

# The Architect within the Circular Economy. The incorporation of the human factor within the urban metabolism framework.

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## I Introduction to the circular economy

This paper is written for the lecture series on research methods. It is used as a heuristic tool for students to become aware of the research methods architects engage within their practice.

Long are left behind the days where the role of the architect was solely one of designing and constructing a building. We now live in a postmodern society, where globalisation and neoliberalism have made the world ever more intertwined and intricate. This has changed the role of the architect, who now has to creatively orchestrate the expertise of numerous disciplines into a cohesive spatial plan. As the field of knowledge has become more complex, it is ever more important for architects to be able to position themselves within and respectively to the disciplines they work with. Through a set of lectures on research methodologies, the course Research Methods raises awareness on this position.

### **Problem statement: from a linear to a circular economy**

Our current economy is a linear model, following a “take-make-dispose” plan, where value is created by producing and selling as many products at the highest possible price<sup>1</sup>. The industrialization of our food system is evidence for this. Though it has helped feed a fast-growing population, it also has caused massive deforestation, air pollution, the contamination of our water supplies, antimicrobial resistance, and public health problems. All together for every one dollar spent on food, two dollars are incurred in economic, health and environmental costs<sup>2</sup>. On top of this, it is extremely wasteful, around 1/3 of the produced food goes uneaten, while 10% of the world population goes hungry<sup>3</sup>

This model also becomes visible in the way our cities operate. Urban policy and city branding have focused on attracting affluent users, business and visitors to the city. To accommodate these new inhabitants, much of the original inhabitants of the neighbourhood have been displaced, and places of consumption have been built to serve the new users needs. The effect of this type of policy is the growing inequality within our cities, which maps itself geographically, with city centres as places of affluence, and the peripheries as areas of poverty<sup>4</sup>. Overall our current economic model shows to be unsustainable and unfair.

The circular economy offers a vision for a sustainable future. The concept of the circular economy is grounded in the study of living systems. Where every actor works in synergy with each other in order to form a healthy ecosystem<sup>5</sup>. In my graduation project, I aim to explore ways of implementing systemic thinking into urban planning, in order to bridge social, environmental problems and lay the basis for creating a healthy neighbourhood where everyone can benefit from. By looking at the way Urban Agriculture (UA) can be implemented into the urban fabric of three low-income neighbourhoods (Geuzenveld, Osdorp Oost and De Aker) located in the Western Garden City-Amsterdam; a sustainable solution can be found which will ensure food self-sufficiency while also providing the neighbourhood with economic, social and environmental benefits; such as the creation of jobs, the stimulation of social interaction, the enhancement of biodiversity, the production of energy and the retention of water.

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<sup>1</sup> Mti, N. (2019, August 16). The Difference Between Linear & Circular Economy. Retrieved January 20, 2020, from <https://www.entrepreneurship-campus.org/the-difference-between-linear-circular-economy/>

<sup>2</sup> Ellen Macarthur Foundation. (2019). Cities and Circular Economy for Food. Retrieved from [https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-for-Food\\_280119.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-for-Food_280119.pdf)

<sup>3</sup> Hunger Notes, How many people are hungry in the world? (2016), <https://www.worldhunger.org/hunger-quiz/how-many-people-arehungry-in-the-world/>

<sup>4</sup> Florida, R. (2017). The New Urban Crisis: How Our Cities Are Increasing Inequality, Deepening Segregation, and Failing the Middle Class-and What We Can Do About It . -: Basic Books.

<sup>5</sup> Het Groene Brein. (n.d.). A circular economy differs from a linear economy, but how? Retrieved January 21, 2020, from <https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-circular-economy/how-is-a-circular-economy-different-from-a-linear-economy/>

## II Incorporating the human factor within urban metabolism

The main purpose of this research is in assessing design professionals and government officials who want to implement circular economy based urban agriculture into the neighbourhood. The research makes use of three neighbourhoods as a case study to illustrate the way the method should be implemented. The results of the case studies are interpreted by me and used as the foundation for my design project.

The foundation of the methodology is based on concepts of urban metabolism). Urban metabolism is a systems-based approach to comprehend the trajectories of resource use and waste production within cities, and the impact these flows have on the environment<sup>6</sup>. It compares cities to a living organism, where energy and resource inputs are used, converted to do work and eliminated through waste. To build up the research different methods and analytical tools have been employed. The step-by-step method is as follows:

In the first step, I conducted a literature study on suitable urban farming techniques that can be implemented within the neighbourhood. Four different techniques were chosen (SPIN farming, roof farming, urban garden and indoor hydroponics) based on the suitability of the techniques within the spatial infrastructure of the neighbourhood.

In the second step, using GIS and AutoCAD the spatial infrastructure of three neighbourhoods were calculated. This was done by dividing the neighbourhood into different spatial typologies. The typology selection was made based on the type of ownership (public, communal and private) and the technical suitability (fit or unfit for roof farming) of the typologies. Only the buildings and public spaces belonging to the communal and public realm were considered applicable for urban farming, as it is easier to comply with these owners. The spatial infrastructure of the neighbourhood is divided as follows: (i) Buildings: collective and public buildings. (ii) Spaces: squares and vacant plots, parks, stream beds, and community spaces.

In the third step, I made use of the scenario method, which illustrates visions simulations of the future. This method can be used as a form of exploration or as a tool for decision making, as it reveals the available choices and its potential consequences<sup>7</sup>

I created three different scenarios based on the three pillars of sustainability: social, environmental and economic. Each scenario represented a unique vision for the future of the neighbourhood and had a specific way of implementing urban farming techniques within the spatial infrastructure of the neighbourhood. Each scenario has a set of benefits or drawbacks over the others, which were illustrated through a series of quantifiable (food production, monetary income, job production, water retention and energy production) and non-quantifiable indicators (social cohesion, biodiversity enhancement and aesthetic value).

The data of each indicator was calculated and processed through excel, a data analysis tool, and presented in the form of a spider diagram. Spider diagrams (aka radar charts), were the most adequate form of representation, as the results of the data are translated into a single surface making it easy for the readers to see the performance of each scenario in one glance.

In the final step, the performance of each scenario was put into relation with the specific social/spatial problems of the neighbourhood, from which the most suitable scenario was chosen. The final step comes down to the architect or the decision-maker to choose from. The chosen

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<sup>6</sup> Pincetl, S., Bunje, P., & Holmes, T. (2012). An expanded urban metabolism method: Toward a systems approach for assessing urban energy processes and causes. *Landscape and Urban Planning*, 107(3), 193–202. <https://doi.org/10.1016/j.landurbplan.2012.06.006>

<sup>7</sup> EFP. (2020, January 22). Scenario Method « European Foresight Platform. Retrieved January 30, 2020, from <http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/scenario/>

scenario shares with the designer or government official the potential values that can be created, but also makes him aware of the downside of the intervention, in order for him to come with an adequate plan.

### III Reflecting on urban metabolism, cartography and the scenario method

For the third part, I will put the central methodology (urban metabolism) and the two main methods (cartography and scenario method) within its historical and theoretical context.

#### **The human factor in urban metabolism**

The first mentions of urban metabolism date back to 1883, when Karl Marx used the term to define the material and energy exchange between nature and society that take place through human activity<sup>8</sup>. In 1965, "The Metabolism of Cities" by Wolman, relaunched the theory of urban metabolism for the engineering community. He had advanced the theory with quantitative proof and spread the notion that urban footprints were not limited to their geographic or political confines<sup>9</sup>. Nowadays, urban metabolism looks through three different approaches, Metabolic Flow Analysis, Life Cycle Analysis and Mass Balance, the way materials and energy flows within and beyond our cities. Creating a framework to quantify our energy and resource use within cities, and to access if these demands are in line with the finite resources of the Earth<sup>10</sup>.

The downside of these frameworks is that they lack the inclusion of the human factor within their methodology. suggests to expand the urban metabolism framework beyond the analyzes of materials and energy flows, and include the human, social, policy and economic systems that influence the metabolism of the city. It is, therefore, necessary to include in the analysis variables related to demography, health, mobility, economy, equity, policies, employment, and education<sup>11</sup>. This type of analysis will bridge urban metabolism towards other disciplines creating new lines of inquiry which can lead us to a true understanding and application of urban sustainability. Moreover, these analyses can be very useful for decision-makers who implement sustainability within our cities, such as planners, designers, engineers and government officials.

When building up my paper I became aware of the research gap within the circular economy. Much has been written about technological development and business models, but publication on policy and society was lacking. In order to bridge this gap within the field of knowledge, I decided to include the human aspect within the analysis of the material flow in the neighbourhood.

#### **From cartography to GIS**

Cartography can be defined as the science or practise of drawing maps, it has been an essential tool for humans to raise spatial awareness and thinking. The first known maps date back to the Babylonian times and are preserved as clay tablets. Throughout the centuries maps have become more sophisticated, as they have integrated mathematics, ground observations, remote sensing and aerial photography within their methods<sup>12</sup>. During the 70s and 80s, when computer technology became popularised, digital mapping systems such as GIS became available changing the field of

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<sup>8</sup> Zhang, Y. (2013). Urban metabolism: A review of research methodologies. *Environmental Pollution*, 178, 463–473. <https://doi.org/10.1016/j.envpol.2013.03.052>

<sup>9</sup> Pincetl, S., Bunje, P., & Holmes, T. (2012). An expanded urban metabolism method: Toward a systems approach for assessing urban energy processes and causes. *Landscape and Urban Planning*, 107(3), 193–202. <https://doi.org/10.1016/j.landurbplan.2012.06.006>

<sup>10</sup> Zhang, Y. (2013). Urban metabolism: A review of research methodologies. *Environmental Pollution*, 178, 463–473. <https://doi.org/10.1016/j.envpol.2013.03.052>

<sup>11</sup> Pincetl, S., Bunje, P., & Holmes, T. (2012). An expanded urban metabolism method: Toward a systems approach for assessing urban energy processes and causes. *Landscape and Urban Planning*, 107(3), 193–202. <https://doi.org/10.1016/j.landurbplan.2012.06.006>

<sup>12</sup> Aber, James S. "History Of Maps And Cartography". Academic.Emporia.Edu.

work of planners. GIS is a computer system that captures, stores, analyzes and displays natural and built entities and activities, which can be displayed on a map<sup>13</sup>.

Within the lines of inquiry on UA and US, the first effort to quantify the application of UA at a global scale was conducted. The research was done using images of the Landsat 5 Collection (a dataset created by a satellite orbiting the earth since 1984), and using a threshold on the Normalized Difference Vegetation Index (NDVI) the natural capital for vertical, rooftop and vacant plots were calculated, in order to determine the suitability for UA. The results were gratifying, with potential for millions of tonnes of food production, thousands of tonnes of nitrogen sequestration, billions of kilowatt-hours of energy savings, and billions of cubic meters of avoided storm runoff from natural capital in urban areas<sup>14</sup>. The research highlights the spatial significance of our urban environment to act as change agents in order to relieve the concern related to unsustainable development and climate change.

### **The scenario method**

The third method I want to discuss is the Scenario Method. Scenarios were first employed by corporations, as planning became more complicated and intricate. Shell was one of the first in the field and became a reference point for corporate scenario planning. It enabled the company to anticipate the rise and fall of the oil process in 1973<sup>15</sup>. Nowadays it is widely used by the public and private sector in order to make simulations of possible futures. This type of insights and forecasting are of high relevance these days when climate, political and economic uncertainties are so prominent.

The interesting part of the scenario method is that it is both an exploratory method and a tool for decision-making, integrating aspects of research and design into a single method. This aspect makes it useful for designers who are supposed to take action on the conducted research. The narrative and qualitative aspect of this method give the decision-maker insights beyond what quantitative methods can offer, bringing for architects a sense of familiarity within the research, as they are used to working with narratives.

## **IV The role of the architect within the circular economy**

I decided to graduate in the field of Architectural Engineering (AE). The studio works with a set of predetermined topics of high relevance today, such as the circular economy, the energy transition or the building of one million homes for NL; but it also gives students the necessary freedom for creative exploration and decision-making. I think this is of great value as it familiarizes students with a specific field and forces them to take a position within it.

Within AE, I specifically choose the studio of Valuable Neighbourhoods. Neighbourhoods are characterised by being geographical areas with localised communities making it the perfect scale for integrating the human aspect into the circular economy.

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<sup>13</sup> Klosterman, R. E. (2001). Urban Planning: Methods and Technologies. *International Encyclopedia of the Social & Behavioral Sciences*, 16055–16058. <https://doi.org/10.1016/b0-08-043076-7/04435-1>

<sup>14</sup> Clinton, N., Stuhlmacher, M., Miles, A., Uludere Aragon, N., Wagner, M., Georgescu, M., ... Gong, P. (2018). A Global Geospatial Ecosystem Services Estimate of Urban Agriculture. *Earth's Future*, 6(1), 40–60. <https://doi.org/10.1002/2017ef000536>

<sup>15</sup> EFP. (2020, January 22). Scenario Method « European Foresight Platform. Retrieved January 30, 2020, from <http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/scenario/>

Our current economic model is the cause of much of the crises we are going through today. To name a few, it has caused the depletion of our resources<sup>16</sup>, the contamination of our environment<sup>17</sup>, the financial meltdown of 2008<sup>18</sup>, the hyper commodification of the housing market<sup>19</sup> and the political polarisation in our society<sup>20</sup>. The winner takes all economy has not only shown to be extremely unfair but also very unsustainable, and is therefore up for disruption. I believe that the transition we are faced to make, from the linear model to the circular, is a challenge that goes in line with highly complex interdisciplinary societal efforts, such as the reconstruction period after WWII or the 19th-century sanitary movement; but also goes beyond anything we have done before, as the postmodern and globalised world we live in today, is more complex and intricate than ever before.

Architects and urban planners play a crucial role within this effort; their spatial skills, the capacity of working across disciplines and creative vision can provide them with a leading role in how urban sustainability can be implemented. For the architect, it is important to be at the vanguard, in the front line ready to implement our latest technological developments into our built environment; but also educated on the latest lines of inquiry within the social sciences, as building strong communities is an essential aspect for achieving this goal<sup>21</sup>.

In order to put my ideas in line with ideas discussed during the lectures, it is first important to explain the two different approaches to the public discussed by Tom Avermaete<sup>22</sup>. The first attitude is the architect as an activist, who has left behind the traditional role as a craftsman, and now fights for social justice and is engaged with the struggle of the community. The second attitude is the architect as the facilitator, here the architect engages the public on how to be self-sufficient and realize a project. I believe the position I described encompasses both, on the one hand, it takes on the role of the activist, who fights for the needs of the community and ensures that within the design of urban systems, resources and wealth are distributed in a just way. On the other hand, it takes on the role of the facilitator, teaching ways on how to implement sustainable design within our environment. | .....

### **Individual architectural position**

By using the above-mentioned methodologies I have further developed my understanding on how urban metabolism works in a specific urban environment, and how the human factor can be implemented in order for it to benefit its community.

Being the climate crisis the biggest challenge my generation is going to face, working towards building resilient cities and strong communities is going to be our main purpose.

I consider that my education, and specifically courses such as research methods, has provided me with the right skills that enables me to position myself into such multidisciplinary efforts.

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<sup>16</sup> Birch, K., Levidow, L., & Papaioannou, T. (2010). Sustainable Capital? The Neoliberalization of Nature and Knowledge in the European "Knowledge-based Bio-economy." *Sustainability*, 2(9), 2898–2918. <https://doi.org/10.3390/su2092898>

<sup>17</sup> Birch, K., Levidow, L., & Papaioannou, T. (2010). Sustainable Capital? The Neoliberalization of Nature and Knowledge in the European "Knowledge-based Bio-economy." *Sustainability*, 2(9), 2898–2918. <https://doi.org/10.3390/su2092898>

<sup>18</sup> S, B. (2009). *Neoliberalism and the Global Financial Crisis* (Master Dissertation). Retrieved from <https://ro.uow.edu.au/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1220&context=artspapers>

<sup>19</sup> Sintusingha, S. (2020, January 25). Neoliberal production of housing inequality. Retrieved January 30, 2020, from <https://msd.unimelb.edu.au/atrium/neoliberal-production-of-housing-inequality>

<sup>20</sup> Stiglitz, J. E. (2019, May 13). Opinion: Three decades of neoliberal policies have decimated the middle class, our economy, and our democracy. Retrieved January 30, 2020, from <https://www.marketwatch.com/story/three-decades-of-neoliberal-policies-have-decimated-the-middle-class-our-economy-and-our-democracy-2019-05-13>

<sup>21</sup> United Nations. (2019, July 23). Cities - United Nations Sustainable Development Action 2015. Retrieved January 25, 2020, from <https://www.un.org/sustainabledevelopment/cities/>

<sup>22</sup> Avermaete, T. (2014). *The Architect and the Public: Empowering People in Postwar Architecture Culture*. HUNCH14.

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As a final remark, I strongly believe that in order for us to move on in this effort, the urban metabolism framework should be widely adopted by architects, and expanded towards including the human, social, policy and economic systems that influence the metabolism of the city. It is then that we can achieve true urban sustainability.

## REFERENCES

- Aber, James S. "History Of Maps And Cartography". Academic.Emporia.Edu.
- Avermate, T. (2014). The Architect and the Public: Empowering People in Postwar Architecture Culture. HUNCH14.
- Birch, K., Levidow, L., & Papaioannou, T. (2010). Sustainable Capital? The Neoliberalization of Nature and Knowledge in the European "Knowledge-based Bio-economy." *Sustainability*, 2(9), 2898–2918. <https://doi.org/10.3390/su2092898>
- Clinton, N., Stuhlmacher, M., Miles, A., Uludere Aragon, N., Wagner, M., Georgescu, M., ... Gong, P. (2018). A Global Geospatial Ecosystem Services Estimate of Urban Agriculture. *Earth's Future*, 6(1), 40–60. <https://doi.org/10.1002/2017ef000536>
- EFP. (2020, January 22). Scenario Method « European Foresight Platform. Retrieved January 30, 2020, from <http://www.foresight-platform.eu/community/forlearn/how-to-do-foresight/methods/scenario/>
- Ellen Macarthur Foundation. (2019). Cities and Circular Economy for Food. Retrieved from [https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-for-Food\\_280119.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/Cities-and-Circular-Economy-for-Food_280119.pdf)
- Florida, R. (2017). The New Urban Crisis: How Our Cities Are Increasing Inequality, Deepening Segregation, and Failing the Middle Class-and What We Can Do About It . -: Basic Books.
- Het Groene Brein. (n.d.). A circular economy differs from a linear economy, but how? Retrieved January 21, 2020, from <https://kenniskaarten.hetgroenebrein.nl/en/knowledge-map-circular-economy/how-is-a-circular-economy-different-from-a-linear-economy/>
- Hunger Notes, How many people are hungry in the world? (2016), <https://www.worldhunger.org/hunger-quiz/how-many-people-arehungry-in-the-world/>
- Klosterman, R. E. (2001). Urban Planning: Methods and Technologies. *International Encyclopedia of the Social & Behavioral Sciences*, 16055–16058. <https://doi.org/10.1016/b0-08-043076-7/04435-1>
- Mti, N. (2019, August 16). The Difference Between Linear & Circular Economy. Retrieved January 20, 2020, from <https://www.entrepreneurship-campus.org/the-difference-between-linear-circular-economy/>
- Pincetl, S., Bunje, P., & Holmes, T. (2012). An expanded urban metabolism method: Toward a systems approach for assessing urban energy processes and causes. *Landscape and Urban Planning*, 107(3), 193–202. <https://doi.org/10.1016/j.landurbplan.2012.06.006>
- S, B. (2009). *Neoliberalism and the Global Financial Crisis* (Master Dissertation). Retrieved from <https://ro.uow.edu.au/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1220&context=artspapers>
- Sintusingha, S. (2020, January 25). Neoliberal production of housing inequality. Retrieved January 30, 2020, from <https://msd.unimelb.edu.au/atrium/neoliberal-production-of-housing-inequality>
- Stiglitz, J. E. (2019, May 13). Opinion: Three decades of neoliberal policies have decimated the middle class, our economy, and our democracy. Retrieved January 30, 2020, from <https://www.marketwatch.com/story/three-decades-of-neoliberal-policies-have-decimated-the-middle-class-our-economy-and-our-democracy-2019-05-13>
- United Nations. (2019, July 23). Cities - United Nations Sustainable Development Action 2015. Retrieved January 25, 2020, from <https://www.un.org/sustainabledevelopment/cities/>
- Zhang, Y. (2013). Urban metabolism: A review of research methodologies. *Environmental Pollution*, 178, 463–473. <https://doi.org/10.1016/j.envpol.2013.03.052>



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