SUMMARY REPORT

DESIGNING WITH FLOWS >

Towards an Urban-Metabolic Agenda for a Circular Future

A series of Masterclasses

Organised by OVAM in collaboration with .FABRIC, Vlaamse Milieumaatschappij (VMM/MIRA), Team Vlaams Bouwmeester and Metabolism Of Cities

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INTRODUCTION

by Walter Tempst (OVAM), Aristide Athanassiadis (BATir/ULB and Platform Metabolism of Cities)

In the context of the International Architecture Biennial Rotterdam (IABR) 2016, with its theme of The Next Economy, the IABR together with Architecture Workroom has set up a partnership with the Brussels-Capital Region, Ruimte Vlaanderen, the Public Waste Agency of Flanders (OVAM) and the Province of Flemish Brabant. The aim of 'Atelier Brussels Productive Metropolis' is to improve the match between a changing economy and the organisation of space in the capital city's metropolitan area.

A healthy city is a productive city. This requires an approach that strives for a strategic anchoring of the future of the economy in the fabric of 21st-century city. International challenges and trends underline the need to reintroduce the manufacturing industry to our regions: from manufacturing that makes the link between knowledge, innovation and production, to a circular economy committed to shorter chains and flows of materials and energy.

The concept of "urban metabolism" is fundamental to developing sustainable and circular cities. Urban metabolism is based upon the idea of directly comparing cities to living organisms. However, unlike living organisms and natural ecosystems, cities in general have a linear metabolism importing large quantities of natural resources and generating significant amounts of waste and pollution.

In practice, the study of an urban metabolism involves "big picture" assimilation and analysis of inputs, outputs, the storage of materials, nutrients, water, energy and any other flows concerning an urban region or city which can provide urban sustainability indicators and data. While the concept of urban metabolism is now gaining momentum in the spheres of academia and government, there are still many aspects that remain grey areas which need to be explored in order to understand the metabolic quantification that is relevant for urban and social economic policies and environmental planning. More specifically, the spatial perspective of urban metabolism has yet to receive the attention it deserves which poses the question: how can we apply the attributes and advantages of flows to urban life through spatial design? Great efforts are still required to establish urban metabolism as an integral part of urban planning and design, and this requires the design community to become far more enlightened about all the different kinds of flows. The challenge ahead therefore becomes to "design the urban metabolism" of circular, inclusive and resilient cities.

The Flemish, Brussels and Dutch governments and the other “Prime Movers” are currently setting up experiments where the urban metabolism approach offers a framework that connects circular challenges for cities and regions to spatial development and creates the opportunity for intervention at many different levels. At the same time this framework offers a number of guidelines to help make the much needed shift from linear and causal planning to a more open planning approach. Its complex nature and very definition make it “a work in progress”. Work is already underway in the Genk region (Limburg), the Brussels metropolitan region and in Brussels Noordrand (Buda), while the Antwerp metropolitan region and Gent are also about to begin using this concept for economic, environmental and spatial planning.

A series of three masterclasses was organised to familiarize the attendees with the theory, concept and practice of urban metabolism. These Masterclasses aimed to stimulate the development of an urban-metabolic agenda (not limited to any urban area in particular) and also create participation and co-operation at the various spatial and inter-governmental levels. This report summarizes the keynote contributions and includes a postscript that surveys key learnings from the debate.

SUMMARIES OF EXPERT CONTRIBUTIONS

MASTERCLASS I
8 DECEMBER 2016

Aristide Athanassiadis
BATir/ULB and Platform Metabolism Of Cities

“The study of urban metabolism is not a particularly recent phenomenon. Karl Marx was a pioneer in linking social forms of organisation with the material conditions supporting these societies. But the concept was only formally coined in the mid-1960s by Abel Wolman, an American sanitary engineer, as way to conceptualise the city as a complex network of flows of materials and energy. In the 1970s the study of urban metabolism was taken up by system ecologists. One of the most comprehensive studies zoomed in on the metabolism of Brussels. The conceptual, Sankey-style diagram developed by ecologist Paul Duvigneaud is one of the most widely circulating representations of an urban metabolism. In the 1980s and 90s the interest in this field of study waned only to be revived in the early years of the 21st century. Today there are hundreds of studies on urban metabolism across the planet.

Why is this field of study important? Urbanisation is on the rise and that trend is set to continue. Soon more than 70% of the global population will live in urban centers. Additionally, cities consume around 75% of global energy and they generate around 75% of greenhouse gas emissions. And new cities are being built every day, particularly in Africa and Asia. This has important implications for our planetary metabolism. Materials and energy consumption has been on a steady increase since the 1950s and that development is correlated with the global growth of cities. The trouble is that our natural resources are being depleted. We have crossed the red line on three of the nine planetary boundaries that have been identified. So there is an imperative to reduce cities’ impact on the planet.
How can the study of urban metabolism help? Key is that it opens a systemic perspective on the city. Cities are studied as systems of stocks and flows, composed of subsystems, and showing feedback structures. Urban metabolism offers various analytic lenses that can help us to understand how a city functions and how its footprint might be reduced:

— A longitudinal perspective on urban inputs and outputs may point to important technological, behavioral or systemic changes over time.

— Studying metabolic flows and indicators at different spatial scales (from the territorial to the neighborhood scale) yields very different insights about urban sources and sinks.

— A move from absolute quantities to relative numbers per capita (or other metrics such as m2 floor area) offers another useful window on consumption patterns.

These analytic strategies demonstrate that there is no silver bullet when it comes to reducing cities' footprint. They reveal a complex and often surprising web of interdependencies.

Analytically it is also important to make a distinction between a 'territorial' and a 'consumption-oriented' approach. The territorial approach draws an imaginary boundary and measures the flows that move across that line (from the environment to the city and vice versa). The consumption approach focuses on what is consumed locally and how that is fed by global supply chains. For instance, when we would consider a laptop as material object then the consumption approach would require us to find out how much water was used to extract the petrochemicals and produce the plastics, and so on. So territorial and consumption-oriented perspectives result in very different assessments. On average it seems that Brussels residents consume outside of Brussels 3,5 times more energy than is consumed in the city. For water the multiplicator is 42. So if we would have the ambition to reduce water consumption in Brussels, where do we start? Do we close our tap or do we change our diet?

It is clear that a metabolic perspective triggers a lot of relevant questions about the drivers of consumption. These insights may point us toward strategies to reduce urban footprints. An important element in that strategic toolbox is the closing of material loops. Today we are locked into a linear metabolism. We import resources and dump our waste and that's basically it. So, if we talk about a circular economy we have a lot to do. Cities are huge stocks of materials. We can choose to waste or exploit them. Even considering minor elements of those huge stocks can have considerable impact. Take carpets in office buildings that are replaced every 20 years. This is a very water and energy intensive material that generates a lot of emissions. So solutions to recycle these products will have a significant environmental impact. In addition there will be positive spinoffs in terms of revenue and employment.

We understand now that urban metabolism is able to generate a valuable picture of the existing functioning of a city in terms of material flows. But is can also be used to model future impacts of material-intensive interventions. For instance, in retrofitting the building stock in a city such as Brussels, it is important to proactively assess the impact on energy use at different time horizons and different scales. This will give local governments a handle on their investment strategy.

The study of urban metabolisms offers a lot of potential to move towards more environmentally sustainable cities. However, we need to be realistic in our expectations. Because it is clear that this is an approach that is very data intensive and interdisciplinary. We are in this for the long haul. Unfortunately, this does not square well with the short time horizons of political decision makers.

Jan Jongert
Superuse Studio, Rotterdam

“As an architect I approach design challenges with the ambition to maximise value from what is already present. At some point I got interested in the role of the economy and I developed a very crude timeline. And that led us quite naturally to a metabolic perspective on the way our economies and societies function.

From the beginning of industrialisation emerged a linear economy. It has been very effective for a long period of time. As consumers this is a very comfortable situation as we do not have to worry about the waste that we produce. From the seventies onward we started to move towards a ‘green economy’: every step in the chain tried to improve its processes, polluting less and less. As a consumer you have to pay a bit more for your products. Not only because it is more expensive to produce in a cleaner way but also to fund the mechanisms to control the system. Plus you have to pay taxes to take care of the waste that is being treated in a more responsible way. So this is a better approach, but also more expensive. Today we are making the first moves toward a circular economy. The focus is on building closed loop systems that connect producers and consumers of energy and materials. Ideally, in such a system, waste is a revenue generator. However, we have as yet little experience with this system and it is unclear how robust it is in dealing with disruptions (such as bankruptcies of participating companies).

A parallel development is the peer-to-peer approach where value is not created in a closed loop but in a complex web of relationships. Whoever is able to add the biggest value to a certain flow of material, either as resource or as waste, will be able to connect a business model to that. The ‘Blue Economy’ concept is an early example of such a dynamic peer-to-peer model.

In our studio's practice we are betting on the power of the peer-to-peer approach to extract value from multilayered design challenges. But in order to do so we need to consider the metabolism at three different levels: the object level, the flow level and the system level.

— At the first level we consider the potential of each object in the environment where we want to intervene. For instance we have integrated decommissioned wind turbine blades as architectural objects in playgrounds and other public infrastructures. Not trivial given that more than 20.000 blades are made redundant every year.

— The flow level is the most typically metabolic. By redesigning flows and connecting excess supply with demand, we can create value for all the actors in a chain. This is particularly interesting when working with energy-intense and intrinsically valuable materials such as metals. But it works across all sectors. We have developed dedicated tools to help us to work with this flow perspective. For instance, the 'Harvest Map' displays all the resources in the Netherlands that can offer essential materials. The map can be accessed online to broaden the reach and build a larger community of users to engage in local value creation. In advanced economies such as the Netherlands the recycling sector is usually well developed. In countries such as China, however, there is an enormous potential for these approaches. We are active there too. It is important to integrate an economic perspective in these analyses and assess the magnitude of not only the material flows but also of the financial flows. Also we like to combine top down interventions, starting from the big picture, and bottom up initiatives, triggered by specific entrepreneurial initiatives. However while these analyses create value, based on what is available, they do not allow to develop future-oriented strategies. That happens at the systems level.

— The systems level is the most complex one as it requires us to assess and model optimal constellations of inputs and outputs. We are not at the point where we have a tool or a platform to support us in that. But there are big opportunities. For instance, a whole new economy can be built on coffee waste. After crude oil, this is one of the top 10 flows transported around the globe. Only 0,2% of the total biomass produced, generates the final value. The other 99,8% is wasted in the process. So there is a big potential. The complexity resides in the fact that there are many different models that show how to generate value in the different parts of the chain. We need to be able to systemically model these interactions to assess what optimal strategies might be. One of the biggest projects Superuse Studio is working on is a showcase for many of the approaches discussed. It's a 12.500 m^2 tropic garden swimming pool com-

plex near the river Maas, in the centre of Rotterdam. This will be transformed into a 'blue economy'-like hub for dozens of companies. But it will be publicly accessible too. And from a designerly point of view we are meshing a densification strategy with a metabolic optimisation approach. We believe that there is lot of potential in this approach.

Ben Kubbinga
Circle Economy, Amsterdam

"Circle Economy is a membership organisation that has the ambition to accelerate the transition to a circular economy. Our members are companies, ranging from startups to mid-caps to larger companies such as Philips and Friesland-Campina. We share the assessment that the linear economy has had its time. We need to move to another paradigm. Three elements are key to a circular economy: resource efficiency, value optimisation and elimination of waste. There are five key strategies to make this happen:

— Recover and recycle;
— Extend product lifetime;
— Enable circular markets;
— Replace products by services;
— Setup sharing platforms.

At Circle Economy we have been expanding the scope of our interventions — based on these five strategies — from company networks that are relatively limited in scope to a regional scale. We believe that working with a city council is a very powerful way to create impact. They know what is happening on the ground, are more easy to convince about the advantages of a circular economy (in terms of environment, jobs and image) and they can help to develop economies of scale. An additional motivation to work at a city scale is the fact that urbanisation is not going to stop anytime soon. We have developed a 4-step approach to transition from the strategic to the operational level. The first step is a macroscopic analysis of how a given city works, politically and economically. This gives an idea of the opportunity space for circular initiatives. This is followed by a more detailed analysis of the material and energy flows. Then we identify focus areas and in these areas a number of workable strategies are identified that bring together various companies in circular initiatives. This approach can also be leveraged beyond the city, at a regional scale.

Finally, we are also involved in developing technologies that are potentially game-changing from a circular perspective. For instance, Fibersort is a machine that relies on near-infrared technology to sort post-consumer textiles. But instead of just focusing on the technology we brought together all the players to maximise the impact on the whole textile chain. Also, Circle Economy has obtained a grant from the eBay Foundation to set up a knowledge platform around the circular economy. Because there is so much happening and none is bringing together all these initiatives. This will be an open-source platform that will also help citizens and political decision-makers to understand what is going on.

MASTERCLASS II
12 JANUARY 2017

Lola Sheppard
Lateral Office, Toronto

"I wanted to use the discussion today to offer a counterplea to how to think about urban metabolism. My starting point is a design practice that hasn't been particularly focused on the urban but has often zoomed in on more remote areas, such as the Canadian North, where climatic and cultural conditions decisively shape the context. These remote communities force us to think in terms of territorial metabolisms.

The study of urban metabolism has been largely tied to an understanding of the city as a kind of ecosystem in which inputs and outputs can be accounted for. This scientific lens to look at metabolisms has held architects' and urbanists' imagination for a long time because they hold the potential to quantify things. I think there are some limitations to that discussion. Part of what I want to do is to expand the notion of metabolism to include the social and cultural dimensions. Cities are not only clusters of biochemical processes, but also sets of spatial and cultural practices. Leveraging these two together is a key challenge for design.

One of the conceptual starting points here could be the reexamination of the notion of 'site'. Our conventional tools of analysis may not fully serve us. In a book called 'Building Context' author Carol Burns unpacks the various notions of site from what she calls a 'planimetric' understanding of site to one that understands site as a series of historical layers and physical geologies. As (landscape architects), we often rely on layers as an analytic frame. We go back to classical GIS methods. One of the limitations is the suggestion that these things can be de-

coupled. They also tend to take a certain boundary — a magical square or circle or whatever — as given. But consider an arbitrary Walmart store in the US. There is the store itself, there is the distribution network that services it. We could draw maps of arsenic levels in the US and it would appear that sources of toxicity are often far from the actual site of pollution. So, the boundaries with which we look at a site should be very flexible. Buckminster Fuller's Dymaxion Map reminds us of the fact that the way in which we draw things completely frames the way we understand site and hence the questions which we will ask to it as we design.

Fuller throws up another interesting question. His perspective was global. But are we able to apprehend things at this scale? I see a lot of beautiful maps but at one point it looks like there are a lot of lines and we don't know what to do with the scale of the information. A question for designers is also: what are the scales at which we work? Different disciplines also work at different scales and different projects.

Let me offer a few simple ideas. One is that metabolic processes offer an opportunity for an extrinsic urbanism, one in which environments are wired to support new economies, ecologies and public ground. A project that demonstrates this logic is the redevelopment of a huge site of a defunct military airport in Iceland. In our design we turned the runways into a set of productive greenways. Each greenway would have a particular programmatic role in relation to the needs of the city: ecology, production, recreation. Then we wired in the existing natural resources of the territory — geothermal energy amongst them — to develop a system of intrastructures, ecologies and open space and to make that as self-sustaining as possible. We also imagined a sort of mirror system below ground. Server farms would leverage the geothermal potential. The heat they would produce would then be used to sustain the greenhouses on the productive greenway.

The second idea holds that the site of metabolic processes extends far beyond the source of activities. At one point we developed a project to 'farm' the Salton Sea in the US. This started from the observation that there is a mismatch between available water resources and processes of urbanisation. The fastest growing cities in the US are in the driest part of the country. This is also the site of massive infrastructural projects built as a result of Roosevelt's New Deal. Part of the project focused on a transition from these massive engineering projects to a softer, more adaptive approach. The Salton Sea is emblematic for this radical manipulation of the landscape. It's the result of an engineering accident whereby a canal overflowed during two years to fill the lowest levels of the Salton Sink in the Colorado Desert. The water has been getting progressively more saline and toxic through evaporation and agricultural runoff. Eventually the whole thing

turned into an ecological disaster and it still is to some degree. What we were interesting in was not remediation but whether we could use the hypersalinity as something productive. So we started to imagine a set of productive pools — as habitats, recreational spaces — all of which would take advantage of the hypersaline water. We also looked in other technologies — fish farming methods, floating wetlands, mobile water transportation. Then we asked whether the hinterland might be reactivated through a small set of modest interventions. The whole project was a kind of plea for an infrastructural entrepreneurialism to produce new economies and public grounds.

A third project focuses on the Canadian North. Our work centers on the eastern Arctic, which is 85% Inuit. There is no other community that has undergone such a radical social transformation in such a short time. The territory is huge and there are few people in it: 110.000 residents north of 60°. And 50% of the population is under age 25. Many of the settlements started as military camps and that legacy is still very present. In a way they are ill adapted to these extreme circumstances. Architecture in these latitudes hasn't been nearly as adaptive as the people. Before we developed a project we did a broad research and started to classify available resources into ecology cells, monetary and transportation. And they became the seeds for many of the projects that we have developed. Much of this work is now documented in a new book: *"Many Norths: Spatial Practices in Shifting Territories'.* The notion of 'many Norths' reinforces the point that owe you frame the very notion of site is depending on what you are looking at. And spatial practices can be multiple. Architecture is not the only factor that leaves a physical imprint on the land. There are permanent infrastructures but also impermanent, indigenous things such as animal migration routes. Much of what we take for granted in our cities becomes a point of attention in the North, because of the acute scarcity of resources, the huge seasonal swings in climatic conditions and the sensitivity to soil and geology of the land.

Although this research is concerned with extreme conditions, I think this notion of looking at our environment with fresh eyes, and across multiple scales, in a way translates to any context.

Julie Marin
Department of Architecture, KULeuven

"The main question I was left with after the first masterclass was: what are we actually designing? We have been talking a lot about new business models and technological innovation, but what about our daily physical environments and

landscapes? When we will change the way material flows circulate through our territories, our physical environments will inevitably also dramatically transform. So how can we guide this change and what role can urbanists play in it?

Settlements used to be very closely linked to landscapes. Resource extraction used to be an important driver of urban patterns. Today that is not the case anymore. We don't know where the water running from our tap or the electricity we use is actually coming from. We are served by centralised networks that distance man, physically and mentally, from the landscape. The move to a circular economy creates a renewed urgency to understand the dependency between resources and urbanisation. The challenge to move towards a leaner, circular metabolism is also a spatial question.

I want to zoom in on a case study in Central Limburg. A year ago the automobile production site of Ford at Genk closed down, shedding 10.000 jobs. Because the area is suffering from economic decline it wants to reinvents itself as a hotspot for a circular economy. The spatial component of that challenge is being investigated in the T.OP Limburg program. In pre-industrial times Limburg was a bio-based economy, with settlement patterns anchored in locally available resources. The discovery of underground coal layers around 1900 changed all this. The scale of infrastructure and landscape manipulation increased dramaticaly. The mining sites became hubs of urbanisation. Later, after the closing of the mines, heavy industry moved into the area. And car infrastructure became the dominant force of urbanisation. So we see a succession of resource landscapes driven by multiple socio-ecological changes. That brings us to the question: what is next?

In our work we focused on renewable resources that are already there but today are underused. The most obvious ones are the waste flows because they will be the material providers of the future. One waste flow that has been identified as quite interesting for central Limburg is biomass from landscape waste. In addition there are infrastructural elements, such as the Albert Canal of the so-called 'Coal Track' — that are underused. Also the landscape, with its terrils and sand and gravel extraction pits, is a resource that is ready to be repurposed. Finally, there is geothermal energy, wind and biomass as dormant resources. The mapping of these resources was not just a numbers exercise. Key was to understand how these flows are rooted in space.

Now how to translate this into future scenarios? How can the transition to a circular economy be more than a technical question? One design effort focused on the Houthalen-Helchteren area where there are already several pioneer projects on circular economy techniques. But they are isolated and quite technocratic. One of

the interesting initiatives is a biomass hub. It is a place where the biomass from all the different kinds of landscapes is collected and sorted, packaged and sold as raw material for bio-industries or wood manufacturing, food for animals, etc. It is an interesting data management challenge to inventorise these residual flows and extract the biomass from the different landscapes in that area.

How does this translate into design? We explored an ecologically valuable buffer zone next to the industrial area and suggested a phased redevelopment, integrating water management with ecological and cultural values. The key is to design a development strategy that gradually activates the landscape as an infrastructure that deals with different challenges and flows at the same time.

A second case study focused on the Ford site that was abandoned about a year ago. We understood from the agencies that are responsible for the redevelopment of this site that their biggest challenge was time. They want to be able to provide jobs as soon as possible and their strategy to do so is to divide the site into plots and develop them as soon as possible with innovative circular industries. But to us it was clear that time would be necessary to find out how this site might function in a circular way. So we proposed an alternative redevelopment process in three phases: activation, incubation and circulation. The first phase is about shaping the mindset and physically preparing the site for redevelopment. During the incubation phase companies can start to experiment in circular configurations. The learning of these experiments is then consolidated in the final phase which leads to the site taking a position as a circular hub in its region. Circular logics can be integrated in each of these phases. Physical remediation can be anchored in a landscape frame that provides ecosystem services in parallel such as pollution extraction and water buffering. Vacant lots can be activated by short rotation wood crops. We envisioned a multifunctional infrastructural framework that provides flexibility and differentiated modal access (rail, water). Regionally, what happens on the site gradually starts connecting to other initiatives and infrastructures in the region (the railway, the canal, the regional green and water structures).

We've tried to shape these efforts as exercises in systemic design. This implies an operationalisation of circular principles across time, spatial scales and flows, and an understanding of how these flows is intimately shaped by connection with the landscape. It's not necessarily the economic potential that is guiding our design efforts in the first place, but potential of flows and infrastructures to connect different socio-economic agendas. While the spatial dimension is key, designing flows goes beyond it. One of the insights is that regulations can be an important stumbling block in enabling circular configurations. And key actors must be will-

ing to put their shoulders under the transition agenda. So design has to become a mediator. It's not about drawing pretty pictures but to integrate knowledge, shape coalitions and shape their disposition to collaborate and act.

Designing circular economies is more than a numbers game. By the way, very often it is very hard to come by the relevant data. And even if we have them we need to ask ourselves what we will do with them. In our design work we didn't want to be hung up on data. As our scenarios take shape we know better what data to look for. Designing with flows requires new methods of collaboration and design. It can build bridges connecting experts, actors and stakeholders with one common language, which is our physical environment, the spaces we work, live and play in.

Phebe Dudek

Former Lead Research Scientist MIT Urban Metabolism Group

"My talk summarises the work I did as lead research scientist at the MIT Urban Metabolism group lead by John Fernandez. Since I have moved back to Europe and I'm currently working at the European Commission. This work I did at MIT focused on the metabolism of African cities. We chose to focus on Africa because, together with China, it will host 85-90% of urban population growth in the coming 40 years. Africa counts 9 out of the 15 fastest growing national economies in the world. The associated urban population boom naturally leads to extreme resource pressures in cities and their hinterland.

The vehicle for our research was an interdisciplinary network of partners in different African cities: the African Urban Metabolism Network. It includes partners from Cairo (Egypt), Nairobi (Kenya), Gauteng (South Africa), Luanda (Angola), Kinshasa (DRC), and Lagos (Nigeria). Altogether the network included 34 experts from 23 organisations, mixing representatives from the research, policy, business and advisory communities.

I will discuss multiple research projects that ran in parallel during a period of about a year. One project focused on the development of a typology of African cities based on statistical data related to their natural resource consumption. The urban metabolism group had developed this previously at a global scale, leading to a classification of cities based on their metabolic profiles. The results were visually represented as star diagrams. We applied a similar approach to African cities. The rationale behind this work is that cities with comparable metabolic profiles would benefit from exchanging experiences and best practices. A big challenge here

was the availability of data. In many African countries there is simply no detailed natural resource consumption data available at city level. We worked our way around this by scaling down national level data and by using proxies for resource consumption (such as demographic and socio-economic data). The research of scaling national level data to city level data is still ongoing.

The project I personally developed was the mapping of urban natural resource flows, by combining Sankey diagrams with cartography of the physical urban space. We selected 13 cities with the largest and fastest population growth, located in different climatic zones of the African continent. Through fieldwork and interviews to each of the partner cities we were able to collect new crucial data. In Cairo, the collaboration with Nour Magdy allowed in-depth collection of data from which we compiled a set of maps for Egypt and Cairo using cartography and Sankey diagrams. This allowed us to visualise the location and direction of flows and to link the spatial and the statistical data across different scales. For instance, we discovered that all the sources of water for Cairo, a city of 18 million people, are supplied by the Nile river and 50% of that is formally used and treated and 50% is used in an informal way, in slums, industrial areas, for domestic uses, etc. The goal was to create maps based on the available data that would facilitate interdisciplinary discussions that are often marred by different perspectives and jargons. With our work we wanted to provide a basis for decision-making about infrastructure investment and governance related to natural resource consumption across scales.

Again, collecting the right kind of data was a challenge. Either the data didn't exist, or they were confidential. For instance, energy-related data tends to be considered as national security-data.

Other work streams focused on compiling 'resource assessment reports', that linked socio-economic aspects to resource flows, and 'alternative urban technology reports', a kind of database of useful technologies to implement for resource efficiency and a transition towards sustainable flows. We complemented these with 'urban vignettes': diagrams that show new industrial symbiosis potential and how ecosystem services can be built into cities.

Finally, we also developed a brief design exercise focused on Lagos, Nigeria. The city is growing at a tremendous speed and is not able to keep up with electricity provision. Also there are challenges at the level of water and food. So in our design we wanted to explore the nexus between energy, water and food. The result was a system-flow diagram that shows the flow interactions. Based on this flow-diagram we developed design proposals on how these extremely dense

neighborhoods could be equipped with new decentralised systems, biodigesters for instance, to produce resources on the local scale. Because we learned that in the African context large-scale infrastructure is often not reliable. Our general approach was therefore to stimulate decentralised projects, which would also help build urban resilience.

Finally I would like to commend the work done in Flanders because it is not evident to have different stakeholders and disciplines talk to each other. It is a big challenge, but yet a very crucial one to stimulate a fluent transition to a sustainable future.

MASTERCLASS III
2 FEBRUARY 2017

Dirk Sijmons
H+N+S Landscapsarchitecten, Amersfoort

“In 2014 I curated the International Architecture Biennale Rotterdam (IABR) under the banner ‘Urban by Nature’. The guiding hypothesis of the exhibition was that most environmental problems have urban roots. What is urban? Where does Brussels as a city end? It is part of a large Northwestern European urban landscape, a metropolis that does not only include built-up areas but also enclosed nature areas, productive territories (for food production, mining) and big infrastructures such as airports etc. Urban metabolisms are playing out on that kind of scale. They don’t care about administrative or national borders at all. Our Northwestern European delta is one of about 40 urbanised deltas worldwide and they include 60% of the global population today.

If we agree that our environmental problems have urban roots, then this means that global environmental challenges have to be tackled in these urban areas. One of the sub hypotheses put forward by the IABR is that finetuning urban metabolisms might be one of the instruments to solve these problems. We have to look under the city’s hood and figure out what makes it tick, where it gets it energy, food and water from and what it does with its waste. But we have to be realistic also, because urban development remains largely real estate-driven. Much of the money is being made there. Nevertheless, urban metabolism could add a novel perspective to that kind of traditional planning.

In the Biennale we showcased 45 projects connected to 9 different flows. It is immediately obvious that designers have an important role to play in shaping these infrastructures of flows. Friedrich Hundertwasser was one of the first who paid attention to this 'dirty' part of our profession. Today we can show many more examples of successful interventions. But there is more to infrastructure then meets the eye. Infrastructure has always been a powerful shaper of spatial order. Cities grow towards and enclose their airports. Train lines are hubs of economic development. It has always been that way. But it also raises questions about equity and power. Who has access and who hasn't? Is the water infrastructure in Mumbai serving the golf courses of the rich or the slums of the poor? These are powerful questions.

Now I want to turn to the question about the interface between flows and matter. How are we drawing processes? How are we drawing flows? That is a very new question for our discipline. We have to reinvent ourselves to make urban metabolism the working interface between environmental and spatial planning. We struggle with the data and with the complexity of the systems we are studying. Do metabolic maps have to be evocative and precise at the same time? In the IABR we relied on infographics that synthesised a lot of information and put forward specific problems related to the 9 flows considered. But this is an area in which people tend to create way to complex visualisations. There is a superstition that with big data and data mining we are going to solve all these problems. I am convinced this is not the way forward. We need to make choices, prioritise what flows we want to show and not be tempted to be comprehensive. The question is: what flows are really formative? How can they really inform urban form? And sometimes we have to look beyond the usual suspects. Sabine Barles has shown how formative the Paris sewer system was in shaping the urban form and its relationship with its hinterland. What was flushed into Parisian toilets was gold, in terms of its nitrogen content, and enormous farms sprung up just outside Paris to produce food for almost half of the city's population.

That connects to a project we did in Istanbul. This is city that is growing faster than planners can cope with. The masterplan that was made 8 years ago is completely outdated. It is going to be one of the biggest cities in the world due to the influx of labourers from rural areas. We were asked by a municipality on the European side of the isthmus to help them to cope with unbridled growth and illegal construction. We proposed to use the fresh water supply as the backbone of our approach. The oldest water sources had already been there since Roman times. The great underground systems are from Ottoman times. And today the city is dependent on just a few large basins. We wanted to use these basins as a spatial structuring device and as a crucial element in an environmental closed loop.

On the hand we wanted to concentrate all urban development on the highest grounds around the basin. Concentration has at least two advantages: it allows control of output and reuse of waste water (in agriculture), and it creates opportunities for public transport. The ecological quality of the basin had to be protected because it provides the city with drinking water. We planned for a natural system of filtering. Extensive grass lands form a buffer zone around the reservoir. A biochar facility was fed with charcoal from the nearby forest area and provided inputs to precision agriculture zones. So the city feeds the agriculture with its waste water and gets increased food and wood production and recreational facilities in return. This is the Paris mechanism revisited, but then in the context of a rapidly growing metropolis. However, the project will never be reality as the Turkish government decided that a second Bosporus is going to be dug exactly in this area.

Can air be formative? Yes it can, in big and small ways. Cities can be designed so that they are naturally ventilated. This may prevent us from tipping into a massive adoption of air conditioning in our cities. Almost one quarter of all the electricity used in the US is for air conditioning. Other strategies to 'design' the quality of the air include landscaping to reduce the noise of incoming aircraft around Schiphol. Or relying on mosses to absorb fine particles and dust. They are vastly more effective in cleaning urban air than trees.

In the end it is all about people. Bruno Latour urges us to turn 'matters of fact' to 'matters of concern'. Take climate change. For a long time we framed the issue as an air pollution system. The whole environmental movement took its cue from the way we tackled the CFK problem. This worked because there were one or two industries worldwide that were easy to regulate. But it doesn't work for climate change. We have to reframe it to an energy problem. The key challenge then is the transition from a fossil fuel-based system to a renewables-driven system. This reframing is having a huge impact on policy making. Data is not yet information. And information is not yet knowledge. And knowledge is not yet wisdom. And wisdom does not result in action. And even if you have action, you don't necessarily have a plan yet. As designers this is our domain. It's not about big data, but about the plan, a perhaps a little bit of wisdom.

SOME KEY LEARNINGS

by Philippe Vandenbroeck, shiftN

We are rediscovering the city as a system of flows. The golden age of designing urban metabolisms is already more than a century behind us. Early 19th century European cities were flashpoints of conflict and disease as a result of rapid population growth, glaring social inequalities and intense environmental pressures. This triggered the Heroic Moment of urban planning: a period typified by urban sanitation, transport and communication projects on a pharaonic scale. Haussman's Paris is the archetype of that modern infrastructural ideal.

Today, changing environmental conditions are putting the fragility of urban metropolises again into relief. 60% of the world population is living in urban areas concentrated in low-lying coastal areas and river deltas. Climate change imperils these communities through flooding, catastrophic events and the rise of infectious diseases. But because of their vast and increasing demands for energy and materials, cities are also one of the key drivers of global environmental change. This is a diabolical feedback mechanism that will have to be restrained in order to avoid unwelcome disruptions to urban communities worldwide.

As in the 19th century, the concern about reinvigorated environmental pressures is coinciding with a phase shift in technological development. Victorians were masters in the mobilisation and evacuation of material flows. Meanwhile we have entered the information age. Improvements in computing and sensor technology are paving the way for vast urban monitoring systems and intelligent infrastructures. And renewable energy sources have matured to the point that a final transition away from our fossil fueled shackles is not inconceivable anymore.

So how will urban planners and designers rise to this challenge? Is it time for another heroic moment? Will a rediscovery and reinterpretation of the city as metabolism again offer a platform for large-scale urban transformation, and if so, how? That is the question that has been addressed in this series of masterclasses.

These gatherings have foregrounded a mix of perspectives: we heard urban designers, environmental engineers, business model architects (and hybrids of them) trying to make sense of the complexities of the modern city through the lens of

urban metabolism. One notable observation from these discussions, however, is the absence of a spirit of Promethean optimism. It is a sign of our postmodern times, of course. We have lost our faith in grand designs. And the challenges are global and developing at breakneck speed. In the coming decade hundreds of completely new, large cities will likely be built to accomodate the grand rural exodus, particularly in Africa and Asia. And, most of all, we understand that the future of the city is not in the first place a technological puzzle but fundamentally a political challenge.

The landscape urbanists in these masterclasses (Sheppard, Marin, Sijmons) handled the metabolic metaphor with circumspection. And justifiably so when we remind ourselves that the 19th century reduction of the urban to the biological had a correlate in its medicalization. The modern practice of urban design was fundamentally therapeutic in its orientation and ambition. As Françoise Choay writes: *"With Cerdá, the urbanist donned the medical whites of the healer, and has never laid them aside since. The city is sick. It is the practitioner's job to find the causes of the malady, make a diagnosis, and apply remedies. (...) Cerdá transposed the notions of the normal and the pathological to the social realm — without exhibiting any apparent methodological qualms. In so doing, he ignored the very different kinds of norms applied in medicine and anthropology, as well as the fact that the organisation of human space answers to cultural and ethical norms."* (Choay, 1997).

The contemporary practice of landscape urbanism takes these cultural and ethical norms on board, and does so in sometimes artful and surprising ways. Lola Sheppard withdraws to the Arctic North, a territory, or rather a theater with mythical resonances where the footprint of human beings is still relatively marginal. The fringe becomes an invitation to a creative articulation of the notion of 'site'. The wide and white open spaces of the North throw us back to a point where nothing is given, and everything has to be constructed. Hence the idea of 'Many Norths'. The construction is inevitably based on a painstaking labor of observation, mapping and contextualisation. Flows can be part of that inventory but are never the cartography's *raîson d'être*. For Sheppard the seasonal pulse of animal migrations is perhaps as important as the flow of crude oil through pipelines on an increasingly wobbly permafrost.

Dirk Sijmons in his talk leaned on Bruno Latour in cautioning us to let go of the 'matters of fact' and turn our attention to 'matters of concern'. At one point, the French thinker declared that *"we might be more connected to each other by our worries, our matters of concern, the issues we care for, than by any other set of values, opinions, attitudes or principles."* And, we might add, than by any kind of metabolic flow (Latour, 2005). Latour's ambition is to construct a map, but of a

hidden geography of affective relationships. *"Each object gathers around itself a different assembly of relevant parties. Each object triggers new occasions to passionately differ and dispute. Each object may also offer new ways of achieving closure without having to agree on much else. In other words, objects — taken as so many issues — bind all of us in ways that map out a public space profoundly different from what is usually recognized under the label of 'the political'."* In other words, 'objects' (and hence also 'flows') constitute a space for a creative process of working towards temporary closure — or 'accomodation' — between different worldviews.

Julie Marin played out this dimension quite emphatically in her plea for a systemic approach to design. This not only implies an operationalisation of circular principles across time, spatial scales and flows, and an understanding of how these flows are intimately shaped by connection with the landscape. It is also 'design for agency', led by an evolving understanding of the way in which flows and infrastructures connect different socio-economic agendas: *"It's not about drawing pretty pictures but to integrate knowledge, shape coalitions and shape their disposition to collaborate and act."*

So the designerly approach is hesitant to foreground urban metabolism. It deftly plays on the intersection of different rationales — spatial, cultural, ecological, political. The subtlety comes, however, with a challenge of codification and transparency. For outsiders it is not easy to appreciate the intricacy with which craft and concept, site and science, and project and politics mesh. This makes it hard to sell to those who are seeking a quick fix, and vulnerable to the interferences of those who are interested in a quick buck. Hence, there is a need to bring the underlying, layered rationale into relief by articulating a set of design heuristics. 'Circularity' is certainly one of these guiding principles, but there will be many others that come into play (e.g. 'resilience', 'isotropy', 'multifunctionality', 'concentration', etc.).

In these masterclasses the perspective of landscape urbanists was counterbalanced by the engineering approach to urban metabolism. It is they who are piloting its revival, based on insights from the practice of industrial ecology. It is clear from the discussions that engineers and designers are working from very different methodological presuppositions. The engineers map and design a metabolism, landscape urbanists design *with* metabolisms. The industrial ecologists' guiding heuristics are pretty clear — 'efficiency' and 'economic value' — while designers tend to see the city as intrinsically unruly, inefficient and as matrices for quality of life. It is not obvious how these diverging professional dispositions can be aligned. The engineering approach hinges on a painstaking inventorising of flows and the construction of relevant indicators. The aim is to inform decision-makers, trigger

behavioral change and create opportunities for systemwide optimisation of flows (reducing inputs and eliminating waste). The task is bedeviled by considerable methodological challenges. Several speakers — both engineers and designers — have lamented how hard it is to get hold of reliable data. The choice of system boundaries is a crucial but fraught decision. Aristide Athanassiadis made a distinction between a 'territorial' and a 'consumption-oriented' approach in inventorizing flows and drawing up urban mass balances. The territorial approach draws an imaginary boundary and measures the flows that move across that line (from the environment to the city and vice versa). The consumption approach focuses on what is consumed locally and how that is fed by global supply chains. The results of these alternative assessments suggest vastly different metabolic strategies.

The risk of obfuscation and political recuperation is also present in the engineering approach. Sijmons and Sheppard warned against number fetishism and the lure of big data. The engineering take on rewiring urban metabolisms seems to rest on a naive assumption that policy makers and citizens will take the right decisions if only they are fed with accurate numbers. Surprisingly, none of the speakers has pleaded for the establishment of a decision arena where the ethical issues surrounding resource transfers can be made transparent, debated and resolved. In absence of these discursive spaces, there is a risk that the city will be increasingly instrumentalised as a flow-optimising computer. The thorny questions about who benefits ("water for the golf courses of the rich or for the slums of the poor?") and what civil liberties need to be curtailed in order to achieve smaller ecological footprints will then be pushed into the background.

The challenges befalling humanity in the 21st century are enormous. There is no easy way out. For the foreseeable future, metropolitan areas will be unable to shed their Jekyll and Hide character: environmental flashpoints *and* levers to increase quality of life for hundreds of millions of residents. We cannot afford *not* to think about how to interfere with the way cities metabolise natural resources, energy, processed goods, information assets, and money. But in doing so we need to negotiate the familiar dilemma between agency and coercion, between necessity and desire.

These masterclasses have been a stimulating opportunity to survey the state of the debate and the choices and strategies involved. 'Urban metabolism' has the potential to act as a boundary object to connect different professional and epistemic communities. Its conceptual richness presents a challenge but is also an asset. It provides a springboard for the articulation of a shared agenda, the reinforcement of existing coalitions and the bringing to life of new actor constellations.

RESOURCES

LINKEDIN PROFILES OF SPEAKERS (IN ORDER OF APPEARANCE)

Aristide Athanassiadis
https://www.linkedin.com/in/arisatha/

Jan Jongert
https://www.linkedin.com/in/janjongert/

Ben Kubbinga
https://www.linkedin.com/in/benkubbinga/

Lola Sheppard
https://www.linkedin.com/in/lola-sheppard-94a2b4a/

Julie Marin
https://www.linkedin.com/in/julie-marin-60407536/

Phebe Dudek
https://www.linkedin.com/in/phebedudek/

Dirk Sijmons
https://www.linkedin.com/in/dirk-sijmons-5965a1a/

VIDEO REPORTS OF MASTERCLASS TALKS

Vimeo
https://vimeo.com/album/4485260

Phebe Dudek
http://bit.ly/2k1dji3

COLOPHON

Designing with Flows
A series of Masterclasses organised by OVAM
in collaboration with .FABRIC, Vlaamse
Milieumaatschappij (VMM/MIRA), Team
Vlaams Bouwmeester and Metabolism Of Cities.

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