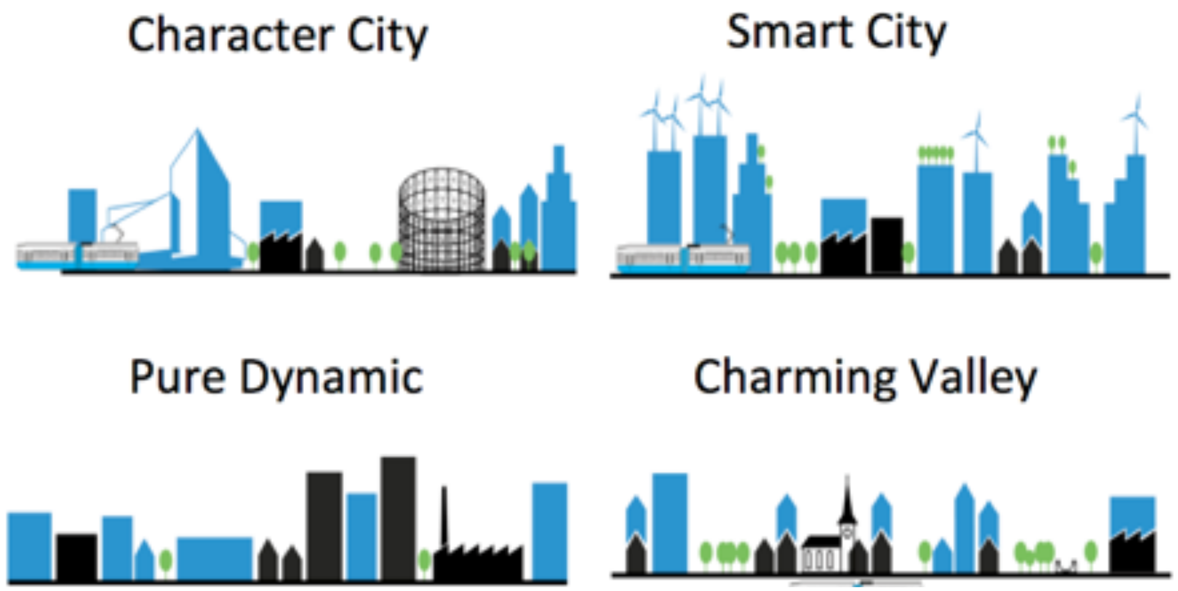
Gallery 8.2 Building visualisation

Halatsch, J. 2010. *Procedural model of a street in Masdar, the planned carbon-free city in Abu Dhabi.* [Simulation-visualization].

Urban simulation - patterns

Urban patterns are the physical expression of specific settlement characteristics. They differ widely throughout the world, determined by climate, culture, history and purpose of the city. They can be decided and designed top-down, or they can develop and change over time according to the forces that shape the city. The reason for looking at urban patterns is often a situation that has become difficult, like for example the growth or decline of population, changes of the settlement's economic base and connections, or transportation issues.

Gallery 8.3 Urban simulation - patterns



Kunze, A. 2012. *The 4 scenaria for the SUPat project in the area North of Zurich, in the Limmattal.* [Urban simulation].

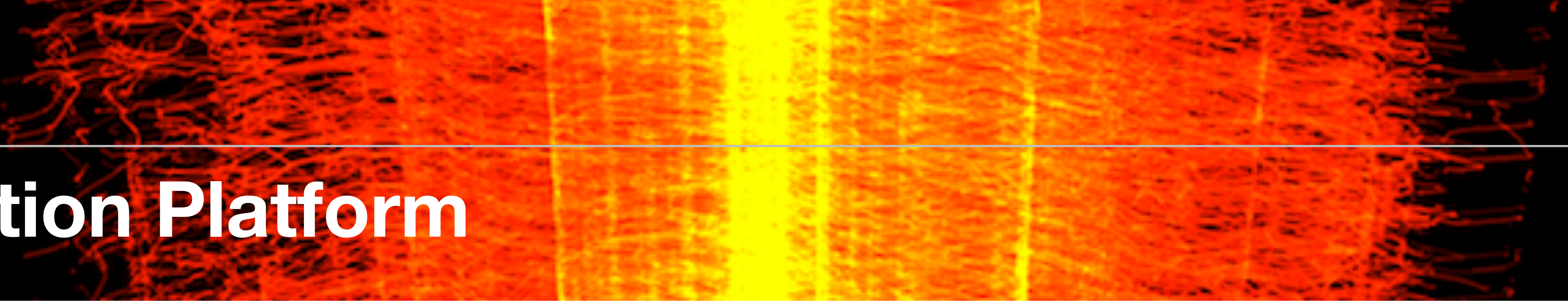
The conscious research for a sustainable future for urban patterns is relatively new, and in this sector Information Architecture and simulation can play a major role. The Swiss National Science Foundation, SNSF, launched a special program on New Urban Quality in 2009. One of the winning projects focuses on Sustainable Urban Patterns - **SUPat**: "SUPat scenarios describe four perspectives focusing on design, technological, economical and ecological aspects of urban development in the Limmattal region.

The scenario "City with Character" presents the Limmattal as a valley with a strong identity, created by a clear sequence of centres and a good mix of land use and architecture. In the scenario "Smart City", the valley positions itself as a cleantech pioneer; it boasts the highest possible energy efficiency, a high density of services and an optimum modal-split-infrastructure design.

The scenario "Pure Dynamics" presents a concept without a joint regional development plan. The valley is shaped by a vaguely defined mix of industrial areas, housing developments, green sites and transport infrastructures with no character of their own. The scenario "Charming Valley" presents the valley as a human ecological system with a strong mix of concentrated developments (informed by modern small-town values) along with a productive and resource-rich agriculture. The research project defines new urban quality as the interaction between human behaviour and the built and non-built environment. The needs and objectives of the population are linked to urban structures (e.g. sufficient open spaces) and their functions (e.g. recreation)".

Section 2

Simulation Platform



DEFINITION

"As citizens, we want to enjoy and contribute to the life of the city. As architects, designers, and planners, we want to understand the city and propose exciting choices considering effects and side effects. In the past, architects and designers could project their visions into the future and hope that citizens would support the design results by adaptation. The growing knowledge of components and their interaction, the increasing wealth of data generated by the city and the rapid progress of computational instruments and computational power have opened new possibilities for the design and management of the city. We call the combination and deployment of this knowledge, information, data and computation *simulation*. To support the urban design process with this activity, we need a *Simulation Platform*." (Schmitt, Gerhard, Module Leader Reflections, mid-term evaluation report, Future Cities Laboratory, Singapore – ETH Centre, May 2013)

Simulation of the city: scenarios

Sometimes, there is the opportunity to design a new city or to redesign an existing city, because unusual situations have made it possible. If such an opportunity arose, why would simulation be important? And why would one need a simulation platform to put together all aspects of the planned city?

Simply put, the simulation platform allows to collect, store, assemble, process, and visualise all information that is available or can be gathered about a city. Take, for example, the situation of Yangon, the largest city in Myanmar, at the beginning of 2013. Major political changes lead to the expectation that the city will develop into a mega city in the coming decades. It is obvious to the decision-makers and to the external observers, that the city cannot just continue to grow as it did in the past. Major strategic decisions are necessary, but must be based on sound evidence. In other words, city planners, citizens, and stakeholders need to know what the result of their decisions will be.

This is the point where the Simulation Platform becomes an indispensable instrument. It will be able to display the historic stock and the infrastructure of the existing city, and it will be able to depict the results and the side-effects of each decision taken with regard to the placement of housing, industry, mixed-use areas, or subways. It will show the carbon footprint of the city, its value creation and prosperity. The Simulation Platform cannot predict, but show scenarios.

The Simulation Platform

Simulation, as we see it, describes integrated future urban scenarios based on the most up-to-date knowledge, information and data. Simulation includes scales within space, time, economic, ecologic and social dimensions. It allows the incorporation of new real-time data from crowdsourcing, and it creates opportunities to move from limited top-down specific and exclusive models towards pre-specific and inclusive models.

The body of knowledge in urban design and planning accumulated over the last centuries is immense and too large to be remembered by a single person or by a team. Not using this knowledge because of naivete would be irresponsible. Design using integrated simulation is therefore becoming essential.

The Simulation Platform increasingly helps to identify and quantify the components of a city, their functions and their connections. For the first time in history, it is possible to directly and interactively visualise stocks and flows of people, energy, water, finances and information in Singapore, a city of more than 5 million people. For this, the Simulation Platform accesses Big Data, explores the role of individual data and discrete populations versus statistics on the urban level, and searches for innovative models of the city. While progress is incremental in each field, researchers in the Simulation Platform continue to question the role and the future of the underlying models and abstractions. At the same time, they are able to support other research modules in the Future Cities Laboratory with the newest hardware, software and data interpretation strategies, thereby keeping the Simulation Platform's modelling capabilities at the forefront of the global state-of-the-art.

Advanced urban design and modelling environment: the Value Lab Asia

Members of the Simulation Platform conceived, designed, and implemented the Value Lab Asia, a physical visualisation,

Gallery 8.4 Value Lab Asia

Aschwanden, G. 2010. *Simulation of the Value Lab 2.* [Photograph].

simulation and interaction space in the CREATE campus. With more than 35 million pixels it offered South East Asia's highest resolution display and interactive touch panels for urban planning.

It is by now a major asset of the Future Cities Laboratory. The Value Lab Asia supports more than 80% of all external and internal presentations at the Future Cities Laboratory and is at the same time a visual programming environment for researchers. The Value Lab Asia has set the standard for interactive urban planning environments and constitutes a role model for Australia (Perth) and Switzerland (Value Lab Zurich). The Value Lab Asia is open to Singaporean educational and research institutions as well as to government agencies. It is also the platform for presentations to industry and the host to the Digital Art Weeks in Singapore.

Teaching and Massive Open Online Courses

The Value Lab Asia has developed into a successful teaching environment with weekly courses between the Value Lab Zurich and Singapore. Classes are interactive and students from Singapore and Zurich participate from both locations. The unique visualisation and sound system of the Value Lab Asia creates an immersive classroom atmosphere, where the participants from Zurich appear in 1:1 scale on the large display in Singapore. The sharing of presentations, drawings, videos, and other media functions seamlessly. The Value Lab Asia is the test bed platform for the emerging Massive Open Online Courses on Future Cities, prepared by the faculty of the Future Cities Laboratory.

Computing and visualising stocks and flows

The Simulation Platform successfully enables visualisation of urban stocks and flows. It displays historic maps of Singapore in high resolution, showing impressively the change of material stock. It allows research into the change of land use over time with associated physical transformations of areas.

Visualisation of stocks and flows of material also illustrates the increase of the land size of Singapore since 1965. This extensive dynamics in stocks and flows of material is unique worldwide. Also unique is the rapid flow of material within the city by reusing the material from demolished buildings for new structures, with the result of increased density. Innovative algorithms by Simulation Platform researchers can automatically detect this physical change over time by comparing satellite images and other sources.

The Simulation Platform is capable of visualising the energy stocks and flows of Singapore or any other city, as far as official data are available. In this case, it is able to break down the energy stocks and flows to the individual building level. The resulting map of the island of Singapore provides an impressive differentiation between areas of comparably low energy consumption, such as housing and office areas, and the highly industrialised areas around Jurong and the airport. The energy intensity indicates origins of the heat island effect. The Simulation Platform is also able to depict the emerging electricity grid of Ethiopia. Planners, decision makers and observers interactively model and manipulate existing and new energy sources on the large touch screens of the Value Lab, attaining a previously unreached level of interaction and precision.

In cooperation with the transportation and mobility specialists of the Future Cities Laboratory, the Simulation Platform simulates the stocks and flows of people, cars and buses in the street network of the entire island of Singapore. Theoretically, every Singaporean can be modelled and displayed as an individual agent. The location and movement of these agents can be displayed on the high-resolution screen in the Value Lab Asia that provides a qualitative jump of analytic capacity over individual screens that can only display a fraction of the information.

A unique feature of the Value Lab Asia Large Display is the realistic visualisation of mobility in the city. On the urban design scale, programs developed by Simulation Platform researchers show the individual movement of people walking through parts of the city. The programs help designers to recognise what people will see, how they make their navigation choices and which parts of the urban area will be most populated. A different programme developed by Simulation Platform researchers visualises the incredibly diverse streams of passengers in Singapore MRT stations at different times of the day. A further interactive visualisation demonstrates whether or not citizens can reach certain destinations in Singapore, in a given time, using public transportation only.

The computational fluid dynamics work of the Simulation Platform produces promising results in defining the best locations to gain the most information with the minimum number of sensors. It generates better knowledge of airflow around buildings in Singapore, which can lead to better design and refurbishment of buildings by increasing the effectiveness of natural ventilation. The use of sensors can also improve the accuracy of other simulations, such as those for temperature. The practical benefits of intelligent sensed cities include more reliably reaching important design goals, such as sustainability, under increasingly changing environmental conditions.

Finally, the architectural effects of urban planning, depicted by three-dimensional visualisations of buildings, are further refined by the use of the procedural modelling tool CityEngine. The CityEngine software has been enhanced by members of the ETH team to rapidly display geometry originating from design decisions, including energy-related information and the effects of design decisions on embodied CO_2 or CO_2 produced by the heating or cooling of buildings.

Collecting, storing, mining: Big Data

The Simulation Platform has accumulated the most impressive dataset of historic, current and emerging data about Singapore. This dataset is available to all researchers of the Future Cities Laboratory, as well as to outside parties. The Simulation Platform thus enables the collection, the storage and the mining of the ever-increasing amount of data about the city. The structure of the database is generalizable, while the content is specific for each city. The Simulation Platform is set up to receive and then take advantage of the major onslaught of Big Data, generated by thousands and soon by millions of sensors and smartphones in use and shared by citizens. It uniquely connects this data to a GIS model of the city.

In this context, it is important to build up trust and to take full advantage of the data that citizens are willing to share. For this purpose, the Simulation Platform offers a safe and attractive environment for depositing and extracting data. The data is then formed and visualised in advanced ways. Big Data visualisation has become one of the major assets of the Future Cities Laboratory, not only for the researchers, but also for the stakeholders of Singapore and for any other city that chooses to employ this concept.

UAV: Dimensions of Singapore and Jakarta

There is no 3D publicly accessible model of all buildings and topologies of Singapore for civil use. The Simulation Platform closes this gap and proposes several innovations on the way. Firstly, the difficulty to achieve high altitude flyover rights in Singapore led to the acquisition of a small and versatile Unmanned Aerial Vehicle (UAV) platform that can take high-resolution images from predefined positions at low altitudes. By flying the UAV at 120 meters above ground, Simulation Platform researchers took more than 800 aerial photographs of the campus of the National University of Singapore, thus acquiring the basis for a full three-dimensional reconstruction. Nevertheless, the extensive tree cover on the ground of the NUS campus obstructed the aerial view of the natural topography and to the facades of most of the buildings. This led to the necessity for ground-based Lidar data acquisition by a Mobile Mapping System, mounted on a car. The combination of the point clouds with image analysis techniques, resulting from both data acquisition methods to arrive at a precise three-dimensional and texture model of the buildings, is a major innovation. The combination of satellite image based 3D reconstruction and point clouds acquired from ground-based Lidar led to precise models of the Rochor area which are now the basis for integrated design studios between ETH, and the Singapore University of Technology and Design, SUTD. In Jakarta, finally, the use of fixed wing UAVs led to crucial point cloud models of Ciliwung River settlements, which can now be transformed into 3D models, and be used as the necessary basis for new designs for the purpose of flood mitigation in the area.

Cooler calmer Singapore

The knowledge accumulated in the Future Cities Laboratory and in the Simulation Platform has led to the recognition of the interdependencies between climate, urban design, energy demand in the city, the heat island effect, the intensity of downpours and flooding in Singapore, population density, and the planned increase of the populace to possibly 6.9 million in 2030 from 5.3 million in 2013. The question is: will it be possible to decrease or at least keep the average temperature stable in the coming years, decrease the noise level, reduce the intensity of downpours, and at the same time increase the population density and guarantee or even improve the liveability of the city? Simulation is the only possibility to generate, evaluate and propose realistic answers to such questions, which are crucial for the future of Singapore. As a consequence, the interest in this topic is high among the population, as well as among city planners and decision-makers. In this case, the Simulation Platform could become a key instrument to improve the quality of life, not only in Singapore, but also in many other emerging tropical cities.

The first step is to collect and confirm relevant data, either from the database of the Simulation Platform, or from any other research institute in the CREATE campus. This collective effort is unique worldwide and has not been tested before, thus the potential for innovation is high. The advanced research institutes from TU Munich and MIT contribute to the Simulation Platform with data and information to make the most realistic assessment about the future of cities. Data are climatic, geographic, energy related, urban design related, geometric, political, economic, and health-related.

The results of the simulation are open-ended. First estimations suggest interesting and far-reaching consequences. For example, Singapore could become the first country in the world that would completely switch to non-fossil individual transportation and thus reduce the heat and noise output. Singapore could also become the first country to function with non-fossil and non-nuclear electricity generated in neighbouring countries with high efficiency photovoltaic and energy storage areas. Singapore could finally become the first country that reverses man-made health and commercial risks such as air pollution and flooding. Singapore could also become the first country in the world to export this knowledge to other countries and emerging cities.

At present, the Simulation Platform is the only instrument that allows the realistic observation, implementation, and long term monitoring of such far-reaching plans. As such, the Simulation Platform would move from an academic, fundamental research driven instrument, into the reality of planning, implementation and monitoring. Implementation and monitoring are necessary subsequent steps for the Simulation Platform, because they will guarantee a constant flow of data and information to verify or falsify assumptions, models, abstractions, and proposals derived from the results of simulations.

Alternative City Models: Quantum City

The basic research group at FCL is dealing with a known problem: more data and more computing power will not solve the old questions regarding cities, because each level of more analytical accuracy is increasing the computation costs exponentially. Therefore, we need new questions to cope with the extraordinary political, economical and cultural dynamics which are explicitly demonstrated by the rise of social media today. The basic research group therefore follows the concept of pre-specific modelling as a next level in computer aided design and decision-making. In case of urban development, the concept of a **Quantum City** was developed. The basic technical question is how to establish a coexistence of citizens within infinite data streams. To get a better understanding, a principle implementation could be developed which illustrates technological questions deriving from these concepts. Pre-specific modelling is not only of theoretical interest, but it also has direct practical implications: A prototype of pre-specific modelling on urban topologies was demonstrated, which illustrates that the costs for setting up city models can be reduced by at least the factor of 100. With a second prototype which focussed on topographies we were able to show that it is possible to generate online datasets with minimal costs that can substitute expensive simulations for most of the questions today. The next step in this line of new tools for modelling will be on text analysis of websites, blogs and news feeds as a source to map abstract parameters, like for example cultural identities, moods, political and economical activity or even city styles. In summary, pre-specific modelling promises, apparently paradoxically, to run a city beyond it‘s optimum.

Dissemination

The Value Lab Asia has developed into a strong instrument of dissemination. On average, more than 200 weekly internal researchers and external visitors make use of the unique modelling and visualisation capacities of this laboratory. There are now more than 65,000 specific entries under “Value Lab” on the Internet, referring to the ETH Value Labs in Zurich and Singapore. Students from the National University of Singapore, from the Nanyang Technological University, and from six different Singapore based primary and secondary schools have interacted with information displayed on the touch panels and on the large display, or they have also seen the UAV in action. They spread this experience to their classmates and parents, and this results in follow-ups.

In Asia and beyond, the Simulation Platform is also becoming known for its quality as an interactive teaching environment. Every semester, students from ETH Zurich as well as from other universities, registered as guest students at ETH Zurich, and participate in the interactive seminars on information architecture and information cities. These courses are increasingly used to disseminate results from all research modules of the Future Cities Laboratory.

Dissemination of results from the stocks and flows research also works through presentations to high-level government delegations from Singapore, Switzerland, Germany and other countries. These presentations result in follow-up visits and research proposals. The Cooler Calmer Singapore project, for example, originates in part from feedback by Singaporeans visiting the Value Lab Asia and seeing representations of the stocks and flows of energy in the city.

The reputation of the Value Lab Asia as an interactive digital library of the most complete geographic and historical data about Singapore is increasing. It has led to the plan to make available data to researchers in the entire CREATE campus and beyond under the title “Data Alliance”.

One of the most prominent modes of dissemination of the results originates from the flights with the UAV across the NUS campus and the follow-up reconstruction of many of the buildings in high detail. This has led to a follow-up project with NEA which aims to detect small water puddles in difficult situations, in order to eliminate the breeding grounds of insects that spread Dengue fever. With its very high accurate Digital Terrain Model, the Simulation Platform also supports the work of a NUS hydrology group, which maintains a hydrology test field on campus.

Regarding alternative city models, such as quantum city, there are several recorded lectures available, as well as papers on conferences and an upcoming summarizing book at Springer in Vienna.

Synergies

Strong synergies have emerged with the research module on transportation and mobility. This module provides data and the MatSim simulation programme, and the Simulation Platform provides the know-how to visualise and interpret the results. The use of the visualisation environment of the Value Lab Asia has led to new qualitative findings regarding transportation processes for two reasons. At first, the size of the large high-resolution display allows the discovery of integrative aspects that cannot be seen on smaller displays while the interactivity of the touch panel displays is the best environment for exploring time-based and dynamic simulation results.

Strong synergies also exist with the Rochor+ project. In this case, three-dimensional information, necessary for the analysis of different building types, was attained by 3D reconstruction from satellite images as well as from point clouds created by Lidar data acquired from the street level. Other synergies include the development of programs that directly and interactively depict what people would see by walking on the streets of Rochor. This program is agent-based and computationally innovative, while at the same time very practical and user friendly.

The Jakarta+ project benefits from the collaboration with the Simulation Platform. In this case, it is the reconstruction of 3D building roofs and flooding prone topography derived from point clouds that were generated by flyovers of a model helicopter, UAV, by the Geomatics group in cooperation with the landscape ecology research module.

Synergies with ETH Zurich and Singapore Agencies are strong. With the Urban Redevelopment Authority URA, a first talent exchange has been agreed on. It means that one person from the Simulation Platform will be directly working with a URA planning group. With the National Environment Agency NEA, a first joint project on detection of Dengue breeding grounds has been completed.

The potential for synergies based on the direct and striking first results of pre-specific modelling is large. Yet it is necessary to integrate them into the mostly applied research context at FCL. This is especially the case in the design studios and the research on simulations, climate and economy. The basic research group, therefore, decided to slow down the conceptional and technological development and concentrate more on the mediation of the theory and technology of pre-specificity into the urban disciplinary discourses, by writing the book “A Quantum City”.

Impact

Simulation Platform members advanced the knowledge on that field with publications on technical innovation, visualization and user interfaces, design research, and city models. Technical innovation papers focus on reality-based reconstruction (Gruen 2013; Huang et al. 2013; Müller Arisona et al. 2013; Qin et al. 2012) and on the future role of sensors in the city (Vernay et al. 2013; Papadopoulou et al. 2013). Visualization, simulation, interaction, as well as data acquisition and management publications (Zhong et al. 2012; Wei et al. 2013; Aschwanden et al 2012; Shin et al. 2012; Dai et al. 2012; Wang 2013) will have impact on the emerging Big Data analysis field. Design research publications integrate technical and design aspects (Schmitt 2013; Schmitt 2013a). City models publications range from urban heat island topics (Berger 2012) to alternative models (Miro 2013, Moosavi 2013). Two book publications cover the fields of engineering informatics (Raphael and Smith, 2013) and digital urban modelling and simulation (Müller Arisona et al 2012) broadly.

The work of the Future Cities Laboratory and Simulation Platform members was featured prominently in the 2012 Annual Report of the ETH Domain and of the ETH Zurich, as well as in the Bank Vontobel’s client magazine “blue” and the Swiss design journal “Hochparterre”.

The Value Lab Asia is a physical, built statement on the future urban design and planning environment (System Integrations Asia 2013). The fact that it is being copied by other countries is a strong sign for its impact. Researchers of the Simulation Platform have used the Value Lab Asia as a base for laboratory work and communication, and have spoken through it in front of large audiences in conferences in Asia, Oceania, the Americas, Europe and Africa. The Value Lab Asia also hosted part of the Digital Art Weeks festival in Singapore from May 6 to May 19, 2013 and displayed patterns between art, architecture, planning, and computer science, nurturing a culture of sustainability.

Researchers from the Simulation Platform were active as experts in the globally leading Smartgeometry Workshop at The Bartlett / UCL, London, from 15-20 April 2013, where they contributed algorithms and interactive tutorials, along with published articles.

For Singapore, visualising the heat island effect by depicting the energy use of the island has a high impact, because it was not visualised before. The same is true for the visualisation of Singapore work locations derived from the transportation and mobility studies, which partially explains certain traffic conditions.

The interactive multi-touch Singapore connectivity application also has a high impact on all visitors, as it depicts the large differences between locations in Singapore with regard to accessibility by public transportation. More specifically, after pointing to the area of their choice, visitors immediately understand which areas in Singapore are advantaged in terms of public transportation and which are not.

The emerging Cooler Calmer Singapore Project has already drawn the attention of decision-makers and researchers in Singapore and beyond. The project shows that context specific topics can lead to scientific contributions beyond the place of application. The preparation of the Cooler Calmer Singapore Project involves stakeholders and opinion leaders from several agencies and universities. Building on the extensive knowledge accumulated in the Future Cities Laboratory, this project is becoming a strong attractor for Singaporean and foreign talents willing to look across the boundaries of their disciplines.

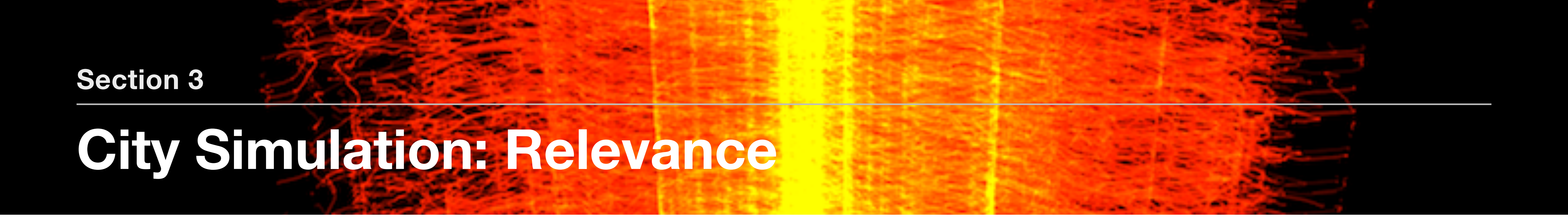
The Quantum city model as basic research field will unfold its impact in the future. It questions the fundamentals of the applied research projects and is obviously disturbing their well-adjusted pragmatics. In the long term, however, this kind of thinking will gain momentum. In theory, these questions exist for more than 120 years, but in information technology this way of thinking became explicit with Google and the social media since 2000. So now applications in economy can be expected soon.

Benefit

The Simulation Platform is on its way to become an interactive companion for decision-makers, urban planners, academics, as well as for the general public. The multitude of programs developed for the Simulation Platform cover an increasing area of interest for the analysis and planning of new cities as for the renewal of existing cities. They allow the integration of large amounts of data and crowdsourcing with traditional top-down decision-making tools.

The Simulation Platform provides a planning and simulation environment, and therefore allows for alternative views and explorations of the urban planning process. Pre-specific modelling promises a way out of the global conditions described prominently by Rem Koolhaas as the generic city and junk space. It has enormous economic impacts and will nevertheless keep the cultural differentiation. But it will take time to change the mind-set of politicians, stakeholders, researches and institutions. On the other hand, and this is probably the most interesting, the citizens of the future cities will change faster, as we see with internet and social media.

In the long run, the Simulation Platform will be an important contributor to the resolution of the conflict between too much pragmatism and too much theory. Equipped with the interactive software and hardware arsenal it is developing, the Simulation Platform will be a major benefit for society. Distributed in a Massive Open Online Platform for teaching, the Simulation Platform will become an important instrument for dissemination of art, engineering, design and planning knowledge on a global scale.



Section 3

City Simulation: Relevance

HOW IS CITY SIMULATION RELEVANT?

City Simulation always existed - in the designer‘s mind, in the builder‘s mind, and in the mind of the people governing a city. Now we have more powerful methods and instruments to externalise these visions, using combinations of science and visualisation:

1. **Make the invisible visible: we know results of processes both from experience and observations, but we cannot directly visualize it - this is where simulation helps.**
2. **Design future scenarios: We have ideas about a future building, urban, or territorial design, but it seems too complex to explain or draw it - this is when simulation helps to design realistic future scenarios.**
3. **Test future scenarios: We have come up with or received a proposal for future urban design, but we are not sure if this will work or have the desired effects - this is when urban simulation is needed to test the assumptions and visualize the results of the design over time.**

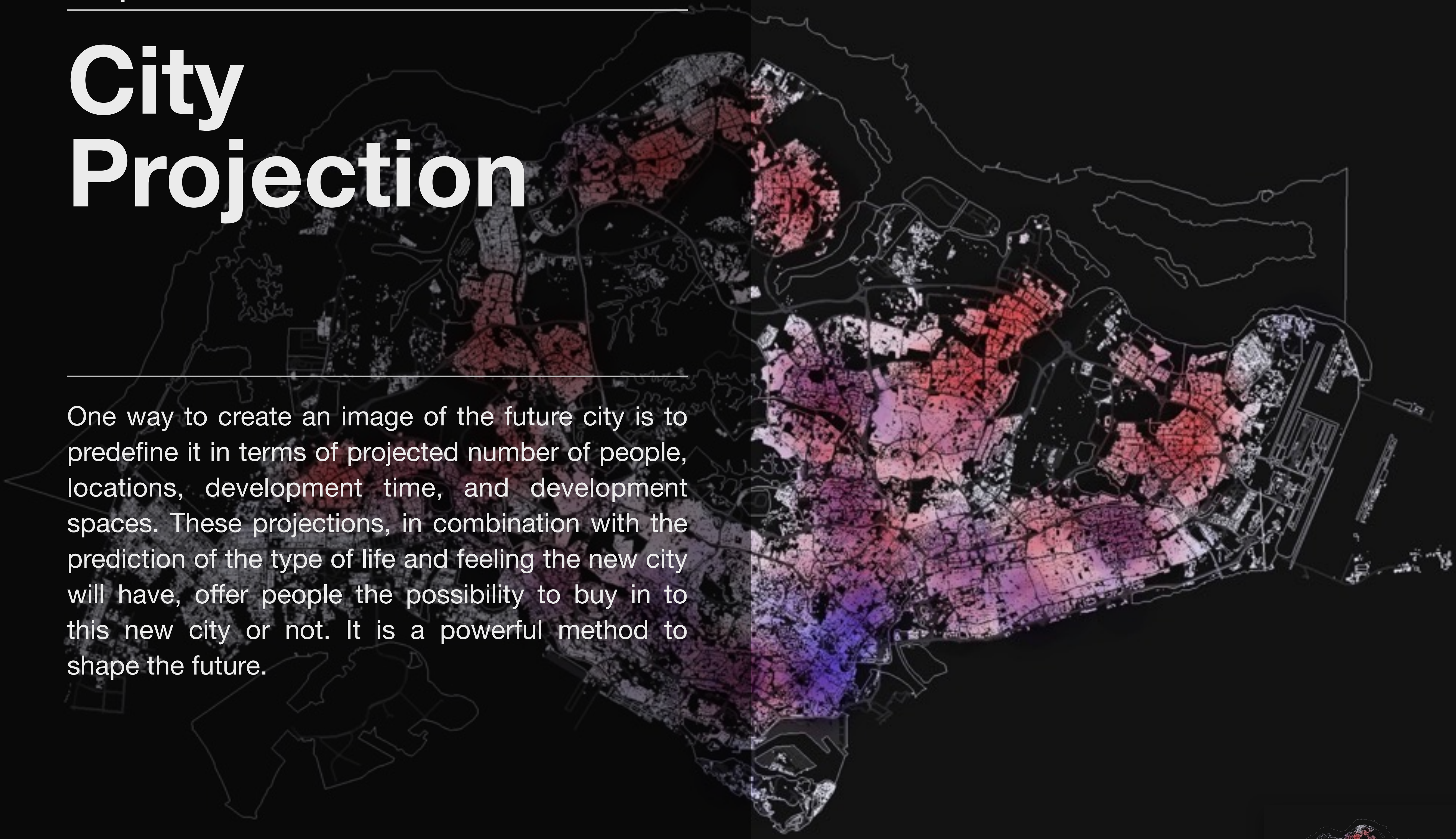
Simulation is a powerful method to structure our thoughts and to put things into order. In spite of the advent of big data and seemingly arbitrary decisions, city simulation grows in relevance over time.

Testing future performance scenarios is a good example: it is possible to simulate the energy consumption and CO_2 production of a city, based on assumptions or goals by the decision-makers. The more factors and the more precise descriptions of the future situation the simulation can take into account, the closer the actual performance will resemble the simulation. This, in turn, gives the confidence to improve the simulation model and to test other, possibly more complex design scenarios with the simulation.

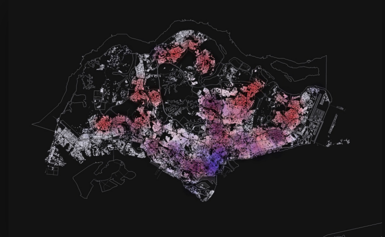
Simulation is also relevant on a shorter time horizon and in a reduced complexity scenario. In this case, we can use simulation to predict a desired reality in the future. If one can guarantee that most of the simulation‘s assumptions can be kept, the future reality will be close to the result of the simulation. We have used this approach in the design and simulation of the ETH Hönggerberg Science City campus, resulting in quite a close match between prediction and reality. Finally, using simulation to make the invisible visible works at every level, especially at the building and the urban design level to demonstrate the stocks and flows working in a building, or in a city. This is necessary to better understand the city.

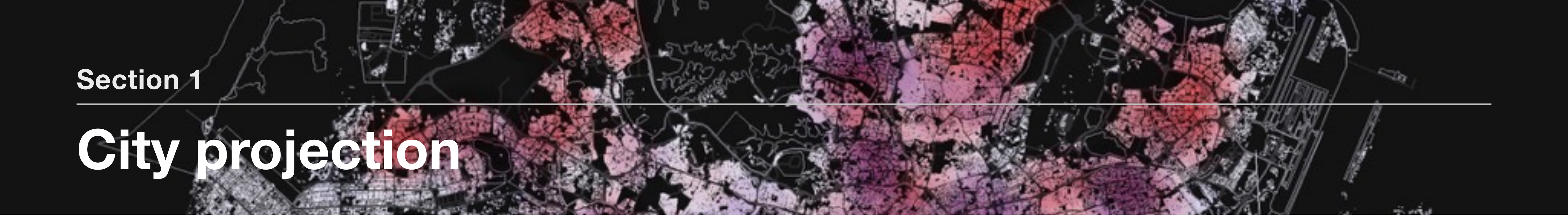
Chapter 9

City Projection



One way to create an image of the future city is to predefine it in terms of projected number of people, locations, development time, and development spaces. These projections, in combination with the prediction of the type of life and feeling the new city will have, offer people the possibility to buy in to this new city or not. It is a powerful method to shape the future.





Section 1

City projection

SINGAPORE - A CASE STUDY

Singapore is a city state that publishes master plans for the growing city in regular time intervals. In early 2013, the city government unveiled a new plan that could possibly increase the population from 5.2 million in 2012 to 6.9 million people in 2030. The planning authorities also describe the necessary steps to reach this goal.

Just before this announcement, the Centre for Liveable Cities published a book describing 10 goals towards a liveable future city. Combined, these two documents project the future of the city for the years to come. We look at this study and projection as a case study, in particular of the components of the city that are deemed important for growth.

In 1965, when Singapore was founded as a state, it had less than 2 million inhabitants. In 2012, more than 5.2 million people lived in the city. The original land area of less than 500 km^2 was increased to more than 700 km^2 during the same time. A first master plan in the 1970s depicting the further development of the island state, led to the construction of several centres in the East and the North of the island, while the West side was mostly dedicated to the growing industry and the expanding harbour. The downtown area in the south of the island grew as well, and forms the hub of business and public transportation.

The **Singapore White Paper** and the Land Use Plan were published in early February 2013 and distributed to all households on the island. “What will the home in 2030 look like?” was the title of one of the papers‘ special edition. The paper started with a look at the improvement to the individuals flats. It continued with an outlook on their realisation of the dream to live in a new flat in the heartland of the island. It predicted that existing older towns would be revitalised by the plan, and that green spaces would offer an increasing value for recreation. In addition, there was a prediction that housing and jobs would move closer together and that there would be no shortage of space, in spite of the already high density on the island. Finally, future liveability was predicted, and a map of land use beyond 2030 offered a view into the distant future. All in all, the Land Use Plan and the White Paper on population development form a coherent city projection.

City projection is very powerful tool to define the future of the city. At the same time, it is subject to changes from within the city and from external forces that might partially or completely change the course of the development.

Internal forces might be the discovery of new situations in the planning area, such as archaeological sites or unstable geological conditions. But most likely the internal forces will be people that either support or do not support a particular projection of the city into the future. This support may vary significantly over time. In the 1950s and 1960s in Europe, there seemed to be a general agreement that individual transportation and mobility was most important and that the city had to accommodate this demand both from a planning and infrastructure standpoint as well as from a governance standpoint. This agreement was superseded in the following years by a deeper understanding of sustainability and livability of a city, and gradually the projection of the city as a system that had primarily to accommodate individual car transportation needs vanished. The emergence of pedestrian zones in the city and the reconquest of streets and public spaces by pedestrians and bicyclists are an expression of this change. It is important to note that at the same time of a rising scepticism towards the dominance of individual and private transportation in Europe, an opposite development took place in many Asian, South American, or African cities, where individual private car transportation was on the rise while it was already in decline in other places of the world. The perception of the importance of the private car is therefore an important factor for the image of the future city and a deciding feature for city projection.

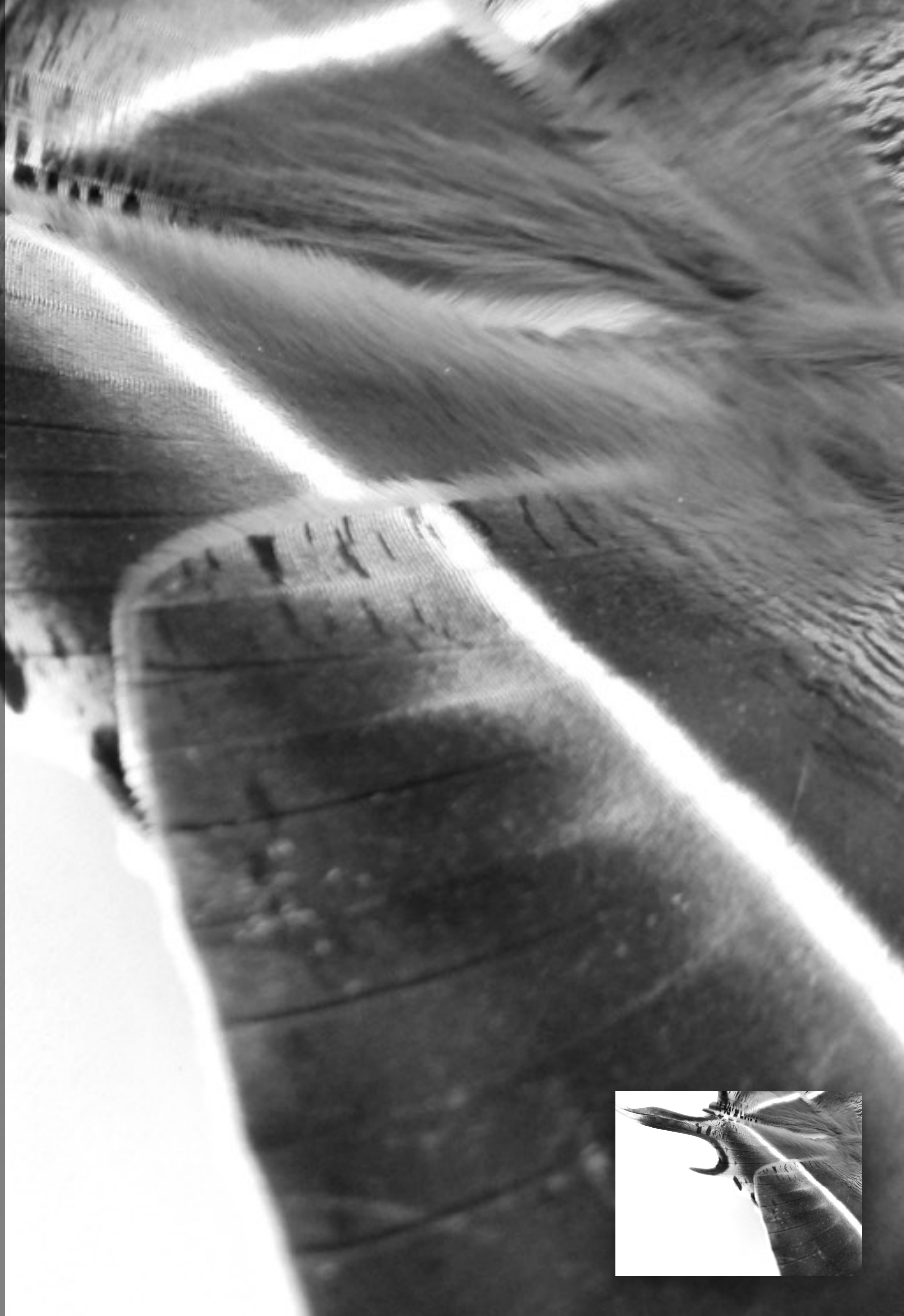
External influences that keep a city from becoming as it was projected may be manifold. For example, the supply of water may run out and require large investments to bring it into the city - investments that then cannot be made for other infrastructure. Or the government of the country may change and other plans may take priority. Or the projection of the city does not include all the public services and amenities necessary for an attractive urban environment, as may be the case with the multimedia super corridor (MSC) or Cyberjaya in Malaysia. A very common external factor is the change of the financial situation that may lead to a delay of construction or to a change of plans, as could be the case in the development of the city projection of Masdar.

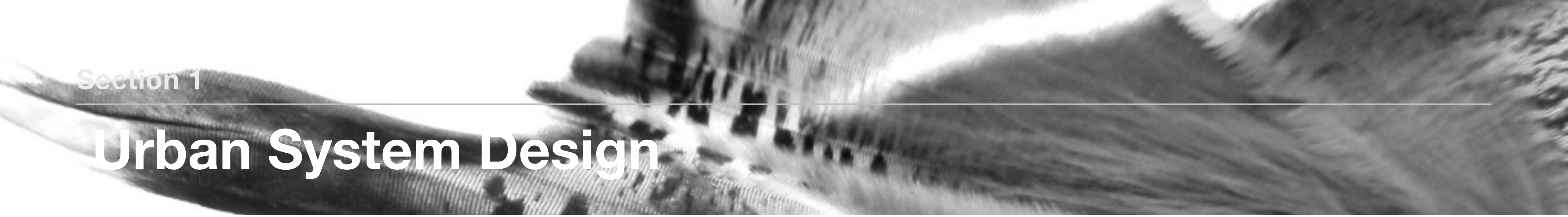
In all those cases, the power of city projection lies in the development of a clear vision and effective plan for the future. The challenges are to guarantee that the internal support for this vision is strong and remains strong, and that the economic reality is such that temporary setbacks can be overcome. If the support of the population vanishes, or the external forces stay negative for too long a time, the entire city projection or parts of it may fail. Understanding the city as a system will lead to the more time-consuming, but possibly more resilient urban system design.

Chapter 10

Urban System Design

The ultimate goal of modelling, simulation, and projection is design. Design is situated outside of science and art, but building on discoveries of both areas. Urban system design is special in that it connects architectural design and territorial design. Informed and responsible parent, system design builds on information and knowledge derived from modelling, simulation and projection.





Section 1

Urban System Design

DESCRIPTION

Urban system design is a new discipline. Situated between naturally and slowly growing cities, between geometrically predefined cities, and between arbitrary growth, it is a challenging, responsible and proactive design activity.

Its foundations should be threefold: the first pillar is the ability to understand, to abstract and to model the urban system. The second pillar is the careful simulation of design ideas, which based on data and information can be placed in and interact with the urban system model. The third step is the projection of various possibilities and the creation of design scenarios that can be discussed with the stakeholders and decision-makers. The design of the final artefact then results in executable plans and multidimensional models, based on which the city can be built or re-built.

Urban systems are large and complex, yet most of them work because of the adaptive capabilities of humans. From the original idea through planning, competitions, commissioning, construction to management, it takes years or decades. This reduces the probability that a single idea will be followed through the entire process and will significantly influence the final result. Nevertheless exceptions are possible and stay in the mind of the public. Examples are Brasilia in Brazil, Chandigarh in India, or Shenzhen in China.

Chandigarh, designed by the Swiss architect Le Corbusier in the 1950s, was a social experiment in system design. Le Corbusier was a foreigner to India and the city has developed in a very different direction since then.

Brasilia, inaugurated in 1960, is directly connected to the work and memory of Oscar Niemeyer, and to the Brazilian president of that time, Kubitschek. It could be described as one of the first system design attempts, as it tried to integrate the human, architectural, political, planning, and infrastructure needs of a future city. Oscar Niemeyer was a native of Brazil, but still the city developed differently to what he originally intended.

Shenzhen is the newest of the three examples and there was no grand architectural urban system design scheme at the beginning. This makes it interesting, because in the city of today, more than 15 million people grew organically.

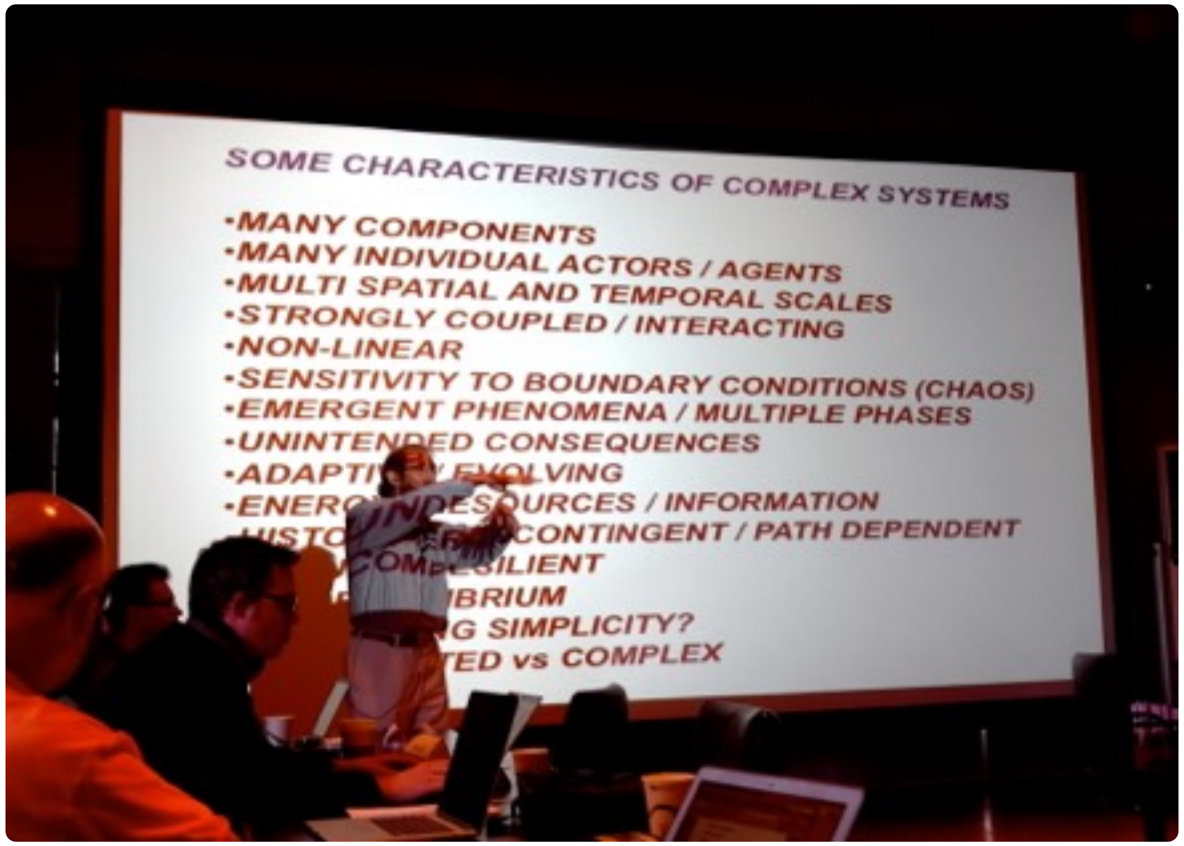
Systems

A **system** defines a set of objects acting together as part of a whole. In the urban context, a system contains buildings, infrastructure, landscape, water and other elements as its parts. Taken together, and adding their individual behaviour and multiple interactions, they form a complex system. Complex systems theory is an important field of science. Its findings are applied to many areas, including urbanisation.

The Santa Fe Institute

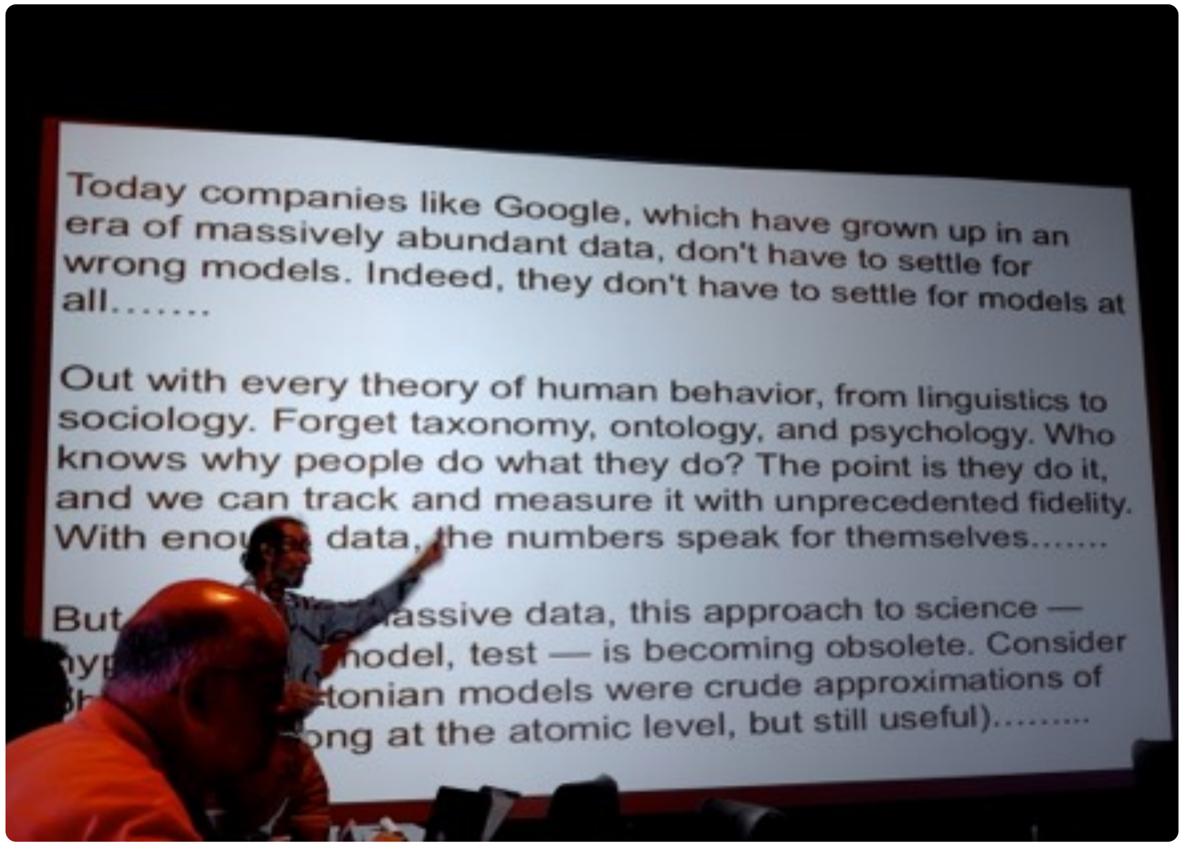
The Santa Fe Institute in New Mexico, USA, is a leading think tank on complex systems and increasingly deals with urban conglomerates as complex systems. It attracts researchers from around the world who explore different aspects of complex systems. Recently, the success of social media and large search engine companies seem to challenge some of the views that were established in the last two decades.

Gallery 10.1 Complex Systems



Schmitt, G. 2013. *Geoffrey West is a leading Complex Systems theorist. A physicist, he increasingly focuses on complex urban systems.* [Photograph]. Santa Fe Institute.

Gallery 10.2 The Santa Fe Institute



Schmitt, G. 2013. *An alternative view on systems by web companies? Geoffrey West at the Santa Fe Institute on September 20, 2013.* [Photograph].


电脑手机超级广场

Urban systems design

Systems design describes the process to define the structure, the model, the components and the necessary data for a system to perform in a desired way. In analogy, urban systems design is the process to define the underlying structure, the desired model, the necessary components and the data and information for an urban system to function in a sustainable way. In an abstract way, it is an extension of architectural design. Rather than buildings interacting with the urban system, the urban system will interact with the territorial system.

Specifications

High-level specifications for an urban system could be sustainability, value creation, happiness of the population, affordability for all income classes, positive environmental impact, and contribution to the functioning of the territorial system surrounding the urban system. The process of defining the specifications is the most challenging and important.

Processes

In a top-down process, a process owner, for example a city mayor or a city planner, assembles a transdisciplinary team of experts to address the specifications. In a bottom-up process, a community or a group of stakeholders organises itself to address the same set of specifications after formulating, ranking, expanding and discussing them carefully.

Results

The results of the process to fulfil the specifications is normally a master plan or a master rule plan. With increasing computational capabilities, crowdsourcing and design oriented social media, the design results will be visible immediately and lead to an interactive process of improving the design and performance.

Implementation

The implementation of the design results will last for years and will continue until an equilibrium is reached, or until the urban system ceases to exist. Traces of the original design can be found today in cities that are more than 2000 years old, and this strength of the original design is a phenomenon that will persist. The **memes** of the urban system design appear like the analogy to genes in biology.

Data collection and feedback

As soon as the first buildings and infrastructures are completed, data collection must start. Data and their prudent monitoring and use are crucial for the functioning of all systems. The extensive application of data in the urban design process is a new phenomenon that was not possible just a few years ago. The data and information feedback loop helps urban systems designers to adjust their designs based on the observed performance and on the degree of fulfilment of the original specifications. This opportunity is specific to the urban systems design of the 21st-century.

Why urban systems may fail

Acemoglu and Robinson convincingly argue in their book “Why Nations Fail” that the most prominent reason for the failure of nations is the extractive nature of national government, in stark contrast to the inclusive nature which fosters growth and makes nations sustainable. The authors mention numerous cities and city states to which this observation also applies.

They argue that it is not geography, or culture, or ignorance which decides if a nation will be successful or will fail. In contrast, they support the view that it is the simple difference between being extractive or inclusive. They give powerful examples under the title “How Venice Became A Museum” and described how Venice, after the decline of the Roman Empire became most likely the richest and most powerful city in the world during the Middle Ages, with several times the size of London at its time.

The description of the rise and fall of Venice, which the authors connect directly with the switch from an inclusive type of economic and political development towards an extractive type of development, was caused by the always inherent wish of the leadership and the elite to concentrate power in their own hands, rather than letting it go to new persons that constantly enrich the economic development. The authors claim that Venice today is a museum and only lives on tourists that come to visit the results of the time when inclusive governmental structures defined the city.

In view of the discussion of the three examples of Chandigarh, Brasilia and Chenzhen, inclusiveness and extraction also play an important role. Chandigarh, after many years of British extractive policies, was founded based on a top-down decision where the next capital should be built. A similar development could be claimed for Brasilia. Also here, the extractive nature of this part of South America is well argued by the authors of “Why Cities Fail”. In fact, the relative economic underperformance of Brazil as compared to North American countries could be one result, stemming from the extractive policies of the previous governments.

In this light, the rapid development of Chenzhen comes as no surprise, because it could be seen as an island of inclusive policies, enabled by an economic development zone. The rapid growth of the city within the last 30 years, which by far surpasses the growth of Chandigarh or Brasilia in more extractive contexts, could be a powerful point to support this theory. In all three cases, it seems indeed a fact that neither culture, nor climate, geography or governance led to the development of the cities as they are today. The example of Shenzhen shows, as does the example of the neighbouring Hong Kong, that inclusive institutions and local governance are dominant factors in the development of cities. They will also eventually decide on their long-term success or failure, and on their long-term sustainability and resilience.

Urban - Rural Systems

Urban systems cannot exist in isolation. They are always connected to their hinterland, or to rural systems. In fact, the combination of urban and rural systems will be one of the main features of future development. Stijn Kuipers describes this trajectory in his article “metropolitan rurality – new alliances for a legible landscape” (Kuipers, 2013). He proposes a new ordering system for the territorial landscape, consisting of (1) a natural buffer zone with 95% nature and 5% recreative infrastructure, (2) lively ribbons with forests, farm and residential yards, horticulture and agriculture, (3) multifunctional forest with some development and recreative infrastructure, (4) dwelling slow zone with fields and dwellings, and (5) industrial production landscapes with farmyards, agriculture and some recreative infrastructure. In summary, he suggests a feasible way to apply urban economies in traditional landscapes through metropolitan rurality.

Chapter 11

System: Construction

Construction used to be simple. There were 2 major approaches: subtractive construction by carving material out of existing rock or earth; or additive construction by adding material on top of each other. Today, the additive approach is dominating and most technical construction support tools are geared towards sophisticated addition of layers. Nevertheless, the construction process shows another aspect of the building as a system: material, function, and process are hyperlinked as part of the building system. This system can be represented in an abstract form as information.

Construction

TYPES OF CONSTRUCTION

Construction is the interaction with and the manipulation, partial destruction and alteration of an existing system. Construction involves the finding, processing, transporting and assembling of material. This process changes the place where the material was found, the place where it is finally used, and all the places in between to a lesser degree.

Construction used to be a localised activity, but with the advancement of construction processes and construction materials, almost every building contains components of a globalised economy. The construction process becomes more knowledge intensive, and the necessity of architects, designers and territorial planners to understand construction as the alteration of the system increases.

Pick any part of a modern building, such as a chair or an oven in any region of the world and try to retrace the path of all the components to their origin. Then, retrace the path to the origins of the materials of the components, and you will probably see a tree like structure spanning most of the globe. If, in addition, you calculate the energy needed and the CO_2 produced for mining, transporting, assembling, shipping, selling, and installing the chair or the oven, you will probably see unexpected and astonishing numbers and places, which make the tree structure even denser. Some of the parts will be equipped with RFIDs to be able to follow them back to the place they were produced, in case something goes wrong. In other words, construction has become a global activity, and it is almost impossible, to build and equip a building using only local material.

Information technology, information architecture, and the information city concept provide for the first time the opportunity to visualise and follow the life cycle of any material, building part, building equipment or even entire buildings. Construction is a typical example of material flows around the world, and probably one of the most energy and CO_2 intensive activities that can be imagined. The result of construction is a building, a material stock. Yet the building‘s life-cycle energy consumption and CO_2 production by far exceeds the amount of energy that went into its original production.

Building construction site

The construction site determines the sustainability of a building to a high degree. Given the right of choice, one could place buildings in locations where they produce more resources than they consume and could become sustainable structures over time. However, a system of restrictions protecting other aspects of the human habitat, often limits this choice to positioning a building intelligently on a small site or, in high-rises, to floor level and orientation.

Gallery 11.1 Building construction site

Schmitt, G. 2008. *Construction location and form follow the function of this simple building close to Einsiedeln.* [Photograph]. Switzerland.

Building construction material

Early construction took the material directly from the vicinity of the construction site. Clay, stone and wood in various variations were chosen in temperate climates. Protected from rain and ground moisture, even organic materials last for centuries. It was and still is the knowledge about the behaviour of the material over time that determines its sustainability. This way, old timber frame buildings can have an extremely small carbon footprint. The challenge is to connect them to modern standards of living.

Gallery 11.2 Building construction material

Schmitt, G. 2008. *Oak wood, with adobe and straw infill. These local materials help sustain this schoolhouse in Schönberg since 1697.* [Photograph].

Construction sites in the tropics

Choosing the right construction site in the tropics involved, like in temperate climates, protection from the elements and from the enemies, as well as access to food and transportation. The absence of snow and frost offers more possibilities than in temperate climates. In these areas, water plays, in general, a larger role, as it is constantly available as convenient stock and flow, providing food and mobility.

Artificial construction sites

Construction sites can be created artificially, if the ideal site cannot be found otherwise. San Francisco for example, created much artificial land to house part of the city. The same is true on a large scale for Hong Kong, Shanghai, or Singapore. Given that all criteria for settlement are perfect in a certain location, but no land is available, it is possible with technical means to create this land. The sustainability of this approach needs to be explored.

Gallery 11.3 Construction sites in the tropics

Schmitt, G. 2011. *Construction site in Nampan, South end of Inle lake in Myanmar, which serves as source of food and provides mobility.* [Photograph].

Gallery 11.4 Artificial construction sites

Bettschart, F. 2012. *View from Marina Bay Sands Hotel on the gardens by the Bay and the Marina barrage. The entire visible land is reclaimed from the sea.* [Photograph].

The archaeology of de-construction

The end of a building often reveals the best view on the construction of the structure. In countries and cities, where building materials are valuable for economic reasons, border recycling of building materials is important for ecological reasons, so every building is taken apart carefully, piece by piece. Almost turning it into an archaeological site, the recycling of buildings has turned into an art. Yet this practice is known for at least 3000 years.

Gallery 11.5 The archaeology of construction

Schmitt, G. 2013. *View on a demolition site in Einsiedeln, Switzerland, where a building is separated into its parts. This process can take a long time, but leads to meaningful recycling.* [Photograph].

Section 2

Future Cities Laboratory: construction

THE ASSISTANT PROFESSORSHIP FOR CONSTRUCTION AT THE FUTURE CITIES LABORATORY

The Future Cities Laboratory at the Singapore–ETH Centre has established an assistant professorship for architecture and construction, since 2011. Dirk Hebel, the founding assistant professor, specialises in sustainable materials and their use in the developing countries around the equator.

The following information was taken from discussions with Dirk Hebel and from the publication "(SEC) Singapore-ETH Center, (FCL) Future Cities Labaratory Booklet, 2nd edition, Zurich," revised on 27 January 2012.

Given the fact that existing and future cities become less and less dependent on their immediate hinterlands, the assistant professorship of Architecture and Construction Dirk Hebel takes special interest in the globalisation of the material flows in constructing and renovating cities. This development is seen as a challenge to the local identity of cities, but also to the efficient use and ownership of material resources. The chair places special emphasis on the category of waste, its possible location in the value chain of construction products and into its potential to increase the ecological and economical efficiency by reducing the global flow of construction materials.

The chair considers the intelligent re-use of material as direct contribution to the construction of buildings. It also conducts research on the process of recycling of potential building materials. The most interesting contribution will be the research of Dirk Hebel and his group to replace energy intensive materials in the existing construction materials. They have embarked on the systematic rediscovery of bamboo as a building material in conjunction with concrete. Eventually, after processed in a way that makes bamboo more resilient with regard to water and decomposition, it may be able to replace steel in concrete throughout wide areas of the world where urbanisation and high-density are not necessarily connected to high-rise construction.

Interactive 11.1 FCL Assistant Professorship of Architecture and Construction - description

Interactive 11.2 FCL Assistant Professorship of Architecture and Construction - exhibition pod

Chapter 12

System: Habitat

Buildings made for people quickly reach a high level of complexity, and as such they form complex information systems. The function of providing a habitat for humans has taken on different forms over time. From the early examples of simple shelters, to sustainable and resilient structures in rough environments and multifunctional mega structures in Asian cities, humans as individuals and as collective communities have shaped their habitat. Information Systems have become an essential component of each new building.

Section 1

Habitat

DEFINITION

Habitat describes the human living and working environment. For each person, it is the centre of her or his activities. Seen from the individual perspective, it appears as the increasingly dynamic spatial centre of human activities. Seen from the outside, it resembles a network with daily and yearly patterns.

Information, its stocks and flows, continuously influences the human habitat. Whereas in early human settlements the protection from and the fight against the elements was key, modern settlements shape the environment.

The United Nations Global report on human settlements describes the development in regular intervals.

The **human habitat** is the place where we spend our life. Every city, village, single house or isolated research station is part of the human habitat. In broader terms, human habitat describes human settlements and housing in particular. The United Nations produced the first **Global Reports on Human Settlements** in 1986. The following reports are entitled “An Urbanising World” (1996), “Cities in A Globalising World” (2001), “The Challenge of Slums” (2003), “Financing Urban Shelter” (2005), “Enhancing Urban Safety and Security” (2007), “Planning Sustainable Cities” (2009), “Cities and Climate Change” (2011), “Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements“ (2013). More and more, the reports come to the conclusion that the integration of all the factors described as chapters in this book - especially the stocks and flows - is crucial for the creation of long-term sustainable and liveable cities.

Focusing on the housing aspect of the human habitat yields the biggest differences between cultures, climates, stages in the development, social preferences and potential for adaptation.

Focusing on the relation between housing and information, information architecture, and information city reveals a high potential for the future in each place on earth. This potential can be realised if information is used as the enabler of a better habitat, in which the individual dwelling, apartment, house, settlement, or city interacts intelligently with its environment.

Housing

Every person needs housing. In the 20th century, housing and working were separated after the forced combination of living and working in polluted areas of the industrialised cities had led to deplorable health and social conditions. The resulting total separation of the activities, led to the known disadvantages of suburban spread, sleeping towns, gated communities and increased need for mobility and single purpose settlements. Information technology offered a first instrument to build a bridge between living and working, and thus to take a pragmatic approach towards combining the advantages of both situations. IT and individual energy generation might even bring new life into the heavily criticized suburban civilization. In Switzerland, the **Manto Report** of 1987 was a first attempt to demonstrate these possibilities.

Housing research at the Future Cities Laboratory

At the ETH Future Cities Laboratory in Singapore, Professor Sacha Menz and his research team focus on “Strategies for optimising the spatial organisation of high density urban areas”. The group assumes, that “National economic growth combined with forward strategic planning have been instrumental in the shaping of Singapore’s residential architecture since the early 1960s. As a result, Singapore’s already limited land area now comes under increasing pressure. The situation demands ever-greater optimisation of land use at urban, site and building scales. This, in turn, places pressure on the balance between functional effectiveness and liveability of the everyday built fabric. Common spaces play a pivotal role in maintaining this balance. First, through their capacity to structure interaction of inhabitants, such spaces have a regulatory effect on the sense of density in the immediate dwelling environment. Second, common spaces positively impact on the liveable quality of domestic spaces, independent of standards of living of the residents.

The ETH Chair of Architecture and the Building Process, together with ETH Centre for Research on Architecture, Society & the Built Environment (CASE), aim to collaborate with relevant Singapore-based institutions to develop an interdisciplinary strategy for exploring significant housing typologies that have emerged over the past fifty years in Singapore. A set of four empirical case studies, focused on different HDB housing estates, will combine quantitative analysis of building and site characteristics with qualitative ethnographic methods. By investigating the quantitative characteristics and spatial organisation of the building and its site, and correlating this to the role of common spaces, we seek to gain greater understanding of the liveability of cities. This gives rise to a set of specific issues concerning the way of common spaces are constituted, used and appropriated, and how this impacts on the overall liveability of particular estates. The anticipated findings of this study have the potential to contribute to the design and production of housing in Singapore as well as other high density living contexts.”

Forms of animal Habitat

Animal habitat and animal housing are areas of intensive research since centuries. Obviously, animals do not have architects or city planners, but the resulting structures sometimes remind us of human settlements. The role of data and information in the construction of animal habitat is not fully explored, but there must be a way for the animals to store the necessary construction instructions in a consistent way.

Gallery 12.1 An animal habitat

Schmitt, G. 2007. *The hornet habitat.* [Photograph]. Germany.

Forms of human Habitat

The shape and form of human habitats has changed dramatically over time. Major forces are climate, landscape, transportation potential, available building material, available financial resources, skills and knowledge of the builders. The forced or voluntary restriction to few materials and colours creates a uniform, also appealing for the human eye settlement pattern. Yet the liveability of these settlements may often not be satisfactory.

Gallery 12.2 Forms of Habitat - Sudan

Schmitt, G. 2007. *A settlement from above.* [Photograph]. Sudan.

Low-density Habitat

Although mostly urbanised, Switzerland and Europe in general still form a low-density habitat. The majority of the population lived in low-density settlements for centuries, before an accelerated move into the industrialising cities occurred in the 19th century. The low-density habitat, reaching from solitary castles to suburbia, is often the dream for people to live in. With information technology, these habitats may gain a new life.

Gallery 12.3 Low-density human habitat

Schmitt, G. 2008. *Relatively low density rural settlement in the Swiss Alps.* [Photograph]. Einsiedeln.

High-density Habitat

Typically, we associate high-density habitats with vertical cities. While Zurich reaches a density of more than 4400 people per square kilometre in its downtown area, Singapore has twice that density. This is achieved by constructing high-rises in close vicinity in the central business district and by adding residential high-rises of up to 55 floors adjacent to the central business district (CBD).

Gallery 12.4 High density human habitat

Schmitt, G. 2009. *Construction of the high density Marina Bay commercial and hotel development in Singapore.* [Photograph]

Habitat: Ora et Labora

During the Middle Ages, Europe experienced difficult times. The population in many areas of the territories suffered from rough climate, poor infrastructure, illiteracy and lack of education, epidemics and pandemics, extractive feudal systems, and often brutal and unreliable governance forms. After the year 1000, islands of education, culture, art, prosperity and sustainability emerged in the form of monasteries throughout Europe. Ora et labora - pray and work - was one of their mottos.

Gallery 12.5 Cistercian habitat in Germany, 1147-2013

Schmitt, G. 2013. *Maulbronn Monastery. Overall model, looking from East towards West.* [Photograph].

Habitat: Contemplative Environments

In Japan and the surrounding territories, shrines, temples and large monastic settlements occupy privileged areas with high liveability throughout the centuries. Often secluded and with restricted access, today they are preferred tourist attractions, especially for visitors of other civilizations or beliefs. Like their counter parts in other countries and religions, they also constitute living labs of material ageing and durability.

Gallery 12.6 Monastic habitat in Japan

Schmitt, G. 2013. *The Ojo Gokuraku-in Hall viewed from the Shinden Hall.* [Photograph]. Sanzenin Temple, close to Kyoto, Japan.

Habitat: Live and Work

In the first decades of the 20th century, the United States of America were in the most dynamic phase of their development, and urbanization increased dramatically. The discovery and availability of cheap gasoline, coupled with new production and marketing techniques, gave the automobile a strong advantage over other forms of transportation, eventually leading to the particular layout of cities such as Los Angeles.

Gallery 12.7 20th century habitat

Schmitt, G. 2013. *Transportation infrastructure and living areas.* [Photograph]. Los Angeles from the air.

Habitat: Live, Work, Play

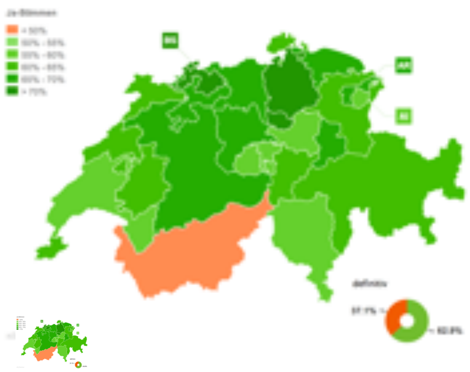
In the first decade of the 21st century, Singapore, along with Abu Dhabi, is one of the urban centres that serve as global best practice examples for emerging countries. The motto of the city of Singapore is “Live, Work, Play”, in that order. The city has also formulated 10 rules to increase liveability. They are seen by other cities as blueprints for their own development.

Gallery 12.8 Early 21st century habitat

Schmitt, G. 2013. *Live, work, play: Singapore River at night, 50 years ago a dense and polluting business area.* [Photograph].

Habitat and Information Architecture

The relations between the habitat and Information Architecture are manyfold. The more people know about their habitat, the more informed they are. Thus, they are able to make decisions that are based on more than good feelings. This is not to devalue the importance of intuitive decisions, if this intuition has been built up over years and generations based on facts. Rather, it is a plea for a more complete and better informed decision-making.



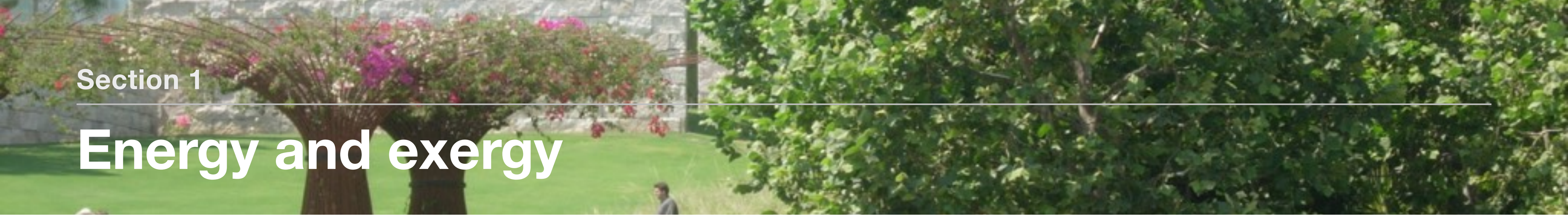
On March 3, 2013, the Swiss population voted on the revision of the "**Raumplanungsgesetz**", the equivalent to a federal zoning law. This is a surprising fact in the first place, because the zoning law authority in Switzerland - like in may countries - belongs to the villages, communities, or cities. Yet it became clear over time – through communicated data and information – that the communities had reserved large areas of previously undisturbed agricultural or natural areas for building activities. The population was informed, that every second one square metre of cultivable land was built over in Switzerland. The Swiss population knows through data, information, and personal observation that clean water, clean air, and a pristine landscape are some of the most important assets of the country. These assets constitute a precondition for tourism, and most important, for the high liveability standards of the country. This meant that the large "Baulandreserven" (building zones), which the communities had dedicated for development, would be detrimental to the overall and the local appearance of the country. Although individuals had an interest in converting their previous agricultural land into building land and thus being able to make significant profits, the overall vote was overwhelmingly against a continuous suburbanisation of the country. The initiative they eventually supported went so far, as to request that sensitive natural areas that had been zoned for building activities would be de-registered for those activities, and thus could cause considerable financial harm to the individuals.

Just a few months earlier, the Swiss population had also voted against the excessive percentage of "Zweitwohnungen" or second residences, mostly owned by foreigners. Again, data had informed the population that in some mountain villages the majority of the buildings were occupied only during a few weeks per year, ruining this way the community spirit of the villages. This vote was particularly interesting, as the urban population, who wanted to preserve the impeccable quality of the Swiss mountain villages and landscape for future generations - but owning most of the "Zweitwohnungen" - was in contrast to some of the mountain villages, who voted against the restriction of "Zweitwohnungen". The villages' reasoning was, that it would harm the local building industry if the restriction was accepted. Interestingly, the only Canton who voted against the "Raumplanungsgesetz" was the one that was most affected by the "Zweitwohnungsinitiative".

Chapter 13

System: Energy

Each building is a **system**. “A system is a set of interacting or interdependent components forming an integrated whole or a set of elements (often called 'components') and relationships which are different from relationships of the set or its elements to other elements or sets” (Wikipedia, 2014). Even the most primitive hut is a system, consisting of load-bearing parts, weather protecting parts, as well as light and temperature controlling parts.



Section 1

Energy and exergy

DEFINITIONS

For the inhabitant, a building has the purpose to provide for a safe and comfortable environment. The building can do so by passive and/or active components. The inhabitant or user of a building, apartment, office space or any other enclosed part of a structure perceives the inner view of a system.

Seen from the outside, a building causes a change to the environment it is constructed in with potential impacts going far beyond the direct vicinity of the building: The change of the Earth‘s surface on the building site, the addition of water and energy supplies, the production of waste in form of material and temperature directly influences the environmental system.

For the future, it will be crucial that the environmental system in which a building is placed is disrupted as little as possible. In that respect, energy and exergy become key concepts.

Energy and exergy

Most people are familiar with the concept of energy and its uses in buildings. They also increasingly understand and see the relation between their personal energy consumption and the long-term impact on the environment. But few are aware that the environmental system surrounding each building – air, earth, or water – offers many opportunities to make use of the energy contained in this environmental system for increasing the comfort inside the building. The concept of **exergy** thus presents a more appropriate measure of energy consumption.

Hansjürg Leibundgut is professor for building physics at the ETH Zurich, and besides performing fundamental research on exergy, he also teaches the subject and implements applications of it in his own practice. He describes the work and purpose of the Low Exergy Module in the Future Cities Laboratory as follows:

“The building sector places one of the heaviest, and increasingly unsustainable, burdens on the world’s energy resources and natural environment. The problems of climate change and finite stocks of fossil fuels will cause severe conflicts in the coming decades if there is no change in the technologies used to construct and run buildings. The supply of energy itself is not a problem because solar radiation exceeds the power requirements of human society by factors of more than 100 at every site of human population. Rather, current technologies inhibit our ability to capture and utilise available renewable energy without negative side effects.

This module proposes, as a consequence, that fundamental changes and innovations are necessary in the way we consider buildings and the flows of energy that they embody. This implies a rethinking of the way in which buildings are designed, constructed, operated, maintained, renovated and, if necessary, demolished. The module is focused on expanding the available range of solutions that can counter the current unsustainable demand that the built environment places on global energy resources. It does so at theoretical, methodological and empirical levels. The module will innovate theoretically around the concept of exergy as a more sophisticated measure of energy consumption in the building sector. It will develop and modify design software, building control and automation systems to optimize the use of renewable energy sources through the operation of low exergy systems. And finally, it will adapt and implement practical solutions being researched in Switzerland in the different climatic and cultural conditions of Singapore. These will take the form of models, pilot projects and at least one full-scaled building project.

The BubbleZERO is the first pilot of low exergy technologies in Singapore. The laboratory contains several technologies including radiant cooling, decentralized ventilation, and wireless sensing and control that will be tested and evaluated for high performance cooling operation in the tropical Singapore climate.

The Low Exergy module researches the development of new low exergy systems for the tropics. The work includes the adaption and performance assessment of existing low exergy systems that have been developed in Switzerland for heating and have been brought to Singapore for evaluation as part of the containers that now form the BubbleZERO laboratory. The research in Singapore is managed by the module coordinator and five PhD students have projects studying different aspects of the low exergy system implementation in the tropics. These topics are:

- radiant high temperature cooling
- decentralized ventilation and indoor air quality optimization
- wireless sensors and control
- low temperature heat rejection
- integrated system design, modeling and visualisation”

(Future Cities Laboratory, *Low Exergy*, 2013)

This example demonstrates, that by focusing on fundamental research, real-world applications can quickly emerge and contribute significantly both to value creation and to the improvement of the environment, by bringing their system back closer to its previous balance.

Chapter 14

System: Water

Water is both necessity and threat for urban systems. It is ubiquitous, like electricity and communication. On the building scale, it is present in almost every single room of a structure. On the city scale, water appears in the form of rivers, lakes, and drinking water reservoirs. And on the territorial scale, it appears as oceans, rivers, storage lakes and in frozen form. Technical devices and networks transform water from a raw material to a sophisticated product. For the sustainability and resilience of the city, water is absolutely crucial, and design should account for this fact.

Section 1

Stocks and flows of water

WATER

1. Building scale
2. Urban scale
3. Territorial scale

Building scale

On the architectural building scale, the use of water is obvious, but its presence is mostly concealed in temporary storage spaces and networks that connect the building to the city and eventually to the region and the territory. Typical examples of water in buildings are water tabs, showers, bath tubs, or swimming pools. Hidden are the water reservoirs needed to flush toilets and the entire sewage system.

City scale

On the city scale, water is omnipresent. We find water in ponds, in small channels next to walkways, in fountains and rivers across the city. Sometimes, water reservoirs for drinking water are located in or adjacent to the city, in other cases aqueducts lead into the city to deliver water to the local reservoirs. We also find waste water treatment stations either inside or close to the cities, before it is disposed as cleaner water into rivers and lakes.

Territorial scale

On the territorial scale, water is the most visible material on earth. Oceans, lakes, and rivers are its most obvious expressions. No society or city can survive without access to territorial sources of water. On the other hand, water can easily and rapidly become life threatening on the territorial scale, as frequent flood and tsunami phenomena demonstrate. But it also can become a slowly rising threat, as shown by the example of the Maldives (Luxner, 2009).

City and water location in history

Most of the cities in the world were founded beside, between or even in bodies of water. Historically, the immediate existence of water in the city or next to it was crucial. With the growth of cities, water had to be carried or piped in from further and further away places. This led either to a sustainable supply of water through an ever-growing network of canals, aqueducts and pipes, or to a failure of the city due to the lack of available water. Many of those failed cities have only been discovered in recent times, especially in Central America and in Southeast Asia.

Gallery 14.1 Water and city in historic times

Schmitt, G. 2011. *Emerging situation between water and city.* [Photograph]. Amarapura, Myanmar.

City and water in modern times

The modern city uses water for similar purposes as in ancient times, yet in different configurations. The dimensions are generally larger, and the physical links between water, land, and built-up structures become more technical. In general, modern cities attempt to tame the raw force of water that used to cause tremendous damage to some old cities. Modern territories and cities try to control the stock and flows of water more precisely to keep it available in necessary quantities at any given time.

Gallery 14.2 Water and city in modern times

Bettschart, F. 2013. *Water as a landscape element for recreation and as a demonstration of power.* [Photograph]. Versailles, France.

Chapter 15

System: Mobility

Mobility has many meanings, but in this context we refer to it as the capacity of citizens to freely move between their living place, their working place, their education place and any other location by any mode of transportation, using the infrastructure of the urban system or the territory surrounding it. Mobility has a growing impact on the planning and management of cities.

Section 1

System: Mobility

DEFINITION

Mobility is essential for human life. It gives us the opportunity to move from one position to another in the physical, intellectual, economic, personal or academic space. We are used to be mobile in all of these aspects. These aspects make societies move, make cities thrive, make people think and advance.

Although mobility seems a natural right for all living systems, its importance might be best explained through its absence: the gradual or complete restriction of mobility can lead to desperation and immobilisation in many aspects. Imprisonment is probably the strictest punishment for humans, as it totally constraints a person‘s ability to be mobile.

In daily life, people in countries such as Switzerland, the United States or Singapore connect mobility with transportation – both public and private. Transportation has taken on an important role in modern societies and represents up to 30% of the entire energy demand of the country.

As mobility is a crucial factor for the planning, the management and the liveability of an urban system, the Future Cities Laboratory in Singapore has dedicated a large group of researchers to this field. The mobility and transportation planning group describes their activity as follows: “The flow of people and goods within and through city areas is a fundamental dimension of contemporary urban design, planning and management. How these flows are accommodated and integrated into the fabric of the city impacts profoundly on the health and satisfaction of residents, and the economic prosperity and long-term sustainability of the city. The simulation of such flows, whether macroscopic or microscopic, static or dynamic, trip-based or agent-based, supports the aim of balancing travel demand (mobility needs) and travel supply (infrastructures of mobility). While the interaction between the daily flows and the built environment is well understood in theoretical terms and at larger spatial scales, a more refined understanding of the interactions between the actors who animate the built environment remains elusive.

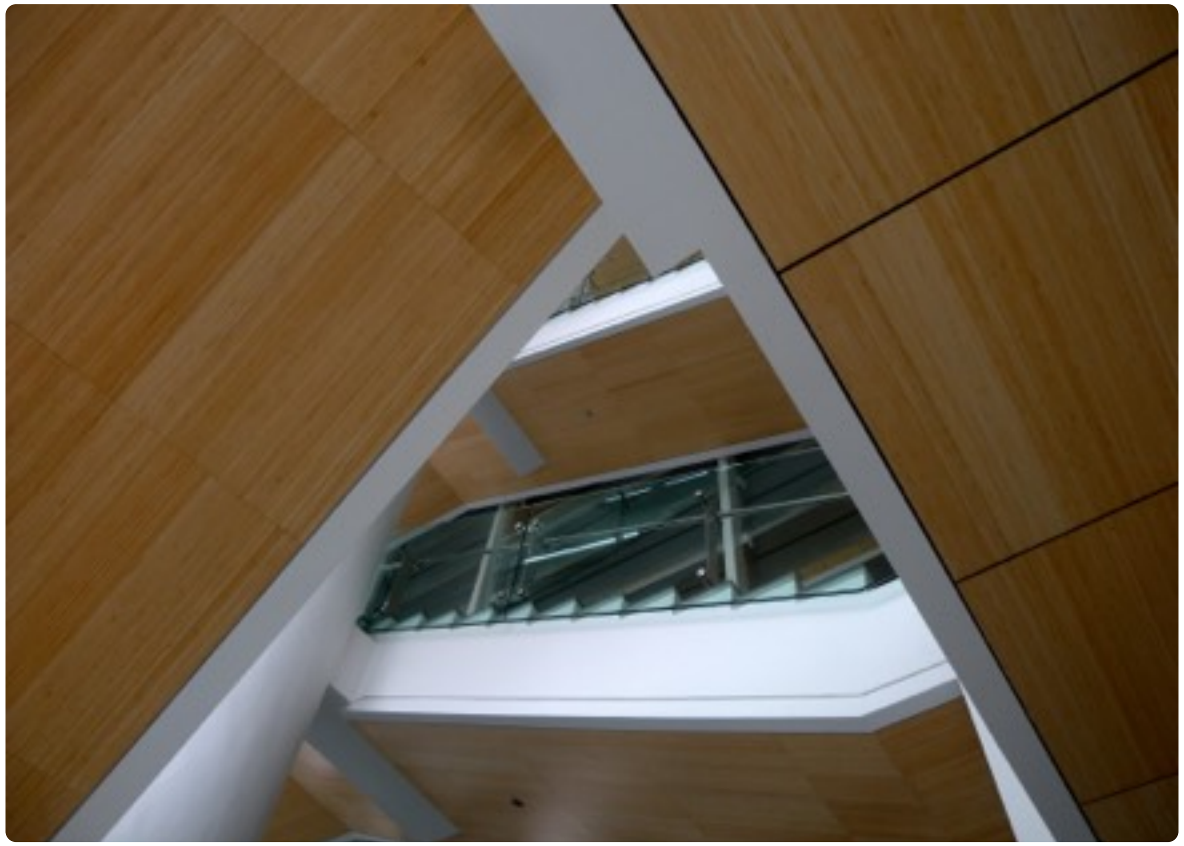
This module will advance research into this field by addressing the complexity involved in optimising the flow of a diverse range of people and goods at different time scales. It does so by extending and implementing MATSim, an agent-based transportation simulation software (developed at ETH Zurich, TU Berlin and now in Singapore – www.matsim.org), in conjunction with the acquisition of everyday social data drawn from censuses and household interviews. The module will examine medium- and long-term time scales. The medium-term scale starts with the current situation, and addresses issues such as changes in infrastructure, regulation and pricing. The long-term scale refers to more structural kinds of change such as household location choice or the choices of service providers. The insights of this research will be used to improve the understanding of residential, workplace and daily travel and location choice, as well as customer/supplier relationships between firms, and directly inform policy-making in the field of transport planning in Singapore and beyond."

(Future Cites Laboratory, *Mobility and Transportation Planning*, 2013)

Types of Mobility

Walking, riding a bicycle, driving a motor scooter, a motorbike, a car are individual types of transportation. Taking a bus, a tram, a subway, a train, a boat or a cable car are public forms of transportation. For a single trip, we often combine different types of mobility. Depending on the choice and frequency, mobility can be detrimental or beneficial for the individual's well-being and health.

Gallery 15.1 Types of mobility



Schmitt, E. 2011. *Using stairs for the simplest form of vertical mobility.* [Photograph]. CREATE staircase, Singapore.

Mobility and Architecture

In buildings, mobility ranges from small scale – to access all spaces by elderly or handicapped people – to medium scale – to connect to outside mobility systems such as cars or public transportation – and to large-scale – such as elevator systems in tall buildings. In very large buildings, that reach the population of small cities between 6000 and 20,000 people, elevator systems are crucial for internal mobility.

Mobility and Planning

On the urban or the territorial scale, mobility is one of the dominant design factors. The capacity to reach desired locations, inside and outside the city, are decision making factors. In industrialised countries, the lack of movement throughout the day can have adverse health effects. Planning can help to increase walkability and thus reduce the overall social cost of personal mobility.

Gallery 15.2 Mobility and architecture

Bettschart, F. 2011. *Ladders as vertical and boats as horizontal mobility elements on Inle Lake.* [Photograph]. Myanmar.

Gallery 15.3 Mobility and planning

Schmitt, G. 2011. *Mobility between campus buildings in Mumbai.* [Photograph]. India.

Mobility and Territory

After water and ground, the air has been used as transportation infrastructure for more than a century. Aeroplanes connect cities, countries, and continents. Compared to the distance travelled, they require minimal infrastructure in the form of airports. Beyond 300 km, air transportation is the fastest way of mobility. Yet in terms of greenhouse gases, air transportation mobility produces the highest social costs.

Gallery 15.4 Mobility and territory

Schmitt, G. 2013. *Airplanes connecting cities and continents for global mobility.* [Photograph]. Over the alps.

Future Mobility

Individual mobility will be attractive for many years to come. Yet the mass introduction of combustion engines into already polluted high-density cities shows the limit of this type of transportation. Electromobility which removes noise and air pollution, but which still requires the production of energy to charge the batteries, is an alternative next to fuel cell hydrogen propelled cars, next to improved public transportation.

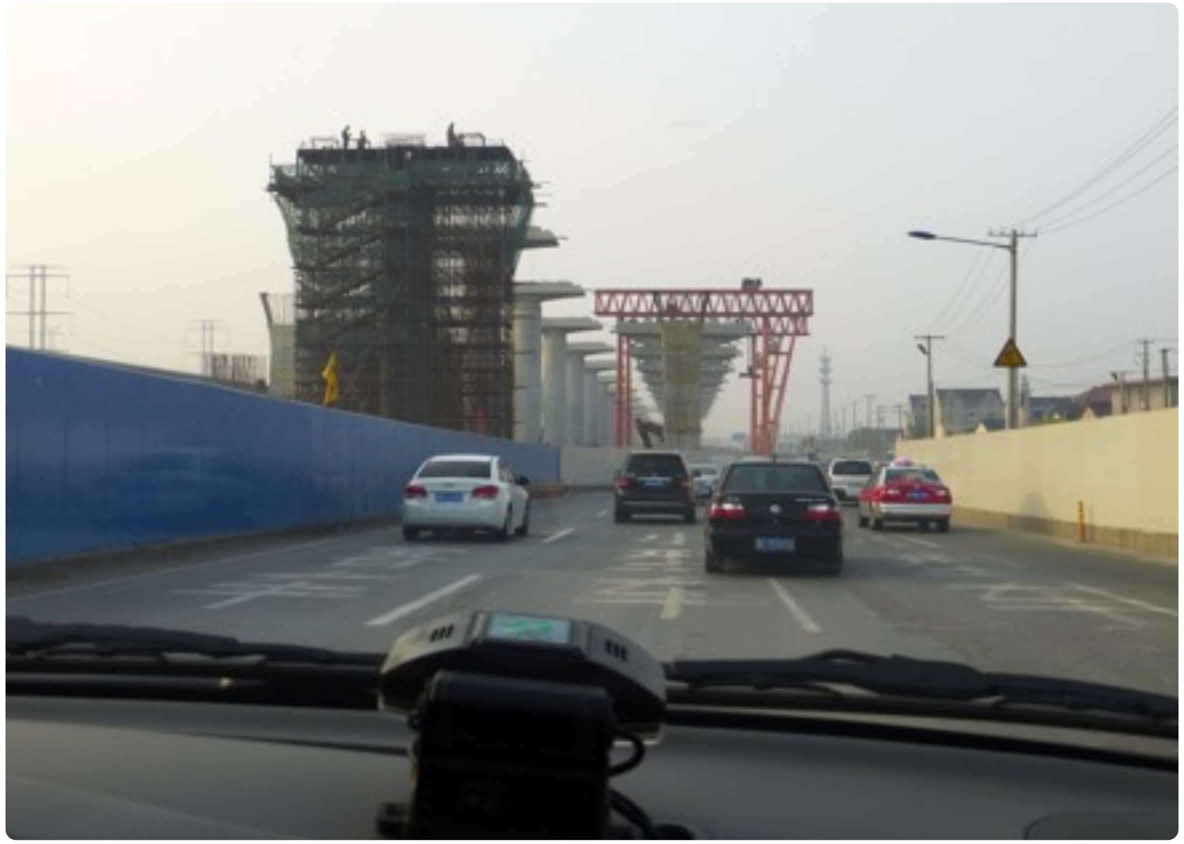
Gallery 15.5 Future mobility

Schmitt, G. 2013. *Electromobility as one possible type of future mobility.* [Photograph]. Shanghai in the morning.

Side effects of mobility

Mobility is a great achievement as it contributes to personal freedom. It always requires infrastructure. This infrastructure begins to influence the urban environment and human habitat in a massive way. Streets and railways are the most visible elements that can take up to one third of the entire city's surface. At this point, mobility can turn into a goal of its own, dominating all the previously important aspects of a liveable city.

Gallery 15.6 Side effects of mobility

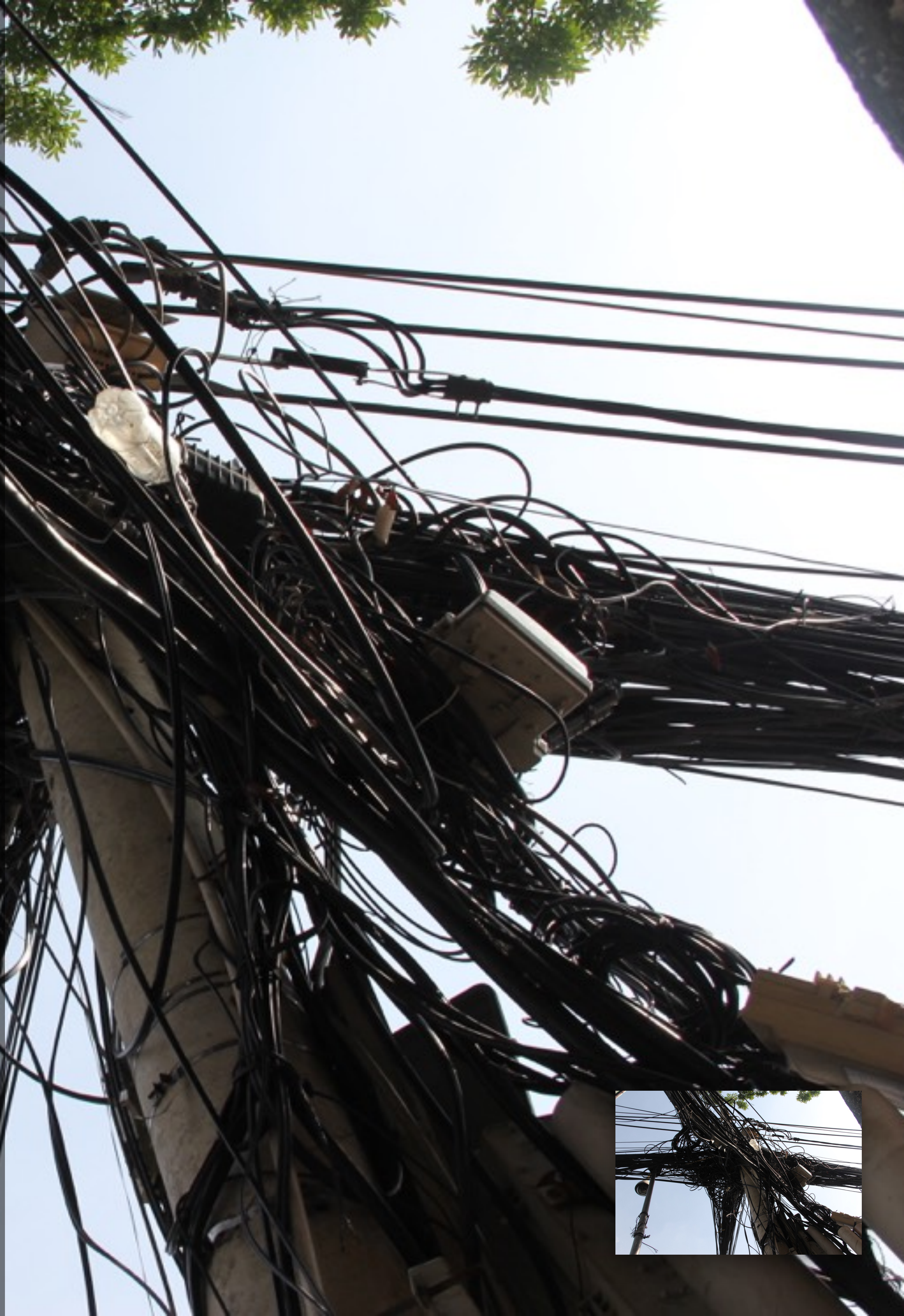


Schmitt, G. 2013. *Noise, pollution, and visual pollution are some of the side effects of transportation.* [Photograph]. Shanghai.

Chapter 16

System: Infrastructure

The impact of infrastructure such as transportation, water, health and energy on urban form and architecture is a fact. With the beginning of the 21st century, buildings and cities are becoming physical and software systems in addition to collections of material and shapes. Water, energy, transportation and health infrastructure are thus crucial dimensions for the design of future sustainable urban systems.



Section 1

Electricity Infrastructure

VIEWS ON ELECTRICITY

In this section we look at Electricity, a specific type of energy carrier, and ask the following questions, as they all have impact on architecture, urban design, and territorial planning:

- **Where is electricity being used?**
- **How is electricity transmitted and distributed?**
- **How is electricity produced?**
- **How is electricity stored?**

We focus on this view, as it enables the integration of electricity into the design process.

Electricity plays a special role among the most important energy carriers, such as crude oil, petroleum, natural gas, coal, district heat, wood, waste, gasoline for transportation, and the emerging range of alternative energies such as sun, biogas or biofuels.

Electricity

Electricity – The effects of which were known for millennia, its engineering ticking off much later - has developed into one of the planet‘s most versatile and important sources in facilitating and simplifying daily life. Its uses are endless, and we cannot imagine a day without it. It supports communication around the globe, mobility from electric vehicles to traffic lights, air travel from lighting to controlling and enabling the mechanical systems, moving people in elevators more than 800 m tall in a few seconds, transporting humans on people movers in extensive airports, cooling down our office spaces, melting gold, steel and aluminium. It literally surrounds us in our habitat. Imagine approaching a modern residential building: a sensor (uses electricity) detects you and turns on the light (uses electricity), you ring the bell (uses electricity), the door opens (uses electricity), you take the lift (uses electricity), and before you enter the door of the apartment, you may have used half a kilowatt hour already. Inside the apartment the situation continues with the use of lighting (uses electricity), air conditioning (uses electricity), heating (uses electricity), the refrigerator (uses electricity), taking a shower (uses electricity), listening to music (uses electricity), using the gym (uses electricity), or the swimming pool (uses electricity). The list of electricity uses (obvious or less obvious) is endless, and it is one of the main reasons why the per capita use of energy, and of electricity in particular, is growing continuously - in Switzerland, for example, it raised from 2000 Watt/person in 1960 to 7000 Watt/person in 2010

Building use of electricity

An average household in Switzerland uses between 3000 and 5000 kwh of electricity per year. Heating, cooling, lighting, cooking, information processing, entertainment, humidification or dehumidification: electricity provides support for all of these processes. Residents, from children to the elderly, are completely aware of the process of turning on and off electricity, with switches or dimmers. Although mishandling can lead to injury or even death, it is totally accepted today as an integral part of our building culture.

Gallery 16.1 Building use of electricity

Bettschart, M. 2010. *Electricity as source of lighting for the interior and exterior of buildings.* [Photograph]. Singapore.

Urban use of electricity

The electrification of cities occurred early on. Extensive streetlighting, electric escalators, trams and buses were the first implementations of electrification. Typically, human, animal, wood or coal powered mechanical systems were replaced with electrically powered engines. Today, electric systems are embedded in every single component of the urban system, from surveillance cameras to above ground or below ground communication lines or power lines, to subways and cooling towers.

Gallery 16.2 Urban use of electricity

Schmitt, G. 2011. *Cooling towers occupy most of the roofs of high-rise buildings in modern cities.* [Photograph]. Seoul, South Korea.

Territorial use of electricity

Electrification played a major role in connecting cities in the territories of the industrialising countries of the 19th and 20th century. Electrified high-speed trains transferred states and countries and also connected nations. Electricity opened up new transportation possibilities in tunnels, because the source of producing electricity is remote from its use. Electrically driven hydraulic pumps regulate water gates on rivers or dams. Electricity in large quantities is needed to produce copper.

Gallery 16.3 Building electricity production

Schmitt, G. 2007. *Electricity from Argentina as essential energy for the production of copper in Chile.* [Photograph]. Atacama desert.

Network use of electricity

Global networks gain importance in the 21st-century. Almost all of these networks are driven or supported by electricity. Transcontinental underwater cables need repeaters to transport information. More prominent in recent years, supercomputers, data storage devices and data centres emerge close to cities or in remote areas all around the world, where cooling is not a problem. The energy consumption of those centres in the form of electricity begins to rival that of international air transport.

Gallery 16.4 Network use of electricity

Schmitt, G. 2011. *The K supercomputer in Kobe, Japan has an installed cooling capacity of almost 30 MW.* [Photograph].

Building electricity infrastructure

In old buildings, free electric cables can be found hanging around the rooms, and in the basements sometimes the electric lines can be followed to reach the fuse boxes. Yet increasingly, the building electricity infrastructure becomes invisible by design, to reduce the danger of accidentally being exposed to high voltage. They only visible elements left are switches and power plugs, secured by different standards worldwide. Nowadays, specialists are needed in order to extend or repair this infrastructure.

Urban electricity infrastructure

Electricity needs to enter the building from the distribution network of the city scale. Tall wooden poles were the first solution to this design problem. They carry the cables transporting electricity and complication beside the streets, and from there inside the building. In advanced cities, the distribution occurs underground. In the future, this network will increasingly transport the electricity back from the building into the network.

Gallery 16.5 Building electricity infrastructure

Schmitt, G. 2009. *Light fixtures and sensors as visible electricity infrastructure in the Monte Rosa shelter.* [Photograph].

Gallery 16.6 Urban electricity infrastructure

Bettschart, F. 2012. *Electricity infrastructure. Multiple lines collect on concrete poles.* [Photograph]. Ho Chi Minh City, Vietnam.

Territorial electricity infrastructure

In territorial level, electricity infrastructure mainly corresponds to high-voltage transmission lines that criss-cross all countries and deliver high voltage electricity. Although they compose an efficient infrastructure of distribution, they often ruin the landscape views. Often, they are under attack from environmental organisations, due to the potential health risks. In general, building sites under high-voltage transmission lines do not have high value. As an alternative, underground distribution is also possible for high-voltage.

Gallery 16.7 Territorial electricity infrastructure

Schmitt, G. 2012. *High voltage power lines crossing oil palm plantations.* [Photograph]. Malaysia.

Network electricity infrastructure

Network electricity infrastructure resembles territorial electricity infrastructure, yet it can develop its own, sometimes surprising, forms. Examples are data centres in the Arctic to avoid high cooling costs, or data centres cattle farms with several thousand cattle providing the biogas to generate the electricity needed to run and cool the centre. Data centres can also contribute to district heating when they are placed inside cities in cool climates.

Gallery 16.8 Network electricity infrastructure

Schmitt, G. 2009. *Train networks as one of the first network electricity infrastructures.* [Photograph]. Rottweil, Germany.

Building electricity production

Photovoltaic and wind are the most popular building electricity production elements. Roofs are most suited to collect the sun‘s energy and to convert about 15 to 20% of it into electricity. After 30 years of research and small-scale tests, photovoltaic is becoming a feasible alternative for building owners to generate their own electricity or even sell it to the grid. Electricity generation with small windmills or light wind constructions is possible, but less popular. All of this might change, once building electricity production becomes part of lifestyle.

Gallery 16.9 Building electricity production

Schmitt, G. 2009. *The Monte Rosa shelter produces all of its electricity with photovoltaic elements.* [Photograph].

Urban electricity production

On the urban scale, electricity production has a long tradition. Water and wind where the first sources, while more recently photovoltaics have become an additional alternative. The fast flowing rivers through cities may be used to generate electricity, but will normally not be enough. Biogas plants, wind farms, or photovoltaic plants may also supplement the electricity needs of the city. However, large cities and megacities need to import most of their electricity from their hinterland or from the territory.

Gallery 16.10 Urban electricity production

Schmitt, G. 2011. *A 265 kW biogas plant supplying electricity for a part of a small town.* [Photograph]. Kastanienhof, Wadern, Germany.

Territorial electricity production

The territory is ideal for large scale electricity production. Gigantic dams, nuclear power plants, coal, oil, or gas power plants are distributed throughout the territory in the most appropriate locations, mostly remote from city centres. Wind farms begin to populate portions of Europe, North America and China, both onshore and offshore. Large biogas or waste to energy plants collect the necessary energy sources and produce electricity centrally. Yet the leftovers of the production are a problem everywhere.

Network electricity production

The electricity grid increasingly transcends national borders, and has already crossed continents. There are powerlines between Africa and Europe, or between Asia and Oceania. This fact increasingly broadens the opportunity for network electricity production. The most well-known are the Desertec initiative in northern Africa, which would be able to supply more than one fifth of Europe's electricity needs, or the gigantic Grenatec network reaching from Australia through the ASEAN countries to China and beyond.

Building electricity storage

Building electricity storage is in its infancy, although it has been a topic of active research since the 1950s. Batteries are the most obvious possibility, but also low scale versions of the large-scale energy storage devices of thinkable, such as compressed air or water tanks on top of high-rise buildings. Building electricity storage will become increasingly important, as a measure to reduce peak loads on the grid, converting buildings into smart elements in the smart grid of the future.

Urban electricity storage

Cities and urban systems have more effective ways to store energy to be converted back, almost loss-free, into electricity. They can use city internal lakes or compressed air tanks, but through incentives and legislation they could increasingly use also the batteries in electric vehicles as a temporary electricity storage, that could reduce the load on the system significantly. Yet more than storing energy, cities will have the opportunity to balance the energy use in a smart grid, by smart pricing.

Territorial electricity storage

On the territorial scale, water is probably the most efficient way to store energy to be converted back into electricity on short notice. This involves pumping water into a reservoir when electricity surplus is sufficient, and retrieving the energy in form of electricity in periods of high demand. Switzerland, Norway, and Germany are actively using this technology on the large-scale. In addition, high-pressure underground air storage is thinkable.

Network electricity storage

As it is difficult on a large scale to store electricity directly, network electricity storage involves the transformation and storage of energy that can be easily reconstructed into electricity. This involves, like into return electricity storage, the use of dams and lakes, but also the production of hydrogen or methane with excessive availability of energy sources at times when there is no demand for electricity. These sources can store the energy that is later rapidly transformed back into electricity.

Gallery 16.11 Network electricity storage

Schmitt, G. 2011. *Sihlsee close to Einsiedeln, as a network electricity storage device with a capacity of 245 MW.* [Photograph]. Switzerland.

Section 2

Photovoltaics

PHOTOVOLTAIC INDUSTRY

The photovoltaic industry is an industry that has grown in double-digits since the beginning of the new millennium. In several countries, the cost of producing electricity from photovoltaic elements has reached parity with other energy transformation technologies, such as natural gas, nuclear or oil. Yet while most experts were monitoring closely development of production costs, others had their doubts about the enormous amount of fossil energy that would go into the production of the actual photovoltaic modules.

Yet the shakeout within the industry after 2010 has led to the necessity to reduce the energy input into the production of photovoltaic modules drastically, which will lead to the fact that after 2015 the net clean electricity production from photovoltaics worldwide will be a reality.

Being a very special technology and crucial for the advance of the use of alternative energies, we dedicate a section to photovoltaics. The principle has been known for decades, and large-scale installations were first implemented in Germany and California already in the 70s and 80s of the last century. But it was not until the German government implemented specific incentives for the production of electricity and it‘s guaranteed purchase price back to the utilities that the installation of photovoltaics took off. Quickly, Germany became a leader in the production of photovoltaic elements, as well as in their widespread installation. While after the first decade of the 21st century factories in China were able to produce and sell photo tag modules at a lower price than any other country, most of the football tight production companies in Germany went bankrupt. However, the installation of photovoltaic elements, based on the attractive incentive by the government to produce energy, continued. In 2013, 40% of the world’s full double photovoltaics production area was installed in Germany, with other countries catching up quickly.

The promoters of photovoltaic had a clear agenda. The opponents argued successfully and often, that the production of the foot will require more energy than it would ever produce. Yet only in 2013, conclusive studies appeared that after 2015 the net energy bands worldwide should be positive. (Golden, 2013)

Section 3

Transport infrastructure

TRANSPORTATION INFRASTRUCTURE

Transportation infrastructure comes in many forms and it is probably the best known of all infrastructures: walkways, paths, elevators, cranes, container harbors, streets, roads, freeways, train tracks, rivers, airports or cosmodromes come to mind immediately.

Transportation infrastructure requires the planning and the investment in future of transportation needs for people or goods. It provides the framework for most human activities and interactions. It is an important element on the building scale in the form of stairs or corridors, on the urban scale in the form of walkways and streets, and upon the territorial scale in the form of highways, trailers and waterways. It has produced its own architectural expressions and will involve rapidly in the coming decade with the emergence of alternative transportation engines.

Transport infrastructure determines to a high degree our interaction with the natural and the built environment on a daily basis. In our apartment building, we use the corridors and stairs to reach the car or bicycle for private transportation or the bus, the train, or the subway for public transportation to get to work. We might use the railway, crossing mountains and rivers in tunnels and bridges to reach our destination. We might arrive at the Seaport to buy fish or to depart for a cruise, or we might just cross the river with the ferry. Transport infrastructure guarantees our mobility, a basic human need.

Transport infrastructure is also an example of the principle of stocks and flows: it guarantees that a stock can be moved from one place to the next in the most efficient and careful way, thus creating a flow of people or goods without accidents or losses. This requires sophisticated maintenance with the goal that the infrastructure has to be kept at the level of performance that it was designed for. This leads to the fact that in countries with excellent transportation infrastructure a significant part of the overall budget is going in to the constant maintenance and update of this infrastructure. Once neglected over a short or extended period of time, it becomes more and more difficult to restore the transport infrastructure to its previous level of performance. This applies to all types of transport infrastructure.

Interactive 16.1 Water Transportation infrastructure

Interactive 16.2 Mass transportation infrastructure

Chapter 17

System: Territory

The territory forms a system on its own. It is composed of urban systems and their hinterlands, which in turn consist of building systems and their infrastructure. The territorial system is composed of natural and man-made components. It is also an intellectual system that changes its character and boundaries over time. The information territory is the metaphor that connects information architecture with the information city.

Section 1

Territory

DEFINITION

A territory describes an area within natural or artificial boundaries. In the context of the human habitat, we consider two perspectives: From the city viewpoint, every human settlement is surrounded by territory. From a global perspective, a territory contains settlements, cities, and infrastructure connecting them, forming a network.

The term territory covers expressions related to countries, political systems, economic units, or human behaviour. It also refers to the area that animals request for their own habitat and which they defend against others.

We extend the definition of the urban system to that of the territorial system in a similar way as we extended the definition of the architectural system to the urban system. We consider that a territory can be described as a metabolic system that functions in analogy to a city‘s metabolism or in analogy to a building‘s metabolism.

Political territories come and go. Physical territories with their mountains, valleys, rivers, fauna, flora, cities and other human made infrastructure are normally longer lasting. The size of the territory changes with the perception of the planners or inhabitants. While the citizens of Russia or Brazil could consider their territory as almost endless, the citizens of Luxembourg or Singapore are very well aware of the precise limits of their territory.

The territory includes land, sea, rivers, air, and underground. Within this multidimensional space, cities and human infrastructure are located. Humans have created more or less artificial territorial boundaries on land, sea and sky. The physical territory is relatively stable over time, if we do not consider time spans exceeding hundreds of thousands of years, or extreme land reclamation.

Humans have organised the territory in many ways. Politically, they draw boundaries, declare everything inside their own, and defend this territory against other nations. The boundaries can be physical on land – as the former wall across Germany between the East and the West part of the country – or they can be invisible, but enforced by defending coordinates in the sea surrounding countries or the air space above countries. With the exception of Antarctica, all continental territories are claimed and dotted with cities and human settlements of varying density. An intense transportation of people and goods occurs between those settlements in the territorial lands, sea, and air.

Section 2

Territory: Relevance for the city

RELEVANCE FOR THE CITY

In planning or developing a city, knowledge of the territory is crucial for two reasons:

1. **The planner needs to understand what the citizens and the city can take from or give to the territory:**
   - **Area of influence and attraction - import: where do citizens come from, where do goods come from**
   - **What can the city offer to the territory - export: know-how, goods, finances, culture**
2. **The planner needs to understand the territorial decision makers‘ view on the city:**
   - **What does the city need in terms of flows – import: people, water, energy, materials, tourists**
   - **What can the city offer to the region or the country – export: goods, services, culture**

In the beginning of human settlement, there was only territory. Today, the territory is mainly conceived as the hinterland, or in the age of the automobile, as the countryside surrounding cities and settlements. The originally vast stretches of open countryside, forests, deserts, jungle and tundra have been converted into patches of cultivated land. The last large areas of undisturbed territory can be found in South America in the Amazonas Forest, in Siberia, and in some islands of the Pacific Ocean, mainly in Papua New Guinea.

Only a few years ago, islands such as Sumatra, Java, Borneo and New Guinea were almost undisturbed by modern civilisation. The territory was the dominating force. In the name of progress, deforestation, land reclamation, and oil palm plantations replaced the original prime growth which hosted the largest variety of animal and plant species.

Today, when we fly over Siberia, Mongolia, the Himalayas or northern China, we can still imagine how the original territory stretched for hundreds , or even thousands of kilometres without human intervention. When we fly across Europe or North America, we see entire continents of so-called cultivated land, which is the original territory converted into productive areas for human habitat. The impact of the territory on the human settlement becomes more visible in those areas were countries are urbanising rapidly, such as Southeast Asia and Africa

Siberian Territory

Siberia appears as a seemingly endless territory, reaching from the Ural mountains to Vladivostok. Over an area larger than 13,000,000 km² live less than 40 million people. Yet seen from the night sky, large heat and light emissions are evident. Responsible for this are the natural gas and oil fields in the north of Siberia. In addition, the cities in the South are far apart and spread out along the trans-Siberian Railroad. This manifests an incredible difference to the tightly populated urban and non-urban networks in South East Asia.

Gallery 17.1 System Territory

Schmitt, G. 2013. *Siberian territory: A morning in Novosibirsk.* [Photograph]. Siberia, Russia.

Singaporean Territory

In Singapore, more than 5 million people live on 715 km², and more than 250 km² were added to the island in the last 50 years. 100 years ago, Singapore was a scarcely populated island with a few fishing villages in its Northern and Eastern part, with rice fields, extensive jungle and a small concentrated British town - today's central business district- where inhabitants might have had the feeling of a territory with regard to Singapore. Today, the entire island feels more like a city with extensive parks, having completely lost its territorial appearance.

Gallery 17.2 Transformation from territory to city

Schmitt, G. 2013. *Approaching Singapore. Most of the islands in the front are artificial, or "reclaimed".* [Photograph].

Territories, settlements, cities: Governance

In the second decade of the 21st-century, China plans to enforce one of the largest resettlements of humans from the countryside into cities. More than 250 million people are encouraged to leave their previous homes and move to newly constructed towns, sometimes far away from their original houses. At the same time, in Java, Indonesia, and India, people do not concentrate in cities, but settle in large, densely populated areas without ever forming formal cities. What could be the reason for that?

Gallery 17.3 From territory to city: differences

Schmitt, G. 2012. *Rio de Janeiro, most of the settlement's inhabitants originally coming from the north of Brazil.* [Photograph].

The Haze

Slash and burn used in Sumatra, Indonesia every year, caused severe haze conditions in Singapore in June 2013. Modern technology helped to identify the sources. The Singaporean minister of environment and resources, Dr Vivian Balakrishnan said: “Our hope is that (by) publishing the coordinates of the hotspots, we will allow for crowdsourcing and identification of the companies”. (Frenchyywy, 2013)

Gallery 17.4 From territory to city: the haze

BBC, 2013. *Singapore economy suffers from smoke.* [online] (19 June 2013) Available at: <http://www.bbc.com/news/business-22961572> [Accessed 20 April 2014].

A Territorial Design Case Study

Between 2010 and 2013, the chair of Information Architecture at ETH Zurich led a research project in the Swiss National Science Foundation program NRP 65 “New Urban Qualities” under the name of “Sustainable Urban Patterns, SUPat”. The area of investigation stretched in the north of Zurich along the river Limmat, with the former villages and towns of Altstetten, Schlieren, and Dietikon. These communities increasingly become part of the agglomeration of Zurich, and at the same time want to maintain their historic and special character. The central challenges were: (1) how to achieve a sustainable transformation that could, at the same time, create new qualities (2) to develop shared ideas of future urban patterns for practical implementation, and (3) to bring together a very heterogeneous interest group with representatives of the Canton, the communities, the owners, the investors, the planners, the architects, the general public and the citizens of these communities.

The Limmattal between the city centres of Zurich and Baden is typical for the unexpected results of only loosely coordinated growth processes since the 1950s. As such, the Limmattal is a representative case for the so-called “Schweizer Normalstadt”. These are the agglomerations, in which most of the people in Switzerland live and work. The region expected a continuous and strong population growth until 2013. Not all the developments are considered positive by the population, they see the danger that the original settlements will lose their special qualities without gaining a new identity. Therefore, the Information Architecture team set out to explore mechanisms to construct a positive relation between infrastructure, settlement and landscape, and to work towards their implementation.

The heterogeneous research team found good knowledge on the disciplinary level on all scales and partners, as well as solid methods to use this knowledge in the planning process. Yet the team identified a lack of diagonal understanding between land use planning, transportation planning, ecology, sociology, and economy, when dealing with the crucial issues of Structure (topography, infrastructure by Cantonal guidelines), Shape (district, quarter by zoning plans and neighbourhood plans), and Form (buildings, green areas by architects, designers and authors). There was a lack of capacity to discuss the topics in a way that it would cross the fund skills and disciplines. Therefore, the first task was to develop a common language to define the planning and political processes and to establish a new communication and collaboration culture which had to consider (1) the dimensions of Structure, Shape, and Form, (2) in close the perspective of all scientific disciplines, and (3) respect the contributions of the different planning groups and clients on all stages of the planning process.

To achieve this, the research team built a platform for a new collaboration culture which offers instruments and practical advise for the multitude of tasks and questions on different scales.

In this process, the creation of qualitative and quantitative regional scenarios is important. The qualitative descriptions and schematic visualisations create possible images of the future region in the imagination of the participants. Yet they are not efficient and sufficient for the revision of the existing rules and regulations, because they do not concretely represent discrete spatial scales and different uses. Therefore, we employed an integrated land use model (UrbanSim) and an agent-based transport model (MATSim) for the simulation of each scenario. As starting data we could use the revised zoning plans for the region and the communities. The results are quantitative, spatially explicit visualisations of economic, ecologic and social qualities in the different scenarios. This includes, for example, the reachability on the regional level, the density of the communities, or the percentage of recreational space on the scale of a neighbourhood. Those indicators can be made visible at different times of the process. The implementation of such complex simulations can help to avoid that decisions on actions are based on to simplistic instruments which provide solutions that are meaningful only at first sight.

The results were political recommendations. Those were: (1) to organise broad-based collaboration processes in the regions, (2) to revise the local and regional strategy development and regional planning, (3) to define the goal of changing the mindset and to develop shared ideas for the future, (4) to define the instruments that accompany and support this process, and (5) to guarantee the participation of communities, the Canton, investors, architects, representatives of the population, and science.

Chapter 18

The City as an Island

The boundary between the city and its surrounding countryside is dynamic and constantly changing. The walls surrounding cities in all cultures were separating the insiders from the outsiders, the citizens from the intruders, the consumers from the producers. Today's cities are dynamic systems, where physical boundaries have mostly disappeared. Yet seen from far away, or from the perspective of information architecture, cities have become islands connected by fragile strings: islands of heat, islands of information, islands of CO_2 production, islands of culture, islands of mobility.

Section 1

City characters

CITY CHARACTERS

The hot and noisy city

Seen from a northern perspective, hot and noisy cities are often associated with the South. Yet the temperature in the city is not only determined by its geographic location, but increasingly by the way the city lives. The temperature of the city and its quarters throughout the day and throughout the years can be measured. In temperate climates, cities are usually slightly warmer than the surrounding area, which is often seen as comfortable during the night and especially in winter, when this condition helps to save heating costs. The noise level in the city can be measured differently, as well as different age groups are more less influenced by noise. It is undisputed that constant noise, and especially at night, is detrimental to human health. This has led the Western countries to heated debates for both planning and scheduling actions around airports. Just the right amount of noise in just the right quarters is seen as a sign of liveliness and quality, and as such contributes to the livability of a city. Yet looking at the livability rankings of cities on a global scale, none of the hot and noisy cities can be found in the top positions.

The cool and calm city

Cool and calm cities are often associated with a high quality of living and productivity. If this is a desirable property of the city, is it possible to build cool and calm cities in the tropics, or to convert hot and noisy cities towards lower temperatures and reduced noise levels in order to increase livability? And what would it take to achieve these goals? Looking at the Asian island city of Singapore, some of these questions might be answered.

Sources of noise

On the large scale, airplanes and particularly busy airports are a constant and prominent source of noise "from above". Thunderstorms contribute to large-scale noise as well, and can have a significant impact if they occur frequently – in Singapore more than 150 times per year. Above the ground, the constant hum of external air-conditioners can create quite a noise profile in the city. On the ground, cars are the most prominent contributors to **city noise**. Up to a certain speed the engines are louder than the wheels, and above a certain speed the tyres generate more noise than the engines. Inside the building, the constant noise of the air conditioning systems and ventilation of different computing and household equipment are prominent, but also traffic noise can contribute significantly. In high density developments, the noise is almost as strong on the top floors as on the bottom floors, with only slightly higher values on the middle floors. Over time, noise can move from being an annoyance to having adverse health effects.

Sources of heat

The main source of heat, of course, is the sun. Airplanes and airports contribute an increasing amount to urban heat. Air conditioning systems on, at, and around buildings are also contributing. Industrial areas and ports are large sources of heat. Cars, trucks, buses and subways, also add a significant amount.

A scenario for a calmer and cooler city

Imagine a situation in which we try to convert a hot and noisy city into a cool and calm city. Which actions are necessary, how costly would they be, what advantages would they have, and how can we make sure that they would have the expected effects in the time allocated? To answer these questions, we need to understand the interactions between all factors responsible for heat and noise and the city, we need to build a model, and we need to simulate the effects of changing each one of these factors.

Reducing heat in the city

Reducing the heat in the city is important, because above a certain temperature range, human action and human work become difficult. This is increasingly the case in Singapore, and the mechanical systems used to reduce the heat for the individual, are producing more heat for the overall city. Looking at the sources, the actions could be as follows: increase the reflectivity of buildings, add exterior shading devices, improve the insulation of walls and windows, and increase the efficiency of every single electrical device used in the building; move the airport to a location where the wind carries away the heat from the city, allow only fuel efficient air planes and optimise the path they take for taking off and landing. In addition, replace all combustion engines in cars with electrical drives, so that minimum heat is generated where the cars are driving. Also generate the necessary electricity with renewable resources far enough away from the city to not increase its temperature.

Reducing the noise in the city

Reducing the noise in the city could have very positive impact on the health of the citizens and would increase the livability of the city. Optimised taking off and landing paths for more fuel efficient and thus quieter and fewer air planes is one possibility. Replacing or even better eliminating individual air-conditioners from buildings and combining them in central systems would be a small-scale action. Switching from combustion engines to electrical drives would add significantly to reducing noise in the city. Finally, placing noisy and polluting factories away from the city would be the most obvious action to take.

Chapter 19

Resilient Cities

Resilient cities are those that are able to master a crisis and which are able to exit the state of crisis stronger than before. The crisis can be a war, natural catastrophes, economic developments, or unprecedented growth, as it occurred in Europe and North America after the industrial revolution, and as it presently occurs in the cities North and South of the equator, where at present the majority of the world's population lives. Resilient cities have the capacity to learn, to remember, and to transform findings of the past into strategie

Section 1

Resilience

RESILIENCE

Sustainability is a good basis for resilience. Resilient cities have a high degree of recycling and turning waste into new and useful materials. Resilient cities transform urban farming, energy generation, information sensing and processing into a lifestyle. Future cities must be planned for resilience. Existing cities can be transformed in order to become more sustainable and resilient.

Resilient cities represent the convergence of science, technology, art, design, and in particular highlight the growing importance of digital interface in our culture.

In order to make cities more resilient, we need to understand the interacting functions of the city, as well as their influence on its people and on the physical, built environment. The metaphor of an urban metabolism and the concept of stocks and flows are helpful to understand and define the factors that shape the city and make it prospering over a long period of time. Important stocks and flows of a city are related to its people: entering the city, living in the city, and leaving the city; its materials, its water, its energy, its finances, the health of its population, its density, and its information. Each one of those stocks and flows is critical, but none of them by itself can guarantee the resilience of the city.

Cities and Organisms

Cities are not organisms, but they bear similarities to organisms: they have a physical presence, a metabolism, and they constantly change. They normally start small and eventually reach a status of balance or maturity. They can grow and prosper, degrade and die. Yet each of these phases can be radically different from known organisms. Although more than half of the world‘s population lives in urbanised areas, today‘s cities are not sustainable. Their resilience greatly depends on the factors that led to their establishment and on the forces that drive them. But it mostly relies on the initiative, ingenuity and adaptability of its people. Detroit is a striking example for this observation.

Resilient Urban Patterns

Few cities today are designed and built from scratch, and few of those are immediately successful. Examples are Brasilia, Chandigarh or Masdar. Instead, a city develops under the constant interaction with its changing environment, starting from the choice of its site and the preconditions that can foster or hinder its development. Sustainable cities consist of sustainable urban patterns. Resilient cities display resilient urban patterns. Sustainability and resilience are interrelated, and design planning must be based on the knowledge of context-based best practice for sustainable and resilient urban patterns.

Sensing, Sourcing and Urban Big Data

In the past, city planners used geometric and mathematical rules to design, engineer, and build the city. Cities were expected to function and grow for a long period of time. Rarely were they planned for constant interaction with their increasingly independent and mobile citizens who demand changes. Today, crowdsourcing and sensing provide powerful instruments to dynamically influence the design and management of cities. This applies mostly to existing urban systems with a large number of people with smart phones, who actively influence the development of their city. Cities are also installing an increasing number of sensors that are able to monitor the day-to-day operations, as well as to alert with regard to expected natural or other threats. Sensing and sourcing also lead to Urban Big Data. The combination of crowd sourcing and urban sensing can increase the resilience of cities, but only if the necessary governance precautions are taken to avoid the misuse of the sensing and sourcing data.

Prosperous and resilient or poor and vulnerable

The combination of powerful information technology, sensing and sourcing, Urban Big Data and the development of intelligent computer algorithms improves the capability to look at the consequences of decisions before they are actually made. It requires the construction of computer models that represent the behavior of cities in the best possible way. These models must be able to handle the different scales of the city, which reach from the building scale to the neighborhood and urban scale, to the territorial scale encompassing the city and its hinterland as an urban-rural system. This way, simulation becomes a necessary instrument for the citizens and the city government to explore future scenarios. The more realistic the scenarios are, the more likely they will support the avoidance of risk, and increase the resilience of cities.

Chapter 20

References

Bibliography

Academia Engelberg. *Future Cities: Technology, Society and Agencies of Change. 11th Dialogue on Science, September 12 - 14, 2012.* [online] Available at: <http://www.academia-engelberg.ch/conference_2012.php5> [Accessed 19 March 2014].

Block Research Group. *NESTown: New Ethiopian Sustainable Town.* [online] Available at: <http://www.block.arch.ethz.ch/brg/research/project/nestown-new-ethiopian-sustainable-town> [Accessed 19 March 2014].

Future Cities Laboratory. *Architecture and Digital Fabrication.* [online] Available at: <http://www.futurecities.ethz.ch/module/digital-fabrication/> [Accessed 19 March 2014].

Future Cities Laboratory. *Assistant Professorship of Architecture and Construction.* [online] Available at: <http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-construction/> [Accessed 19 March 2014].

Future Cities Laboratory. *Assistant Professorship of Architecture and Territorial Planning.* [online] Available at: <http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-territorial-planning/> [Accessed 19 March 2014].

Future Cities Laboratory. *Assistant Professorship of Architecture and Urban Design.* [online] Available at: <http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-urban-design/> [Accessed 19 March 2014].

Future Cities Laboratory. *Housing*. [online] Available at: <http://www.futurecities.ethz.ch/module/housing/> [Accessed 19 March 2014].

Future Cities Laboratory. *Landscape Ecology.* [online] Available at: <http://www.futurecities.ethz.ch/module/landscape-ecology/> [Accessed 19 March 2014].

Future Cities Laboratory. *Low Exergy*. [online] Available at: <http://www.futurecities.ethz.ch/module/low-exergy/> [Accessed 19 March 2014].

Future Cities Laboratory. *Mobility and Transportation Planning.* [online] Available at: <http://www.futurecities.ethz.ch/module/mobility-and-transportation-planning/> [Accessed 19 March 2014].

Future Cities Laboratory. *Simulation Platform.* [online] Available at: <http://www.futurecities.ethz.ch/module/simulation-platform/> [Accessed 19 March 2014].

Future Cities Laboratory. *Territorial Organisation.* [online] Available at: <http://www.futurecities.ethz.ch/module/territorial-organisation/> [Accessed 19 March 2014].

Future Cities Laboratory. *Transforming and Mining Urban Stocks.* [online] Available at: <http://www.futurecities.ethz.ch/module/transforming-and-mining-urban-stocks/> [Accessed 19 March 2014].

Future Cities Laboratory. *Urban Design Strategies and Resources.* [online] Available at: <http://www.futurecities.ethz.ch/module/urban-design-strategies-and-resources/> [Accessed 19 March 2014].

Future Cities Laboratory. *Urban Sociology*. [online] Available at: <http://www.futurecities.ethz.ch/module/urban-sociology/> [Accessed 19 March 2014].

Aschwanden, G. D. P. A., Wullschleger, T., Müller, H. and Schmitt, G., 2012. Agent based evaluation of dynamic city models: A combination of human decision processes and an emission model for transportation based on acceleration and instantaneous speed. *Automation in Construction*, 22, pp.81-89.

Berger, M., 2012. Urban heat-balling. In: T. K. Sheng and P. Hing, eds. 2012. *Sustainable future energy 2012 : International Energy Conference, Brunei Darussalam & 10th Sustainable Energy and Environment (SEE) Forum Proceeding.* Bandar Seri Begawan: University Brunei Darussalam. pp.445-451.

Dai, D., Prasad, M., Schmitt, G. and Van Gool, L., 2012. Learning Domain Knowledge for Facade Labelling. In: A. Fitzgibbon, S. Lazebnik, P. Perona, Y. Sato and C. Schmid, eds. 2012. *Computer Vision - ECCV 2012.* Springer Berlin Heidelberg. pp.710-723.

Giap, T. K., Woo, W. T., Tan, K. Y., Low, L. and Ee, L. G. A., 2012. *Ranking the Liveability of the World's Major Cities*. Singapore: World Scientific Pub.

Gruen A., 2013. Next generation Smart Cities - The role of Geomatics. In: ISPRS (International Society for Photogrammetry and Remote Sensing), *International Workshop on "Global Geospatial Information"*. Novosibirsk, Russian Federation, 25 April 2013. Novosibirsk: SSGA

Huang, X., Gruen, A., Qin, R., Du, T. and Fang, W., 2013. Integration of mobile laser scanning data with UAV imagery for very high-resolution 3D city modelling. In: ISPRS (International Society for Photogrammetry and Remote Sensing), *(MMT 2013) 8th International Symposium on Mobile Mapping Technology.* Tainan, Taiwan, 1-3 May 2013.

Jacobs, J., 1969. *The Economy of Cities.* New York: Random House Inc.

Kuipers, S, 2013. Metropolitan rurality – new alliances for a legible landscape. In: *Built Environment 2012 – 2013*. Rotterdam: Department of the built environment at Eindhoven university of technology and nai010 publishers. pp.36 - 38.

Moosavi, V. and Hovestadt, L., 2013. Modeling Urban Traffic Dynamics in Coexistence with Urban Data Streams. In: 2nd ACM SIGKDD International Workshop on Urban Computing, *19th ACM SIGKDD Conference on Knowledge Discovery and Data Mining (KDD).* Chicago, USA, 11-14 August 2013. New York: ACM USA.

Müller Arisona, S., Aschwanden, G., Halatsch, J. and Wonka, P., 2012. *Digital Urban Modeling and Simulation.* Springer Berlin Heidelberg.

Müller Arisona, S., Zhong, C., Huang, X. and Qin, R., 2013. Increasing detail of 3D models through combined photogrammetric and procedural modelling. *Geo-Spatial Information Science,* 16(1), pp45-53.

Papadopoulou, M., Raphael, B., Smith, I.F.C. and Sekhar, C., 2013. Sensor Placement for Predicting Airflow Around Buildings to Enhance Natural Ventilation. In: ASHRAE IAQ 2013 Proceedings: Environmental Health in Low Energy Buildings, *IAQ 2013 Conference.* Vancouver, British Columbia, Canada, 15-18 October 2013.

Qin, R., Gruen, A. and Huang, X., 2012. UAV project - Building a reality-based 3D model of the NUS (National University of Singapore) campus. In: AARS (Asian Association on Remote Sensing), *33rd Asian Conference on Remote Sensing 2012.* Pattaya, Thailand, 26-30 November 2012. New York: Curran Associates, Inc.

Raphael, B. and Smith, I.F.C., 2013. *Engineering Informatics: Fundamentals of computer-aided engineering*. 2nd ed. New York: John Wiley & Sons, Inc.

Roman, M., 2013. Four Chairs and all the others / EigenChair. In: 31st eCAADe Conference, *Computation and Performance*. Faculty of Architecture, Delft University of Technology, Delft, The Netherlands, 18-20 September 2013.

Schmitt, G. 2013. Spatial modeling issues in future smart cities. *Geo-Spatial Information Science,* 16(1), pp7-12.

Schmitt, G. 2013. The Future Cities Laboratory. *disP - The Planning Review,* 48(3), pp64-67.

Shin, D., Müller Arisona, S., Georgakopoulou, S., Schmitt, G. and Kim, S., 2012. A Crowdsourcing Urban Simulation Platform on Smartphone Technology: Strategies for Urban Data Visualization and Transportation Mode Detection. In: 30th eCAADe Conference, *Digital Physicality*. Czech Technical University in Prague, Faculty of Architecture, Czech Republic,12-14 September 2012.

Takashi, U., 1996. *Archaeology of the Future City: Mirai Toshi No Kokogaku [Exposition Itinérante, 1996].* Tokyo: Tokyo Shimbun.

Vernay, D.G., Raphael, B. and Smith, I.F.C., 2013. Augmenting Simulations with Measurements: Application to Building-scale Wind-flow Modeling. In: Computational Intelligence for Engineering Solutions (CIES), *2013 IEEE Symposium.* Singapore, 16-19 April 2013. Singapore: IEEE.

Wang, T., 2013. Interdisciplinary Urban GIS for Smart Cities: Advancements and Opportunities. *Journal of Geo-Spatial Information Science,* 16(1), pp.25–34.

Zeng, W., Fu, C.W., Müller Arisona, S. and Qu, H., 2013. Visualizing Interchange Patterns in Massive Movement Data. *Computer Graphics Forum*, 32(3pt3), pp.271–280.

Zhong, C., Wang, T., Zeng, W. and Müller Arisona, S., 2012. Spatiotemporal Visualisation: A Survey and Outlook. In S. Müller Arisona, P. Wonka, G. Aschwanden, and J. Halatsch, ed. 2012. *Digital Urban Modeling and Simulation*. Communications in Computer and Information Science (CCIS), Volume 242: Springer Berlin Heidelberg.

Non-Scientific Publications

Singapore-ETH Centre features collaborative wall to enhance discussions. *System Integrations Asia*, Issue December-January 2013, pp.82-83.

Frenchyywy. *Worst haze in 16 years sparks diplomatic tension.* [online] Available at: <http://frenchyywy.unblog.fr/2013/06/20/worst-haze-in-16-years-sparks-diplomatic-tension/> [Accessed 06 May 2014].

Golden, M., 2013. Global solar photovoltaic industry is likely now a net energy producer, Stanford researchers find. *Stanford news*, [online] Available at: <http://news.stanford.edu/news/2013/april/pv-net-energy-040213.html> [Accessed 06 May 2014].

Luxner, L., 2009. Raising the Maldives. *Saudi Aramco World, Arab and Islamic cultures and connections,* [online] Available at: <http://www.saudiaramcoworld.com/issue/200903/raising.the.maldives.htm> [Accessed 05 May 2014].

Platt, H.K., 2012. Zaha Hadid vs. the Pirates: Copycat Architects in China Take Aim at the Stars. *Spiegel online International,* [online] Available at: <http://www.spiegel.de/international/zeitgeist/pirated-copy-of-design-by-star-architect-hadid-being-built-in-china-a-874390.html> [Accessed 05 May 2014].

Wikipedia, 2014. System. [online] Available at: <http://en.wikipedia.org/wiki/System> [Accessed 15 April 2014]

Acemoglu and Robinson

"Why Nations Fail: The Origins of Power, Prosperity, and Poverty is a non-fiction book by two American economists, Daron Acemoglu from the Massachusetts Institute of Technology and James A. Robinson from Harvard University. The book applies insights from institutional economics, development economics and economic history to answer why nations develop differently, with some succeeding in the accumulation of power and prosperity, while others fail. The authors also maintain a website (with an active blog) about the themes of the book."

Wikipedia, 2013. *Why Nations Fail.* [online] Available at: <http://en.wikipedia.org/wiki/Why_Nations_Fail> [Accessed 24 March 2014].

Acemoglou, D. and Robinson, J.A., 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York: Crown Publishers.

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Alex Lehnerer

“PLANS AND POLITICS

We investigate collective form and its physicality as a result of historical and contemporary processes, as well as projective conception—at a scale bigger than a building and smaller than a city. The methodological analysis of collective form does not only include comparative observations and critical commentary, but also the search for strategic tools that can be used to shape our built environment in order to produce specific public qualities as cumulative effects. The intellectual challenge lies exactly in the confrontation of the individual with the collective, the object with texture, the political with the planned, and autonomy within its cultural context. The results are thematic formats that can be read as critical discursive urban projects, both as research and pedagogy.”

Future Cities Laboratory. *Assistant Professorship of Architecture and Urban Design.* [online] Available at: <http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-urban-design/> [Accessed 24 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Barriers

“In parallel computing, a barrier is a type of synchronization method. A barrier for a group of threads or processes in the source code means any thread/process must stop at this point and cannot proceed until all other threads/processes reach this barrier.

Many collective routines and directive-based parallel languages impose implicit barriers. For example, a parallel do loop in Fortran with OpenMP will not be allowed to continue on any thread until the last iteration is completed. This is in case the program relies on the result of the loop immediately after its completion. In message passing, any global communication (such as reduction or scatter) may imply a barrier.”

Wikipedia. *Barrier (computer science).* [online] Available at: <http://en.wikipedia.org/wiki/Barrier_(computer_science)> [Accessed 24 March 2014].

Related Glossary Terms

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Index Begriff suchen

Centre for Liveable Cities, Singapore

"Vision: A leading knowledge centre for liveable and sustainable cities

The Centre for Liveable Cities (CLC) was set up in 2008 based on a strategic blueprint developed by Singapore's Inter-Ministerial Committee on Sustainable Development. The Centre's mission is to distil, create and share knowledge on liveable and sustainable cities. CLC distils key learning points from Singapore's experiences over the last half-century, while creating knowledge to address emerging challenges. It also shares knowledge with, and learns from, other cities and experts.

CLC receives guidance from its Advisory Board, comprising senior figures from academia, industry and the public sector. A high-level panel of Distinguished Advisors - comprising prominent former politicians and senior civil servants - contributes to the intellectual development of the Centre. CLC works closely with its Stakeholder Agencies - representing Singapore's urban planning, governance and development expertise - to integrate their knowledge. CLC Experts are domain experts with technical knowledge and expertise that CLC will tap for future consultancy projects. The Centre operates as part of the Ministry of National Development, and comprises a dynamic CLC Team of officers from diverse disciplines and backgrounds. Guided by the CLC Framework for Liveable and Sustainable Cities, the Centre works across three main areas - Research, Capability Development, and Promotion.

Research is central to the Centre's work, and is conducted in close collaboration with local and international partners. CLC's research activities include its Integrated Urban Solutions Research, and Research Workshops, as well as Urban Systems Studies. The Centre develops print and digital Publications for global audiences, to share its research as well as the knowledge of its partners, through such titles as the Singapore Urban Systems Studies booklet series, the biannual Urban Solutions magazine, as well as the monthly CLC e-Newsletter.

Capability Development is a key arm of the Centre's activities, as it aims to draw on its research to become a leading academy for cities. CLC's flagship initiative in this area is its Leaders in Urban Governance Programme for local public servants, as well as the Temasek Foundation Leaders in Urban Governance Programme, which is aimed at international city leaders.

Promotion refers to the Centre's efforts to collaborate with partners to share knowledge, particularly through Events. CLC is a co-organiser of the World Cities Summit - the global platform for government leaders and industry experts to address liveable and sustainable city challenges, share innovative urban projects and forge partnerships. CLC also co-organises the World Cities Summit Mayors Forum, and the Lee Kuan Yew World City Prize. The regular CLC Lecture Series is another platform for thought leaders and experts to exchange ideas and share knowledge. Supporting these efforts, CLC forges strategic Partnerships with local and international experts and organisations."

Centre for Liveable Cities. *About CLC.* [online] Available at: <http://www.clc.gov.sg/AboutUs/Aboutclc.htm> [Accessed 27 March 2014].

Related Glossary Terms

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Index Begriff suchen

Chen ZHONG

"Chen Zhong is a PhD candidate at ETH Zurich's Future Cities Laboratory. Her background is computer engineering. Her research interests include spatial analysis, spatiotemporal visualization, and urban simulation. Currently, she is working on spatial analysis and modelling of transportation data, and aims at building a GIS-based simulation model to support urban planning decision-making. 2011.2 - now PhD candidate @ Singapore-ETH centre (Singapore) Major in spatial analysis and modelling Supervisor: Prof. Gerhard Schmitt, Prof. Michael Batty and Dr. Stefan Muller Arisona 2010.9-2010.12 Research Assistant @ AVIZ, INRIA (France) 2010.3-2010.8 Exchange Student @ CERMA, ECNantes (France) 2008.9-2010.6 Master student @ LIESMARS, Wuhan University (China) 2004.9-2008.6 Bachelor student @ Wuhan University (China)

RESEARCH

Her PhD research is focusing on spatiotemporal analysis of urban movement and land use patterns, taking Singapore as a case study. This research make insights into the use of urban space through mining the transportation data, including surveyed data and smart card data, which reflect people's daily travel behaviors. These travel behaviors are considered as a function of urban functionality, spatial interaction, spatial structure of centers and borders, which are elements of land use planning. In general, this research seeks for a deeper understanding of urban dynamics. The main idea is to integrate geographic science with design, resulting in a systematic methodology to support urban planning."

Future Cities Laboratory. *Chen ZHONG.* [online] Available at: <http://www.futurecities.ethz.ch/person/chen-zhong/> [Accessed 24 March 2014].

Related Glossary Terms

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Index Begriff suchen

Christian Schmid

"Christian Schmid is geographer, sociologist and urban researcher. He is Titular Professor of Sociology at the Department of Architecture, ETH Zurich, and Researcher at ETH Studio Basel / Contemporary City Institute.

Christian Schmid was born in Zurich in 1958 and studied Geography and Sociology at the University of Zurich. Since 1980, he has been active as video activist, organizer of cultural events and urban researcher. He was part of the group Ssenter for Applied Urbanism (SAU), and worked in the Rote Fabrik cultural centre in Zurich. He has authored, co-authored, and co-edited numerous publications on Zurich's urban development, on international comparative analysis of urbanization, and on theories of the city and of space. In 1991, he was a cofounder of the International Network for Urban Research and Action (INURA). In 1993–94, he was a fellow researcher at the Laboratoire de Géographie Urbaine, Université Paris X Nanterre, and in 1995–96 he worked in the interdisciplinary research project La ville: villes de crise ou crise des villes, Institut d'Architecture, Université de Genève. From 1997–2001 he was an assistant lecturer for economic geography and regional research at the Geography Department of the University of Bern. In 2003, he received his Ph.D. from the Friedrich Schiller University in Jena. The book with the title Stadt, Raum und Gesellschaft – Henri Lefebvre und die Theorie der Produktion des Raumes (City, space and society – Henri Lefebvre and the theory of the production of space) was published in 2005. In 1999, he became the scientific director of the project Switzerland: An Urban Portrait at the ETH Studio Basel. A book with the same title was published in 2005, authored by Roger Diener, Jacques Herzog, Marcel Meili, Pierre de Meuron and Christian Schmid. Since 2001, he has been a lecturer in Sociology at the Faculty of Architecture of ETH Zurich. Since 2009 he has been Titular Professor at the Faculty of Architecture of ETH Zurich."

Chair of Sociology. *Prof. Dr. Christian Schmid.* [online] Available at: < http://www.soziologie.arch.ethz.ch/en/prof-dr-christian-schmid2> [Accessed 24 March 2014].

More information about Prof. Dr. Christian Schmid and Urban Sociology module can also be found in the following link: http://www.futurecities.ethz.ch/module/urban-sociology/

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Christophe Girot and Paolo Burlando

Prof. Christophe Girot

"Christophe Girot is Full Professor at the Chair of Landscape Architecture at the Department of Architecture of the Swiss Federal Institute of Technology in Zurich (ETH). His research addresses three fundamental themes: New topological methods in landscape design, new media in landscape analysis and perception, recent history and theory of landscape design. Emphasis is placed on the fields of action in contemporary large-scale urban landscape with a particular attention given to sustainable design."

Chair of Landscape Architecture. *Prof. Christophe GIROT.* [online] Available at: <http://girot.arch.ethz.ch/about-us/welcome-to-our-chair/former-staff/christophe-girot> [Accessed 31 March 2014].

Prof. Paolo Burlando

"He actively carries out research as individual and research group leader in the fields of water resources planning and management, rainfall field analysis (mathematical models of precipitation, scaling properties of rainfall fields) hydrologic extreme forecasting and prediction (real-time prediction of temporal rainfall, flood forecasting and real-time rainfall prediction, design criteria of hydrological forecasting systems, extreme value analysis in the frequency domain), global change and water resources (downscaling of climate scenarios from Global Circulation Models, analysis of long-term hydrological time-series, impact of global change on the hydrological cycle and on water resources systems, impact of global change on urban drainage systems design), water resources in mountainous regions, hydrology and ecology interactions in mountain floodplains."

Institute of Environmental Engineering. *Prof. Paolo Burlando.* [online] Available at: <http://www.ifu.ethz.ch/staff/paolob/index_EN> [Accessed 31 March 2014].

More information about Prof. Christophe Girot, Prof. Paolo Burlando and Landscape Ecology module can also be found in the following link: http://www.futurecities.ethz.ch/module/landscape-ecology/

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

City noise

“A major source of urban noise is attributed to mass transit as well as other transportation modes. Noise from motor vehicles includes engine acceleration, tire/road contract, horns, and alarms. Therefore, strategies to decrease noise are being considered to improve the quality of life among urban dwellers.The associated health outcomes from noise are considerable.”

UCLA HIA-CLIC. *Noise Pollution.* [online] Available at: <http://www.hiaguide.org/sectors-and-causal-pathways/pathways/noise-pollution> [Accessed 29 April 2014].

“Le bruit est depuis longtemps la principale source de nuisance de la population, en particulier en milieu urbain, et les exigences en matière de confort sonore ne cessent d'augmenter. L'approche de la dimension sonore prend donc une place de plus en plus importante tout au long des processus d'élaboration des projets architecturaux et urbanistiques, tant au niveau de la conception que de la réalisation ou de l'exploitation.”

EPFL. *Acoustique et mobilité, 2011-2012, Bachelor semestre 6*. [online] Available at: <http://isa.epfl.ch/imoniteur_ISAP/!itffichecours.htm?ww_i_matiere=321157184&ww_x_anneeAcad=2011-2012&ww_i_section=69034007&ww_i_niveau=&ww_c_langue=fr> [Accessed 29 April 2014].

More information about City Noise can also be found in the following link: http://www.gcaudio.com/resources/howtos/loudness.html

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Related Glossary Terms

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Chapter 18 - Energy and exergy

City Science

“Why Cities?

The world is experiencing a period of extreme urbanization. In China alone, 300 million rural inhabitants will move to urban areas over the next 15 years. This will require building an infrastructure equivalent to the one housing the entire population of the United States in a matter of a few decades.

In the future, cities will account for nearly 90% of global population growth, 80% of wealth creation, and 60% of total energy consumption. Developing better strategies for the creation of new cities, is therefore, a global imperative.

Our need to improve our understanding of cities, however, is pressed not only by the social relevance of urban environments, but also by the availability of new strategies for city-scale interventions that are enabled by emerging technologies. Leveraging advances in data analysis, sensor technologies, and urban experiments, City Science will provide new insights into creating a data-driven approach to urban design and planning. To build the cities that the world needs, we need a scientific understanding of cities that considers our built environments and the people who inhabit them. Our future cities will desperately need such understanding.”

Massachusetts Institute of Technology. *About City Science.* [online] Available at: <http://cities.media.mit.edu/about/cities> [Accessed 29 April 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Crowdsourcing

“Crowdsourcing is the practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, rather than from traditional employees or suppliers. This process is often used to subdivide tedious work or to fund-raise startup companies and charities, and can also occur offline.[2] It combines the efforts of numerous self-identified volunteers or part-time workers, where each contributor of their own initiative adds a small portion to the greater result. The term “crowdsourcing” is a portmanteau of “crowd” and “outsourcing”; it is distinguished from outsourcing in that the work comes from an undefined public rather than being commissioned from a specific, named group.

The word “crowdsourcing” was coined in 2005 and can apply to a wide range of activities. [3] Crowdsourcing can involve division of labor for tedious tasks split to use crowd-based outsourcing, but it can also apply to specific requests, such as crowdfunding, a broad-based competition, and a general search for answers, solutions, or a missing person.”

Wikipedia. *Crowdsourcing.* [online] Available at: <http://en.wikipedia.org/wiki/Crowdsourcing> [Accessed 29 April 2014].

More information about Crowdsourcing can also be found in the following sources:

http://www.wired.com/wired/archive/14.06/crowds.html?pg=1&topic=crowds&topic_set=

Hudson - Smith, A., Batty, M., Crooks, A. and Milton, R., 2009. Mapping for the Masses: Accessing Web 2.0 through Crowdsourcing. *Social Science Computer Review*, 27, 524-538.

Related Glossary Terms

Second Life

Index Begriff suchen

Data

“Data (/ˈdeɪtə/ day-tə or /ˈdætə/ da-tə, also /ˈdɑːtə/ dah-tə) is a set of values of qualitative or quantitative variables; restated, data are individual pieces of information. Data in computing (or data processing) are represented in a structure that is often tabular (represented by rows and columns), a tree (a set of nodes with parent-children relationship), or a graph (a set of connected nodes). Data are typically the results of measurements and can be visualised using graphs or images. Data as an abstract concept can be viewed as the lowest level of abstraction, from which information and then knowledge are derived.

Raw data, i.e., unprocessed data, refers to a collection of numbers, characters and is a relative term; data processing commonly occurs by stages, and the “processed data” from one stage may be considered the “raw data” of the next. Field data refers to raw data that is collected in an uncontrolled in situ environment. Experimental data refers to data that is generated within the context of a scientific investigation by observation and recording.

The word data is the traditional plural form of the now-archaic datum, neuter past participle of the Latin dare, “to give”, hence “something given”. In discussions of problems in geometry, mathematics, engineering, and so on, the terms givens and data are used interchangeably. This usage is the origin of data as a concept in computer science or data processing: data are accepted numbers, words, images, etc.

Data is also increasingly used in humanities (particularly in the growing digital humanities) the highly interpretive nature whereof might oppose the ethos of data as “given”. Peter Checkland introduced the term capta (from the Latin capere, “to take”) to distinguish between an immense number of possible data and a sub-set of them, to which attention is oriented.[1] Johanna Drucker has argued that the humanities affirm knowledge production as “situated, partial, and constitutive” and that using data may therefore introduce assumptions that are counterproductive, for example that phenomena are discrete or observer-independent.[2] The term capta, which emphasizes the act of observation as constitutive, is offered as an alternative to data for visual representations in the humanities.”

Wikipedia. *Data.* [online] Available at: <http://en.wikipedia.org/wiki/Data> [Accessed 24 March 2014].

Related Glossary Terms

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Index Begriff suchen

Datum

“Etymology: From Latin datum.

datum (plural data or datums)

1. (plural: data) A measurement of something on a scale understood by both the recorder (a person or device) and the reader (another person or device). The scale is arbitrarily defined, such as from 1 to 10 by ones, 1 to 100 by 0.1, or simply true or false, on or off, yes, no, or maybe, etc.
2. (plural: data) (philosophy) A fact known from direct observation.
3. (plural: data) (philosophy) A premise from which conclusions are drawn.
4. (plural: datums) (cartography, engineering) A fixed reference point.”

Wiktionary. *Datum.* [online] Available at: <http://en.wiktionary.org/wiki/datum> [Accessed 24 March 2014].

Related Glossary Terms

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Chapter 2 - Data, information, knowledge

Dirk Hebel

“Dirk Hebel is currently holding the position of Assistant Professor of Architecture and Construction at the Future Cities Laboratory in Singapore. Prior to that, he was the founding Scientific Director of the Ethiopian Institute of Architecture, Building Construction and City Development in Addis Ababa, Ethiopia. Between 2002 and 2009 he taught at the Department of Architecture, ETHZ as the coordinator for first year architectural design program and the director of the’ Master of Advanced Studies’ program in Urban Design with Prof. Dr. Marc Angélil. The resulting work of his teaching and research has been published in numerous academic journals and book publications, lately SUDU: THE CONSTRUCTION OF A SUSTAINABLE URBAN DWELLING UNIT (forthcoming) and CITIES OF CHANGE ADDIS ABABA (with Marc Angélil). In 2008, he published the book DEVIATIONS (with Marc Angélil), an experiment in architectural design pedagogy and in 2005 BATHROOM UNPLUGGED (with Jörg Stollmann). Dirk Hebel practices architecture by activating unusual building materials such as air (DISCOVERIES, an exhibition for the Foundation Lindau Nobel Prize Winners and ON_AIR, and installation for KunstWerke Berlin), water (as the project manager for the BLUR Building for EXPO.02 in Switzerland) or plastic bottles (as in the award-winning project UNITED_BOTTLE).

RESEARCH

The research of Dirk Hebel at FCL Singapore concentrates on alternative building materials and construction techniques and their applications in the field. Currently, he and his team investigate the possibility to replace steel as a reinforcement material in structural concrete applications with an organic fiber composite material. He and his team are also engaged in a research on waste as an alternative building material.”

Future Cities Laboratory. *Asst Prof Dirk HEBEL*. [online] Available at: <http://www.futurecities.ethz.ch/person/asst-prof-dirk-hebel/> [Accessed 24 March 2014].

More information about Asst Prof. Dirk Hebel can also be found in the following links:

http://www.hebel.arch.ethz.ch

http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-construction/

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

DOE-2

“Project Status: Legacy

DOE-2 is a computer program for the design of energy-efficient buildings. Developed for the U.S. Department of Energy by Lawrence Berkeley National Laboratory's Simulation Research Group, DOE-2 calculates the hourly energy use and energy cost of a commercial or residential building given information about the building's climate, construction, operation, utility rate schedule, and HVAC equipment.”

Simulation Research Group. *DOE-2.* [online] Available at: <http://simulationresearch.lbl.gov/projects/doe2> [Accessed 24 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Ecotect

“Autodesk® Ecotect® Analysis sustainable design analysis software is a comprehensive concept-to-detail sustainable building design tool. Ecotect Analysis offers a wide range of simulation and building energy analysis functionality that can improve performance of existing buildings and new building designs. Online energy, water, and carbon-emission analysis capabilities integrate with tools that enable you to visualize and simulate a building's performance within the context of its environment.”

Autodesk. *Autodesk Ecotect Analysis.* [online] Available at: <http://usa.autodesk.com/ecotect-analysis/> [Accessed 24 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Chapter 8 - Types of simulation

Electricity

“Electricity is the set of physical phenomena associated with the presence and flow of electric charge. Electricity gives a wide variety of well-known effects, such as lightning, static electricity, electromagnetic induction and electrical current. In addition, electricity permits the creation and reception of electromagnetic radiation such as radio waves.

In electricity, charges produce electromagnetic fields which act on other charges. Electricity occurs due to several types of physics:

- electric charge: a property of some subatomic particles, which determines their electromagnetic interactions. Electrically charged matter is influenced by, and produces, electromagnetic fields.

- electric field (see electrostatics): an especially simple type of electromagnetic field produced by an electric charge even when it is not moving (i.e., there is no electric current). The electric field produces a force on other charges in its vicinity.

- electric potential: the capacity of an electric field to do work on an electric charge, typically measured in volts.

- electric current: a movement or flow of electrically charged particles, typically measured in amperes.

- electromagnets: Moving charges produce a magnetic field. Electrical currents generate magnetic fields, and changing magnetic fields generate electrical currents.

In electrical engineering, electricity is used for:

- electric power where electric current is used to energise equipment;

- electronics which deals with electrical circuits that involve active electrical components such as vacuum tubes, transistors, diodes and integrated circuits, and associated passive interconnection technologies.

Electrical phenomena have been studied since antiquity, though progress in theoretical understanding remained slow until the seventeenth and eighteenth centuries. Even then, practical applications for electricity were few, and it would not be until the late nineteenth century that engineers were able to put it to industrial and residential use. The rapid expansion in electrical technology at this time transformed industry and society. Electricity's extraordinary versatility means it can be put to an almost limitless set of applications which include transport, heating, lighting, communications, and computation. Electrical power is now the backbone of modern industrial society.[1]

The word electricity is from the New Latin ēlectricus, “amber-like”[a], coined in the year 1600 from the Greek ήλεκτρον (electron) meaning amber, because electrical effects were produced classically by rubbing amber.”

Wikipedia. *Electricity.* [online] Available at: <http://en.wikipedia.org/wiki/Electricity> [Accessed 24 March 2014].

Related Glossary Terms

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ETH Zurich

“ETH Zurich is one of the leading international universities for technology and the natural sciences. It is well known for its excellent education, ground-breaking fundamental research and for implementing its results directly into practice.

Founded in 1855, ETH Zurich today has more than 18,000 students from over 110 countries, including 3,900 doctoral students. To researchers, it offers an inspiring working environment, to students, a comprehensive education.

Twenty-one Nobel Laureates have studied, taught or conducted research at ETH Zurich, underlining the excellent reputation of the university.”

ETH. [online] Available at: <https://www.ethz.ch/en/the-eth-zurich.html> [Accessed 19 September 2014].

More information about ETH Zurich can also be found in the following link:

http://en.wikipedia.org/wiki/ETH_Zurich

Related Glossary Terms

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Exergy

" "Available energy" redirects here. For the meaning of the term in particle collisions, see Available energy (particle collision).

In thermodynamics, the exergy of a system is the maximum useful work possible during a process that brings the system into equilibrium with a heat reservoir. When the surroundings are the reservoir, exergy is the potential of a system to cause a change as it achieves equilibrium with its environment. Exergy is the energy that is available to be used. After the system and surroundings reach equilibrium, the exergy is zero. Determining exergy was also the first goal of thermodynamics. The term "exergy" was coined in 1956 by Zoran Rant (1904–1972) by using the Greek ex and ergon meaning "from work", but the concept was developed by J. Willard Gibbs in 1873.

Energy is never destroyed during a process; it changes from one form to another (see First Law of Thermodynamics). In contrast, exergy accounts for the irreversibility of a process due to increase in entropy (see Second Law of Thermodynamics). Exergy is always destroyed when a process involves a temperature change. This destruction is proportional to the entropy increase of the system together with its surroundings. The destroyed exergy has been called anergy. For an isothermal process, exergy and energy are interchangeable terms, and there is no anergy.

Exergy analysis is performed in the field of industrial ecology to use energy more efficiently. Engineers use exergy analysis to optimize applications with physical restrictions, such as choosing the best use of roof space for solar energy technologies.[3] Ecologists and design engineers often choose a reference state for the reservoir that may be different from the actual surroundings of the system.

Exergy is a combination property of a system and its environment because it depends on the state of both the system and environment. The exergy of a system in equilibrium with the environment is zero. Exergy is neither a thermodynamic property of matter nor a thermodynamic potential of a system. Exergy and energy both have units of joules. The Internal Energy of a system is always measured from a fixed reference state and is therefore always a state function. Some authors define the exergy of the system to be changed when the environment changes, in which case it is not a state function. Other writers prefer[citation needed] a slightly alternate definition of the available energy or exergy of a system where the environment is firmly defined, as an unchangeable absolute reference state, and in this alternate definition exergy becomes a property of the state of the system alone.

However, from a theoretical point of view, exergy may be defined without reference to any environment. If the intensive properties of different finitely extended elements of a system differ, there is always the possibility to extract mechanical work from the system. Also, it is possible to formulate the exergetic content of a single body in thermodynamical disequilibrium (with intensive properties varying with location, such as having a temperature gradient).

The term exergy is also used, by analogy with its physical definition, in information theory related to reversible computing. Exergy is also synonymous with: availability, available energy, exergic energy, essergy (considered archaic), utilizable energy, available useful work, maximum (or minimum) work, maximum (or minimum) work content, reversible work, and ideal work.

The exergy destruction of a cycle is the sum of the exergy destruction of the processes that compose that cycle. The exergy destruction of a cycle can also be determined without tracing the individual processed by considering the entire cycle as a single process and using one of the exergy destruction equations. Information found in thermodynamics by Yunus A. Cengel"

Wikipedia. *Exergy.* [online] Available at: <http://en.wikipedia.org/wiki/Exergy> [Accessed 24 March 2014].

Related Glossary Terms

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Chapter 13 - Energy and exergy

Extraction

In their book “Why Nations Fail: The Origins of Power, Prosperity, and Poverty”, Daron Acemoglu and James Robinson identify extraction as the main negative aspect in leading a country to failure. They describe extractive businesses, extractive corporations, extractive governments and extractive countries. None of them enables the long-term growth and sustainability that help nations to survive over long periods of time.

Acemoglou, D. and Robinson, J.A., 2012. *Why Nations Fail: The Origins of Power, Prosperity, and Poverty.* New York: Crown Publishers.

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Fabio Gramazio and Matthias Kohler

“Prof Gramazio, along with Prof Kohler, also founded the world’s first architectural robotic laboratory at the Swiss Federal Institute of Technology ETH Zurich, the academic research of Gramazio & Kohler concentrates on a multi-disciplinary practice between computational design, robotic fabrication and material innovation. This ranges from 1:1 prototypical installations to the design of the design of robotically fabricated high-rise buildings at the SEC Future Cities Laboratory (FCL). Gramazio & Kohler were awarded the Swiss Art Awards, the Global Holcim Innovation Prize and the Acadia Award for Emerging Digital Practice.”

Future Cities Laboratory. *Prof. Fabio GRAMAZIO.* [online] Available at: <http://www.futurecities.ethz.ch/person/prof-fabio-gramazio/> [Accessed 31 March 2014].

More information about Fabio Gramazio and Matthias Kohler can also be found in the following links:

http://www.futurecities.ethz.ch/module/digital-fabrication/

http://www.futurecities.ethz.ch/person/prof-matthias-kohler/

Related Glossary Terms

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Future Cities Preface - Future Cities Preface

Fences

“Fencing is the process of isolating a node of a computer cluster or protecting shared resources when a node appears to be malfunctioning.[1][2]

As the number of nodes in a cluster increases, so does the likelihood that one of them may fail at some point. The failed node may have control over shared resources that need to be reclaimed and if the node is acting erratically, the rest of the system needs to be protected. Fencing may thus either disable the node, or disallow shared storage access, thus ensuring data integrity.”

Wikipedia. *Fencing (computing).* [online] Available at: <http://en.wikipedia.org/wiki/Fencing_(computing)> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Firewall

“In computing, a firewall is a software or hardware-based network security system that controls the incoming and outgoing network traffic by analyzing the data packets and determining whether they should be allowed through or not, based on applied rule set. Firewalls can be defined in many ways according to your level of understanding. A firewall establishes a barrier between a trusted, secure internal network and another network (e.g., the Internet) that is not assumed to be secure and trusted.

Many personal computer operating systems include software-based firewalls to protect against threats from the public Internet. Many routers that pass data between networks contain firewall components and, conversely, many firewalls can perform basic routing functions.”

Wikipedia. *Firewall (computing).* [online] Available at: <http://en.wikipedia.org/wiki/Firewall_(computing)> [Accessed 25 March 2014].

Related Glossary Terms

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Future Cities Laboratory

“The Future Cities Laboratory (FCL) is a transdisciplinary research centre focused on urban sustainability in a global frame. It is the first research programme of the Singapore-ETH Centre for Global Environmental Sustainability (SEC). It is home to a community of over 100 PhD, postdoctoral and Professorial researchers working on diverse themes related to future cities and environmental sustainability.

Challenge

Cities accommodate more people today than at any point in history. Cities are more interconnected than ever before. Cities concentrate some of the most intractable of contemporary social, political and economic dilemmas. And, as substantial consumers of energy and producers of greenhouse gases, cities are central to the project for global environmental sustainability. But successful cities are also, more than ever, the engines of national and transnational economies, sites of diversity and creativity, and centres of innovation and entrepreneurship. As such, cities are likely to be the places where the challenges of urbanisation and environmental sustainability will be most productively addressed.

The general principles of sustainable, equitable and vibrant development for cities are well known. They are the basis of such documents as the report of the World Commission on Environment and Development, the Global Agenda 21, and the United Nations Millennium Goals. Achieving the ambitious goals set out in these documents involves appreciating both the threats that cities pose to social equity and environmental sustainability, and the potential they contain to innovatively respond to such threats. More specifically, we ask: how might cities be designed, produced, managed, maintained, and inhabited in a way that supports the aims of global sustainability? The Future Cities Laboratory is committed to addressing both the wider threat and potential of the contemporary city, and the specific implications of this question through a transdisciplinary frame.”

Future Cities Laboratory. *Future Cities Laboratory (FCL).* [online] Available at: <http://www.futurecities.ethz.ch/about/fcl/> [Accessed 27 March 2014].

More information about The Future Cities Laboratory (FCL) can also be found in the following link: http://www.futurecities.ethz.ch

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Related Glossary Terms

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Gini coefficient

“The Gini coefficient (also known as the Gini index or Gini ratio) (/dʒini/) is a measure of statistical dispersion intended to represent the income distribution of a nation's residents. It was developed by the Italian statistician and sociologist Corrado Gini and published in his 1912 paper “Variability and Mutability” (Italian: Variabilità e mutabilità).

The Gini coefficient measures the inequality among values of a frequency distribution (for example levels of income). A Gini coefficient of zero expresses perfect equality, where all values are the same (for example, where everyone has the same income). A Gini coefficient of one (or 100%) expresses maximal inequality among values (for example where only one person has all the income). However, a value greater than one may occur if some persons have negative income or wealth. For larger groups, values close to or above 1 are very unlikely in practice.

Gini coefficient is commonly used as a measure of inequality of income or wealth. For OECD countries, in the late 2000s, considering the effect of taxes and transfer payments, the income Gini coefficient ranged between 0.24 to 0.49, with Slovenia the lowest and Chile the highest. The countries in Africa had the highest pre-tax Gini coefficients in 2008–2009, with South Africa the world's highest at 0.7. The global income inequality Gini coefficient in 2005, for all human beings taken together, has been estimated to be between 0.61 and 0.68 by various sources.

There are some issues in interpreting a Gini coefficient. The same value may result from many different distribution curves. The demographic structure should be taken into account. Countries with an aging population, or with a baby boom, experience an increasing pre-tax Gini coefficient even if real income distribution for working adults remains constant. Scholars have devised over a dozen variants of the Gini coefficient.”

Wikipedia. *Gini coefficient.* [online] Available at: <http://en.wikipedia.org/wiki/Gini_coefficient> [Accessed 25 March 2014].

Related Glossary Terms

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Chapter 7 - Urban sociology

Global report on Human Settlements

“Planning and Design for Sustainable Urban Mobility argues that the development of sustainable urban transport systems requires a conceptual leap. The purpose ‘transportation’ and ‘mobility’ is to gain access to destinations, activities, services and goods. Thus access is the ultimate objective of transportation. As a result, urban planning and design should focus on how to bring people and places together, by creating cities that focus on accessibility, rather than simply increasing the length of urban transport infrastructure or increasing the movement of people or gods. Urban form and the functionality of the city are therefore a major focus of this report, which highlights the importance of integrated land-use and transport planning.”

UN-HABITAT, 2013. *Planning and Design for Sustainable Urban Mobility: Global Report on Human Settlements 2013*. UN-HABITAT.

Related Glossary Terms

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Begriff suchen

Hansjürg Leibundgut and Arno Schlüter

“Hansjürg Leibundgut has been Professor of Building Systems at the Institute of Technology in Architecture at ETH Zurich since the 15th September 2005. After studying mechanical engineering at ETH Zurich with the main focus of his studies on reactor technology and fluid dynamics, he became involved in the fields of solar technology and absorption technology and concluded his time at ETH with a dissertation. After 4 years' industrial experience he transferred to Zurich's cantonal administration. In 1989 he returned to the private sector and became part-owner and chief engineer with Amstein + Walthert AG. Due to a lack of suitable construction components, he has been developing various new products for decentralised building systems since 1997, in conjunction with Swiss industrial partners. This involvement became a key aspect of his research at ETH, out of which the system Sol2ergie emerged”.

Future Cities Laboratory. *Prof Dr Hansjürg LEIBUNDGUT*. [online] Available at: < http://www.futurecities.ethz.ch/person/prof-dr-hansjurg-leibundgut/> [Accessed 15 April 2014].

“Arno Schlüter received his diploma in architecture at Technische Universität Karlsruhe, Germany in 2003. During his studies he worked as a student researcher at the Institute of Industrial Building Production (Prof. Dr. Niklaus Kohler, em. Prof. Dr. Fritz Haller) focusing on computer application in architectural design. He continued his education at ETH Zurich, pursuing postgraduate studies in Computer Aided Architectural Design (Prof. Dr. Ludger Hovestadt) and his dissertation in the fields of information technology and sustainable building systems as a researcher at the Building Systems Group (Prof. Dr. Hansjürg Leibundgut). To apply the research in real-life building projects he co-founded the ETH CleanTech Spinoff keoto AG in 2009, where he is currently head of the management board. In 2010 he was appointed Assistant Professor of Architecture & Sustainable Building Technologies at the Institute of Technology in Architecture (ITA), ETH.”

Future Cities Laboratory. *Asst Prof Dr Arno SCHLÜTER.* [online] Available at: <http://www.futurecities.ethz.ch/person/prof-dr-arno-schluter/> [Accessed 15 April 2014].

More information about Hansjürg Leibundgut, Arno Schlüter and the Low Exergy module can also be found in the following link: http://www.futurecities.ethz.ch/module/low-exergy/

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Human habitat

"Any of the conditions in which people live. Also all human settlements in villages, towns or major cities, which require environmental management to provide water, public spaces, remove public wastes, etc. (Source: WRIGHT)

broader terms:

human settlement

related terms:

Housing"

EIONET GEMET Thesaurus. *human habitat.* [online] Available at: <http://www.eionet.europa.eu/gemet/concept?ns=1&cp=13120> [Accessed 25 March 2014].

Related Glossary Terms

Liveability

Index Begriff suchen

Chapter 12 - Habitat

Inclusion

"Inclusion is an organizational practice and goal stemming from the sociological notion of inclusiveness which is the political action and personal effort but at the same time the presence of inclusion practices in which different groups or individuals having different backgrounds like origin, age, race and ethnicity, religion, gender, sexual orientation and identity and other are culturally and socially accepted and welcomed, equally treated, etc.

Miller and Katz (2002) presents a common definition of an inclusive value system where they say, "Inclusion is a sense of belonging: feeling respected, valued for who you are; feeling a level of supportive energy and commitment from others so than you can do your best work." Inclusion is a shift in organization culture. The process of inclusion engages each individual and makes people feeling valued essential to the success of the organization. Individuals function at full capacity, feel more valued, and included in the organization's mission. This culture shift creates higher performing organizations where motivation and morale soar.

Gasorek (1998) notes her success of instituting diversity and inclusion initiatives at Dun & Bradstreet, a credit-reporting firm. Hyter and Turnock (2006) offer several case studies of engaging inclusion with corporate organizations such as BellSouth, Frito-Lay, Home Depot, and Procter & Gamble.

Roberson (2006) notes that the term inclusion is often coupled with the term diversity and these terms are often used interchangeably, however they are distinctly different. The Institute for Inclusion, a nonprofit organization, has collectively attempted to define inclusion apart from diversity. It has developed a set of core values and general principles and conceives of inclusion as requiring a paradigm shift in human consciousness, awareness, and interaction.

Interactional participation skills are not currently standardized in formal evaluations of communicative competence, and there will probably be much controversy surrounding any proposals to standardize the testing of interactional competence. Nonetheless, we need some set of inclusion guidelines to decide what skills to look for and how to document them. (page 116, Sawzin, 1984)

This study focused on the aspects of Jennie that can be appreciated. "Positive analysis" is a strategy which has much utility in many contexts, but is very much needed in the lives of children and adults with developmental difficulties. There are many opportunities for parents, professionals and neighbors to minimize their fears, and to move from expectations of deviance to acceptances of difference. (page 122, Sawzin, 1984)

Also see for paradigms out of phase, Martin Sawzin, 1981, Paradigmatic Aphasia and An Antidote: Developmentalism"

Wikipedia. *Inclusion (value and practice).* [online] Available at: <http://en.wikipedia.org/wiki/Inclusion_(value_and_practice)> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Chapter 7 - Urban sociology

Information

“Information (shortened as info or info.) is that which informs, i.e. that from which data can be derived. Information is conveyed either as the content of a message or through direct or indirect observation of some thing. That which is perceived can be construed as a message in its own right, and in that sense, information is always conveyed as the content of a message. Information can be encoded into various forms for transmission and interpretation. For example, information may be encoded into signs, and transmitted via signals.

In Thermodynamics, information is any kind of event that affects the state of a dynamic system that can interpret the information.

Information resolves uncertainty. The uncertainty of an event is measured by its probability of occurrence and is inversely proportional to that. The more uncertain an event, the more information is required to resolve uncertainty of that event. The bit is a typical unit of information, but other units such as the nat may be used. Example: information in one "fair" coin flip: log2(2/1) = 1 bit, and in two fair coin flips is log2(4/1) = 2 bits.

The concept that information is the message has different meanings in different contexts. Thus the concept of information becomes closely related to notions of constraint, communication, control, data, form, instruction, knowledge, meaning, understanding, mental stimuli, pattern, perception, representation, and entropy.”

Wikipedia. *Information.* [online] Available at: <http://en.wikipedia.org/wiki/Information> [Accessed 19 September 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Chapter 2 - Data, information, knowledge

Information architecture

“Information architecture (IA) is the structural design of shared information environments; the art and science of organizing and labeling websites, intranets, online communities and software to support usability and findability; and an emerging community of practice focused on bringing principles of design and architecture to the digital landscape. Typically, it involves a model or concept of information which is used and applied to activities that require explicit details of complex information systems. These activities include library systems and database development.

Historically the term “information architect” is attributed to Richard Saul Wurman[page needed] and now there is a growing network of active IA specialists who comprise the Information Architecture Institute.”

Wikipedia. *Information architecture.* [online] Available at: <http://en.wikipedia.org/wiki/Information_architecture> [Accessed 25 March 2014].

Related Glossary Terms

Information cities, Richard Saul Wurman

Index Begriff suchen

Chapter 2 - INFORMATION Architecture

Information cities

Information city describes the extension of information architecture to the urban scale. In analogy to information architecture, information city has two main meanings: (1) making the invisible visible on the scale of a city and thus helping to understand the functioning of an interaction between components of the city, and to design new cities; (2) information city might become a metaphor for the structuring and ordering of vast amounts of data, created increasingly by the city‘s inhabitants and its infrastructure.

With information city we do not mean the various InfoCities projects that focus on the seamless integration of information and communication technologies. We also do not mean completely virtual cities.

Related Glossary Terms

Information architecture

Index Begriff suchen

Chapter 3 - Information city

Jantar Mantar

“The Jantar Mantar is located in the modern city of New Delhi. It consists of 13 architectural astronomy instruments. The site is one of five built by Maharaja Jai Singh II of Jaipur, from 1724 onwards, as he was given by Mughal emperor Muhammad Shah the task of revising the calendar and astronomical tables. There is a plaque fixed on one of the structures in the Jantar Mantar observatory in New Delhi that was placed there in 1910 mistakenly dating the construction of the complex to the year 1710. Later research, though, suggests 1724 as the actual year of construction.

The primary purpose of the observatory was to compile astronomical tables, and to predict the times and movements of the sun, moon and planets. Some of these purposes nowadays would be classified as astronomy.

Completed in 1724, the Delhi Jantar Mantar had decayed considerably by 1867. Much like the Great Sphinx of Egypt, however, it was not too late to return the calculating instruments of Delhi’s Jantar Mantar to their former glory.”

Wikipedia. *Jantar Mantar, Delhi.* [online] Available at: <http://en.wikipedia.org/wiki/Jantar_Mantar,_Delhi> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Chapter 2 - INFORMATION ARCHITECTURE

Kay Axhausen

Prof. Dr. Kay Axhausen is a Professor at the Institute for Transport Planning and Systems (IVT) of ETH Zurich.

More information about Prof. Dr. Kay Axhausen can be found in the following links:

http://www.ivt.ethz.ch/people/axhausen/index_EN

http://www.futurecities.ethz.ch/module/mobility-and-transportation-planning/

Related Glossary Terms

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Future Cities Preface - Future Cities Preface

Kees Christiaanse

"Kees Christiaanse studied architecture and urban planning at the TU Delft. From 1980 until 1989 he worked for the Office of Metropolitan Architecture (OMA) in Rotterdam, becoming a partner in 1983. In 1989 Kees Christiaanse founded his own office ir. Kees Christiaanse Architects & Planners in Rotterdam, KCAP since 2002, which expanded to Shanghai and Zurich. From 1996 until 2003 he taught architecture and urban planning at TU Berlin (DE). Since 2003 he is professor at the ETH in Zurich (CH). In 2009 Kees Christiaanse was curator of the International Architecture Biennale Rotterdam (IABR) entitled "Open City. Designing Coexistence". Since 2011 Kees Christiaanse is Programme Leader of the Future Cities Laboratory in Singapore and Principal Investigator as well as Module Leader for Module IV 'Urban Design Strategies and Resources'. Next to his work as an architect, Kees focuses on urban assignments in complex situations and guiding urban processes. He is a consultant to several airports and expert in the development of university campuses and in the revitalisation of former industrial, railway and harbour areas."

Future Cities Laboratory. *Prof Kees CHRISTIAANSE.* [online] Available at: <http://www.futurecities.ethz.ch/person/prof-kees-christiaanse/> [Accessed 25 March 2014].

More information about Kees Christiaanse and the Urban Design Strategies and Resources module can also be found in the following link: http://www.futurecities.ethz.ch/module/urban-design-strategies-and-resources/

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Knowledge

“Knowledge is a familiarity, awareness or understanding of someone or something, such as facts, information, descriptions, or skills, which is acquired through experience or education by perceiving, discovering, or learning. Knowledge can refer to a theoretical or practical understanding of a subject. It can be implicit (as with practical skill or expertise) or explicit (as with the theoretical understanding of a subject); it can be more or less formal or systematic. In philosophy, the study of knowledge is called epistemology; the philosopher Plato famously defined knowledge as “justified true belief”. However, no single agreed upon definition of knowledge exists, though there are numerous theories to explain it.

Knowledge acquisition involves complex cognitive processes: perception, communication, association and reasoning; while knowledge is also said to be related to the capacity of acknowledgment in human beings.”

Wikipedia. *Knowledge.* [online] Available at: <http://en.wikipedia.org/wiki/Knowledge> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Chapter 2 - Data, information, knowledge

Lee Yi Shyan

“Lee Yi Shyan (simplified Chinese: 李奕贤; traditional Chinese: 李奕賢; pinyin: Lǐ Yìxián; born 9 March 1962) is a Singaporean politician. A member of the governing People's Action Party (PAP), he is a Senior Minister of State in the ministries of Trade and Industry and National Development. He has been a Member of Parliament (MP) representing the East Coast Group Representation Constituency (East Coast GRC) since 2006.”

Wikipedia. *Lee Yi Shyan.* [online] Available at: <http://en.wikipedia.org/wiki/Lee_Yi_Shyan> [Accessed 15 April 2014].

He declaired that:

“One subject of increasing and intense interests amongst many, ranging from governments and urban planners, is sustainable development. How can we urbanise while maintaining harmony – socially, economically and environmentally? How do we balance short-term needs with long-term demands? How do we ensure that we can go on building cities, while retaining a healthy environment for our children and grandchildren?”

Giap, T. K., Woo, W. T., Tan, K. Y., Low, L. and Ee, L. G. A., 2012. *Ranking the Liveability of the World’s Major Cities*. Singapore: World Scientific Pub.

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Future Cities Preface - Future Cities Preface

Liveability

A liveable city is one where people like to and can afford to live. Criteria for livability include: safety, income possibilities, living options, climate, culture, private and public transportation, equality and inclusion, medical care, and city governance. Persons of different age and different background place varying weighting factors on each of those criteria. In the related surveys (http://en.wikipedia.org/wiki/World's_most_livable_cities), Cities in Europe, Canada and Oceania have occupied top positions for many years.

More information about Liveability can also be found in the following source: Giap, T. K., Woo, W. T., Tan, K. Y., Low, L. and Ee, L. G. A., 2012. Ranking the Liveability of the World's Major Cities. Singapore: World Scientific Pub.

Related Glossary Terms

Human habitat

Index Begriff suchen

Future Cities Preface - Future Cities Preface

Low Exergy

Hans-Jürg Leibundgut coined this term from physics for use in architecture. He also started to describe possible design impacts of this principle:

Leibundgut, H., 2013. *LowEx Building Design for ZeroEmission Architecture*. Zurich: vdf Hochschulverlag AG.

Forrest Meggers et al. give further explanations of this principle for architecture and urban design:

"Low exergy (LowEx) building systems create more flexibility and generate new possibilities for the design of high performance buildings. Instead of maximizing the barrier between buildings and the environment using thick insulation, low exergy systems maximize the connection to the freely available dispersed energy in the environment. We present implementations of LowEx technologies in prototypes, pilots and simulations, including experimental evaluation of our new hybrid PV-thermal (PV/T) panel, operation of integrated systems in an ongoing pilot building project, and cost and performance models along with dynamic simulation of our systems based on our current office renovation project. The exploitation of what we call "anergy sources" reduces exergy use, and thus primary energy demand. LowEx systems provide many heating and cooling methods for buildings using moderate supply temperatures and heat pumps that exploit more valuable anergy sources. Our implementation of integrated LowEx systems maintains low temperature-lifts, which can drastically increase heat pump performance from the typical COP range of 3–6 to values ranging from 6 to 13."

Meggers, F., Ritter, V., Goffin, P., Baetschmann, M. and Leibundgut, H., 2012. Low exergy building systems implementation. *Energy*, 41(1), pp.48-55.

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Future Cities Preface - Future Cities Preface

Manto Report

“Abstract

The impact of new technologies has been mostly under-estimated in the past and, as a result, the transitions from one era to another have occurred more or less by chance. The MANTO research project is intended to avoid mischances. So it indicates potential developments in the telecommunications sector and, in particular, investigates their effects upon transport and settlement and also upon society, the economy and the environment. Nevertheless, MANTO does not merely take a look at the future, like the Greek oracle from whom it takes its name; by means of concrete recommendations, MANTO is intended to provide persons in responsible positions with a tool with which they can consciously organise that future. Risky developments are to be precluded in advance while desirable consequences are to be promoted.”

Springer. *MANTO — a research project of telecommunication applications for the future information society.* [online] Available at: <http://link.springer.com/article/10.1007%2FBF00145758> [Accessed 25 March 2014].

More information about Manto Report can also be found in the following source:
Rotach, M.C., 1987. MANTO — a research project of telecommunication applications for the future information society. *Transportation*, 14, Issue 4, pp 377-393.

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Marc Angélil and Franz Oswald

"Marc Angélil is Professor at the Department of Architecture of ETH Zurich. His research at the Network City and Landscape (NSL) and the Future Cities Laboratory (FCL) in Singapore focuses on social and spatial developments of large metropolitan regions world wide. He is the author of several books, including Cidade de Deus! City of God! on informal mass housing in Rio de Janeiro, Building Brazil! on proactive urban upgrading of informal settlements, Deviations – A Manual on methods of teaching, Indizien on the political economy of contemporary urban territories, and Cities of Change Addis Ababa on urban transformation in developing countries. He received his architectural degree from ETH Zurich where he also completed his doctoral dissertation summa cum laude. He taught at the Graduate School of Design at Harvard University and at the University of Southern California in Los Angeles. He was Dean and Senior Dean of the Department of Architecture of ETH Zurich from 2009-2013. He practices architecture with his partners Sarah Graham and Manuel Scholl at agps, an architectural firm with ateliers in Los Angeles and Zurich. Recent projects include the headquarters extension of the International Union for Conservation of Nature (IUCN) in Gland-Geneva, the Children's Museum of Los Angeles (CMLA), the Portland Aerial Tram Incorporated (PATI) infrastructure project in Portland, Oregon, the Zurich International School (ZIS), and a slum upgrading project in Addis Ababa, Ethiopia. Marc Angélil is a member of the Board of the Holcim Foundation for Sustainable Construction and of the Consultative Committee of the Canadian Center for Architecture (CCA) in Montreal."

Future Cities Laboratory. *Prof Dr. Marc* Angélil. [online] Available at: <http://www.futurecities.ethz.ch/person/prof-dr-marc-angelil/> [Accessed 7 August 2014].

"Franz Oswald is Professor em. of the Swiss Federal Institute of Technology (ETH Zurich) and Head of AUS, the Office for Architecture and Urban Studies.

Franz Oswald was Professor of Architectural Design at the ETH Zurich 1972-1993 and also Director of the Institute for Local, Regional and National Planning (ORL). He was also guest professor at the École Polytechnique Fédérale de Lausanne (EPFL), Switzerland; Cornell University, USA; Cooper Union, USA and visiting professor at Technion, Israel; New Jersey Institute of Technology, USA and consultant at Addis Ababa University, Ethiopia.

He studied philosophy, literature and art history at the University of Bern and the University of Zurich before studying architecture at the ETH Zurich. His post-doctoral studies were completed at Universität zu Köln, Germany and Cornell University, USA.

His office for Architecture and Urban Studies (AUS) in Bern, Switzerland was responsible for projects, building construction, and research and development predominantly in Switzerland, Germany and Israel, and was responsible for the restoration project of the Sassanidic palaces in Iran. AUS received the Deutscher Betonpreis für Wohen der Zukunft.

Franz Oswald is a former Dean of the Faculty of Architecture at ETH Zurich and former president of SCUPAD (Salzburg Congress of Urban Planning and Development). He has published numerous works on the topics of architecture, teaching architectural design, and theory of urban planning."

Academia Engelberg. *Franz Oswald*. [online] Available at: <http://www.academia-engelberg.ch/franz_oswald.php5> [Accessed 19 September 2014].

More information about Marc Angélil, Franz Oswald and the Territorial Organisation module can also be found in the following link: http://www.futurecities.ethz.ch/module/territorial-organisation/

Related Glossary Terms

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Future Cities Preface - Future Cities Preface

Memes

“The selected approach also introduced the notion of memes to design. British scientist Richard Dawkins first suggested in his book “The Selfish Gene” (Dawkins 1976) that cultural evolution is based on similar mechanisms as biological evolution. Ideas or memes, as the smallest units of memetic evolution tend to replicate by separating themselves from their authors and being picked up by the public. The Phase(x) setup tries to apply this theory to architectural content. By splitting a rather complex design process into clearly defined units (the phases), compatible memes6 are generated. The memes are stripped from their authors by be- ing placed into the public realm of the database and can then be copied as digital files by the next author without loss of substance. The attention is focused on how ideas develop under the hands of changing authors, rather than by any single author; the Phase(x) replaces single authorship through collective authorship because all relations between works, authors and timeline are recorded in the database and can be rendered and evaluated.”

Kolarevic, B., Schmitt, G., Hirschberg, U., Kurmann, D. and Johnson, B., 1998. An Experiment in Design Collaboration. In: ACADIA (Association for Computer-Aided Design in Architecture), *ACADIA 98*. Quebec City, Canada, 22-25 October 1998.

Related Glossary Terms

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Chapter 10 - Urban System Design

Milica Topalovic

“Milica Topalovic has been attached to the ETH Future Cities Laboratory in Singapore as Assistant Professor of Architecture and Territorial Planning since 2011. In 2006 she joined the ETH as head of research at the Studio Basel Contemporary City Institute and the professorial chairs held by Diener and Meili, where she taught research studios on cities and on territories such as Hong Kong and the Nile Valley. Milica graduated with distinction from the Faculty of Architecture in Belgrade and received Master’s degree from the Dutch Berlage Institute for her thesis on Belgrade’s post-socialist urban transformation. Since 2000 her work includes different scales and media from urban research and design, to architecture and spatial installation. She lectured and exhibited in deSingel, Antwerp, Munich’s Haus der Kunst and the Swedish Architecture Museum, among others. She contributes essays on urbanism, architecture and art to magazines and publications including Oase and San Rocco.

RESEARCH

Architecture of Territory investigates the processes and phenomena of territorial urbanization at the start of the 21st century. The current research theme, the hinterlands, looks at the territorial impact of cities at various spatial scales, from their traditional, proximate hinterlands to their global networks of dependencies. The tri-national metropolitan region of Singapore serves as the paradigmatic research case. The city-states’ urban impact beyond its national borders is in focus, with investigations ranging from the economical incorporation of territory and labor in the neighbouring provinces of Indonesia and Malaysia, Riau and Johor, to the Singapore’s role as the global logistics hub. Design research studios are integral to the research.”

Future Cities Laboratory. *Asst Prof Milica TOPALOVIC.* [online] Available at: <http://www.futurecities.ethz.ch/person/asst-prof-milica-topalovic/> [Accessed 25 March 2014].

More information about Asst Prof Milica Topalovic and the Assistant Professorship of Architecture and Territorial Planning can also be found in the following link: http://www.futurecities.ethz.ch/module/assistant-professorship-of-architecture-and-territorial-planning/

Related Glossary Terms

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Future Cities Preface - Future Cities Preface

Mobility

"1. the ability to move or be moved freely and easily:

e.g. this exercise helps retain mobility in the damaged joints

2. the ability to move between different levels in society or employment:

e.g. industrialization would open up increasing chances of social mobility"

Oxford Dictionaries. *Mobility.* [online] Available at: <http://www.oxforddictionaries.com/definition/english/mobility> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Modeling

“Scientific modeling is a scientific activity the aim of which is to make a particular part or feature of the world easier to understand, define, quantify, visualize, or simulate. It requires selecting and identifying relevant aspects of a situation in the real world and then using different types of models for different aims, such as conceptual models to better understand, operational models to operationalize, mathematical models to quantify, and graphical models to visualize the subject. Modeling is an essential and inseparable part of scientific activity, and many scientific disciplines have their own ideas about specific types of modeling.[1][2] There is also an increasing attention to scientific modeling[3] in fields such as philosophy of science, systems theory, and knowledge visualization. There is growing collection of methods, techniques and meta-theory about all kinds of specialized scientific modeling.”

Wikipedia. *Scientific modeling.* [online] Available at: <http://en.wikipedia.org/wiki/Scientific_modeling> [Accessed 25 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Index Begriff suchen

Chapter 2 - Information ARCHITECTURE

Nanyang Technological University

"Nanyang Technological University (Abbreviation: NTU) is one of the two largest public universities in Singapore (the other being the National University of Singapore). Its 200-hectare Yunnan campus, located in the west side of Singapore, is the largest university campus on the island. NTU is also host to the autonomous National Institute of Education, Singapore's main teaching college.

NTU was inaugurated in 1991, originally as an English-medium technical and teaching college occupying the grounds of the former Nanyang University, a Chinese-medium university which had been consolidated into the National University of Singapore (NUS) in 1980. Over the years, NTU has grown to become a full-fledged research university, with a student population of around 33,000.

In recent years, various college and university rankings have placed NTU amongst the top universities in Asia. In 2013, the QS World University Rankings ranked it 41st globally (8th in Asia), a rise of 36 places from four years previously. In the Times Higher Education World University Rankings, it is ranked at 76th globally (11th in Asia), and at 91-100th place in the separate World Reputation Rankings survey. NTU's business school, Nanyang Business School, was been rated by the Economist Intelligence Unit in 2013 as 64th globally (4th in Asia, and top in Singapore).

In 2013, NTU ignited controversy over academic freedom in Singapore when it denied tenure to Associate Professor Cherian George, a prominent local critic of Singapore's media controls."

Wikipedia. *Nanyang Technological University.* [online] Available at: <http://en.wikipedia.org/wiki/Nanyang_Technological_University> [Accessed 27 March 2014].

More information about Nanyang Technological University (Abbreviation: NTU) can also be found in the following link: http://www.ntu.edu.sg/Pages/home.aspx

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Related Glossary Terms

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National University of Singapore

The National University of Singapore (NUS) is a comprehensive research university located in Singapore, being the flagship tertiary institution of the country which has a global approach to education and research. Founded in 1905, it is the oldest higher learning institute in Singapore, as well as the largest university in the country in terms of student enrolment and curriculum offered.

The university's main campus is located in southwest Singapore at Kent Ridge, with an area of approximately 1.5 km2 (0.58 sq mi). The Bukit Timah campus houses the Faculty of Law, Lee Kuan Yew School of Public Policy and research institutes, while the Duke-NUS Graduate Medical School Singapore is located at the Outram campus. It is the best university in Asia as of 2013 QS World Rankings.

Wikipedia. *National University of Singapore.* [online] Available at: <http://en.wikipedia.org/wiki/National_University_of_Singapore> [Accessed 27 March 2014].

More information about National University of Singapore can also be found in the following link: http://www.nus.edu.sg

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Related Glossary Terms

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Begriff suchen

Quantum City

The definition of the quantum city expression is not complete yet. “Quantum City explores the metaphorical relationships between quantum theory, urban design and the concept of the city, with a very serious aim: to radically change the way the urban realm is both experienced and designed.”

Arida, A., 2002. *Quantum City*. Oxford: Architectural Press.

The Ars Electronica 2011 shows work in progress on the quantum city idea: “Quantum city is an installation that combines physical computing, data visualization and real time computation by the use of interoperable devices, applications and models. The installation will be based on a physical model of a continuously transformed city and a projection that will allow the visitor to understand the interconnection between the environment that surround us, the energy we consume and produce, the water we consume and the geographical data of our habitat.”

Ars Electronica. *Quantum City*. [online] Available at: <http://www.aec.at/nextidea/quantum-city/> [Accessed 31 March 2014].

Ludger Hovestadt presents his review of a quantum city at the Academia Engelberg in 2012: http://www.academia-engelberg.ch/fotos_2nd_day_september_13_2012.php5

Related Glossary Terms

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Richard Saul Wurman

“Richard Saul Wurman (March 26, 1935) is an American architect and graphic designer. Wurman has written and designed over 83 books, and created the TED conference, as well as the EG conference, TEDMED and the WWW suite of gatherings, now in development.

Wurman chaired the IDCA Conference in 1972, the First Federal Design assembly in 1973, and the annual AIA Conference in 1976. He is perhaps best known for having created and chaired the TED conference from 1984 thru 2002, bringing together various thinkers in the fields of Technology, Entertainment and Design. He also created the TEDMED conference (1995-2010) and the e.g. conference in 2006.

In 1976, Wurman coined the phrase “information architect” in response to the large amount of information generated in contemporary society, which is often presented with little care or order.”

Wikipedia. *Richard Saul Wurman.* [online] Available at: <http://en.wikipedia.org/wiki/Richard_Saul_Wurman> [Accessed 26 March 2014].

Related Glossary Terms

Information architecture, Urban Observatory

Sacha Menz

Prof. Sacha Menz is Principal Investigator in Module X ”Housing” at the Future Cities Lab, Singapore - ETH Centre (SEC) in Singapore.

More information about Prof. Sacha Menz can be found in the following links:

http://www.bauprozess.arch.ethz.ch/people/menzs/index_EN

http://www.futurecities.ethz.ch/module/housing/

Related Glossary Terms

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Santa Fe Institute

“The Santa Fe Institute (SFI) is an independent, nonprofit theoretical research institute located in Santa Fe (New Mexico, United States) and dedicated to the multidisciplinary study of the fundamental principles of complex adaptive systems, including physical, computational, biological, and social systems.

The Institute consists of a small number of resident faculty, a large group of “external” faculty, whose primary appointments are at other institutions, and a number of visiting scholars. The Institute is advised by a group of eminent scholars, including several Nobel Prize winning scientists. Although theoretical scientific research is the Institute's primary focus, it also runs several popular summer schools on complex systems, along with other educational and outreach programs aimed at students ranging from middle school up through graduate school.

The Institute's annual funding comes from a combination of private donors, grant-making foundations, government science agencies, and companies affiliated with its business network. The 2011 budget was just over $10 million.”

Wikipedia. *Santa Fe Institute*. [online] Available at: <http://en.wikipedia.org/wiki/Santa_Fe_Institute> [Accessed 26 March 2014].

More information about Santa Fe Institute can be found in the following link: http://www.santafe.edu

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Related Glossary Terms

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Second Life

“Second Life is an online virtual world, developed by Linden Lab. A number of free client programs, or Viewers as they are called in Second Life are used to use the Second Life world so the users in Second Life, called Residents, can interact with each other through avatars. Residents can explore the world (known as the grid), meet other residents, socialize, participate in individual and group activities, and create and trade virtual property and services with one another. Second Life is intended for people aged 16 and over, with the exception of 13–15-year-old users restricted to the Second Life region of a sponsoring institution (e.g. school).

Built into the software is a three-dimensional modeling tool based on simple geometric shapes that allows residents to build virtual objects. There is also a procedural scripting language, Linden Scripting Language, which can be used to add interactivity to objects. Sculpted prims (sculpties), mesh, textures for clothing or other objects, animations, and gestures can be created using external software and imported. The Second Life terms of service provide that users retain copyright for any content they create, and the server and client provide simple digital rights management (DRM) functions. However, Linden Lab changed their terms of service in August 2013, to be able to use user-generated content for any purpose. The new terms of service prevent users from using third-party textures from some specific texture services, as these have been pointed out explicitly. Users can also photograph in Second Life with the camera technology the client programs have.

Second Life was launched in June 23, 2003, and has existed since then.”

Wikipedia. *Second Life*. [online] Available at: <http://en.wikipedia.org/wiki/Second_Life> [Accessed 26 March 2014].

Related Glossary Terms

Crowdsourcing

Index Begriff suchen

Chapter 3 - Information city

Senseable City Lab

“The MIT Senseable City Laboratory aims to investigate and anticipate how digital technologies are changing the way people live and their implications at the urban scale. Director Carlo Ratti founded the Senseable City Lab in 2004 within the City Design and Development group at the Department of Urban Studies and Planning, as well as in collaboration with the MIT Media Lab. The Lab's mission states that it seeks to creatively intervene and investigate the interface between people, technologies and the city. Recent projects include “The Copenhagen Wheel” which debuted at the 2009 United Nations Climate Change Conference, “Trash_Track” shown at the Architectural League of New York and the Seattle Public Library, “New York Talk Exchange” featured in the MoMA The Museum of Modern Art, and Real Time Rome included in the 2006 Venice Biennale of Architecture.”

Wikipedia. *MIT Senseable City Lab*. [online] Available at: <http://en.wikipedia.org/wiki/MIT_Senseable_City_Lab> [Accessed 26 March 2014].

More information about Senseable City Lab can be found in the following link: http://senseable.mit.edu

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Related Glossary Terms

Zugehörige Begriffe hierher ziehen

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Chapter 3 - Information city

Server farms

"A server farm or server cluster is a collection of computer servers usually maintained by an enterprise to accomplish server needs far beyond the capability of one machine. Server farms often consist of thousands of computers which require a large amount of power to run and keep cool. At the optimum performance level, a server farm has enormous costs associated with it, both financially and environmentally.[1] Server farms often have backup servers, which can take over the function of primary servers in the event of a primary server failure. Server farms are typically collocated with the network switches and/or routers which enable communication between the different parts of the cluster and the users of the cluster. The computers, routers, power supplies, and related electronics are typically mounted on 19-inch racks in a server room or data center."

Wikipedia. *Server farm*. [online] Available at: <http://en.wikipedia.org/wiki/Server_farm> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 2 - INFORMATION Architecture

Simulation

In science, simulation is becoming an important method in addition to theory and experiment. In architecture, simulation has been used for decades, mainly to predict structural behavior, energy consumption or life cycle cost. In urban design, simulation is gaining importance in exploring future scenarios in pedestrian movements, vehicle mobility, or land use alternatives. And in territorial planning, simulation helps to predict the functioning of large-scale operations in transportation or energy supply.

“Simulation is the imitation of the operation of a real-world process or system over time. The act of simulating something first requires that a model be developed; this model represents the key characteristics or behaviors/functions of the selected physical or abstract system or process. The model represents the system itself, whereas the simulation represents the operation of the system over time.

Simulation is used in many contexts, such as simulation of technology for performance optimization, safety engineering, testing, training, education, and video games. Often, computer experiments are used to study simulation models. Simulation is also used with scientific modeling of natural systems or human systems to gain insight into their functioning. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is also used when the real system cannot be engaged, because it may not be accessible, or it may be dangerous or unacceptable to engage, or it is being designed but not yet built, or it may simply not exist.

Key issues in simulation include acquisition of valid source information about the relevant selection of key characteristics and behaviours, the use of simplifying approximations and assumptions within the simulation, and fidelity and validity of the simulation outcomes.”

Wikipedia. *Simulation*. [online] Available at: <http://en.wikipedia.org/wiki/Simulation> [Accessed 26 March 2014].

Related Glossary Terms

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Simulation Platform

“Informing design and decision-making processes with new techniques and approaches to data acquisition, information visualisation and simulation for urban sustainability

In science, simulations play a critical role in enhancing interactions between theory and experiments. In architecture, simulations function similarly through integrating important design, construction and life-cycle management activities. Moreover in urban planning, simulations are now indispensable for generating and analysing scenarios. The role of simulation has recently been extended by a rapid growth in the availability of urban-related data. However, most current simulations are capable of representing and interacting with only a fraction of the available information. Addressing this shortcoming is not only a matter of generating appropriate computer power to process huge amounts of distributed data. Investigations involving advanced methodologies that activate live and dynamic data, reveal that traditional software systems, such as GIS, are ill-equipped to exploit the potential.

This module includes investigations that examine strategies for maximizing the utility of urban-related data. It investigates new techniques and instruments for data acquisition, organisation, retrieval, interaction, and visualisation. Techniques are proposed for designers, decision-makers and stakeholders to make use of data in innovative and dynamic ways. There are two types of actions. Firstly, other research modules in the Future Cities Laboratory are supported through supplying services such as data-acquisition methods and visualisation facilities. Secondly, original research is carried out on advanced modelling, visualisation and simulation techniques in order to enrich the complex decision-making processes that shape contemporary cities.”

Future Cities Laboratory. *Simulation platform*. [online] Available at: <http://www.futurecities.ethz.ch/module/simulation-platform/> [Accessed 26 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Singapore White Paper

“The Population White Paper: A Sustainable Population for a Dynamic Singapore (Jan 2013) has projected that Singapore could have a population of between 6.5 and 6.9 million by 2030. This will require 76,600ha of land, an increase from the current supply of 71,000ha.

To support this larger population, we need to (a) reclaim additional land; (b) develop some of our reserve land; (c) intensify new developments; and (d) recycle land with lower intensity uses such as old industrial areas and some golf courses to achieve higher land productivity.”

Ministry of National Development. Population White Paper. [online] Available at: <http://www.mnd.gov.sg/landuseplan/> [Accessed 16 April 2014].

More information about Singapore White Paper 2030 can be found in the following link: http://population.sg

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Related Glossary Terms

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Chapter 9 - City projection

Social equality

“Social equality is a state of affairs in which all people within a specific society or isolated group have the same status in certain respects. At the very least, social equality includes equal rights under the law, such as security, voting rights, freedom of speech and assembly, property rights, and equal access to social goods and services. However, it also includes concepts of health equity, economic equity and other social securities. It also includes equal opportunities and obligations, and so involves the whole of society.

Social equality requires the absence of legally enforced social class or caste boundaries and the absence of discrimination motivated by an inalienable part of a person's identity. For example, sex, gender, race, age, sexual orientation, origin, caste or class, income or property, language, religion, convictions, opinions, health or disability must not result in unequal treatment under the law and should not reduce opportunities unjustifiably.

Social equality refers to social, rather than economic, or income equality. “Equal opportunities” is interpreted as being judged by ability, which is compatible with a free-market economy. A problem is horizontal inequality, the inequality of two persons of same origin and ability.

In complexity economics, it has been found that horizontal inequality arises in complex systems, and thus equality may be unattainable. It has been speculated by some conservatives like David Horowitz that socialism, a system advocating social equality, played a significant part in 20th Century murder and torture under dictators in the USSR, Maoist China and Cambodia.”

Wikipedia. *Social equality*. [online] Available at: <http://en.wikipedia.org/wiki/Social_equality> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 7 - Urban sociology

Social inequality

“Social inequality refers to relational processes in society that have the effect of limiting or harming a group’s social status, social class, and social circle. Areas of social inequality include access to voting rights, freedom of speech and assembly, the extent of property rights and access to education, health care, quality housing, traveling, transportation, vacationing and other social goods and services. Apart from that it can also be seen in the quality of family and neighbourhood life, occupation, job satisfaction, and access to credit. If these economic inequalities harden, they can lead to social inequality.

The reasons for social inequality can vary, but are often broad and far reaching. Social inequality can emerge through a society’s understanding of appropriate gender roles, or through the prevalence of social stereotyping. Social inequality can also be established through discriminatory legislation. Social inequalities exist between ethnic or religious groups, classes and countries making the concept of social inequality a global phenomenon. Social inequality is different from economic inequality, though the two are linked. Social inequality refers to disparities in the distribution of economic assets and income as well as between the overall quality and luxury of each person's existence within a society, while economic inequality is caused by the unequal accumulation of wealth; social inequality exists because the lack of wealth in certain areas prohibits these people from obtaining the same housing, health care, etc. as the wealthy, in societies where access to these social goods depends on wealth.

Social inequality is linked to racial inequality, gender inequality, and wealth inequality. The way people behave socially, through racist or sexist practices and other forms of discrimination, tends to trickle down and affect the opportunities and wealth individuals can generate for themselves. Thomas M. Shapiro presents a hypothetical example of this in his book, The Hidden Cost of Being African American, in which he tries to demonstrate the level of inequality on the “playing field for blacks and whites”. One example he presents reports how a black family was denied a bank loan to use for housing, while a white family was approved. As being a homeowner is an important method in acquiring wealth, this situation created fewer opportunities for the black family to acquire wealth, producing social inequality.”

Wikipedia. *Social inequality*. [online] Available at: <http://en.wikipedia.org/wiki/Social_inequality> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 7 - Urban sociology

Stack

" • A pile of objects, typically one that is neatly arranged:

e.g. a stack of boxes

• (a stack of/stacks of) - *informal:* A large quantity of something:

e.g. there's stacks of work for me now

• A rectangular or cylindrical pile of hay or straw or of grain in sheaf.

• A vertical arrangement of hi-fi or guitar amplification equipment.

• A number of aircraft flying in circles at different altitudes around the same point while waiting for permission to land at an airport.

• A pyramidal group of rifles.

• (the stacks) Units of shelving in part of a library normally closed to the public, used to store books compactly:

e.g. the demand for items from the stacks

[as modifier]:*the new premises provided a reading room and a stack room*

• Computing a set of storage locations which store data in such a way that the most recently stored item is the first to be retrieved."

Oxford Dictionaries. *Stack*. [online] Available at: <http://www.oxforddictionaries.com/definition/english/stack> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 2 - INFORMATION Architecture

Stocks and flows

“Economics, business, accounting, and related fields often distinguish between quantities that are stocks and those that are flows. These differ in their units of measurement. A stock variable is measured at one specific time, and represents a quantity existing at that point in time (say, December 31, 2004), which may have accumulated in the past. A flow variable is measured over an interval of time. Therefore a flow would be measured per unit of time (say a year). Flow is roughly analogous to rate or speed in this sense.

For example, U.S. nominal gross domestic product refers to a total number of dollars spent over a time period, such as a year. Therefore it is a flow variable, and has units of dollars/year. In contrast, the U.S. nominal capital stock is the total value, in dollars, of equipment, buildings, inventories, and other real assets in the U.S. economy, and has units of dollars. The diagram provides an intuitive illustration of how the stock of capital currently available is increased by the flow of new investment and depleted by the flow of depreciation.”

Wikipedia. *Stock and flow*. [online] Available at: <http://en.wikipedia.org/wiki/Stock_and_flow> [Accessed 14 April 2014].

More information about Stocks and flows can be found in the following links:

http://www.bbc.co.uk/news/business-15748696

http://www.economist.com/content/global_debt_clock

Related Glossary TermsRelated Glossary Terms

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Chapter 6 - Stocks and flows

SUPat

“Aim of research

Establishing a collaborative platform for the transdisciplinary development of sustainable urban patterns; tools for evaluating urban quality and visualising urban patterns to promote shared objectives.

Expected output

- Documentation of urban typologies
- Guidelines for formative analysis of scenarios in a functional collaboration between science and practice; development of systematically established, relevant regional scenarios
- Quality indicators for sustainable urban patterns

Criteria for urban quality which can be applied to other case studies (procedural modelling)

- Modelling and visualisation tools
- Elaboration of a model for collaborative processes of urban development

Preliminary results

The Limmattal between Zurich and Baden serves as an example of a “normal city” in Switzerland. Green sites in the area are nothing more than space which is not reserved for urban development; there is no productive concept. The “normal city” is defined as non-urban, a fact that is related not only to the actual landscape but also to attitudes: Residents are unwilling to be or become urban. Overall, there is a need for gentle transformation strategies which build upon local patterns and connect the numerous spatial and functional fragments in a plausible way.

SUPat scenarios describe four perspectives focusing on design, technological, economical and ecological aspects of urban development in the Limmattal region. The scenario “City with Character” presents the Limmattal as a valley with a strong identity, created by a clear sequence of centres and a good mix of land use and architecture. In the scenario “Smart City”, the valley positions itself as a cleantech pioneer; it boasts the greatest possible energy efficiency, a high density of services and an optimum modal-split-infrastructure design.

The scenario “Pure Dynamics” does without a joint regional development concept. The valley is shaped by a vaguely defined mix of industrial areas, housing developments, green sites and transport infrastructures with no character of their own. The scenario “Charming Valley” presents the valley as a human ecological system with a strong mix of concentrated developments (informed by modern small-town values) and a productive and resource-rich agriculture.

The research project defines new urban quality as the interaction between human behaviour and the built and non-built environment. The needs and objectives of the population are linked to urban structures (e.g. sufficient open spaces) and their functions (e.g. recreation).”

New Urban Quality. *Sustainable Urban Patterns*. [online] Available at: <http://www.nfp65.ch/E/projects/urban_expansion_natural_resources_better_life/Pages/default.aspx> [Accessed 26 March 2014].

Related Glossary Terms

Zugehörige Begriffe hierher ziehen

Swiss Urban Sprawl Vote

“A Long-Awaited Revision

The sustainable land-use planning discussion is not new to Switzerland. In 1980, the Swiss Spatial Planning Act (RPG) came into being in an attempt to avoid greenbelt encroachment and to promote the efficient use of land. Although the RPG obliges cantons to regulate housing development, there has been an execution problem under existing law: Over the last 30 years, municipalities and cantons have had free rein in the area of spatial planning, which has resulted in an over-generous amount of land being set aside for construction, much to the dismay of environmental and conservation groups such as Pro Natura and the Swiss Landscape Forum (FOLA). After decades of heated debate about the unsatisfactory implementation of existing spatial planning regulations, the federal authorities set out to tighten legislation to restrict the total amount of buildable land available. On March 3, 2013 a majority (63 percent) of the Swiss population came out in favor of regulated housing development in Switzerland – in a way that preserves the Swiss landscape by slowing down urban sprawl – by voting “yes” to a revised Spatial Planning Act (see box “RPG”). Most significantly, the new RPG will give the Confederation the powers to make the cantons and municipalities comply with federal law.”

Credit Suisse. *Sustainability*. [online] Available at: <https://www.credit-suisse.com/ch/en/about-us/corporate-responsibility/news/sustainability.article.html/article/pwp/news-and-expertise/2013/07/en/can-switzerland-halt-the-sprawl.html> [Accessed 14 April 2014].

More information about Swiss Urban Sprawl Vote can be found in the following link (article in German):

http://www.nzz.ch/aktuell/schweiz/abstimmung-raumplanungsgesetz-ja-volk-1.18036934

Related Glossary Terms

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System

1. "A set of things working together as parts of a mechanism or an interconnecting network; a complex whole:

   e.g. *the state railway system,*

   fluid is pushed through a system of pipes or channels

- Physiology: A set of organs in the body with a common structure or function: e.g. *the digestive system*
- The human or animal body as a whole: e.g. *you need to get the cholesterol out of your system*
- Computing: A group of related hardware units or programs or both, especially when dedicated to a single application.
- Geology: (in chronostratigraphy) a major range of strata that corresponds to a period in time, subdivided into series: e.g. *the Devonian system*
- Astronomy: A group of celestial objects connected by their mutual attractive forces, especially moving in orbits about a centre: e.g. t*he system of bright stars known as the Gould Belt*
- short for crystal system.

2. A set of principles or procedures according to which something is done; an organized scheme or method:

   e.g. *a multiparty system of government*

   the public-school system

- A set of rules used in measurement or classification: e.g. *the metric system*
- [mass noun] Organized planning or behaviour; orderliness: e.g. *there was no system at all in the company*
- A method of choosing one's procedure in gambling.

3. (the system) The prevailing political or social order, especially when regarded as oppressive and intransigent:don't try bucking the system

4. Music a set of staves in a musical score joined by a brace."

Oxford Dictionaries. *System*. [online] Available at: <http://www.oxforddictionaries.com/definition/english/system> [Accessed 26 March 2014].

Related Glossary Terms

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Systems design

“Systems design is the process of defining the architecture, components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development. There is some overlap with the disciplines of systems analysis, systems architecture and systems engineering.”

Wikipedia. *Systems design*. [online] Available at: <http://en.wikipedia.org/wiki/Systems_design> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 10 - Urban System Design

TED

"TED (Technology, Entertainment, Design) is a global set of conferences owned by the private non-profit Sapling Foundation, under the slogan "ideas worth spreading".

TED was founded in 1984 as a one-off event.[1] The annual conference began in 1990, in Monterey, California.[4] TED's early emphasis was technology and design, consistent with its origins in the Silicon Valley.

The TED main conference is held annually in Vancouver, British Columbia and its companion TEDActive is held in Whistler. In 2014, both conferences moved to British Columbia from Long Beach and Palm Springs, California respectively.[5] TED events are also held throughout North America and in Europe and Asia, offering live streaming of the talks. They address a wide range of topics within the research and practice of science and culture, often through storytelling.[6] The speakers are given a maximum of 18 minutes to present their ideas in the most innovative and engaging ways they can. Past presenters include Bill Clinton, Jane Goodall, Malcolm Gladwell, Al Gore, Gordon Brown, Richard Dawkins, Bill Gates, Bono, Google founders Larry Page and Sergey Brin, and many Nobel Prize winners.[7] TED's current curator is the British former computer journalist and magazine publisher Chris Anderson.

Since June 2006,[1] the talks have been offered for free viewing online, under Attribution-NonCommercial-NoDerivs Creative Commons license, through TED.com.[8] As of January 2014, over 1,600 talks are available free online.[9] By January 2009 they had been viewed 50 million times. In June 2011, the viewing figure stood at more than 500 million,[10] and on Tuesday, November 13, 2012, TED Talks had been watched one billion times worldwide, reflecting a still growing global audience."

Wikipedia. *TED (conference)*. [online] Available at: <http://en.wikipedia.org/wiki/TED_(conference)> [Accessed 26 March 2014].

Related Glossary Terms

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Chapter 2 - INFORMATION Architecture

Urban Observatory

Raad, M. (ESRI), 2013. Big Data and Smart Cities: New Research, Educational Possibilities and Business Opportunities. In: *How Far Can "Big Data" Take Us Towards Understanding Cities?*. Santa Fe Institute, Santa Fe, New Mexico, 19 – 21 September, 2013. New Mexico, USA.

"Understanding Precedes Action.

Richard Saul Wurman, Radical Media, and Esri bring you the Urban Observatory—a live museum with a data pulse. You'll have access to rich datasets for cities around the world that let you simultaneously view answers to the most important questions impacting today's global cities—and you. Compare and contrast visualized information for a greater understanding of life in the 21st century.

Why Does It Matter?

You have the opportunity to join a first-of-its kind virtual experience that takes advantage of GIS as an integrative platform. Information about urbanization does not exist in comparative form. Several cities have already signed on to participate. By contributing, you empower your citizens, constituents, colleagues, and the global community.

Access the Art of the Possible

The creative and technical forces at Radical Media and Esri build you a one-of-a-kind, futuristic virtual experience that's complete art and science. You'll make your data come to life using an interactive exhibit complete with the finest software, hardware, fiber optics, custom kiosks, quality sound system and monitors.

Contribute Your Data

The focus of the Urban Observatory is on the people who live in cities, the work they do there, the movement made possible through transportation networks, the public facilities needed to run the city, and the natural systems which are impacted by the city's footprint. If you are a city with datasets in any of these categories, we urge you to contribute it to the project. See the Participation Guide [PDF] for more information.

Map Data

- Climate—Annual heating and cooling degree days
- GDP Per Capita
- Age Distribution
- Poverty
- Air Quality Measurements
- Map Data
- Population—By smallest census unit
- Income—By smallest census unit
- Demographics—By smallest census unit
- Road Networks—Categorized by type
- Public Transit Networks—Lines and stations
- Public Transit Participation—Number of riders per network
- Fire Station Locations—Number of staff per location and facilities per capita
- Law Enforcement Facilities—Number of staff per location and facilities per capita
- Crime Locations
- Crime Statistics—By smallest census unit
- Hospital Locations—Number of beds and facilities per capita
- Emergency Rooms—Number of beds and facilities per capita
- Open Public Spaces
- Schools and Universities
- Sports Facilities
- Public Libraries
- Building Footprints—Coded by number of stories
- Cemeteries and Crematoria
- Sanitation—Major networks and facilities
- Water—Major networks and facilities
- Electricity—Major networks and facilities
- Homelessness—Locations and by smallest census unit
- Health—Per capita disease rates
- Corrections—Coded by number incarcerated
- Government Spending Per Capita
- New Construction/Permits
- Labor Force Participation—By smallest census unit
- Education Level—By smallest census unit
- Environmental Hazards/Pollutants—Locations and per capita"

Urban Observatory. *Understanding Precedes Action*. [online] Available at: <http://www.urbanobservatory.org> [Accessed 26 March 2014].

Related Glossary Terms

Richard Saul Wurman

Urban sociology

“Urban sociology is the sociological study of life and human interaction in metropolitan areas. It is a normative discipline of sociology seeking to study the structures, processes, changes and problems of an urban area and by doing so provide inputs for planning and policy making. In other words it is the sociological study of cities and their role in the development of society. Like most areas of sociology, urban sociologists use statistical analysis, observation, social theory, interviews, and other methods to study a range of topics, including migration and demographic trends, economics, poverty, race relations and economic trends.

The philosophical foundations of modern urban sociology originate from the work of sociologists such as Karl Marx, Ferdinand Tönnies, Émile Durkheim, Max Weber and Georg Simmel who studied and theorized the economic, social and cultural processes of urbanization and its effects on social alienation, class formation, and the production or destruction of collective and individual identities.

These theoretical foundations were further expanded upon and analyzed by a group of sociologists and researchers who worked at the University of Chicago in the early twentieth century. In what became known as the Chicago School of sociology the work of Robert Park, Louis Wirth and Ernest Burgess on the inner city of Chicago revolutionized the purpose of urban research in sociology but also the development of human geography through its use of quantitative and ethnographic research methods. The importance of the theories developed by the Chicago School within urban sociology have been critically sustained and critiqued but still remain one of the most significant historical advancements in understanding urbanization and the city within the social sciences.”

Wikipedia. *Urban sociology*. [online] Available at: <http://en.wikipedia.org/wiki/Urban_sociology> [Accessed 26 March 2014].

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Uta Hassler

“Uta Hassler heads the Institute for Historic Building Research and Conservation at ETH. Her research interests are in long-term conservation of values in buildings and building stocks, historic construction techniques and research methods in these fields. Uta Hassler holds a Doctoral Degree in Engineering and a Diploma in Architecture from Karlsruhe Institute of Technology. She joined civil service as a member of staff at the Ministry of Finance and completed the leadership academy of the German state of Baden-Wuerttemberg. From 1991 -2006 she was a professor at Dortmund University, where she established the chair for architecture research, conservation and design. To date, Uta Hassler serves on various commissions (on municipal, state, federal and EU-levels) charged with questions of the built environment, academic curricula and research in Germany as well as Switzerland.”

Future Cities Laboratory. *Prof Dr Uta HASSLER.* [online] Available at: <http://www.futurecities.ethz.ch/person/prof-dr-uta-hassler/> [Accessed 26 March 2014].

More information about Uta Hassler and Transforming and Mining Urban Stocks can be found in the following link: http://www.futurecities.ethz.ch/module/transforming-and-mining-urban-stocks/

Related Glossary Terms

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