Nonlinear Urbanism

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Anton Falkeis, Anastasia Shesterikova,
Benjamin James, Michael Tingen,
Institute of Architecture at the University of
Applied Arts Vienna (Eds.)

Nonlinear Urbanism

Towards Multiple Urban Futures

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Dismissing Nonlinearity Means Ignoring Reality

Gerald Bast

It's been almost 100 years since the German physicist Werner Heisenberg formulated the uncertainty principle and his theory of quantum mechanics broke not only the paradigms of physics, but also those of philosophy. And yet today, we are still accustomed to arguing and acting primarily along linear patterns of causality within isolated boxes of fragmented sciences. The world no longer fits into these rigid parameters. We are now being forced to accept that the extinction of uncertainty is an unrealistic illusion, or even an ideological allegation.

We are living in a world characterized by change, ambiguity and unpredictability. Never before in human history have changes been taking place so fast, and been so deeply disruptive in various areas at the same time, interconnected with each other and demonstrating global repercussions. While our societies have been constantly growing ever more complex, and we are having to increasingly acknowledge that seemingly different aspects of our realities are interconnected, the history of universities has been one of fragmentation, speeding up over the last few decades. On the one hand, this has been necessary for the dramatic expansion of our scope of knowledge. On the other hand, the price we have paid for this has been a general loss of perspective on interrelationality.

The impression that a photo, video, object or building leaves on a viewer's retina is necessary, but not sufficient in and of itself. The decisive factor is the effect it has on our minds — which is dependent on the creation of contexts of experience and interpretation.

Hans Hollein once placed a pill on a piece of paper and named it "single-family home in a rural setting."

One of the most significant developments in our modern world is the increasing existence of uncertainty. From Heisenberg's uncertainty principle to Schrödinger's cat, which is, in a quantum mechanical sense, alive and dead at the same time; from breathlessly keeping pace with the digital information society to fear of the total surveillance state; from the crisis of political institutions to the crisis of the financial system. Jürgen Habermas identified the displacement of politics by the market ten years ago, and now the markets are going crazy as well. Uncertainty dominates our attitude towards life — but will it ever be possible to get rid of uncertainty? To prohibit uncertainty? How can we ignore multilinearity and transdisciplinarity?

What we are currently experiencing is the phenomenon of those who have been socialized in our supposedly enlightened society trying to escape this increasingly unsettling world. People are looking for security, simple answers, certainty, the elimination of doubt. And this comes as no surprise when we realize that people who are educated and socialized in intellectual environments tend to avoid nonlinearity and doubts. Dismissing nonlinearity also means rejecting certain realities, including that of our brain's neural network. A flight from doubt is also a flight from enlightenment!

I would like to extend my thanks to Anton Falkeis and all the authors of this publication who are following the culture of nonlinear investigations.

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Nonlinear Urbanism, Towards Multiple Urban Futures

Anton Falkeis

The Problem of Linearity

Throughout history, urban development has been fueled by technological innovations. Ever since the ancient Romans exported their urban techniques while conquering the world, urban design has become synonymous with infrastructure technology and technological solutions. These technologies were mainly based on innovations initially driven by military and later by economic interests. Disruptive technologies became fundamental to laws and regulations for urban development, ultimately determining the forces that shape urban space. They significantly changed the way we inhabit our cities, and the way we live, work or move in urban space. The integration of large-scale technological inventions into urban life has marked major turning points in history, causing substantial damage to societal structures and urban space.[1] As we have seen throughout the course of the Industrial Revolution(s), more or less every aspect of everyday life was affected by this development, and still is up until the present day. Modern societies, as well as modern cities, are rooted in this period of radical transformation of work and life.

The first wave of the Industrial Revolution completely shifted our production routines from being based on hand production methods to being driven by steam-powered machines. Breaking apart preindustrial societal structures, the spatial concentration of labor established a new type of urban structure: the manufacturing plant. Site and location evolved into becoming the essential criteria for industrial manufacturing. The traditional production techniques — defined by the spatial coexistence of life and work — dissolved into spatially dissected concentrations of monofunctional activities. Executing this strategy on an urban scale led to an unprecedented, radical segregation of urban life. Thus, isolation and exclusion eventually became the core policies of an industrialized city.[2]

The second wave pushed the production output towards one that resulted in an unparalleled quantity of goods. This first form of mass production was based on the division of labor. The workflow was disassembled into less complex sequences. Structured into rigorous, linear processes, these smaller portions of work were then reassembled alongside assembly lines, regardless of what kind of product was being manufactured. This concept was applied to the first and most well-known assembly line, the Ford line, to the lesser-known Cincinnati slaughterhouse lines. Mass production, powered by electrical energy, provided products at affordable prices by minimizing input costs.

As a result of this development, automobiles made an appearance on the urban agenda. Having the most influence on urban planning up to date, they became the driving force behind city development. Once populated by a variety of activities, the streets and public spaces of preindustrial cities were now facing being relegated to exclusively hosting traffic. Back in these days of a rising age of the automobile, US car companies began systematically buying up public transport systems in order to shut them down, leaving millions of Americans stranded. Now having to depend entirely on car mobility, cities developed into sprawling urban forms.

1 Kiess, W. (1991). Urbanismus im Industriezeitalter. Berlin

2 Falkeis, A. (2015). "Thinking Out of the Urban Design Tool Box." In: Arts, Research, Innovation and Society. New York: Springer

This development of rapid suburbanization had had a big and long lasting impact on urban, as well as societal, structures.

Logistics and new means of transportation enabled spatial differentiation between production and consumption. This process of separation was very disruptive, not only to the existing manufacturing landscape but also — and maybe even more importantly — the perception of urban space. What is known as spatial segregation — the core model of a functionalized city — is rooted in a strict chronological order. Organized alongside linear processes, the city's development followed the path of a solely economical practice. Consequently, linearity was established as the fundamental principle of an industrialized world, crucial towards all transformations that would follow.

Hence, the predominance of linearity did not diminish with the third wave of the Industrial Revolution. Following the same logic as the previous waves, the third Industrial Revolution was only different in terms of the efficiency of scaling. Whereas production during the first two waves was only scalable by 'adding bodies to the lines,' the third wave of the Industrial Revolution introduced automation to the production chain for the first time in history. Machines that were able to repeat a linear series of simple tasks partially replaced humans on the assembly lines. Just as the physical abilities of man and animal defined the pace of the preindustrial world, the speed of machinery determined the pace of the industrialized world.

Throughout this process of transforming humanity into an industrial society, the prevalence of linearity has shaped the way we think and speak. This can clearly be seen in metaphors we live by:[3] orientational metaphors such as 'good is up' and 'good is forward' have become deeply embedded in Western culture. Thus, we understand progress as a linear movement going forward and upwards.

Following the same logic, 'more,' in its spatial expression, means stacking one thing on top of the other. Therefore, as a spatialization metaphor, 'more is up' is directly coupled with 'good is up,' which is coherent with 'more is better.'[4] These most fundamental metaphorical structures in Western culture coincide with their most fundamental values. Such culturally embedded metaphors as 'progress is a linear movement forward and upwards' and 'more is better' have given birth to the imperative of unlimited growth and an ever-increasing economic output.

From Linearity to Exponential Growth

All future models of how we inhabit our planet have been developed alongside this single but all-determining factor. Addicted to growth, our belief in economic growth became almost religious. Rarely discussed, it remained virtually unchallenged for a long period of time. For more than half a century, mainstream economists failed to question whether or not growth is always possible, desirable, or even necessary at all.[5]

3 Lakoff, G. et al. (1980). Metaphors We Live By. Chicago: University of Chicago Press

4 Lakoff, G. et al. (1980). Metaphors We Live By. Chicago: University of Chicago Press

5 Raworth, K. (2017). Doughnut Economics. Seven Ways to Think Like a 21st-Century Economist. London

Moreover, the only attempt to question unlimited growth, the "Limits to Growth" report[6] published in 1972, was harshly rejected by the same mainstream economists.

Dismissing the report as holding radical views, they were overlooking the obvious: its basic thesis — that unlimited economic growth on a finite planet is impossible — was indisputably correct.

By means of a global computer model utilizing system dynamics theory, the team formed around the leading report author, Donella Meadows, analyzed 12 scenarios resulting in different environmental outcomes of world development over two centuries, from 1900 to 2100. The scenarios displayed how population growth and natural resource depletion interacted to impose limits on industrial growth. As a sobering result, the model showed an "overshoot and collapse" of the global system by the mid-to-late 21st century.[7]

On the 20th anniversary of the publication in 1992, there was compelling evidence that humanity was moving deeper into unsustainable territory. We had already extended our demands on the planet's resources, which had sunk beyond what could be sustained over time. The main challenge that was identified was that of how the world could be moved back into sustainable territory (Meadows 1992).

In a comprehensive update of the report 30 years later, the authors were far more pessimistic than they had been in 1972. Although there had been some progress in terms of a new awareness of environmental problems and the implementation of more sustainable technologies, humanity at large had missed the opportunity to correct its course over the previous 30 years. Numerous symptoms of a world in overshoot clearly demonstrated that we were moving towards an environmental and economic global collapse. Now, the main challenge identified in the report is that of how to soften the impact.[8]

A calculation formula to measure growth was already developed in the 1930s. It is based on the income generated within a nation's border. With this calculation — first referred to as gross national product (GNP) and later on as gross domestic product (GDP) — the most influential element in world economics was launched. The possibility of comparing and competing with other nations using just a single number as a measure made GDP a truly powerful tool. Governments, eager to push their own growth into the lead, set questionable priorities within a variety of social fields. In this way, GDP became the main driver behind governmental policy, while the powerful political interests that have allowed it to dominate today's economies remained hidden.[9] The appeal of having a single year-on-year indicator for measuring economic progress became far too strong. GDP growth shifted from being a policy option to a political inevitability, and finally, to the actual policy goal. As the concept of GDP exclusively follows the logics of quantitative methods, the fundamental problems of this most powerful number demonstrate how little relevance it has to principles such as equity, social justice, and environmental protection. With its "first priority [of achieving] the highest sustainable growth" (OECD Convention 1961), GDP

6 Meadows, D. et al (1972). The Limits to Growth: A Report of the Club of Rome's Project on the Predicament of Mankind. New York

7 Meadows, D. et al (1992). Beyond the Limits. White River Junction, VT: Chelsea Green Publishing Company

8 Meadows, D. et al (2004). Limits to Growth: The 30-Year Update. White River Junction, VT: Chelsea Green Publishing Company

9 Fioramonti, L. (2013). Gross Domestic Problem: The Politics Behind the World's Most Powerful Number. London: Zed Book

obviously sustains growth of output, not the environment. Trapped in the logic of linear thinking, output growth had become the overriding policy object of industrial countries, and the theory of growth became the driving force behind their economies — an addiction that has endured to this day.

For more than a century — like an ever-rising line indicating GDP — the world has been experiencing exponential growth in a number of areas, including its economy, production, consumption, emissions, environmental destruction, and population. For instance, in 1900, the world's population had a doubling time of 100 years. But a hundred years later, in 2000, the time it took for the world's population to double in size was less than 40 years. With more than 50 percent living in cities, the world had become urban by 2007. For the first time in history, the global urban population has exceeded the global rural population, and there is evidence showing that the number of urban dwellers is continuing to grow faster than the rural population. As people across the globe continue to move to growing cities, the share of the world's population living in urban areas is expected to reach 60 percent by 2030. By 2050, the world will be more than two-thirds urban, which is roughly the reverse of the global rural-urban population distribution of the mid-20th century.[10] But even more problematic: as a consequence of the increase in urban population, today's cities are growing twice as fast in terms of land area as they are in terms of population. Over the past century, most cities have expanded their built-up area more than 16-fold.[11] Consequently, projections indicate that future trends in urbanization could result in the global urban land area almost tripling by 2030. If these trends continue and all areas with high probabilities of urban expansion undergo change, then by 2030, urban land cover will increase by 1.2 million km^2. This additional amount of land will be developed into urban levels of density. Such urban expansion will destroy biodiversity and will contribute largely to carbon dioxide emissions through deforestation and land-use change.

One of our most significant nonrenewable resources is productive land and fertile soil. Land-use change is therefore of great concern because of how the rate of topsoil renewal slows down as a result. It takes approximately 500 years for a 2.5 cm layer of topsoil to become fertile. With increasing urbanization triggered by population growth, the amount of arable land available for each person is continually dropping. Currently, each human being has only 2000 m^2 at his or her disposal. In 1961, that figure was twice as high. The amount of arable land available per person will decrease to 1500 m^2 by 2050.[12] Moreover, 40 percent of global food production is lost each year after harvest or wasted in retail and households. Resulting in produced but unconsumed food, this adds almost 1.4 billion hectares of vainly occupied land to an already dramatically decreasing amount of arable land.

10 *United Nations (2019). World Urbanization Prospects. The 2018 Revision (ST/ESA/SER.A/420). New York: United Nations. (https://population.un.org/wup/Publications/Files/WUP2018-Report.pdf)*

11 *Angel, S. et al. (2011). Making Room for a Planet of Cities (Policy Focus Reports). Cambridge, MA: Lincoln Institute of Land Policy*

12 *UNCCD (2014). Land Degradation Neutrality: Resilience at Local, National and Regional Levels. (https://www.unccd.int/sites/default/files/relevant-links/2017-08/v2_201309-unccd-bro_web_final.pdf)*

Towards Multiple Urban Futures

Looking into our collective urban future, we must take on all these urgent, global questions. We have to recognize these clear signals and understand to what extent the exclusiveness of a linear model of development and the subsequent overriding principle of exponential growth have pushed the world into overshoot. According to António Guterres, UN Secretary-General, "we are on the edge of an abyss — and moving in the wrong direction."[13]

Water shortage and energy scarcity, climate change, global poverty, inequality, and refugee crisis — and most recently, the coronavirus disease — all these concerns are colliding head on in urban agglomerations. Being at the forefront, cities are playing a central role in the global response to those crises, raising fundamental questions about sustainable and synergetic development.

Unravelling complexity into a chronological order, the linear model of urban growth in 20th century city planning did not involve models of complexity; it was not expected to be evolutionary. Since it was not based on strategies similar to those employed by living organisms, the planned city was unable to operate different activities simultaneously. On the contrary, segregation, fragmentation and exclusion are the exact countermodels of a system in which diversity provides the resources for change.

This system lacked flexibility, and failed to open up the design system and keep conflicting elements in play.[14] Therefore, this model is not able to operate within our vulnerable contemporary conditions.

In this state of flux, design and urban planning have crucial roles to play. Replacing the rigidity of form and program with an open system creates elastic urban conditions — from innovative solutions to entirely new urban formations. We have to rethink future urban development in terms of its social, cultural, economic and environmental nonlinearity — towards a multiplicity of urban futures.

13 *António Guterres, Secretary-General's address to the 76th Session of the UN General Assembly, New York, September 21, 2021*

14 *Falkeis, A. (2017). Urban Change. Basel: Birkhäuser*

Img. 1:
Unknown Author, Workers on the First Ford Assembly Line, 1913

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On How to Read the Book

Benjamin James
Michael Tingen
Anastasia Shesterikova
Anton Falkeis

Nonlinear Urbanism is a collection of speculative essays discussing a multitude of disruptive and nonlinear futures of urban agglomerations. The book is based on urban innovation research conducted at the Department for Special Topics in Architecture at the Institute of Architecture at the University of Applied Arts Vienna. In addition to investigations by students, renowned experts contribute to questions related to our urban future.

The structure of the book is nonlinear in itself. Graphically and thematically interconnected cross-references allow for both a contextual as well as sequential reading of the book. Merging the printed volume with an additional digital layer offers an interlaced and simultaneous experience, navigating multiple levels of content, thereby mirroring the complexity of urban systems.

This book consists of nonlinear, interwoven explorations of design on *global*, *urban*, *architectural*, *societal* and *individual* scales. The short texts and evocative imagery serve as both discrete, standalone works and as interconnected pieces of a larger ecosystem.

The underlying concept of this publication is that the texts may be read in multiple ways, similar to how we experience and understand the interconnected design ecosystem:

1. The texts can be read in a conventional and linear manner by progressing sequentially through articles using scale as a guide to understanding the different topics examined.

2. The texts may be read in a nonlinear manner by using graphic annotations and highlights embedded within articles to jump between sections that are thematically and conceptually connected. This is shown by text fragments that are annotated with a colored box and then connected to the page edge with a dotted line. The color(s) of the box indicate the scale of the corresponding articles and the dotted line leads to a particular section of another conceptually linked article. In this way, it is possible to leave the current article and intersect it with a new article covering a similar concept.

3. The texts may also be read in an augmented manner through augmented reality (AR) digital content that exists, grows and is updated beyond the printed physical text. This AR content is graphically indicated with a large cross adjacent to an image. This signals that this image triggers additional content in the AR app. To experience interactive augmented reality content, please visit the QR code below.

Ultimately, the evolving and multithreaded reading of this publication will allow for different experiences and perspectives on the same text, depending on the manner in which one reads the work.

[Author, page number]

[Image 1]

[Image 2]

Img. 1:
QR Code to the Nonlinear Urbanism Website, https://starch-ioa.at/index.php/nonlinearurbanism/

Img. 2:
iheartblob, _Sources; Image 2 indicating AR content, 2020

Global Scale

Projects in this section address topics on scales that are interurban, international, intercontinental, and even interplanetary. The inferences raised and conclusions drawn are related to macroeconomic, social, and cultural trends with impacts that transcend geopolitical borders. Due to the expansive nature of their scopes, these articles serve as contextual frameworks for other works within the magazine and discourse.

[c23, m80, y42, k13]

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The Synchronous Garden (SynG)
New Perspectives between Architecture and Ecology

MAEID (Tiziano Derme, Daniela Mitterberger)

Keywords:
- *Metabolic Architecture*
- *Expanded Media*
- *Technological Advancement*
- *Ecology*
- *Management and Control*
- *Synchronicity*
- *Social Exchange*
- *Natural Systems*
- *New Forms of Communication*

Human societies have shaped and influenced ecological patterns and the biosphere significantly, whether it has been directly through agriculture, initiating species migration, pollution, or climate change. To sustain ecological patterns without altering them any further has also become increasingly more difficult and complex. Ecology, in the broadest sense, represents the balance between human presence and nature. These relational conditions are becoming increasingly too complex to fully understand or evaluate and are being continuously mediated by technology. This technological mediation is defining our experience of the world, signifying a dominating discourse in terms of human relations to technology and defining a technical understanding of nature and ecology. We consider environmental sciences and ecology on a historical level, we refer to obsolete models such as gathering information, data analysis, design, building, maintenance. These models have generated concepts and concerns such as remediation, regeneration, and human safety concepts that are symptoms of an optimized gaze of science that is trying to extract from the environment, to make the natural world 'how it should be.'

We may start to look at ecology as a point of departure in order to encompass and promote other agencies, deoptimizing the way we look at the world, deconstructing the false belief in precision and control in order to move towards new forms of intelligence and autonomy. This may support the reflection that ecology is a thoroughly dynamic dimension, rather than something capable of being frozen or trapped between binary concerns. This new look at ecology may avoid any static definition of nature and ecology and instead support a definition that exists in a technological continuum of different media, signals, scales and temporalities.

1: Architecture of the Expanded Media

Architecture — seen from the perspective of being a physical perturbation of an environmental condition — is fundamentally an act of betrayal of the natural environment. It requires a critical displacement of 'natural' relationships,[1] through actions such as site clearing, material assembly, and the continued consumption of natural resources. Those actions, created to serve a finished building, reinforce an image in which the built environment faces and battles the natural one. Undoubtedly, leaky roofs, cracking foundations, spalling surfaces, insect infestations, fires, floods and earthquakes all demonstrate that architecture fundamentally struggles with natural phenomena. In opposition to this concept, architecture could be also understood as a category of life, with a capacity for continual adaptation, evolution, change, and a precise lifespan. Considering architecture as a category of life favors the creation of new cultural associations, with completely different features, biological ranges, and expanded capabilities to

1 Ingersoll, R. (1992). "The Ecology Question and Architecture." In: The SAGE Handbook of Architectural Theory. SAGE Publications Ltd.