RAMBOLL

DE
SIGN

EXCELLENCE 2022

this book is dedicated to the few
who commit themselves to the
cause of purposeful design
and to the imperative of
environmental congruency.

... to the many who help progress
the cause, day in and day out,
one project at a time.

... and to the two visionary and
dedicated engineers who started
the journey for the thousands of
us in Ramboll all those years ago,
to Børge Johannes Rambøll and
Johan Georg Hannemann ...

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A Message
From Our Sponsor

Søren Brøndum
Managing Director, Ramboll Buildings

When Prof. Rambøll and Prof. Hannemann started Rambøll and Hannemann, a boutique consulting engineering firm in the aftermath of the Second World War, they had a vision for the engineering profession which went beyond numbers and drawings. They envisioned a key role for engineers, together with architects and others, in the reconstruction of our devastated cities and the broken societies.

This was distilled in the mission of the company which is still the mission of today 75 years later; to create sustainable societies where people and nature flourish.

In Ramboll, we believe in a system-based and holistic approach to the issue of the environment. We believe in a regenerative approach to healing the damage inflicted on the natural environment. Ramboll's mantra of partners for sustainable change, the ambition to lead our industry in the direction of continuously and consciously helping the societies in which we are active, towards better living standards, remain as close to the hearts of our 18,000 people today as they were to the hearts of our two young founders.

The 4 strategic unifying themes of Decarbonisation, Resilience, Circularity and Biodiversity in Ramboll's strategy 2022-2025, are the themes that everything we do in the company should be measured against wherever we sit and whatever we do.

Our Design Excellence initiative, which is a new initiative but in reality, is the continuation of the ethos and the vision of our founders, is gaining momentum. Ramboll Design System (RDS) unifies the 3 pillars of Design, Sustainability and Technology. RDS views sustainability as a set of goals, technology as a set of tools, and design as the enabler that uses the technological tools to achieve our environmental and sustainability ambitions: all in a unified system.

I hope you will enjoy and benefit from this proceedings of Ramboll's inaugural Design Excellence forum. It is themed after the 3 RDS pillar, combining "Society", "Technology", "Ecology" and "Ethos". Themes which are very close to the hearts of us all at Ramboll.

Our Design is:

Purposeful
In service of a higher cause

Regenerative
Doing more good to help heal the damage

Augmented
A sophisticated approach
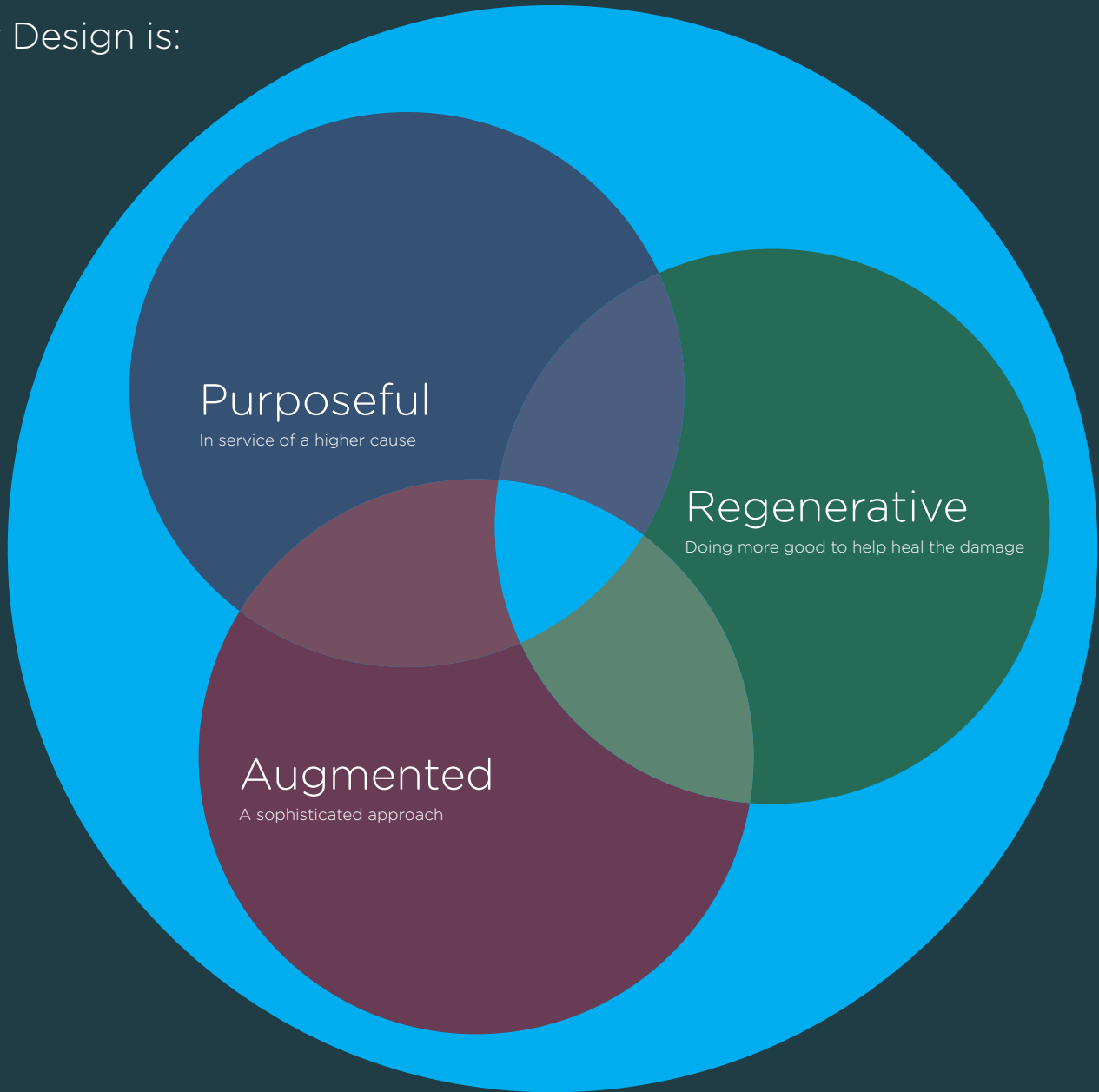
Ramboll Design System (RDS)

Prologue

hossein rezai-jorabi
global design director, ramboll

in its purest and most valuable form, design is about the impact we have in the societies we live in and equally about the ecology we form as part of nature.

the key theme of the inaugural Ramboll Design Excellence Forum is "design", that illusive thing we have been in pursuit of over thousands of years, perhaps since way before we started building cities on this planet!

design is
"**aesthetics**" to one,
"**purpose**" to another.

it is about
"**justice**" or
"**outcome**" to some,

"**environment**" or
"**impact**" to others

to us at Ramboll it is about
a systemic approach to all that we do.

Water

for us, design is about **water, and the scarcity of it**.

Biodiversity

it is about **biodiversity**, and its near annihilation down to as little as 30% of what it was in as recent as 1970s.
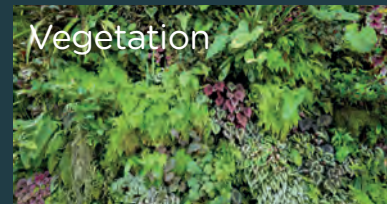
Vegetation

it is about **vegetation**, perhaps not so much the manicured landscapes but the rewilding agenda.

Air

it is about **air, carbon and greenhouse gases** which have gone up in the atmosphere by a factor of 7 since the 1940s.

Sound

but design is about more than these. it is also about **sound**; sound of a primary forest is very different from that of a tree orchard.

Colours

it is about **colours of nature versus those of a mono-culture plantation**.

Shades

Lines
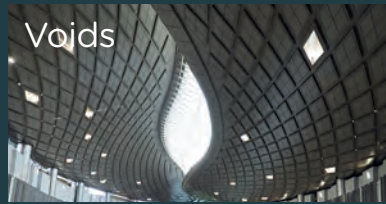
Edges

Solids

Voids

it is about **shades and massings of our buildings, lines, edges and adjacencies in our built environment**, as well as about **solids and voids that allow natural ventilation** through.

Co-existence

Collaboration

Justice
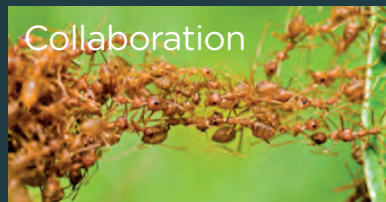
Economy

Politics

the list continues,
into **coexistence, collaboration, justice**: both environmental and social justice, and extends to include **economy**: our value system, and **politics**: the way we run ourselves and the governance we have created.

Ecosystem of Thought - Ecology of Design

design for us touches
all that we do, and imagine.

this book is the proceedings of the inaugural Ramboll Design Excellence Forum held in october 2022 (RDEF22).

as we share the insights and knowledge exchanged during this transformative event, we embark on a journey that touches upon the essence of design. within these chapters, we explore the intricate relationship between design and society in Session A, the delicate harmony between design and ecology in Session B, the fusion of design and technology in Session C, and the symbiotic integration of design with ethos and business culture in Session D.

each session is a tapestry woven by passionate minds, reflecting the collective expertise and experiences that have shaped our understanding of design. from the significance of water and the urgency of managing scarcity to the potential of rewilding landscapes and confronting the challenges of air quality and carbon emissions, design emerges as a formidable force for transformation.

as the pages unfold, we invite you to embark on this journey of discovery and enlightenment with us. the Ramboll Design Excellence Forum is not just an event but a shared commitment to envision a future where design thrives as an agent of positive change. this book stands as a testament to the dedication and creativity of those who came together to explore the endless possibilities of design in shaping a sustainable, equitable, and thriving world.

may it serve as a guiding light, inspiring engineers, architects, designers, and visionaries to continue pushing the boundaries of excellence in design for generations to come.

LE
MOUVEMENT
DES
IMAGES
ART. CINÉMA
5 avril 2006 – 29 janvier 2007

Centre
Pompidou

A Place For All People...

Session A

Design
x Society

Responsible design is not purely about aesthetics, beauty or form; it no longer celebrates itself; it is not vain, but it is in the service of a higher purpose. Designers, architects, and engineers ought to have high-level ambitions that go beyond buildings and structures, but instead help deal with the challenges we face today like climate change, inequality, equitable access to education, health and security.

In Ramboll, we believe that Purposeful Design must work in harmony with Regenerative Design and Augmented Design – the three pillars that make the Ramboll Design System – for the much needed and effective societal change.

Relearning Relevance

Sarah Ichioka

Director, Desire Lines

Sarah is an urbanist, strategist, curator, and writer. She leads Desire Lines, a strategic consultancy for environmental, cultural, and social-impact initiatives and organisations.

I've worked in and around the built environment for nearly two decades. Reflecting on those years of professional interactions with architects, the image that recurs to me is of rowing a boat back and forth – between a large, messy mainland teeming with diverse actors, interests, and resources; and a small, manicured and fortified island.

This island has been maintained for centuries by a monastic order, the members of which, after years of vigorous initiation, have become party to secrets, rules, and a canon of precedents that must be referred to at all times. The monks speak together in a secret language, which has several distinct (and sometimes competing) dialects. Affect is attuned to in-group values: erudite cynicism and knowing reference are highly prized; "worthiness" and earnestness more likely to be derided as signs of weakness.

When a foreign vessel approaches the island's shores, border guards scan its markings and check its crew's credentials. A few of the grumpier monks throw rocks, though others eagerly greet whatever fresh cargo has been imported from the mainland. Many of the inhabitants are too busy redecorating and photographing the interior of their island to heed what's happening at the docks (let alone on the horizon). Some adventurous islanders stow away to visit the wider world; a subset build their own boats. Their remaining comrades pace the shore, clicking their tongues and wringing their hands at the erosion of the island's coastline.

Of those who police the perimeter most enthusiastically, the rower wonders: what is the nature of the perceived threat?

Is it invasion? Perhaps this is how it appears to one influential architect who claimed that "our influence has been reduced to a territory that is 2cm thick"?

Is it contamination – as it appears to a prominent architectural critic who, upon hearing plans for an exhibition of critical urban research, asked me with concern, "But where's the *architecture*?"?

Or is the threat that of enlistment in too daunting a cause? Instead of advocating for systemic change, the former head of a major architectural institute urges his peers to focus on cladding their high-rise buildings with solar panels.

Such statements serve only to perpetuate a limited understanding of what architects can and should do. Simultaneously they heighten anxieties over potential disempowerment or infringement, rather than advocating for expanded forms of practice.

Contributing to these anxieties are the rules of engagement in architecture itself. Substantial time and money go into an architectural education and qualification; and yet the pay prospects that await the architect are relatively lower compared with many other professions. Understandably, these are all factors that discourage the participation of more diverse initiates.

However, as we find ourselves facing a much shorter collective deadline for undertaking transformative action, we simply cannot afford to continue minimising our agency any longer.

Architects and other built environment professionals are implicated in the global volume and pace of degenerative development that is leading us to continually overshoot our planetary boundaries. Despite everything that we have learned about the harmful repercussions, we continue to shy away from taking responsibilities and helping to deal with the challenges we face today.

What do we know, as professionals who relate explicitly to the shaping of the physical world, that can support our collective transformation towards a viable, life-centered civilisation?

What we know shapes how we act, and how we act shapes the world. But what shapes what we know in the first place are the ways in which we look at the world. It's *how* we know, and who is included within "we."

In order to regenerate ourselves and our environment, we must actively seek to break the spell of frameworks and attitudes that have shaped human actions, but that no longer best serve us or the rest of the living world. We must critically engage with the types of knowledge that we need to unlearn and change the types of questions we ask.

Matter of Fact vs. Matter of Concern

In architecture and design, the tendency is to focus on the *objects* of our practice. What kind of questions can we come up with if we shift the focus to our practice's consequences instead?

Hearteningly, an international diaspora from the island has been gaining mainstream recognition for architectural work that articulates alternative parameters of value. In their landmark Spatial Agency database and book, Tatjana Schneider and Jeremy Till borrow from philosopher Bruno Latour to argue for shifting our thinking from architecture as a "matter of fact" to a "matter of concern." Instead of treating buildings as objects in their own terms, as matters of concern, they "enter into socially embedded networks, in which the consequences of architecture are of much more significance than the object."

Along these lines, I've also been deeply inspired by the writer, television producer, and environmentalist Ken Saro-Wiwa who once declared of his own profession that "the writer cannot be a mere storyteller; he cannot be a mere teacher; he cannot merely X-ray society's weaknesses, its ills, its perils. He or she must be actively involved [in] shaping its present and its future." In the context of human-made existential crises, we all need to work to expand our sense of what is possible, and what we ourselves can contribute.

Being Relevant

It can be frightening to let go of shared assumptions and group norms, to leave the perceived safety of familiar territory. But it can also be liberating; a source of fresh energy, invigorating purpose and new alliances.

The architect and educator Nabeel Hamdi calls us to "be relevant." Hamdi has had an accomplished career as a consultant to NGOs and development agencies for participatory action planning and upgrading urban informal settlements around the world. Before this, he had seen his role as an architect merely as someone who designs buildings. His call to "be relevant" came at a conference called "The Purpose and Meaning of Architecture" where one of his colleagues, an anthropologist, asked "Why is it that every time you meet, you architects talk about the meaning and purpose of architecture? You can carry on doing that for 50 years or you can just stop and be relevant." This caution remains relevant for us, today.

This same adjective, relevant, was used by architect and educator Marina Tabassum to describe her own work. Her studio focuses on projects within her home country of Bangladesh. In a marked departure from some previously valorised types of architecture (such as an Olympic stadium or an international museum franchise), Tabassum has attracted acclaim for work grounded in her region's materials, climate, and culture, and which integrates concerns of environmental and social impact for some of the world's most vulnerable ecosystems and people. She defines architecture not as a building or an object-making process, but as an agenda much larger than just making nice-looking buildings. She calls architecture that goes beyond and strives to make an impact, "the architecture of relevance."

Holistic knowledge

Moving beyond these discussions about architecture, how do we think about and practice design in a way that is truly relevant to the challenges of our time, rather than merely gesturing towards them?

How can we shift from a state of self-referential knowingness towards conditions of expansive curiosity, and ground reciprocity?

This is a process that requires a different kind of knowledge: a way of knowing that is embedded and embodied, and that complements technical knowledge.

A holistic knowledge system would encompass, alongside technical knowledge, self-knowledge, interpersonal knowledge, intergroup knowledge, and knowledge of place. Self-knowledge emerges from diligent practices of self-discovery through active healing from trauma, mindfulness, lifelong learning, and self-compassion. To achieve interpersonal knowledge, we must train ourselves to actively listen and to articulate our questions, intentions, and requests in clear language. Gaining intergroup knowledge requires us to think of positionality. *Who* is doing the knowing? What kinds of knowing and knowledge are valued? These are inquiries that aspire to lasting relevance, especially when we incorporate the perspectives of future generations and of other-than-human life forms.

Finally, a knowledge of place requires us to comprehend natural and cultural elements, whether currently visible in informal solutions, historically present in healthy ecosystems and indigenous practices or emergent. There are some "banished knowledges" (to use the term of James Ogude) which may also need to be recovered.

How then do we bridge this knowledge to design? One of the best descriptions I've found of this way of working comes again from Nabeel Hamdi: "Practice is about opening doors, removing barriers to knowledge and learning, finding partners and new forms of partnership, building networks, negotiating priorities, opening lines of communication and searching for patterns. It means designing structures – both spatial and organisational – and facilitating the emergence of others, balancing dualities … And all this in a world which is inherently unequal and unstable … working with all levels, working in between levels."

In a world filled with uncertainties, when we collectively shift from knowingness to relevance, our activated attention and empathy can turn conditions of the unknown, the new, the changing, into prompts for humility, curiosity, and possibility.

Working at the Forefront of Meaninfgful Design and Architecture

Lennart Grut

Senior Partner, RSHP

In 1986 Lennart joined the architectural studio Rogers Stirk Harbour + Partners, recently renamed RSHP, where he is a Senior Partner. He has been principally responsible for managing the practice's international projects.

What was my contact with Ramboll and Hannemann?

"

Professor Hannemann was professor at Denmark's Technical University where I was a student. I attended a number of his lectures. Furthermore, he was one of the assessors for my final project at the university, which was a rather ambitious conference or concert hall with a concrete arch system for the roof. I think he was a bit frustrated with me because I spent too much time designing the concert hall, the acoustics, and the layout, rather than concentrating on the details of the concrete structure design. But he was always very kind and tolerant with my approach.
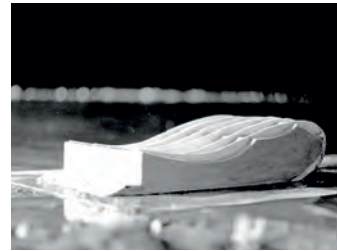
Architecture and society

I will present my thoughts here for a number of levels of architecture and society;

The Business	Politics and Publications	The City and Neighbourhoods	The Building and its Contexts	The Building and its Occupants

The Business

How do you approach architecture and society as a business?

Richard Rogers who established the practice, which is now RSHP, always intended that there should be no ownership of the practice by the partners of the practice. And that if there was any success, that success should be shared with those who had less. To that end, with the other founder partners he created a charitable trust, which owns the partnership.

The deed of the charity, which we call the Constitution, has as its preamble, the following:

"

The practice of architecture is inseparable from the social and economic values of the individuals who practice it and the society which sustains it. We, as individuals, are responsible for contributing to the sustainability of our environment to the society in which we practice and to the welfare of the team with whom we work. To this end, we agree that ownership of the practice is wholly devolved into a charitable trust so as to ensure that all the capital value of the enterprise and annual dividends or donations are directed to charitable purposes, and that by the surrender of private share ownership, both private trading and inheritance of shares are eliminated. It has always been our intention to ensure that our work is beneficial to society and to exclude work that is knowingly considered directly destructive to our environment and social fabric.

This was written 40 years ago, it is as fresh today as it was written then. This has led to some of the principles which we try to apply to our design and buildings;

City + Context
Our architecture is a product of its place, both physically, socially, and culturally.

Integrity
We celebrate the act of building with places and spaces that are honest, inclusive, inviting and uplifting.

Adaptability
Our spaces accommodate multiple activities today and offer the possibility for a long lifespan and future use.

Sustainability
Energy Efficiency and building performance is integral to our architectural response.

Community
We create unique, bold and meaningful responses that elevate urban quality.

Economy + Delivery
We aim for elegance and quality through economies of scale and standardised systems.

Politics and publications

How do you approach architecture and society from the public point of view?

While architecture can strongly contribute to our environment and to the built form around us, Richard felt that in order to actually change things socially and otherwise, you need to engage with a broader public. And that led to his public participation, doing lectures, the production of his books such as "Cities for a Small Planet" and engaging himself in politics. Whereas Lord Rogers representing the Labor Party, he was tasked as chairman of the Urban Task Force, which through their work developed the political policy 'towards an urban renaissance', which advocated the regeneration of our city centers and the reuse of brownfield sites and derelict land rather than encouraging urban sprawl.

The City and Neighbourhoods

Grand Paris

We work at all scales. The city scale being the starting point. We were employed by the then-president of France with a number of other teams to look at what the future of Grand Paris might be in the 21st century. The key problem facing the Greater Paris was the core known as the 20 arrondissements of Paris, which was wealthy and successful, and surrounded by a whole range of communities called the Banlieue with a very varied population who were excluded to a large extent from the benefits from the center. So, the study undertaken was to look at ways to reinforce the connections between the center and the Banlieue. The Banlieue was reconnected by creating a public transport ring around the city and introduce a whole range of small interventions to improve the permeability between the Banlieue and the center.
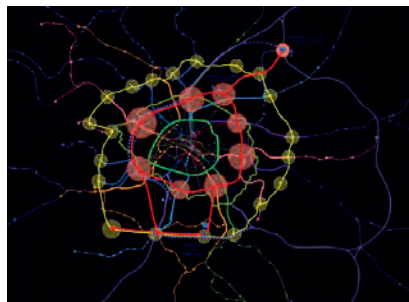
New circumferential connections were created to link the different urban centres of the periphery to complement and reinforce the existing radial system.
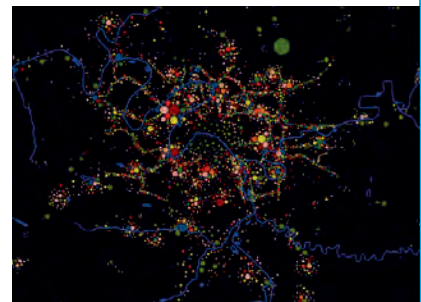
The approach was not a "Grand Project" but a multitude of interventions - "1000 projects".

DCN Madrid

In Madrid, the railway infrastructure leading to Charmartin Station has broken the urban fabric between the two sides of the rail infrastructure. It has left a huge swathe of land, which can be developed. Six kilometers of land from the Chamartin station out to the M 40 which bounds the city of Madrid. New urban centers and connectivity to the surrounding communities can be created on this land. Covering the rail and redeveloping the Chamartin station creates the opportunity for creating a new central business district. The financing coming out of this can be used to bridge over the railways to create parkland and connectivity to the communities on the other side of the railway. A new smart city to be developed for the future.

The Pompidou Centre

The Pompidou Centre is a great cultural contribution to Paris and a major piece of regeneration for that part of the city as it was in a not well-developed situation. With the closing of Les Halles market, there were swathes of land that were not properly used and deprived in the area. Apart from the architecture of the building, the key design driver was to ensure that the building that did not fully occupy the site so that at least half the site could become what we call the 'piazza', a people's place where people could gather and enjoy the environment and the building. The facade itself was originally accessible by a public escalator, so the public could rise to the top of the building and enjoy the views. Unfortunately, with the success of the building which was originally designed for 5,000 visitors a day and which now easily reaches 25,000 visitors these days, that escalator is now reintegrated into the museum. It is only accessible if visitors pay to enter the museum.

The regeneration of the Pompidou Centre
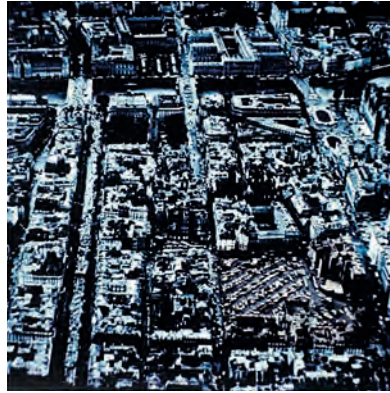
Barangaroo South Masterplan

The other major urban regeneration development is the Barangaroo South Master plan. This is a major piece of urban regeneration. The Barangaroo area was old industrial land that had subsequently been used as a container port and cruise liner port. The existing CBD to the east was separated from it by roadways and the denivelation in landform. The client, Lendlease, realised that they had to have a critical mass to create a successful development. They presented a scheme to construct three towers of 300,000 square meters of office space and large areas of retail, F&B and waterfront housing all in one go. A brave decision considering 300,000 square meters of office in a city of 5 million people was certainly something fraught with a major level of risk as to attracting tenants in such a concentrated time frame. The ground plane was designed as a highly permeable, friendly, accessible space, a space full of retail and F&B. This has attracted people from the existing center down to the waterfront and has now created the most successful go-to area of Sydney. The office spaces were occupied at 60 to 70% on opening day.

Shanghai Sijing, China

In China, we achieved a number of changes in the way housing developments are perceived from the typical serried ranks of buildings in a gated environment. Diagonal access paths create permeability and enable people to traverse the development to get to their work from the station infrastructure on either side of the site. This enables people to enjoy the landscape and the amenities that are built within the development together with the inhabitants on their way to work.

Buildings and their context

The Leadenhall Building

The Leadenhall building's form has been dictated by the planning constraints. Due to the prescribed protected views, we had to slope this building to ensure that we didn't encroach on the protected view of St. Paul's. But what was more important was our decision to lift the building of four to six floors off the ground in order to create a new public space. Interestingly, studies in Denmark on typical city streets demonstrated that only about 6% of the space available was actually dedicated to pedestrian traffic. So, there is always a major shortage of public space within cities. The new ground space, together with the existing small square next to the building, has created a major new public space for people to enjoy from the surrounding offices.
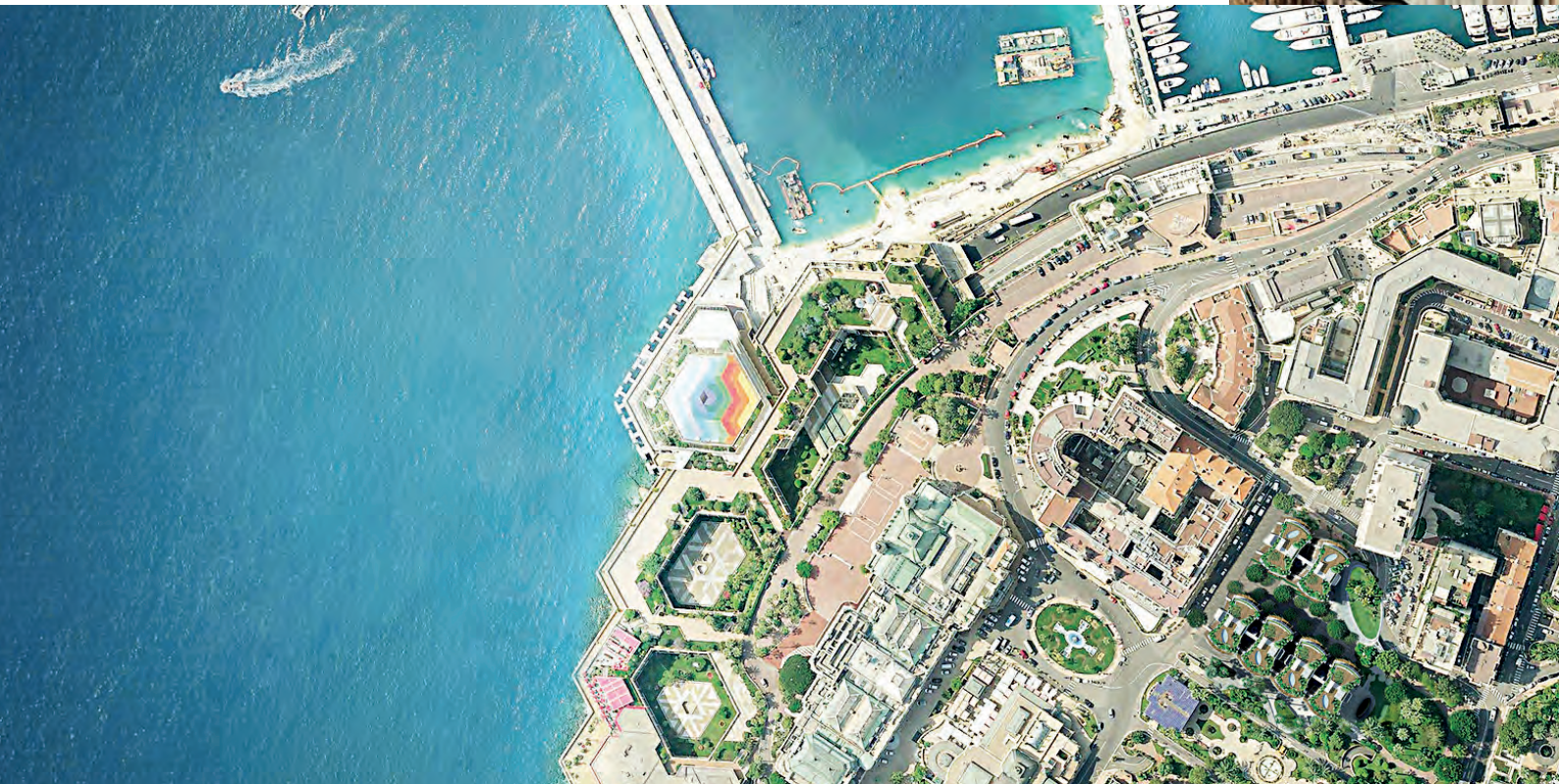
One Monte Carlo

In Monte Carlo, the brief was to redevelop an existing site into high-wealth individual residences and retail. Our intention right from the start was to avoid a typical case of a gated community. The existing site, called the Sporting D'Hiver, next to the Hotel de Paris and the Casino, was a closed block. Our proposal was to create two residential building blocks pulled apart to create a new public pedestrian avenue between the buildings, allowing access for people around the buildings. All vehicle access is below grade as the ground plane is left as a public space contribution back to the city.

The building and its occupants

E8 Chifley Square, Sydney

The cityscape is made by lifting the building off the ground and creating a public space below. Furthermore, there are open levels within the building, the central level and the roof, which become and create accessible spaces and garden spaces for the users. We introduced the concept of villages, interlocking levels for the offices. When the owner was publicising, selling or renting out the space, they promoted it with their own words; "at once both timeless and revolutionary, 8 Chifley Square remains at the leading edge of commercial space thinking and is one of the first office towers in Australia to incorporate vertical villages across the entire building, enabling visibility and collaboration across the workplace, together with stunning views and abundant natural light. Here you can see the villages, the views, and the way people can be working together".
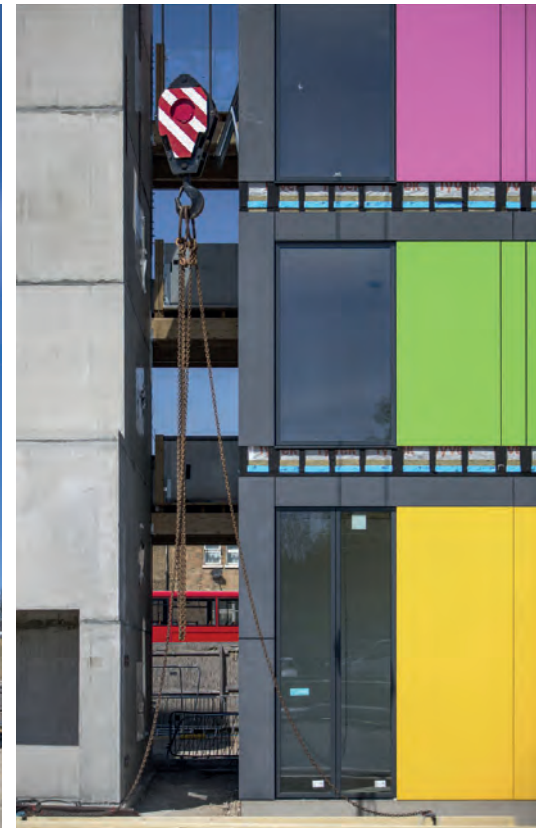
The Cancer Center, Guy's Hospital

The cancer center, Guy's Hospital has a similar concept of villages. Given the nature of cancer treatment, whereby the patients are in a vulnerable state, we decided not to have a large, single reception to the building. This was to avoid people getting lost in finding their destination. Instead, we created separate treatment centers we referred to as villages. We persuaded the client to move heavy radiology rooms off the ground to provide the Radiology village treatment in proximity to the Chemotherapy village. At the top of the roof, there are hospital beds for people who have to stay overnight. Visitors who arrive at the Welcome Area are directed and sent to their village where they can find an environment which is of a human scale, friendly, and not intimidating as they are amongst people who are having the same treatment. Thus, they feel safer and find themselves in a far better psychological situation.

LadyWell Social Housing, Off-site Volumetric Housing

Finally, how to achieve better housing and better living? Offsite construction is something that has been talked a lot about and has been difficult to realise, but we have managed to do four projects with offsite manufacturing. Two for the YMCA, one in Lewisham for meanwhile living and a new development in Cardiff of individual houses. One key advantage of offsite is speed, far faster to build, far less disturbance on site because there's no heavy vehicles other than bringing in the modules and the quality is of a different character. Basically, the quality inside these individual dwellings is such that it can be called tenure blind. The only difference between, what would you call low cost social and an owner-occupied apartment is the quality of the equipment in the kitchen and the bathrooms. The environment inside is unique and the ability of offsite is to achieve targets of net zero. In fact, the current Cardiff project is expected to be energy net positive.

Intervening in
Complex Urban Systems

Stanislava Boskovic

Research Associate, Imperial College London
Founding Director, LRL Space, Lugano, Switzerland

Stanislava is an architect and urban designer. Her research is focused on improving public health and well-being in cities through the systematic implementation of nature-based technologies. More recently, she founded LRL Space, in Lugano, with an emphasis on the environment and the improvement of the planet and citizens' health.

The climate change-related phenomena and all its consequences are putting an enormous strain on urban infrastructure, its services, quality of life and on public health and well-being. The importance from our point of view, is a scientific understanding of this effect and the understanding of space as an organic complex and multi-scale system with many dimensions that are in constant transition.

It seems extremely important to the consideration of the true dimension of ecological and environmental crisis to identify the link between the local problems, regional scale problems, and planetary problems. There's an opportunity to intervene and connect nature, society, natural and artificial components of urban systems and create a dialogue between urban and rural areas of territory.

The Systemic Design (SyD) Approach

The complexity of the urban systems is very high. To address this, we have to go beyond the conventional rules of urban design. New frameworks can be introduced to rethink and contribute to planet earth's health and to people's quality of life. At the center of our research at Imperial College London is a framework called Systemic Design (SyD) approach [1] (Figure 1).
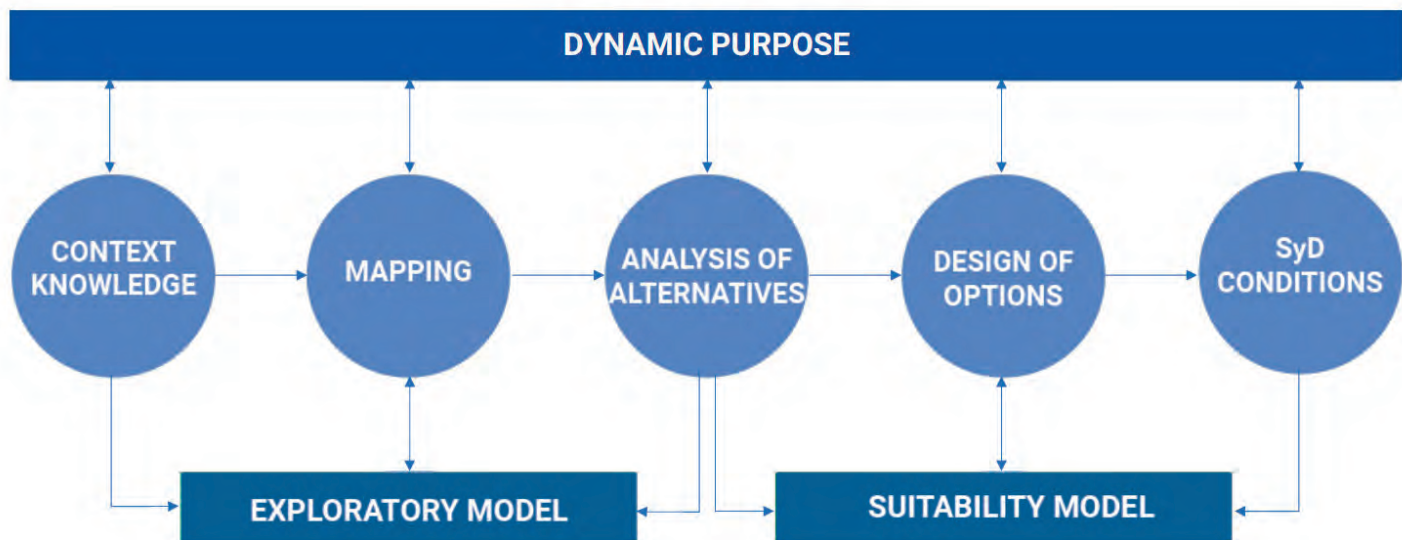
Systemic Design for Multifunctional NBS

Figure 1 Systemic design approach framework

The understanding of the purpose of a project is important to start intervene in a complex and dynamic system. That purpose can be multiple and different. It is dynamic because it is interdependent on different systems and it changes with time. The purpose will define every step of the process.

First, the context is studied from different aspects such as the climatic, geographic, social and cultural points of view. This knowledge then goes to the mapping phase and an exploratory process. An analysis of alternatives or interventions to the process can be then incorporated. For example, an alternative to any new development would be to build on a greenfield or brownfield site, or to retrofit an existing built environment. Through models and simulations, Design Of Options can be formulated and Systemic Design (SyD) conditions can be defined.

This helps guide the process of informing the decision-makers and urban planning authorities with an integrated quantitative and science-based analysis that precedes the phases of the further design. The knowledge gain through the six steps presented in Figure 1, includes the definition of the purpose, which can assist in making better decisions that might not otherwise have been taken without this analytical process.

There are two examples of how we can work with the SyD framework; One is for the defined purpose of Water Neutrality in the city of London, and the other is focused on Health and Citizens' Well-Being.

The Water Neutrality Concept

First, you will see how the framework works in the work dedicated to the Water Neutrality concept [2]. We have been working with the prospects of the future development of housing in London, knowing the target for the next 10 years to be about a half million units of new housing to be built. These new urban developments will increase water demand, urban flood risk, and river water pollution levels. We introduce here the Water Neutrality concept that does not mean a zero-water consumption. But instead it shows the ability to first minimise the impacts of the new development and then offset the remaining impacts within the existing urban system, without increasing the current overall impact levels. This being the main focus of our Water Systems Integration (WSI) research group and expertise, we try to apply the Water Neutrality concept to this 10 year target and the hypothesis of half a million new homes. If we apply it, we know that it will have a strong impact on different indicators connected with the Urban Water Security (UWS) which, in the case of our study, are urban consumer demand, the flood risk, and water quality. We know that it'll have an impact on the water system of the city of London. This is numerically shown in percentages, as shown in Figure 2.
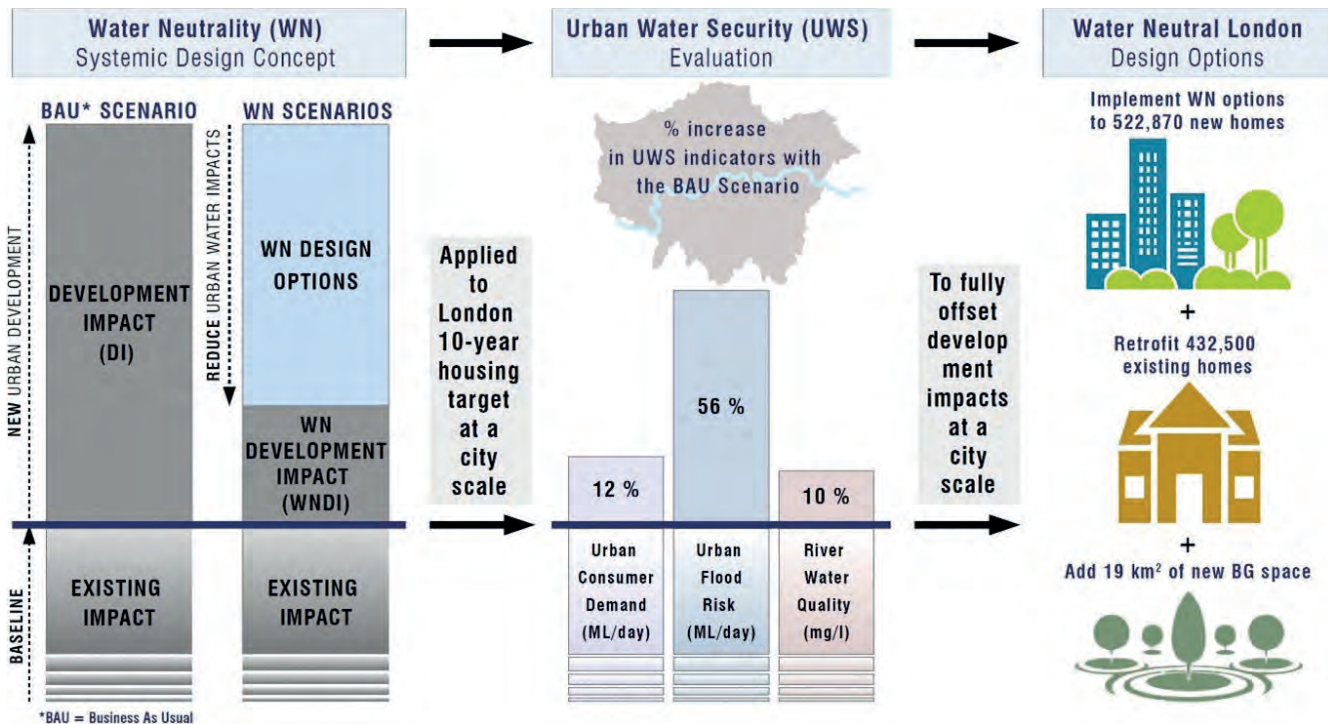

Figure 2 Water Neutrality at London scale

To fully offset the pressure of new developments,

we have to introduce design options that take into account the blue-green infrastructure, combining options such as water-efficient appliances, and water reuse systems which would reduce the impact with respect to business as usual. To reach this blue line of water neutrality, we would also need to retrofit more than 400,000 existing homes, and to add a significant amount of blue-green space, almost 20 square kilometers.

CityWat

To model and simulate this impact, we use different tools that are based on the integrated modeling CityWat [3] which integrate spatial data. This allows us to deal with numerical parameters such as density, pervious and impervious areas (Figure 3) with an integrated urban water management model. This model deals with groundwater, rivers, consumption and distribution. It enables viewing urban design at a systems level and having a systematic assessment of future scenarios. Evaluation tools can be added to create a ranking score which could help in choosing the most favorable location.

Water Neutrality Decision-Support Tool

Here in Figure 4, is an example of the London Borough of Enfield where we are working to test the impact and opportunities scores in some of the previously mentioned urban development sites. More than that, we can help to create what we call a virtual decision room to suggest which other areas could be also used for an intervention to better offset the impact of the Water Neutrality. This system of multi-criteria decision-making is called Water Neutrality Decision-Support Tool or WaNetDST [4] and is the way we analyse the spatial allocation.
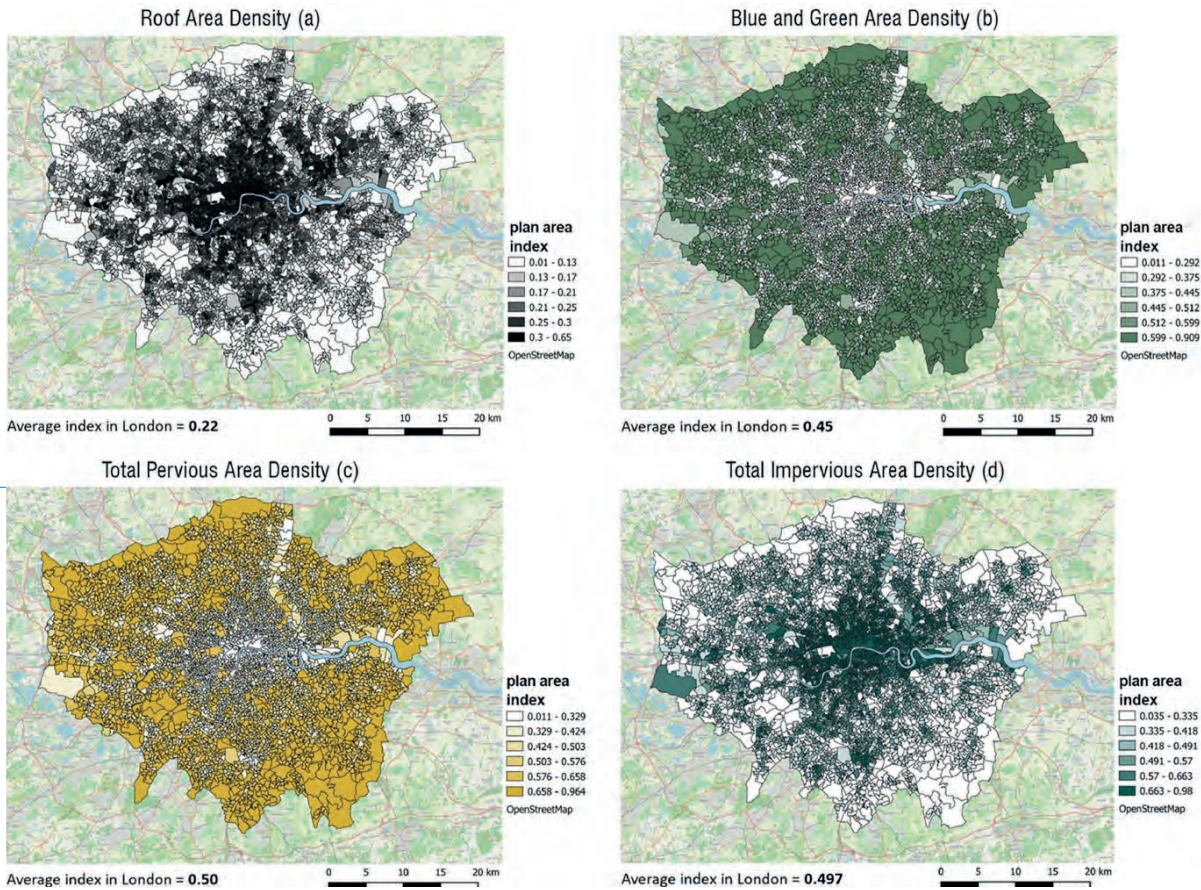
Figure 3 Some of the key London's water-neutrality urban form proprieties
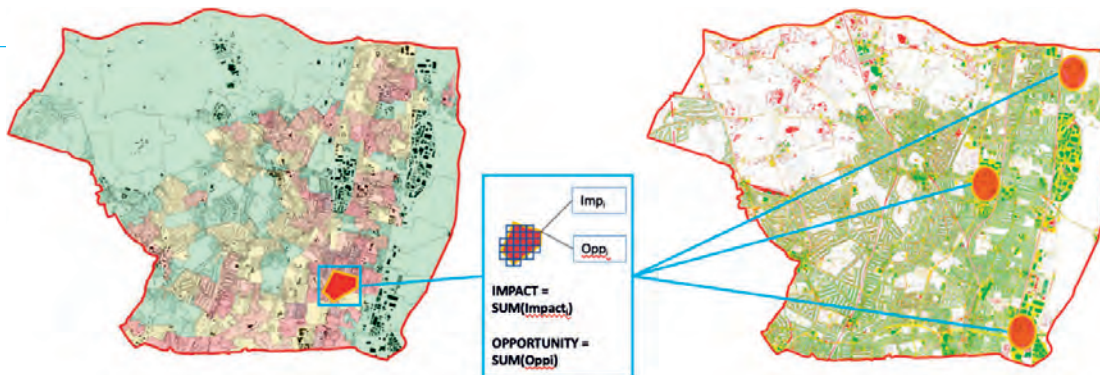
Figure 4 WaNetDST functionality at borough scale in Enfield

Urban Morphology

The next step of this work is focusing not only on where we are allocating the most favorable position from the point of view of water neutrality, but also how we define new developments (Figure 5). Here we are dealing with urban morphology, its possible connection with Water Neutrality and further research on the morphology, most adaptive for very specific conditions.
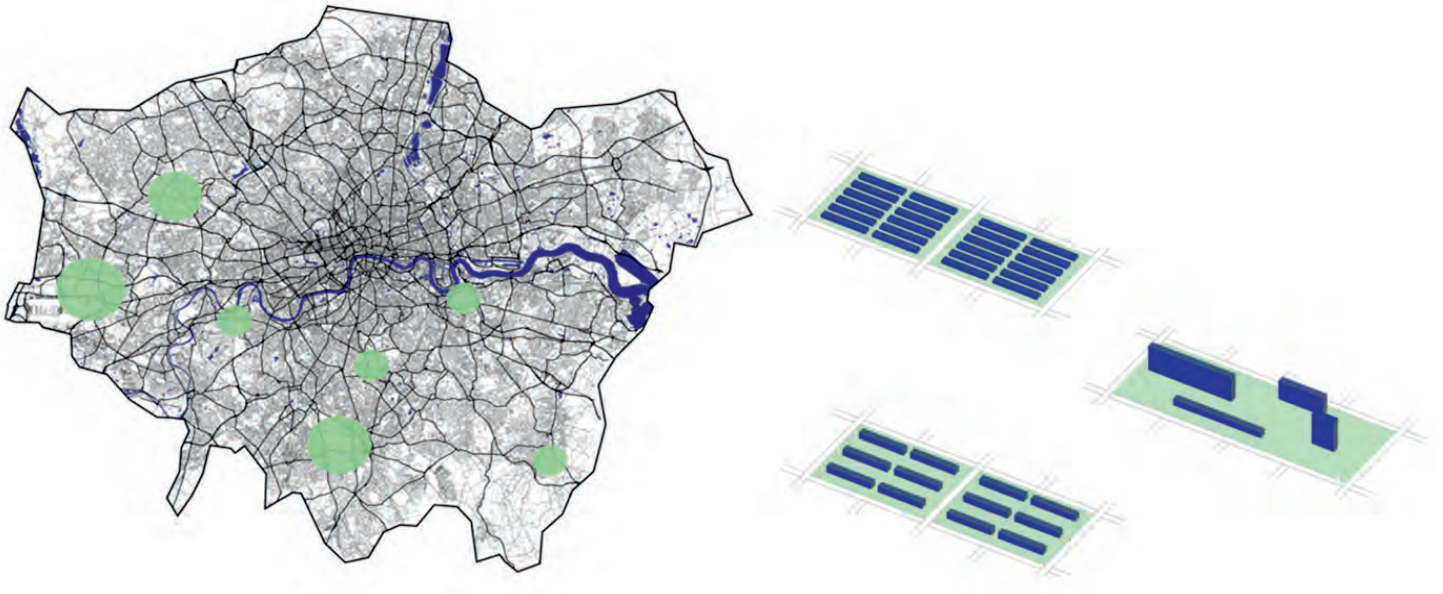
Figure 5 Studies on urban morphology potential impact on Water Neutrality in London. Morphology examples after Ludwig Hilberseimer

It would help us reduce the subjectiveness of our approach to inform the decision makers of the future steps. In this case, we are dealing with Water Neutrality but the future work is to link it with other systems like energy and transport, in the way to best improve knowledge of the context and to best inform the future stages of development of the targeted areas.

The second group of projects I would like to talk about are two multidisciplinary European projects, euPOLIS[1] (Integrated systemic design to enhance health & well-being of citizens) and HEART[2] (Healthier Cities through Blue-Green Regenerative Technologies), whose main purpose is the enhancement of health and well-being of citizens.
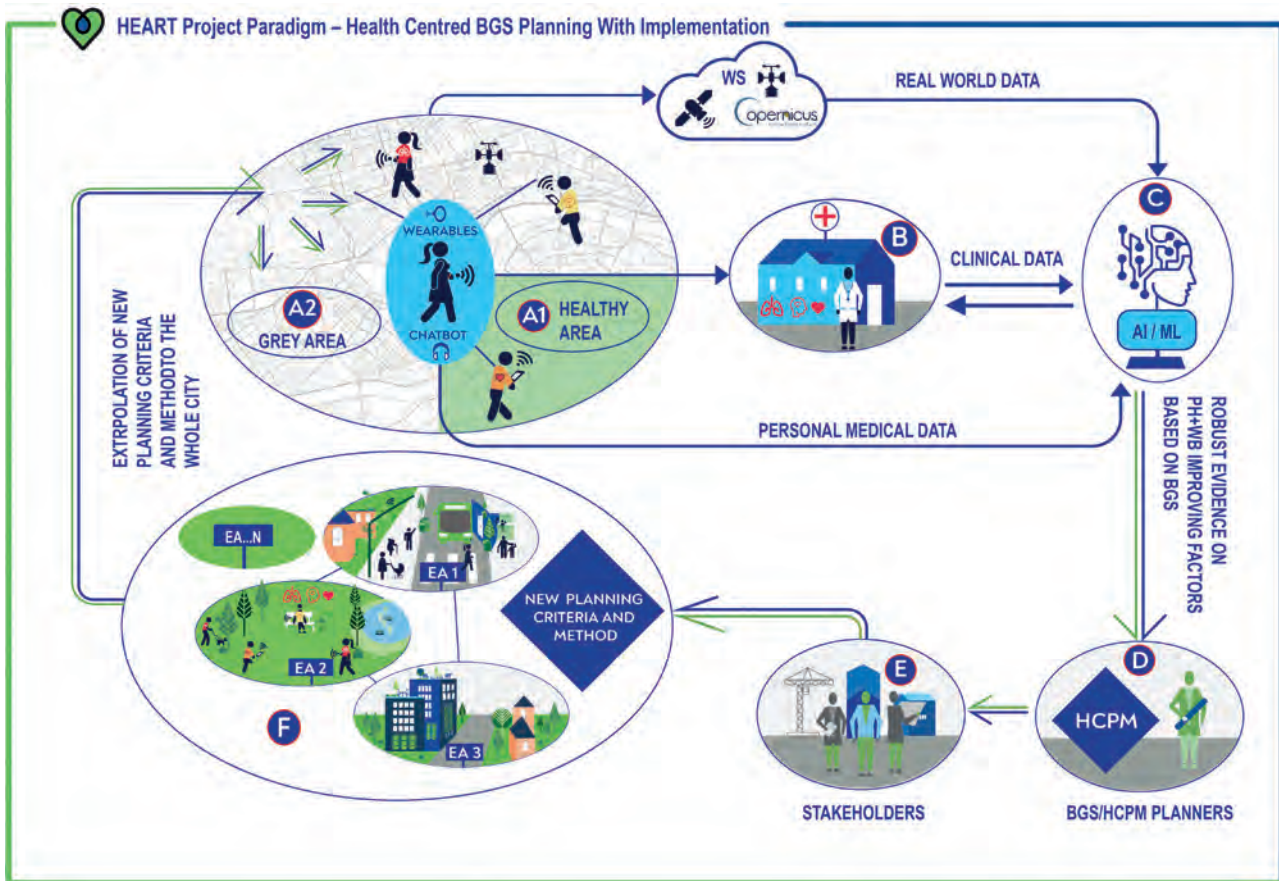
Figure 6 HEART Project Paradigm. Technical process

HEART Project

HEART project aims to systematically improve urban health and reduce health disparities through an innovative mechanism of urban planning that embraces health and citizens' wellbeing as a key design criterion. This project aims to use medical evidence in both clinical and non-clinical settings. For all clinical studies a sufficient group of individuals from three areas in Aarhus, Attika and Belgrade, will be selected to participate. HEART will follow a technical process that also includes a variety of information coming from medical data in non-clinical settings, as illustrated in Figure 6.
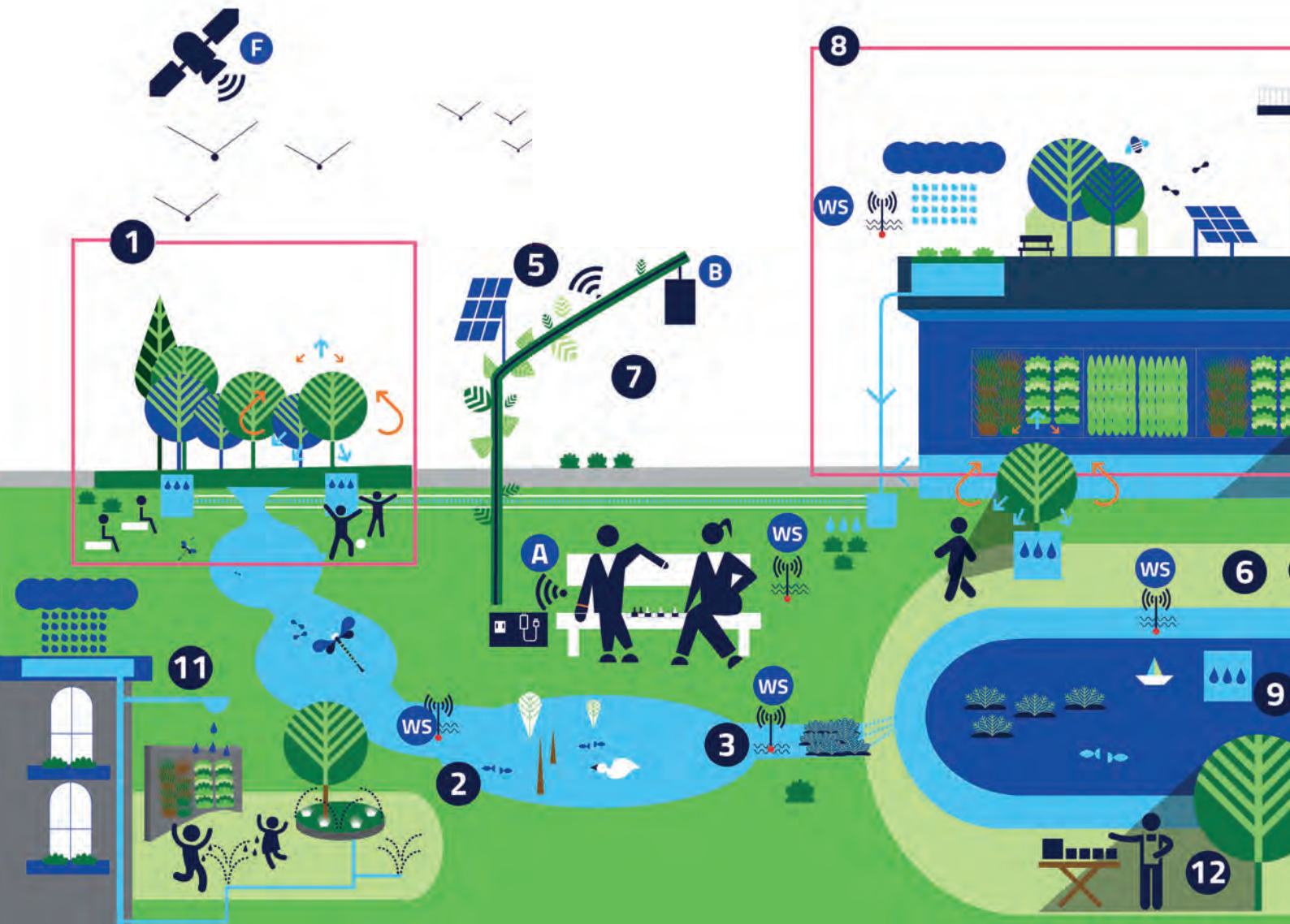
Figure 7 Set of Nature-based solutions to be used in euPOLIS cities

Legend:

1. NBS-based multi-functional (MF) pocket parks accessed by NBS locally conditioned pathways and shared spaces
2. Waterway with mini biotope nodes, aquatic biodiversity
3. NBS for surface runoff quality and pluvial flood management
4. Ground-water abstraction for water, energy, greenery nexus
5. MF NBS canopy for socializing, "recharging electronics", or "green bus stop" etc.
6. MF Live vegetation shaded waterfront promenade
7. Air pollution abatement shrubs, trees and vertical green curtains
8. Metabolic hub with MF ecotechnology demonstration/promotion, roof garden and art and culture performance
9. MF floating island, river water purification
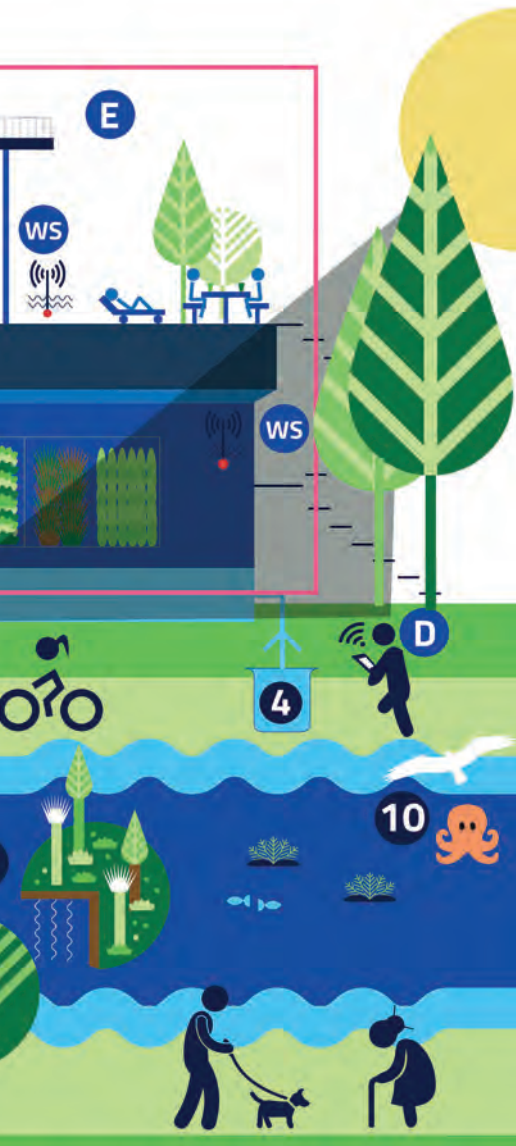
The euPOLIS Project

While the euPOLIS project introduces an integrated urban planning methodology, through the implementation of nature-based solutions in public spaces in 4 European cities (Belgrade in Serbia, Gladsaxe in Denmark, Lodz in Poland and Piraeus in Greece). They are very concrete demonstration of sites where some of the solutions are based on multifunction. Nature-inspired solutions will be tested, evaluated and validated for their positive impact on health, social inclusiveness and well-being of cities [5].

It is a multi-disciplinary project alongside experts from the cities' planning authorities, urban designers, engineers, partners from academia, and technology providers, all involved in the design process at the very early stages of the project. Also, we work very intensively with institutes of social studies which helps us understand the process and involvement of stakeholders, who are both experts, citizens, and future users of the spaces that we are designing.

Additionally, we worked together with a group of medical experts who've support us at the very start of the project. They assisted in choosing the interventions and selecting the precise indicators that are connected with the expected outcomes of the project and guided us through their discipline lenses on what the health indicators are and their possible improvements in our cities.

We used different technologies to support this research. The expected outcome of the project is to have robust data and evidence on the improvement of public health. We started this project already having in mind a list of possible interventions that could be carried out in different cities, as shown in Figure 7.

10. Coastal sea bottom marine aquatic biotope with euPOLIS-NBS
11. MF euPOLIS Urban square/streetscape
12. Space for NBS business activation and promotion Monitoring- ICT System:

A. Wearable devices for monitoring PH & WB,
B. Visualisation equipment,
C. Renewable energy sources,
D. Citizens observatories,
E. Sensor network,
F. Remote sensing, WS. Microclimate/ wireless weather station

Following the SyD framework, after creating the context knowledge, the goal of the analytical part of the project is to:

1. Select appropriate Nature-Based Solutions (NBS) tailored to local climate and existing resources in the cities

2. Create inclusive urban spaces and address the key global challenges of environmental quality and water stress

3. Respond to specific local conditions

How do we do that?

We perform very detailed site surveys and analyse all other current projects and existing use of NBS in the city where we work. Additionally, we carry out a very detailed mapping of the stakeholders with very different involvement methodologies, such as questionnaires and semi-structured interviews. There are also series of workshops, as these images show (Figure 8) from City of Belgrade where the intentions of the project are presented to local citizens.

During these meetings, we learn from citizens about their needs and concerns that they deal with in their everyday lives. This together with the knowledge of the geographical conditions of the place. Here in Belgrade in Usce Park situated at the confluence of the Sava and Danube Rives, there is great potential for interventions based on, or driven by, nature and blue-green infrastructure. An additional focus of this project is in the improvement of the social characteristics of the spaces, as several areas we are working in are degraded. This requires an improvement in accessibility to public spaces and a better sense of place, where the co-creating process is crucial.

Figure 8 euPOLIS project, stakeholders involvement and project presentation in Usce Park, Belgrade on May 31st 2022
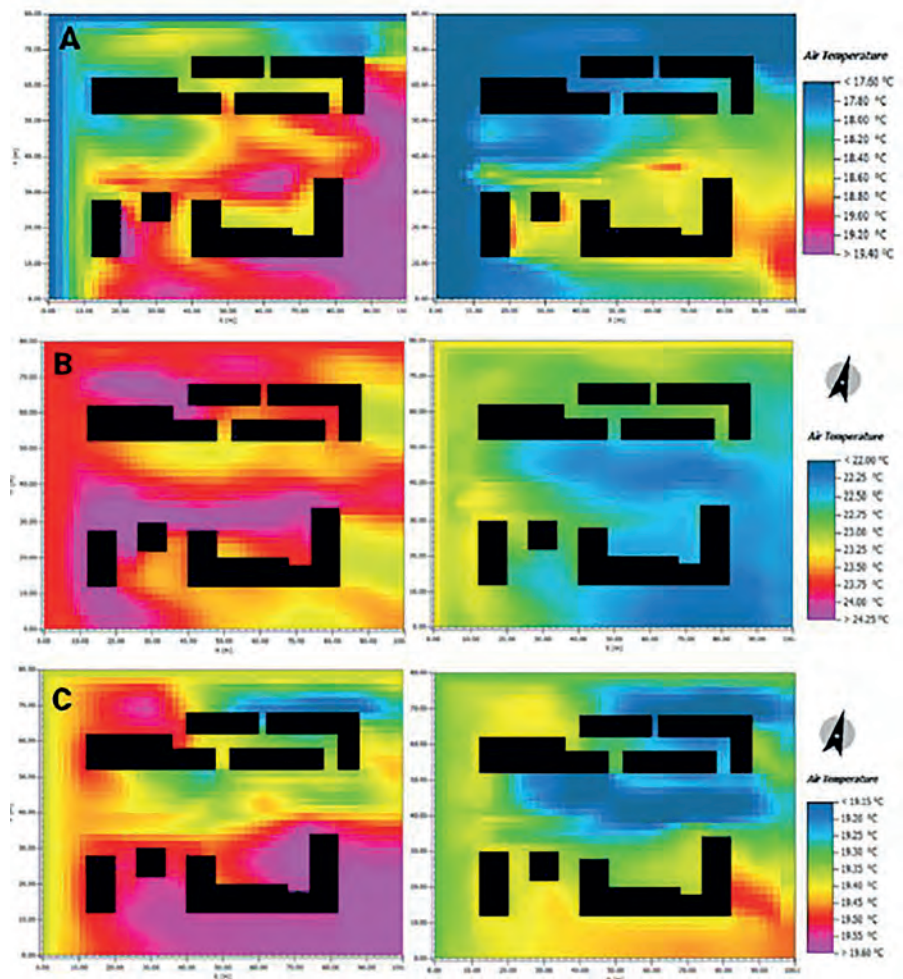
Figure 9 euPOLIS project, future scenario models with newly identified interventions for further thermal comfort

After mapping the context knowledge and main challenges in every specific demo site, we proceed with analysing alternatives and assessing the possible environmental impacts of the interventions, as illustrated in Figure 9. Those challenges include climate resilience, water quality, air quality, biodiversity, and the quality of life of end-users, citizens and their possible connection with disease clusters through the precise impact on public health.
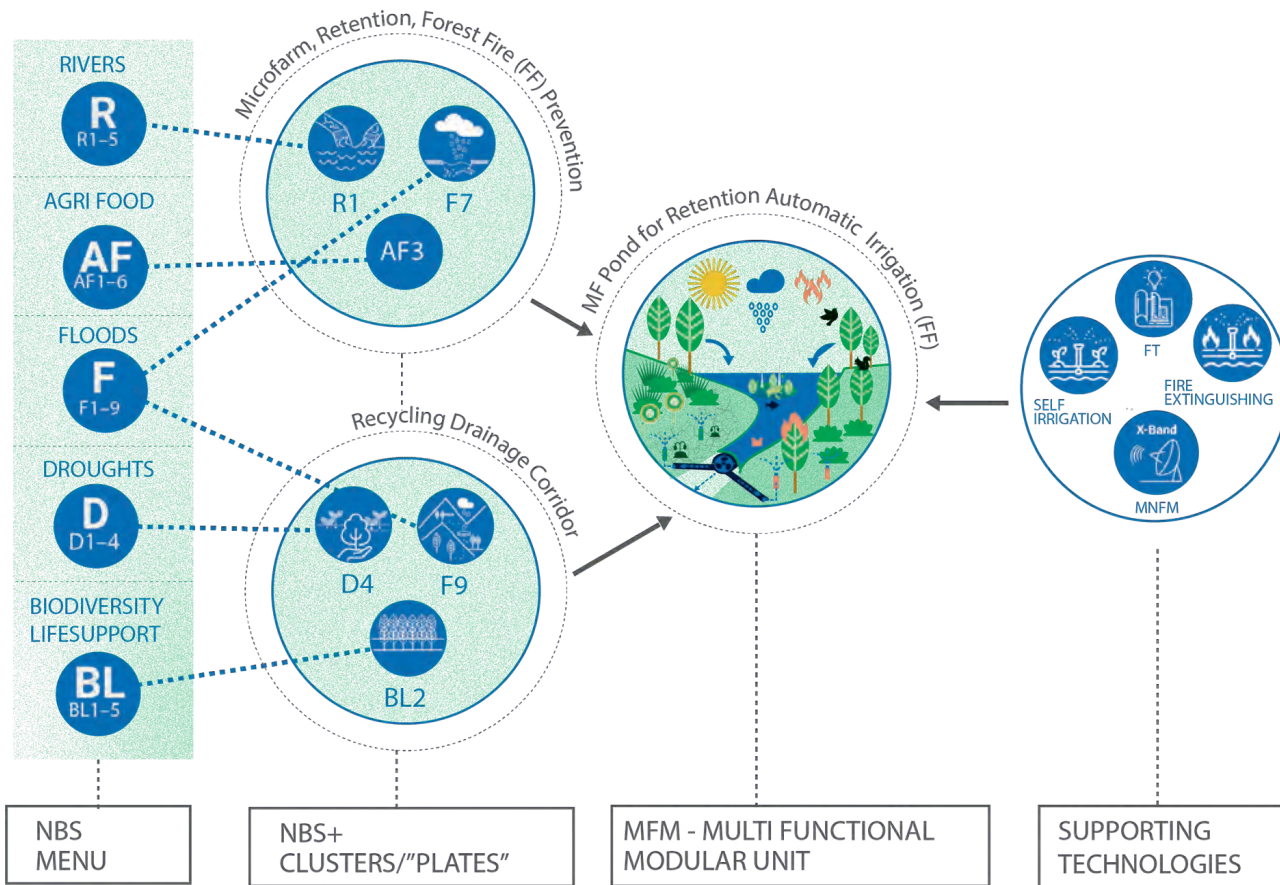
Figure 10 Example of NBS clusters combinations - NBS à la carte

We then proceed with the choice of the NBS, which is much more complex than using just one solution. We analyse the local conditions in depth, to then combine several solutions for specific conditions (Figure 10). We call it a la carte because we choose from different categories. In the case of Belgrade, we choose the categories that are connected with the river, such as flood risk and then add the supporting technologies. These technologies could be meteorological nowcasting, or for metabolic improvement of water quality to arrive at the one solution that is modular. In this stage, we are also testing the possible solutions through air quality and pollution concentration, the ideal combinations of NBS.
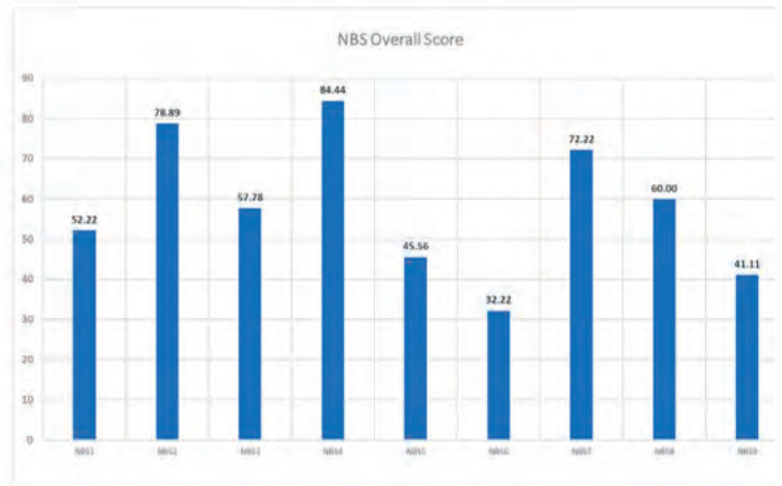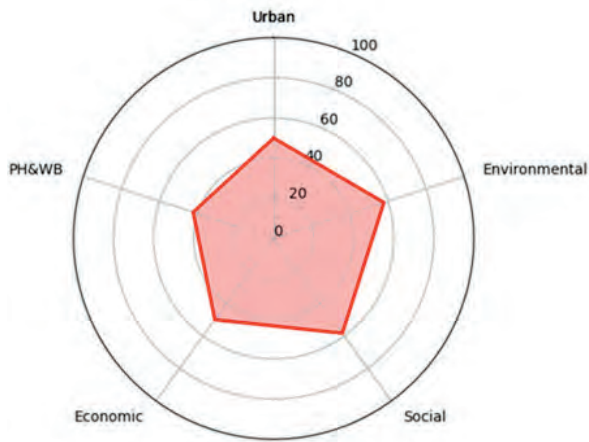
Figure 11 Example of a diagram showing the score estimated for an NBS in euPOLIS at each concern category and, right, diagram showing the overall score for a set of NBS

Site screening and further NBS selection are also based on scoring the concerns of citizens. The knowledge acquired through the analytical process is achieved to map different concerns and tailor the NBS for each demonstration site.

Figure 11 shows different areas of concern such as urban, environmental, social, economic, public health and well-being (PH&WB) and their respective severity. This gives us a methodological reading of the possible interventions that we can apply [6].

This consequently, gives us support when going through the further stages of modeling, design and the realisation of the project. The methodology for facilitating a preliminary assessment of the identified NBS interventions at a site of interest has been developed in the form of an online tool by two project partners NTUA (National Technical University Athens) and Resilience Guard.

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To finish, I would like to say that we are continuously working on dissemination and the circulation of our work.

We truly believe that the sharing of knowledge and experience is something that will help all of us to continue the work and to better understand the crisis that we are living in, and most importantly, to try to find the solution on the local and also on the planetary scale.

Panel
Discussion

Sarah Ichioka (Moderator)
Bjørn Tore Landsem
Lennart Grut
Stanislava Boskovic

[Sarah] Our shared topic of design and society might seem so large as to be overwhelming, and it can certainly be interpreted in diverse ways, as we've seen within the two presentations. We're all here as professionals, but I'd really love for us and the audience to get to understand one another as people because if we can't connect to our own human natures, it seems to me that we have little hope of meaningfully connecting with the perspectives and needs of others. I'd like to ask each of you in turn to share with us a key memory from your early life.

When did you first begin to understand the social impact that design could have?

[Stanislava] Well, I think it starts from the very beginning at home where I was born and grew up. My hometown is small however there are still public spaces to meet many people who shaped my life and shaping it one way or another. Both of my parents are architects and city makers. They create the public space internally at home as well as externally for the public. On the multi-scale level, I would say that the spaces that we are surrounded by closed or open are actually the scene for human interactions, for people to share their experiences and to create a community. What is a city without the people? It started from the home of mine.

[Bjørn] Well, my father is an engineer. I'm an engineer. My eldest daughter is an engineer. I think we have always been a family looking to at buildings, looking inside the buildings. I'm an MEP engineer and always when I was with my father in grocery stores, office buildings etc, we were looking up at the ceiling, looking into the ventilation ducts and everything. Maybe that triggered me to be an engineer who could also use the technical part as an environment of the building as well. We have a lot of examples that are not so pretty, both inside and outside the buildings as well. I think that was the starting point for me.

[Sarah] We have a family theme running through the first two responses. Lennart, how about you? When did you first start to understand the social impact potential of design?

Pompidou Center

[Lennart] I think very clearly for me that is slightly different. It is meeting and working with Richard Rogers because his whole ethos was so imbued in the whole social value of what architecture could bring. The whole approach to the working ethos. It clearly marked what we are today as the practice, and also my involvement. I had a different interaction because at that time I was actually working for Arup and I was responsible for the steelwork on the Pompidou Center. However, his whole influence on the way we worked, his generosity and the way he wanted to involve everybody in the process. As I've talked about in our constitution, giving back to society some of the success you might have in your professional life. I think for me that can only be the major marker in my career.

[Sarah] Thank you. I understand that Lord Rogers had that impact on so many people he interacted with.

[Sarah] Now, Bjørn Tore, we've heard from Lennart and Stanislava about their work. I thought we should balance the scales by learning a bit more about yours. In particular, can you please tell us more about the Ramboll Foundation? I understand that members of the Ramboll Foundation Board work to ensure that the Ramboll group and its affiliated and associated companies behave in an ethical, responsible and socially minded manner to earn the respect and trust of customers and business partners and to increase satisfaction amongst employees.

What does this relationship look like in practice from the view of a board member and how does it positively shape the social focus of Ramboll's work?

Børge Ramboll and Johan Hannemann

[Bjørn] Yes, it's a long phrase and there's a lot of responsibility being the main owner. Because we, the foundation, represent 95% of the ownership of Ramboll. From our founding fathers, Børge Rambøll and (Johan) Hannemann, we are taking care of the company on behalf of all the employees. We are not digging into the day-to-day business. We're trying to be an active and also proactive owner looking after the investments, for instance, and the ethical part as you described. We also donate a lot of money during one year, approximately 20 million Danish kronor for different initiatives both from outside Rambøll, but also from employees that have volunteer work, for instance, around the world.

We have meetings in the foundation board and also the chairman for both the Ramboll group and the chairman from the foundation as well. Looking into the business, the ethical pact, the social part, discussing how to make the company going forward and taking the responsibility that we have from our heritage, from our founding fathers as well.

[Sarah] Thank you.

Lennart, you've already shared with us about how the late Lord Rogers wished to ensure that RSHP had a clear socially governed framework and how ownership was passed to a charitable trust to achieve this. Based on your experience, what advice would you offer to other built environment professionals or clients who are tuning in today whose companies may currently have more traditional business models but who want to significantly improve the social contributions that their work makes to the world?

The Practice and the RSHP Charitable Trust Constitution

[Lennart] Well, that is a very challenging question you're asking there and puts some perspective on it that others perhaps have more experience with.

I think in the end it's all back to people and how you engage people in your business. We have engineers who've created their own, much as Ramboll, their own trusts to ensure that there's always an oversight on what you are doing. I think as far as we're concerned, given the ethos that's behind the practice and the fact that everybody has the opportunity to donate to charity, there is almost a day-to-day awareness of the fact that there are people out there that need help.

If we have the thinking process that then goes into our architecture or our thinking around projects that are given to us are always related to people and how we engage with people and how we can contribute to the project in some form or other can contribute to the environment in which it's built. I can't say I can be the great guru of telling people how to create their ESG in their own companies. I think the big engineering companies, and even a lot of the management companies, are selling their wares on that front very well these days. I'll have to leave it to them to advise others. I think we have to concentrate on the very challenging environment we are in today, and how we continue to help those around us.

[Sarah] Thanks. In my own work, I've certainly noticed an uptick in organisations that are restructuring as community-benefit companies or employee-owned trusts or even B Corps. I wondered if, for any of the three of you, you see this as a promising trend or is it just something that Lennart referred to, is this just something that consultants are selling?

[Lennart] Yes, I think there's one important point one mustn't forget as one tries to broaden one's responsibilities, is you can only help if you're a successful business. You have to combine whatever benefits you want to apply to the company to outside of the company by being a successful business. I think those are the places where people want to work, and those are the places, therefore, have money to spend on helping others. It's no good being very environmentally friendly and all this stuff but if your business fails it's not going to help you or anybody else.

[Sarah] Let's move, actually, from the private sector focus but staying with this idea of how the structure of the organisations that we work within shapes the work that we do.

Stanislava, you trained as an architect, but now you work as an academic within the Department of Civil and Environmental Engineering at Imperial College.

Can you share with us, how does the context of a university, or the EU government-funded projects you're a part of, shape the socially-orientated nature of the work that you do?

[Stanislava] It's true that from working many years in academia, in the schools of architecture, and practice as an architect after I focused on academic work at the Civil and Engineering department at Imperial College. From my perspective, it is very important to scientifically understand complex things that we work on. There is a lot of connection between practical and scientific work, more than we realise.

The social aspect of this project that we are working on, is funded by the European Union and it's collecting the needs or the concerns of people that are living in the surroundings. The public spaces are the focus of our scientific approach. We build the knowledge of the projects' context through the dialogues we have with the citizens and users. We see the projects as an intervention as in a connection between the context and the future prospects.

From a multidisciplinary approach, an academic institution such as Imperial College London can not only create a dialogue between different departments within our university, but also with other universities, and also with technology providers, businesses, and governments. The academy does quite an effective job to create a platform to exchange knowledge, experiences and perspectives on the multiscale projects that we are working on.

[Sarah] Thank you. Perhaps we could see a spectrum for the work that you're doing in the nonprofit sector as context of a university working together with the profit motive-driven private sector companies.

Now, you raised the point of having platforms for dialogue. I understand that it's Ramboll's ambition for this forum to become an annual event. Since we have the luxury of being on the first panel on the first day of the first, the inaugural edition, I thought, let's think ahead to next year, if we were going to curate it. Are there any specific topics or challenges in this broad and diverse space of design in society that you'd hope to see addressed in more detail?

[Lennart] Well, I've been trying to preach to my children. At my age, I've got grandchildren at a certain age, that they think very carefully about climate change because they have such concentration on trying to get through their studies and trying to succeed in their lives, that I think they're losing sight of what is the dramatic changes that are going to occur. It's not going to be my problem. I'll be long gone, but it's going to be their problem.

I think one of the themes that could go through is how we think we can address climate change because, much as we think we might want to reduce it to 1.5 degrees, I do unfortunately think there's scant hope that we'll achieve that. Should we not be, as professionals, looking closer at what happens at 3 degrees, and what can we do, start thinking about today? Because the politicians aren't going to do that because that's not going to get them votes. I think it must be back to the professionals to start thinking and advising what can be done and should be done in the future.

We've had a question posed to us about what are we going to do about the number of people who are going to be moving. In the UK, if you get 50 cm or 75 cm of higher water levels, it means several hundred thousand people moving from the coast to other places in the country, and there's a whole urban structure that has to be recreated. Where are they going to live? How are you going to recreate? I do think that, as a theme, would be of extreme value for everybody that comes after us.

[Sarah] Absolutely. If we think about the global audience for this event too, obviously, in neighboring countries in Asia, where I'm based, governments are already having to engage very clearly with those. I think designers who can go and research those existing conditions as well as projecting forward to the countries where it's still to come.

[Sarah] Bjørn Tore or Stanislava, do you have any topics that you'd like to put in the ring for future consideration?

[Stanislava] I agree with what Lennart said. Definitely, there is a lot of research on knowing what are the perspectives, but also imagining and simulating the different scenarios that might happen. That research is something that is really important. I believe that for following editions, of course, it's important to know more from what we have today on the panel, but also potentially from other disciplines that are involved in architecture and urban environments because those are exactly on the edge of disciplines where we can maybe find a solution that otherwise wouldn't have crossed to our minds. Yes, I believe that widening any opinions, and somehow establishing this platform for a wider dialogue is something that could really be even more interesting to see.

[Sarah] Thank you. I'm hearing an emphasis on interdisciplinary exchange, maybe expanding the diversity of participants. I'm also hearing a desire for thinking about using professional design tools to think about how we plan across the longer term. Now, Bjørn Tore in closing do any of these topics resonate with the work that you're doing, either in Buildings or in your role on the board of the Ramboll Foundation? Are you able to share with us any forthcoming initiatives that the foundation might be planning that could relate to some of these topics?

[Bjørn] Yes, first of all, I want to add some comments also around the challenges that we have due to the climate part.

> **"**
> I think we have to challenge ourselves every day, the clients, the contractors to challenge the everyday solutions that we produce in buildings, in roads, in all of our work every day. I think that will be the main topic for us all going forward.

Bjorn Tore Landsem

The Ramboll Foundation Board of Trustees (2023)

[Bjørn] Yes, I have some news to tell you about. Actually, the Ramboll group and the foundation have joined a program named Society Impact Program. This is a great opportunity to establish a more proactive, coherent and also impactful approach to increase the society impact through volunteering and donations we do every year.

The Foundation Board decided to support this program two weeks ago in a meeting. This initiative is spot on our legacy from our founding fathers being a purpose driven company. You can say it's spot on in the Ramboll DNA to be a society consultant as well. The aim of this Society Impact Program would be to support the overall transition to a more sustainable global society building on the legacy. The program will also support underprivileged groups and communities through two main tracks. The first one is for minority groups to enter our industry [either as] individuals or families to improve access to education. The second track is supporting societies that are struggling to make the transition to a more sustainable society, which don't have the capacity themselves in building lasting capacity and implementing sustainable solutions as well, and help them towards a greener future, so to speak.

I think this initiative will bring minority groups into our industry, in our markets and local communities as well. It will also build capacity within both sustainability and the science, technology, engineering, mathematics education in underprivileged communities as well. The last one is that this could be an implementation of sustainable solutions and infrastructure as well in those societies. This will be a partnership from Ramboll group, the Ramboll Foundation and non-profit organisations that we can have as partners and an engagement program for volunteers within Ramboll as well. I think this is a great opportunity to really step up for this.

[Sarah] Thanks for giving us that preview. I'm sure in particular the Ramboll colleagues who are in the audience are excited to think about how they can engage with that.

A Place For All Life...

Design
x Ecology

Traditional sustainability thinking on its own is no longer enough because it is founded on "doing less harm", and less harm is still harm. What is needed is a reversal of the damage and a move towards healing our relationship with the natural environment. Regeneration is about generosity, giving and healing; it is about co-creating with nature as a partner. Designers, architects and engineers need to move away from the single-species mantra of "people centricity", and instead become design-centric people who appreciate ecology and respect the rights of other species who live on this planet with us.

Ecology-based Design

Ken Yeang

Chief Executive Officer, Hamzah & Yeang

Ken Yeang is an architect and ecologist, delivering signature hyper-green architecture, a field he pioneered since 1971. His work is differentiated by an ecosystem-based approach that performs beyond conventional green-rating systems.

What is ecology-based design?

It is designing with nature based on the science of ecology. The reason why we're doing it is for the resilient future of the planet.

Why ecology?

Simply stated, ecology is the environmental context for everything that we do on the planet, for all human activities, upon which the planet's health is dependent. We should study ecology because, if the ecology is damaged then the planet is affected.

We must look at the planet and its ecology as a whole. Now, ecology is not the only factor in design.

A design must:

- Function effectively ('it must work'); If a design does not work, that is a useless piece of hardware.

- Meet criteria (health, safety, cost, time, quality, etc.)

- Be inspiring; it must engender a sense of achievement in people.

- Engender human well-being ('happiness'); good architecture and design must make people happy. It must give pleasure to their lives.

- Be immensely beautiful (aesthetically fulfilling); This is what we are about. We are artists. If it's not beautiful, then you don't need an architect. You just need a draftsman and an engineer.

- Be green. (ecologically positive)

- Other factors in design

Figure 1 Biointegration by design

Ecological design is biointegration into a whole.

Designing is one part of the equation that brings all five factors together.

Designing that is the integrator of these five factors into a whole. That is the challenge that we must try and achieve in ecology-based design.

Now, when designing with ecology, these are the factors (Figure 1) to consider:

Nature
Nature consists of biosphere, the biogeochemical cycles around the planet, the ecosystems, and humans.

Human Society
Societal systems like social, economic, political, institutional, and cultural systems.

Hydrology (water)
Water is part of nature, but I've taken it out as a separate factor because water is what life is all about. Without water, there is no organism, there are no living systems. When astronomers look into the sky, and at planets and asteroids, the first thing they look for is signs of water. If there's water, there's life. Water is very important. There's water that comes from the rivers, rain, the sea, snow, waterways and there's groundwater as well.

Structures & Infrastructure
Everything that we make and do as human beings, that's the built environment. There are structures and the infrastructure.

Energy Systems
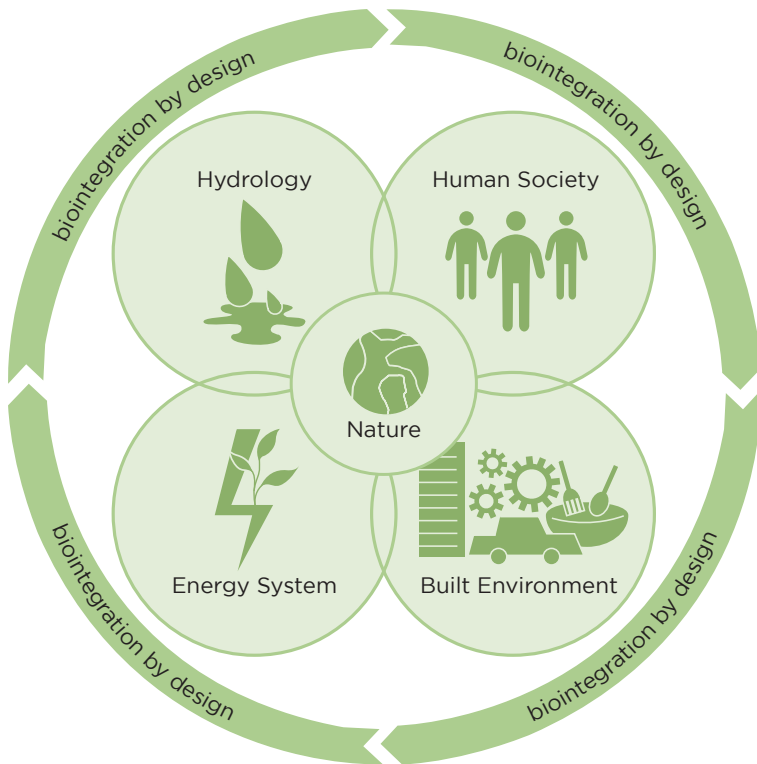which our whole human society depends upon.

The Biosphere

Now, let's start with nature. Nature is the distance from around the planet called the biosphere where organisms live. Within this biosphere, there are units which are called ecosystems. The ecosystem consists of communities of plants and animals existing together to form a holistic system. Holism is the property that differentiates organisms from technological systems and mechanical systems because mechanical systems are non-holistic. In a mechanical system, the whole is not greater than the sum of its parts.

Now, within this community of animals and the physical environment, there is us as human beings. Human beings are, in fact, part of the animal community, a species in nature. But I've taken this out because we are different from all the other species in nature.

We're the most powerful of all species.

We can change the planet.

We can change the landscape.

We can deforest the trees.

We can change the climate.

We can change biogeochemical cycles.

We make things for what is our built environment.

We make more things than any other species in nature.

We make buildings.

We make infrastructure.

We make clothing.

We make toys.

We make food.

We are the most powerful of all species in nature.

This power we must exercise with great care...

We and the built environment we design treat the planet in a very careless and non-caring way. That is the cause of environmental disasters and conflicts, causes of extreme environments and all the issues that the world is experiencing now. If you talk to a scientist, they say we don't have very much time left. We've got maybe about 30 to 50 years left before the environment becomes unhabitable. If we continue what we're doing, it will become so toxic, that human beings cannot survive. Nature doesn't care. All human beings can become extinct and nature will continue to thrive and will recover over time.

What we're doing in sustainable design is really for the future human beings and all the species and the environments on the planet. We must be careful of what we do and we have to start now.

Biointegration of ecosystem attributes

Now, one of the ways we need to do this is to make our built environment into human-made ecosystems or constructed ecosystems. A constructed ecosystem is the built environment that emulates, replicates, and augments with nature.

Characteristics of the
ecosystem that we must emulate:

- Biological structure
- Biodiversity
- Connectivity
- Provision of ecosystem services
- Biointegration
- Responsive to climate
- Use and cycling of materials
- Hydrology
- Symbiosis
- Homeostasis
- Food production
- Succession

If you look at the existing built environment today and at its biological structure, you find that it is mostly made of physical constituents (abiotic).

Where is the community of plants and animals? Where are the biological constituents (biotic) such as plants community, animal community, community of plant and microbes)? Consider the room you are currently in and everything within it, everything in this room, except for you and the bugs, is inorganic.

Ecological Design

The planet's biodiversity tends to be higher near the equator. As we move away from the equator, biodiversity level gets less and less. For instance, London is about 52 degrees above the equator, so it is not as biodiverse as in the tropics.

Ecological design requires researching the surroundings of the site to study the species that were removed from it by the development. We need to create new habitats within the balconies, the roof, the walls and on the ground.

In creating the habitats, we aim to identify indigenous fauna species that can coexist safely with humans and reintroduce them to the site. Then, we identify the flora species that will attract these fauna species.

Following which, we examine the interactions between fauna and flora species within the various habitats, considering the built system of the development and design of the landscape aspects of these habitats.

Figure 2 Ecocell

One of the devices we use in ecological design is the "ecocell" shown in Figure 2. The ecocell is a continuous vegetated ramp that starts on the upper level of this project and spirals down to the basement level, where we create a bioswale. It brings daylight, vegetation, and better ventilation to the inner parts of the building.

Vertical Greening Patterns

How can we bring more biotic constituents into the built environment?

Five greening patterns are depicted in Figure 3.

| Centralised | Dispersed | "Stepping stone" | Spine with fingers | Corridor with fingers |
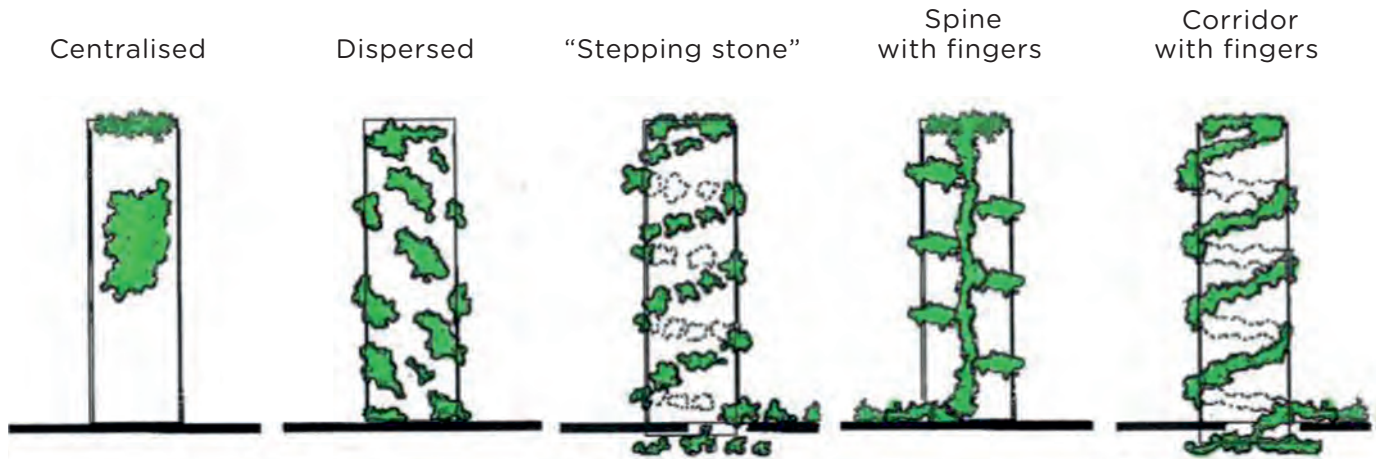
Figure 3 Patterns of biointegrating biotic constituents with the abiotic constituents on a building

These are:

Centralised
All greenery in one location

Dispersed
A spotty relationship

"Stepping stone"
Patches of greenery are not quite connected, but some species can move from one patch to the other patch, but it's not ideal

Spine with fingers
Less connected and linked, much like the structure of a tree, where you have a central trunk with branches extending outward

Corridor with fingers
The ideal pattern is the spiral pattern where the ecology is interconnected, allowing species to move from one part of the site to another. This interconnectedness enables a larger pool of natural resources to be shared among the species.

Continuous plantation

Skycourts

Vegetated mount
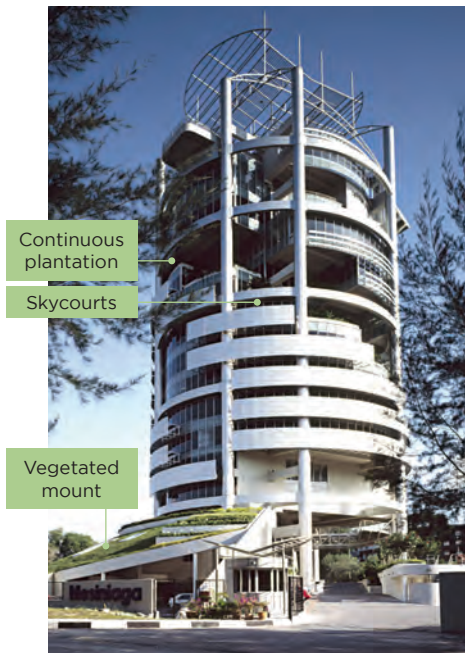
Figure 4 Menara Mesiniaga

Dispersed Greening Pattern

An early example of us creating habitats within buildings using the dispersed greening pattern can be seen in Menara Mesiniaga in Figure 4. This is one of the early schemes where we had a patchy pattern of habitats. As mentioned earlier, this design is not ideal because the habitats are not connected. This was an early design (about 30 years ago), it is a 35-story building with vegetation on the exterior terraces.
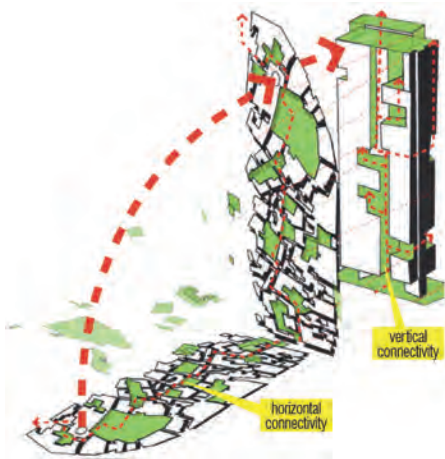
Figure 5 Building with the greening pattern of spine with fingers

Spine With Fingers Greening Pattern

The Biodiversity concept in a vertical version is shown in Figure 5.

For the high-rise, we have vegetation that rises up like a tree and then it spreads out like branches into pockets of balconies, which also collects rainwater. The building collects the rainwater as a vertical sponge, which is then recycled.

The flora species at the façade are selected to attract butterflies and dragonflies at a lower part of the building, songbirds at the middle section, and migratory birds at the upper part. These are the biodiversity measures for the vertical built form.

Spiral Greening Pattern

With the spiral greening pattern, we can bring the vegetation continuously to flow up the built system. The vegetation starts from a ramp on the ground level and spirals all the way up to the roof level. We call this landscaped ramp a "linear park". To avoid the monotony of a built linear park, we punctuate the corners of the building with sky courts. The corner terraces of the building are places where people can interact with the people inside. We sought to bridge across and vegetate to the adjoining building. This way, the existing city eventually becomes green. This is the concept where the building becomes a device to shade and create habitats to green the entire city.

Progression to a Constructed Ecosystem

The following is the progression from a mostly inorganic city to a constructed ecosystem in Figure 6:

Present day -
Separation of cities and nature

The city is barren. It was almost devoid of any vegetation although there are some green areas.

Intermediate -
Integration of greenery in cities to increase biotic constituents

Increase planting into the built environment. It's what we're doing in many cities today.

Transitional -
Integration of greenery in buildings by creation of habitats

To Integrate it into greater, better, and tighter relationship between the vegetation and the built environment.

Transformation -
Integration of ecology in cities to enhance biodiversity

Transform the built environment, not just bringing vegetation in, but changing the materials we use, changing the energy systems we adopt.

The city as a constructed ecosystem -
Integration of productive landscape as constructed ecosystems

The built environment becomes the constructed ecosystem. Creating habitats by integrating buildings with vegetation not just on the ground plane, but also vertically up the building. Habitats with patches of green on the ground, ecocells and skycourts. The habitats that we can put into our structures can be in atriums, on walls, terraces, roofs and so forth. This is the strategy that we must adopt in our designs.
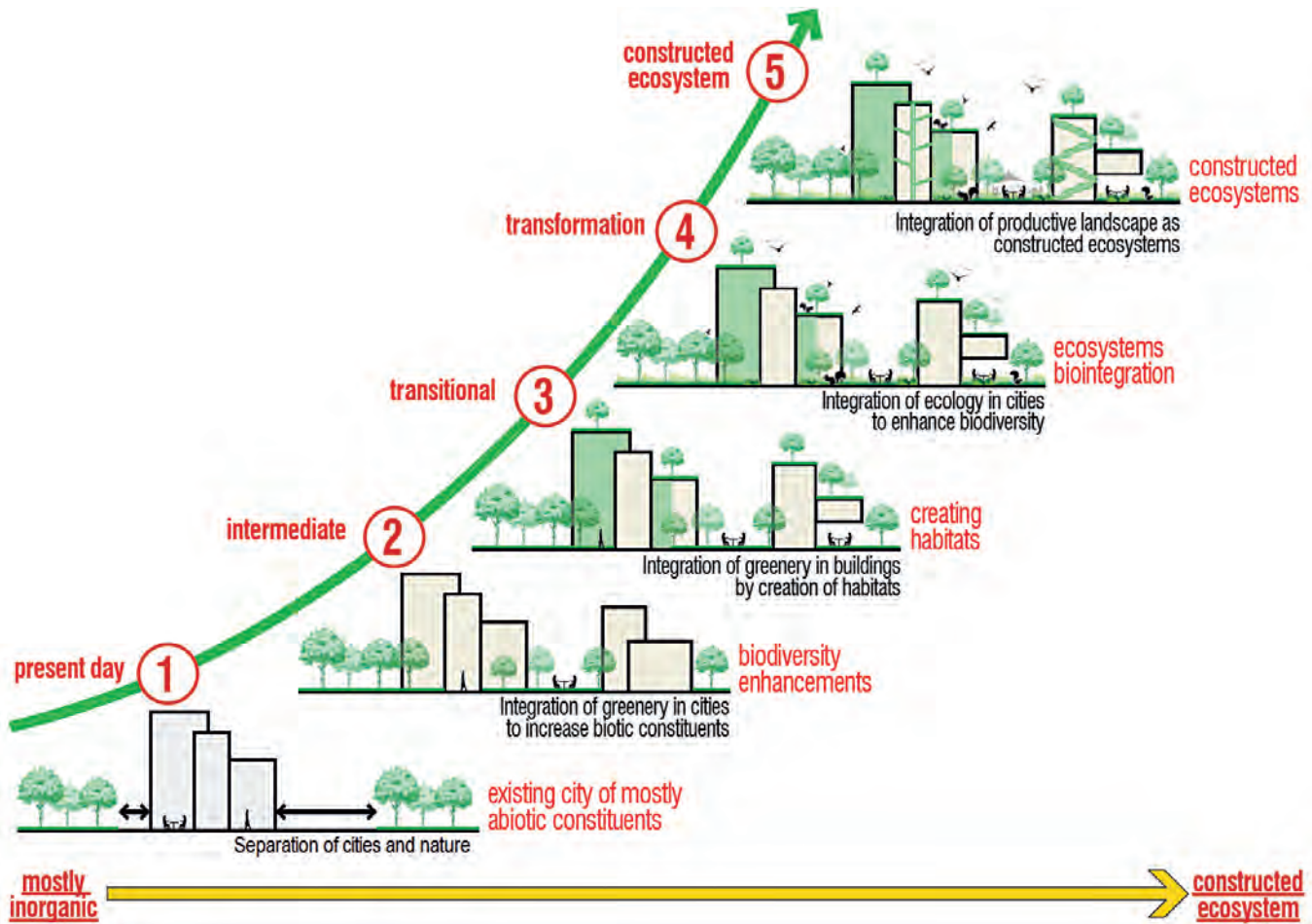
Figure 6 From a mostly inorganic city to a constructed ecosystem

Creating habitats in the urban realm

Habitats in the urban realm can be created similar to vertical greening as shown in Figure 7. Five greening patterns are depicted in Figure 3.

An interconnected city is one with corridors with fingers. This is the ideal pattern which is encouraged to be adopted.

To bring ecosystem services into the city, the design concept is to have the vegetation as close as possible to the built-up areas so that it provides the ecosystem services to the built-up areas.

Water bodies are also integrated into the fabric of the city. By sourcing species from the waterfront and interconnecting green spaces, a meaningful pattern of vegetation emerges throughout the urban areas.

Patterns of biointegrating biotic constituents with the abiotic constituents

Centralised	Dispersed	"Stepping stone"	Spine with fingers	Corridor with fingers
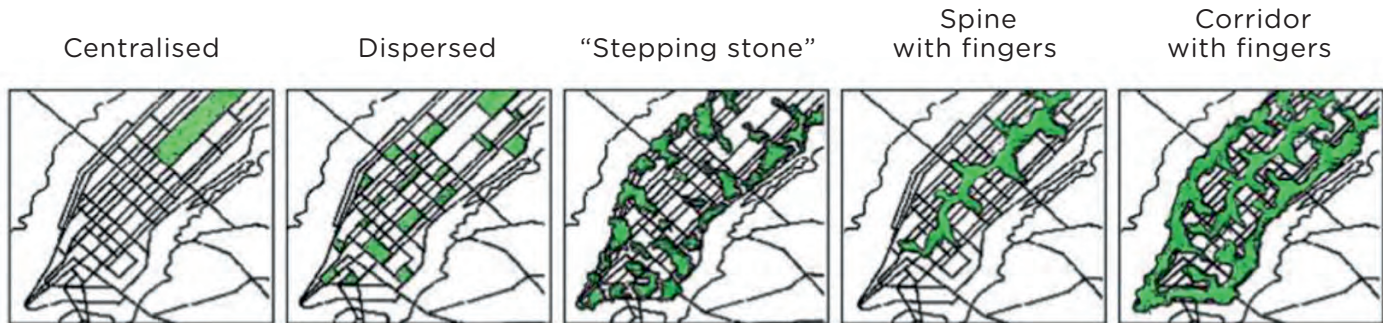
Figure 7 Patterns of biointegrating biotic constituents with abiotic constituents in the urban realm

Figure 8 Nitte University Materplan, India

In a masterplan in India (Figure 8) we sought to integrate the vegetation in a similar way, by bringing the ecological fingers across the entire site. On the right-hand side of the site is the forest reserve. A series of vegetated fingers stretch across the site so we can link the habitats from the other sites. This way, the whole locality becomes a linked habitat.

Once we laid the roads on the site, the infrastructure cuts into green areas. One of the ways to maintain the continuity of the vegetation is the use of eco-bridges.

An eco-bridge is essentially a bridge that spans over a road. The vegetation from one part of the site is linked to the other part of the site in a continuous pattern and not fragment the site.

Green Infrastructure

Infrastructure is important. What a lot of green architects are doing is just placing vegetation all over the structure.

If we start a green infrastructure with (by creating a green) green energy system with a water green management, anything that we put in after makes it easier to green the city.

Ecosystem Services

Nature provides ecosystem services for the benefit of the Planet's natural environment without human intervention. Our approach must contribute to providing 'ecosystem services' for the locality and for the larger region within which it is located in order to benefit the planet. Ecosystem services are the many and varied services provided by the natural environment.

Ecosystem services include:

1. Production of oxygen

2. Maintenance of biological and genetic diversity

3. Purification of water and air

4. Storage, cycling and global distribution of freshwater

5. Regulation of the chemical composition of the atmosphere

6. Maintenance of migration and nursery habitats for wildlife

7. Decomposition of organic wastes

8. Sequestration and detoxification of human and industrial waste *natural pest and disease control by insects, birds, bats and other organisms

9. Production of the genetic library for food, fibers, pharmaceuticals and materials

10. Fixation of solar energy

11. Management of soil erosion and sediment control

12. Flood prevention and regulation of runoff

13. Protection against harmful cosmic radiation

14. Regulation of the chemical composition of the oceans

15. Regulation of the local and global climate

16. Formation of topsoil and maintenance of soil fertility

17. Production of grasslands, fertilisers and food

18. Storage and recycling of nutrients

19. Others

If we continue to deforest the planet and to clear the planet of vegetation, we will have a planet that is totally incapable of providing ecosystem services.

Presented here are the factors we need to consider in ecological design, nature and its system, our built environment and its interconnected system. All these need to be harmoniously and seamlessly integrated into our human-made built environment with constructed ecosystem.

Design and Ecology in a Globalised World: How Far Have We Come?

Nirmal Kishnani

Associate Professor, National University of Singapore

Nirmal Kishnani has been at the frontlines of sustainability, advising on projects and policies in Asia, formulating new platforms and scrutinising the space between front-line theory and design practice.

Some years ago,

" I began looking at projects in Asia that go beyond the idea of greening projects that actively reshape the conversation on sustainability. I found quite a few and they had one thing in common. They each sought out nature. They sought out our place within ecological systems.

From this search emerged a book, *Ecopuncture*, that argues that ecology is not simply a good-to-have, it is a must-have. The forces of industrialisation and urbanisation need to be countered with new ideas of how ecology is integrated into architecture and urbanism.

We are, however, confronted by mindsets about our place in nature. *Oxford Dictionary* defines nature as the phenomena of the physical world collectively, including plants, animals, the landscape, and other features and products of the earth as opposed to humans and human creations. *Collins Dictionary* says it is all the animals, plants, and other things in the world that are not made by people, and all the events and processes that are not caused by people. Nature is always the other, the thing outside human existence. This underlying belief leads us to a position of design. Yes, we must be sympathetic to nature, conserve it where we find it, but it is set apart.

And so what happens in cities is very different from what happens in forests.

This is a condominium in Singapore (referring to the Reflections at Keppel Bay) built next to an important biodiversity hotspot on the Southern Waterfront.

What it offers us is a visual representation of nature, towers that seemingly sway in the wind. It does not, however, actively engage with or support the natural systems that surround it.
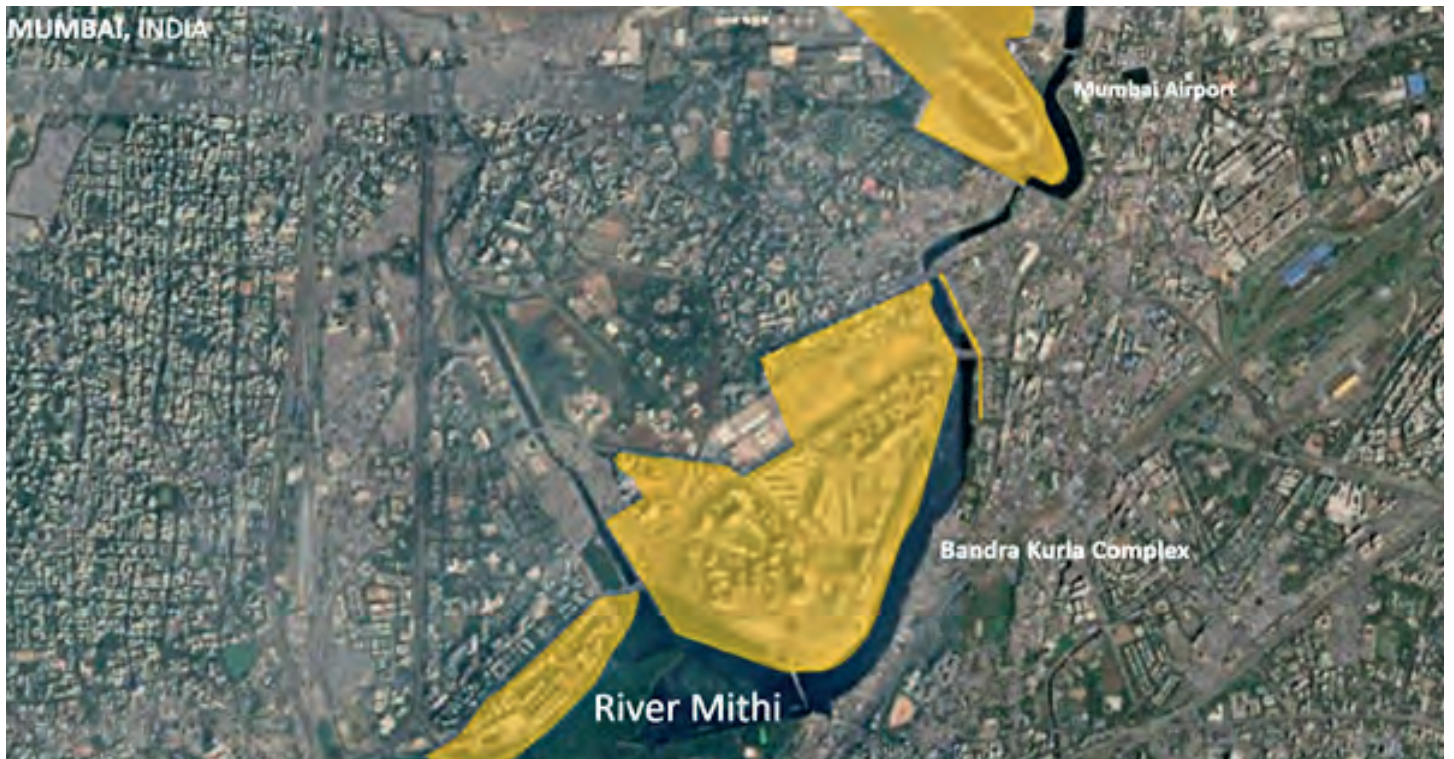
This view of nature has consequences. What are they?

Figure 1 Mumbai's Mithi River in 1960s

Here is an example of consequences. This is Mumbai's Mithi River as it was in the 1960s in Figure 1, a vibrant ecosystem of mudflats and wetlands. The areas marked in yellow highlight changes to the system. In the late 1970s, the government decided on a new central business district to bring in some 200,000 jobs into the city. Approximately 220 hectares were reclaimed from Mahim Bay, reducing the Mithi River in the process to a canal with no means of overflow. In the 1980s, the construction of a second runway at Mumbai Airport resulted in a series of very disruptive 90-degree bends over a short stretch of the Mithi. These disruptions to the hydrology of the area created conditions for annual floods that Mumbai faces every year during the monsoon season. The worst of these in 2005 cost almost a thousand human lives.

Going back to the definition of nature, early ideas of nature were concerned with the mapping of the diversity of organisms or describing laws that govern the physical world. This has transitioned to a more dynamic view of systems and processes, complex flows and exchanges that can result in emergent outcomes. What does this mean for the design of buildings and human settlements?

The Sustainability Conversation

Here in Figure 2 are some key events and publications from the last 60 years leading to present-day thinking on sustainable development. We start off with a position on protecting nature. Books like 'Silent Spring' warned us about the impacts that the post-war industrial complex was having on ecosystems often far away from where farming or factories were located. The book 'Limits to Growth' projected the impact of population growth and consumption on planetary systems. The central message of both books and others like these was that nature needed to be protected from human actions.
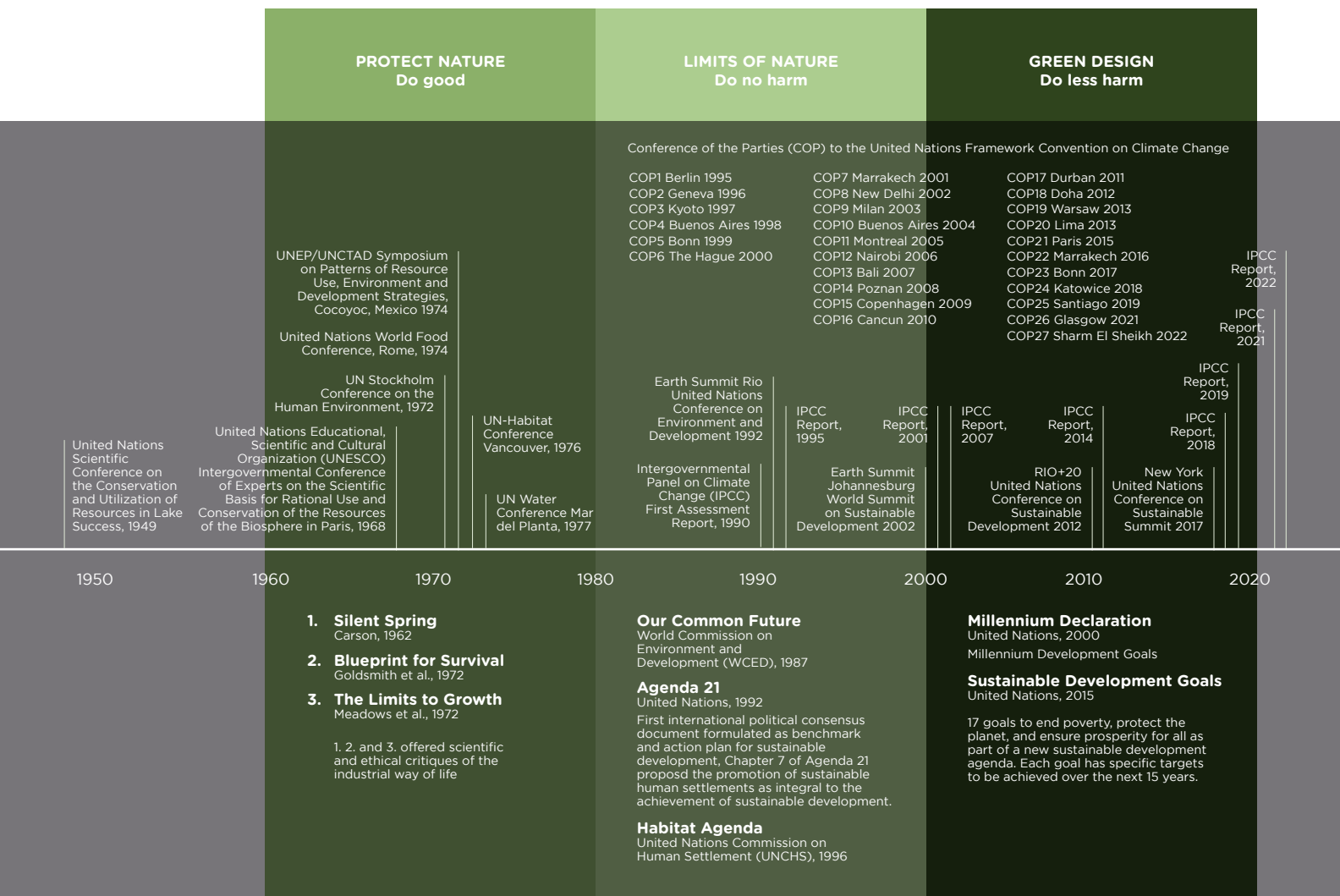
PROTECT NATURE Do good	LIMITS OF NATURE Do no harm	GREEN DESIGN Do less harm

Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change

COP1 Berlin 1995
COP2 Geneva 1996
COP3 Kyoto 1997
COP4 Buenos Aires 1998
COP5 Bonn 1999
COP6 The Hague 2000

COP7 Marrakech 2001
COP8 New Delhi 2002
COP9 Milan 2003
COP10 Buenos Aires 2004
COP11 Montreal 2005
COP12 Nairobi 2006
COP13 Bali 2007
COP14 Poznan 2008
COP15 Copenhagen 2009
COP16 Cancun 2010

COP17 Durban 2011
COP18 Doha 2012
COP19 Warsaw 2013
COP20 Lima 2013
COP21 Paris 2015
COP22 Marrakech 2016
COP23 Bonn 2017
COP24 Katowice 2018
COP25 Santiago 2019
COP26 Glasgow 2021
COP27 Sharm El Sheikh 2022

IPCC Report, 2022

IPCC Report, 2021

UNEP/UNCTAD Symposium on Patterns of Resource Use, Environment and Development Strategies, Cocoyoc, Mexico 1974

United Nations World Food Conference, Rome, 1974

UN Stockholm Conference on the Human Environment, 1972

IPCC Report, 2019

IPCC Report, 2018

United Nations Scientific Conference on the Conservation and Utilization of Resources in Lake Success, 1949

United Nations Educational, Scientific and Cultural Organization (UNESCO) Intergovernmental Conference of Experts on the Scientific Basis for Rational Use and Conservation of the Resources of the Biosphere in Paris, 1968

UN-Habitat Conference Vancouver, 1976

UN Water Conference Mar del Planta, 1977

Earth Summit Rio United Nations Conference on Environment and Development 1992

Intergovernmental Panel on Climate Change (IPCC) First Assessment Report, 1990

IPCC Report, 1995

IPCC Report, 2001

Earth Summit Johannesburg World Summit on Sustainable Development 2002

IPCC Report, 2007

IPCC Report, 2014

RIO+20 United Nations Conference on Sustainable Development 2012

New York United Nations Conference on Sustainable Summit 2017

1950	1960	1970	1980	1990	2000	2010	2020

1. **Silent Spring**
   Carson, 1962

2. **Blueprint for Survival**
   Goldsmith et al., 1972

3. **The Limits to Growth**
   Meadows et al., 1972

   1. 2. and 3. offered scientific and ethical critiques of the industrial way of life

Our Common Future
World Commission on Environment and Development (WCED), 1987

Agenda 21
United Nations, 1992

First international political consensus document formulated as benchmark and action plan for sustainable development, Chapter 7 of Agenda 21 proposd the promotion of sustainable human settlements as integral to the achievement of sustainable development.

Habitat Agenda
United Nations Commission on Human Settlement (UNCHS), 1996

Millennium Declaration
United Nations, 2000
Millennium Development Goals

Sustainable Development Goals
United Nations, 2015

17 goals to end poverty, protect the planet, and ensure prosperity for all as part of a new sustainable development agenda. Each goal has specific targets to be achieved over the next 15 years.

Figure 2 Key events and publications on sustainable development

Positive Impact

Nature-Based Solutions

Salutogenic Design
Renewable Energy
Resource Recycling

Super Green
Minimal Impact

Super Green Design
· *Zero Energy and Water*
· *Foster Wellness*

Efficiency and Optimisation
Indoor Environmental Quality

Green
Less Negative Impact

Green Design
· *Reduce consumption and waste*
· *Reduce negatives on health and comfort*

Code Compliance

Conventional
Negative Impact

Conventional Practice
"One step better than breaking the law"
(Croxton)

Negative Impact

Figure 3 From do-less-harm to do-good

In the conversations on the built environment, we co-opted this idea of limits wherein the goal was somehow to eliminate negative impact, maintain a balance sheet of what we take and how fast the system can recover.

In the building sector, this quickly segues into green design, the notion that we must simply do less harm. If a building, for instance, were to reduce its impact, the aggregated outcome of all such actions in a city would be enough. We know now that green is not enough. We have, in fact, in the last few decades, been distracted by this less-harm approach, which has further destroyed and damaged ecosystems. The only way forward must be to repair and to regenerate. From the idea of a conventional building, we have progressed to the idea of green which is still negative. We are now seeing examples of super green buildings, zero energy, zero waste and zero water projects that strive to have no negative impact, but this is not enough. It does not begin to address the damage that has already been done. Now the conversation is shifting towards net positive developments. One of the ways this is done is by adopting nature-based solutions (Figure 3).

Now let me illustrate this with the works of one Singapore firm, WOHA (Figure 4). WOHA has been working with building integrated greenery in its buildings for many years. In 2007, Newton Suites had over 130% green plot ratio. The green plot ratio is a metric that accounts for the total surface area of greenery relative to the site area. Then came Parkroyal Collection Pickering in 2013, and the ratio here jumped to 240%. With Oasia Hotel Downtown in 2016, it peaked at 1,110%. Beneath this escalation was an evolving and shifting idea of the role of nature in architecture.

Parkroyal is discussed by its architects in relation to the green space in front. The building, by matching the vegetation of this park, becomes a de facto extension, a part of the urban network of green. With Oasia Hotel Downtown, the conversation progressed to the question of biodiversity and habitat creation. The building's facades are home to small animals and birds, about half of what is found in nearby patches of urban green.

Newton Suites (2007)
Green Plot Rate 130%

Parkroyal Collection Pickering (2013)
Green Plot Rate 240%

Oasia Hotel Downtown (2016)
Green Plot Rate 1110%

Figure 4 WOHA's building integrated greenery in its buildings

Figure 5 Kampung Admiralty

Kampung Admiralty

Perhaps the most instructive of recent WOHA projects is Kampung Admiralty in Figure 5, a mixed-use community and elderly housing development. What's interesting here is how ecology is positioned. The first of these ideas is to mimic ecosystems by replicating the services that they would perform in the natural setting.

Rainwater is captured on the roof, it is cleaned on its way down via a series of cascading planters. Clean water is then collected at the bottom and recirculated through the building for non-potable uses. This cleaning of water by natural means is an example of an ecosystem service. The roof is a remarkable space. There is a pocket park and a biodiversity node. It is open to the public as amenities like playgrounds and exercise areas. It has also become a draw for birds and insects to forage and nest in the vegetation. The building stacks these social and

ecological layers vertically creating a shared space for human and non-human life while it actively performs ecosystem services. In a 2018 audit of several locations in the neighbourhood, it was found that Kampung Admiralty has the highest species count, 50 in total, exceeding those of nearby patches of green. The building has also become a social nexus for the housing estate. In the years since it opened, it has hosted over 130 community activities and drew more than 83,000 visitors from across the city.

This symbiosis of the urban and the ecological is seen in other projects in Asia that recreate ecosystems in a bid to generate new urban systems.

Figure 6 Wusong Riverfront pilot project

Wusong Riverfront Pilot Project

An example of this is the Wusong Riverfront pilot project in China near the city of Kunshan (Figure 6). Like many Chinese cities, its waterways have been polluted by waste that is discharged by industry or from runoff from farms. A study identified multiple sources of pollution. While pollution must be tackled at source, the question remains of what to do with land that has been contaminated. Kunshan project attempts to answer this.

Here is phase one of the development, a new park made up of a series of water bodies taking contaminated water from the river, cleaning it, clean enough to then create conditions for the return of fauna and people. Phase two will see a stage construction of a mixed-use neighbourhood south of the park. Now, as a result of these, phase one biodiversity has returned to the site and ecosystem services have been restored.

Air quality, for instance, and ambient temperatures have been corrected while a survey of bird and insect species shows an increased presence of fauna. Since the completion of phase one, property prices in nearby districts have risen and this supports the idea that an increase in natural capital leads to a rise in social capital which in turn increases the prospect of financial capital.

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Jetwing Hotels

Here in Figure 7 is another project, this time a resort in Sri Lanka. This is situated in a farming area in the center of the island near an archaeological tourist site. The site was selected by the developer because it had been severely degraded over the years by poor farming practices. When he decided to spend millions on the restoration of blue-green systems, many thought he was crazy. The resort was built during the Civil War and so the idea that tourists would come and pay top dollar seemed quite unimaginable at the time. He set about hiring the landscape consultant first who restored the hydrological system.

This meant on-site capacity for water cleaning, storage, and floor. It meant reconnecting the fragmented waterways both in and beyond the site to improve the hydrology of the area. The architecture seems to hover above this blue-green landscape without touching the ground directly. Many of the buildings are elevated on stilts. As a result of this, the flora and fauna are free to roam and thrive undisturbed. The surrounding land has not flooded since the resort opened. The site is now home to a vast number of species, including 140 birds, 25 mammals, 36 butterflies, 25 reptiles and amphibians.

It is the presence of the loris though, an endangered nocturnal primate, that has created a real buzz in particular among nature enthusiasts everywhere. The result is now one of the most awarded eco-resorts in the world. Prior to the current crisis in Sri Lanka, it was almost always full despite the high price of the villas. It is a flagship property of the Jetwing Hotels Group, and so it is likely when Sri Lanka is back on its feet, this development will be profitable again.

Figure 7 Jetwing Hotels

The final project is Organo Naandi, a private development with about 70 homes in India. The sales brochure of this project spoke of a healthier life and a safer home for its residents. Families who bought a unit here sought to escape the big city. The big city in question was Hyderabad. This is situated on the outskirts of Hyderabad near farming communities.

Now, this type of development we see in many parts of developing Asia where typically it is gated and accessible only to the residents, but Organo Naandi would be different. It would be self-sufficient in food, energy and water, creating a healthy lifestyle for its inhabitants, and in the process, engaging the community around it.

The layout of the estate consists of a ring of villas surrounding patches of water and vegetation. There is a very good water management here along with a careful selection of vegetation that attracts birds and small animals. The homes are designed as private villas each with its own food garden. The villas are fitted with solar panels and water reticulation systems that make the estate zero energy and zero water. The systems of the villa are then connected to the systems of the estate as a whole.

Figure 8 Organo Naandi

Figure 9 Local communities farming, training workshops

While energy and water could be managed with technology, the production of food was more complex. This required human labor and expertise. This could be only achieved if the estate owners cooperated with the local community of farmers. First, farmers had to be persuaded to work for pay on the farming areas within the estate. Second, they had to themselves switch to safer organic farming techniques in their own farms, which had the potential to contaminate end water in the area.

In the years since it has opened, Organo Naandi has carried out a series of training workshops to educate farmers and enter into this mutually beneficial relationship with them. The estate has become an advocate for better farming through seminars and events on-site. Farmers are encouraged to diversify crops to meet wider market demand.

Positive Impact

Regenerative Design
Symbiosis of human-made
and natural systems

Nature-Based Solutions

Salutogenic Design
Renewable Energy
Resource Recycling

Super Green
Minimal Impact

Super Green Design
· *Zero Energy and Water*
· *Foster Wellness*

Efficiency and Optimisation
Indoor Environmental Quality

Green
Less Negative Impact

Green Design
· *Reduce consumption and waste*
· *Reduce negatives on health and comfort*

Code Compliance

Conventional Practice
"One step better than breaking the law"
(Croxton)

Conventional
Negative Impact

Negative Impact

Figure 10 Progression from a Conventional building to a Regenerative design

As of 2018, 93 farmers in the district had switched to organic methods. The ecology of the site is transformed. Rain is collected through a network of trenches and swales that either percolates into the soil or is channeled through recharge pits. These measures came to fruition in 2017 with the full recharge of the nearest aquifer, the elevation of the water table by 36 meters.

What we're seeing in these projects from Kampung Admiralty to Wusong Park, Vil Uyana to Organo Naandi is Asia's answer to regenerative design. These projects understand the interconnectivity of the built and the ecological, that there is a direct link between healthy ecosystems, thriving social systems, and economic gain. Nature not only looks good and makes us feel better, it has a real long-term value.

These constructed ecosystems, if done right, expand room for all life, not only ours. In these emerging systems, the outcome isn't social or ecological, it is both.

Understanding this mutualism and embeddedness is at the very heart of regenerative design. Green walls have become the trend today. Biophilia is the new buzzword, but ecology is much more. Nature is not what we look at, it's who we are. We are the makers of future ecosystems.

Biomimicry as an Integral Part
of Regenerative Design Thinking

Michael Pawlyn

Director, Exploration Architecture

Michael Pawlyn established Exploration Architecture in 2007 and has built
a reputation as a thought leader in regenerative design and the circular economy.

I'm going to be sharing why I think sources of biologically-inspired design are going to be essential to making the shift from a sustainable mindset to a regenerative one.

Now, this diagram from Bill Reed (Figure 1), is a really useful description of the difference between a sustainability paradigm and a regenerative one. This shows different levels of achievement in environmentally-responsible design. The most basic level, you could call Conventional Practice, or "One step better than breaking the law."Above that is the realm of green design for relative improvement, and that's where a lot of schemes that use LEED and BREEAM are. Then above that, is fully Sustainable, or as William McDonough has called it, "100% less bad."
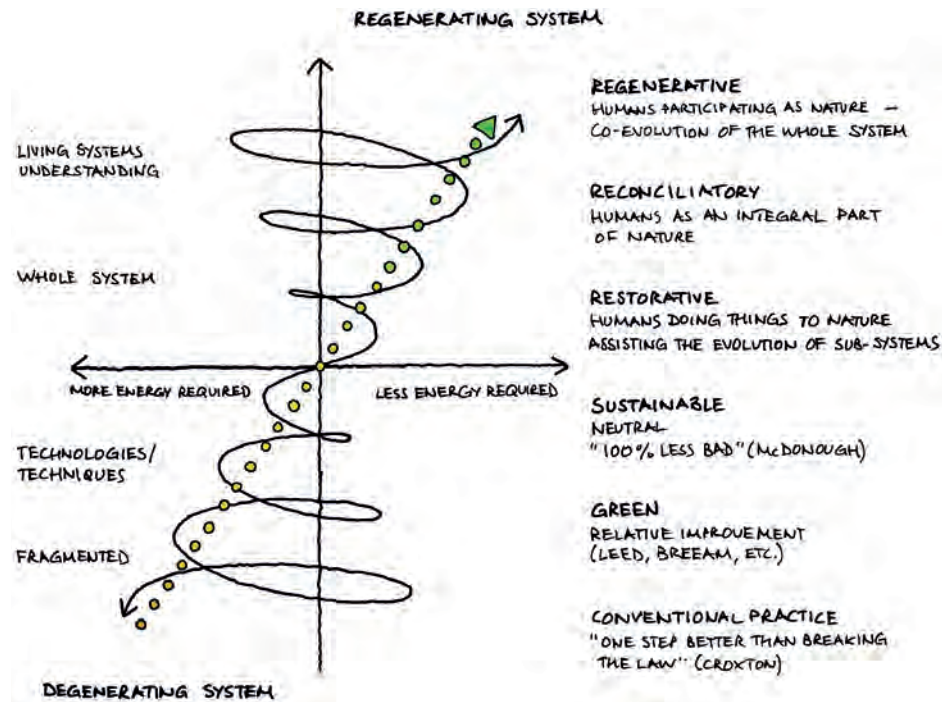
Figure 1 This diagram conveys why the conventional framing of sustainability is insufficient. Most sustainable design could be described as being 'less bad' and forms part of a degenerative cycle. We need to strive to get above the line of neutrality and set our sights on the highest level of regenerative development.

Now, the problem is that most of what we've been doing over the last 20 to 30 years in sustainability is below that line of neutrality. That means that it's just part of a downward, degenerative cycle. I found this quite painful to accept, really. I thought all that time I'd been working in sustainability for 30 years I was making things better. Actually, a lot of that time, I was just making things a bit less bad. It's becoming increasingly clear that less bad is not good enough. What we really need to do is to get above that line of neutrality into the realm of net positive.

Just as we had a really lively debate 20 years ago about what the ultimate in sustainability means, now I think we need to be debating what is the ultimate in regenerative design.

My view is that biomimicry and biologically-inspired design approaches are going to be a big part of how we will get to that ultimate stage of humans participating as nature and co-evolving as the whole system.

Sarah and I argued in our book that there are really three key differences between sustainable and regenerative.

One, I've already mentioned, it's moving from less bad to net positive. Sustainability also tended to be very anthropocentric, it was just about humans. We need to broaden that to a whole planetary perspective. Thirdly, sustainability tended towards being rather mechanistic, just focusing on a limited number of metrics, and we need to adopt a much more systemic approach than that.

Regenerative Materials

Starting with regenerative materials, this is a coccolithophore (Figure 2). This is a marine microorganism and according to Gaia theory, which was put forward by James Lovelock and Lynn Margulis, these were parts of the regulating system of carbon dioxide levels in the atmosphere on planet Earth. Historically, in geological history, that is, when there were increases in levels of CO_2 in the atmosphere, you would have had massive blooms of these microscopic organisms growing these beautiful skeletons out of calcium carbonate, falling to the ocean floor and building up as layers of limestone, transferring carbon from the atmosphere via the sea into the rock and maintaining that balance.

There's a very good case for saying that we should be making more stuff from atmospheric carbon. Timber is an obvious example. I think it's also important to appreciate that because planet Earth has evolved to become a very complex system, some would say a self-regulating system, there's a lot that we can learn from the way that planet Earth functions to help us make this shift from sustainable to regenerative. As one example, nature makes up 96% of all living matter from just four elements, carbon, nitrogen, hydrogen, and oxygen.

Of the remaining 4%, nearly all of that is just seven elements, so biology uses a limited and safe subset of the periodic table and assembles those in very ingenious ways. You can see that rather than making materials that emit huge amounts of CO_2 as we do when we make concrete, the closest equivalent in biology to concrete is coral. It's a large mineral structure and it grows by taking carbon out of its immediate environment and really, there ought to be a lot of research going into geomineralisation and biomineralisation so that when we make buildings, we will be delivering a net positive by actually taking carbon out of the atmosphere. I think there's also a very big part for biological raw materials.

There's a high-performance insulation made by a company called Biohm Limited. This is just made out of plant fiber, agricultural waste added to mycelium, and it grows into this very high-performance, completely nontoxic, fireproof insulation. We can also learn from nature how to assemble those materials in very ingenious ways.
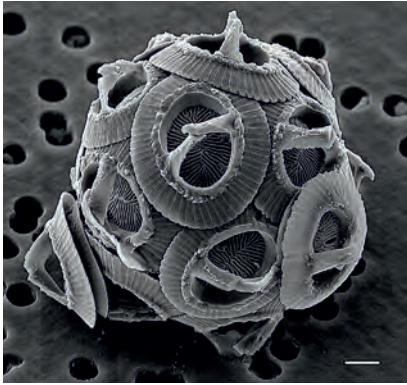
Figure 2 Scanning electron micrograph of coccolithophore Gephyrocapsa oceanica (scale bar = 1.0Qm). These marine micro-organisms are thought to be part of the Earth's long-term carbon cycle and, prior to the Industrial Revolution, maintained a balance by transferring carbon from the atmosphere to the lithosphere, in the form of limestone.
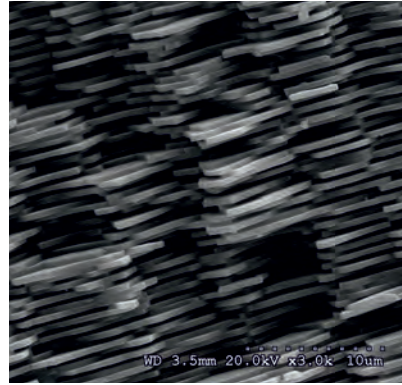

Figure 3 Shells may be one of the earliest sources of biomimicry but now designers can benefit from the scientific knowledge that reveals how its microstructure contributes to its phenomenal toughness.
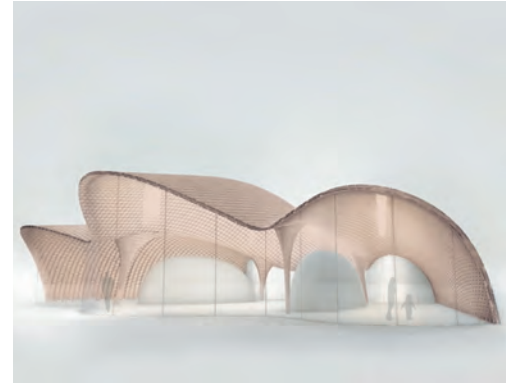
Figure 4 Abalone House

This is a marine mollusk (Figure 3). It's called an abalone. If you look at that under a powerful microscope, you see that it's made out of these layers of calcium carbonate. Those are connected together with a flexible protein.

At a chemical level, it's almost identical to ordinary blackboard chalk, but because of that microstructure, it achieves 3,000 times the toughness.

Here's a house (Figure 4) that my office designed based on some of these ideas, so it uses curves to create a stiff shape, and then it uses this idea of layered tiles, very similar to the abalone, to make a structure that is as thin as eggshells in relative scale terms. We're pretty confident this house would use less than half the amount of material of a conventional approach.

My colleagues and I designed a table for an exhibition. It is made of a biologically derived polymer, so partly made of atmospheric carbon. This biologically derived polymer is used to 3D print a table that is designed using principles from bone and tree growth patterns. This is based on biology in two senses, it's a biologically derived material and a biologically derived form, striving to get to the kind of levels of structural efficiency that you find in biology.

Regenerative Buildings

This is a scheme (Figure 5) that we worked on for a client in India. It's a zero-waste textiles factory. As I'm sure, most of you know, textiles is an incredibly energy-intensive and water-intensive industry. Our client wanted to create a new model for industrial buildings in India, so we conceived of the building as having three main realms, there was the water cycle, the energy cycle, and then the factory itself. Within the factory, there are lots of different processes and machines that have different resource flows.

By looking at each of those resource flows and seeing how we could make use of underutilised resources such as waste heat, we achieved really significant improvements in efficiency. The big breakthrough came from shifting from fossil fuels to biomass, so now we were getting heat and power. We were able to make use of a lot of the waste heat from the factory.

Then, for the water cycle, we worked with a biologist, a chemist and a water expert to design out all the normal toxins that are used in a factory process like this. By doing that, we were then able to use biological forms of water treatments that allowed us to get very close to a closed loop on water.

Down the middle there between the two factory units, that's the water treatment system. It uses plants and micro-organisms to treat the water and also provides a useful visual amenity. The building in the middle is the staff canteen, so at least three times a day the staff can get out of the working environment and get a connection to nature.

This is another really important aspect of biologically-inspired design, Biophilia. There are some great examples of hospitals that have used Biophilia to achieve really impressive improvements in people's recovery rates, so people can recover as much as 8% more quickly and with half the amount of pain-relieving drugs when they're in an environment with a close contact with nature.

Figure 5 Zero Waste Textiles Factory

Figure 6 The Biomimetic Office represents the first office building to be comprehensively designed using principles of biomimicry. The design team, led by Exploration Architecture, found inspiration from nature including stone plants and brittle stars in devising daylighting solutions; bird skulls and giant Amazon water lilies for the structure; termites and polar bear fur for the environmental control; and mimosa leaves and beetle wings for the solar shading.

This is another building (Figure 6) we designed using biomimicry. This is an office building. We looked at nearly 100 different biological organisms helping us to rethink all the common functional challenges of office design, the structure, the daylighting, the ventilation, the fire protection, and so on. We managed to make some really significant breakthroughs in resource efficiency.

Regenerative Cities

The most persuasive model that I've heard of comes from a group in the US called Biomimicry 3.8. What they argue is that the way we design cities at the moment doesn't go anywhere near far enough. What we should do is we should start by analysing how a pristine mature ecosystem in that part of the world would function.

How much carbon would it sequester? How much water would it filter? How much oxygen would it produce? How much wildlife would it accommodate? A whole range of ecological performance criteria. Those should become the metrics for our new pieces of a city. We are nowhere near this at the moment with tools like LEED and BREEAM, but there are sufficient examples of elements of this that have been built that make me confident that this is perfectly achievable.

I think we're going to see more and more buildings that incorporate vegetation. I'm not completely convinced by the idea of putting trees on tall buildings, but I do think there's a good case for incorporating more vegetation to create habitats and psychological benefits. We also need to find a way of doing this without increasing the embodied carbon of the building. Probably using more in the way of timber-framed buildings.
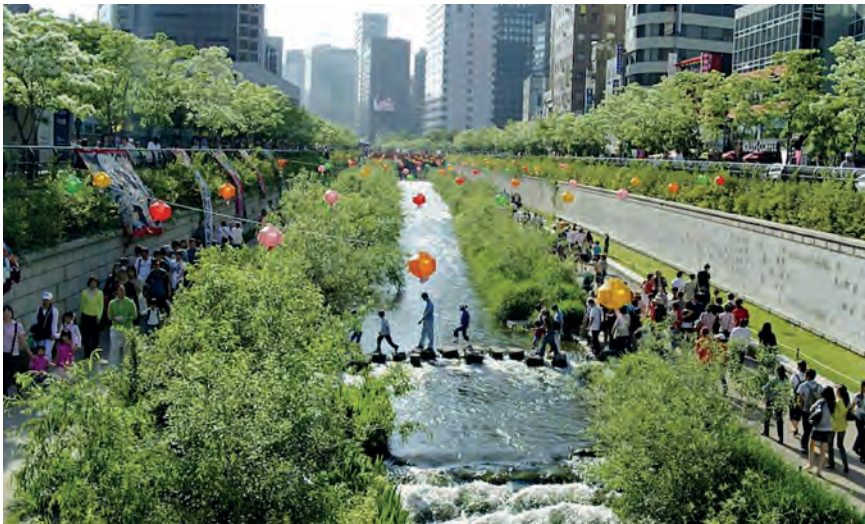
Figure 7 Cheonggyecheon after restoration

One of the biggest differences, I think, we'll see in a regenerative city is in the spaces between buildings. (Figure 7) This is a fantastic example. In South Korea, in Seoul, the capital, the mayor persuaded people to tear down a six-lane motorway that used to cover this river, and they restored it and created this linear park, which has become a really well-used and popular immunity within the city, even contributing to significantly lower temperatures in summer in this part of the urban area.

Another crucial discipline that we need to use in cities is the idea of biomimicry and ecosystem models. What I mean by this is conceiving a city or maybe the set of industrial processes as being the equivalent of an ecosystem where each of those elements is equivalent to a species with its resource flows.

Just as in a real ecosystem, where the waste from one part of the system becomes the input or nutrient for something else in that system, that's what we need to move towards. Bringing cycles of food, energy, water, and waste together so that we can achieve major breakthroughs in resource efficiency and finding synergies between all of these different things.

Regenerative Landscapes

The Sahara Forest Project is a project that I jointly initiated quite some time ago. What we were trying to do here really was to address multiple challenges simultaneously by using clever integrated solutions. The things I'm referring to here are challenges such as food shortages, water shortages, desertification and climate change.

We were looking particularly at arid parts of the world and we were quite struck that a lot of the world's deserts were actually vegetated a fairly short time ago. For instance, when Julius Caesar arrived in North Africa, what he found was this wooded landscape of cedar trees and cypress trees. His armies set about clearing those and creating an intensive farm which supplied the Roman Empire with about a half a million tons of grain a year for a certain amount of time. After about a 100 to 150 years, they had substantially trashed that landscape.

Previously, it was quite abundant and it had plentiful rainfall. When they'd finished with their very extractive model of land use, it had become a desert. Could we perhaps intervene at some of the edges of those deserts in a way that would generate renewable energy, produce food and re-vegetate deserts in ingenious ways?

Figure 8 The Sahara Forest Project Pilot Facility in Qatar brought together a cluster of synergistic technologies and explored revegetation techniques to regenerate areas of desert.
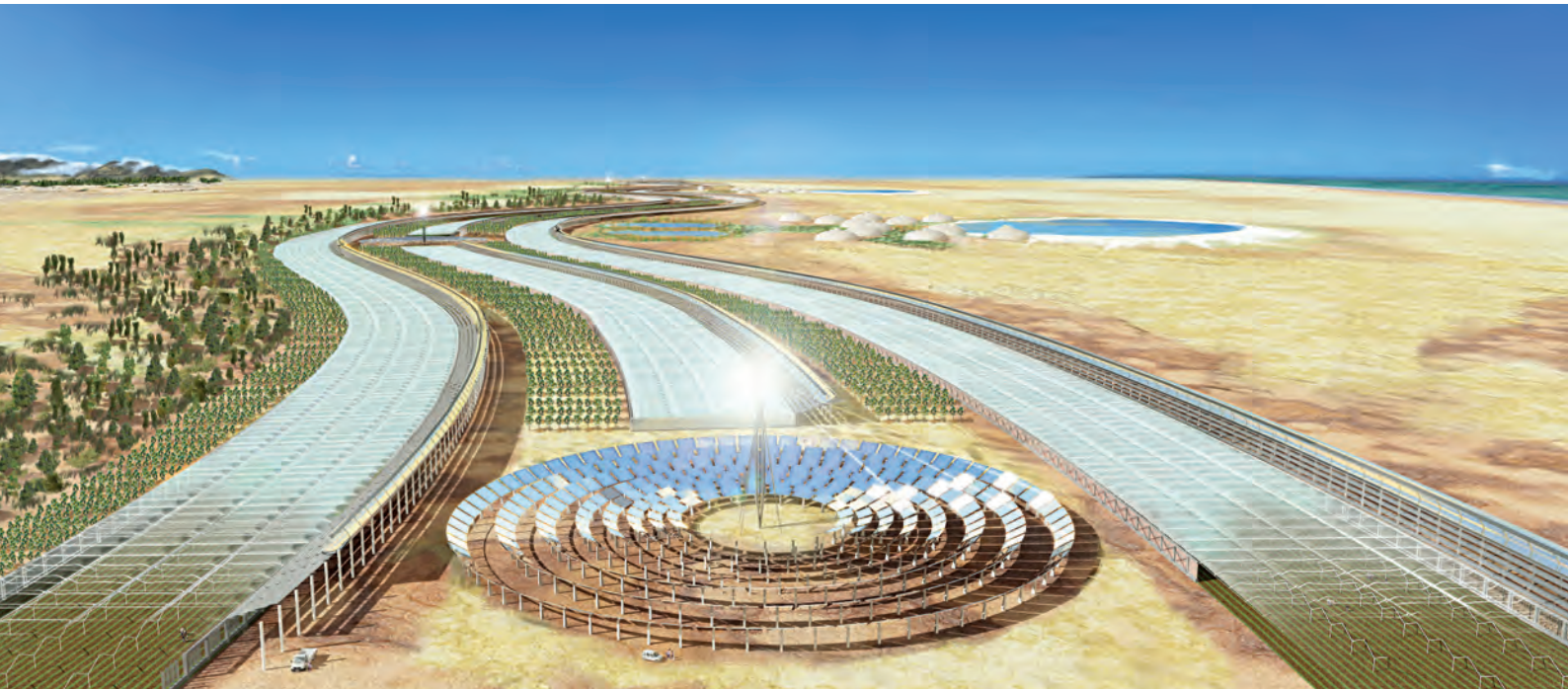
This was the first visualisation we created. There are three core technologies here: forms of solar energy, a type of greenhouse that is cooled and humidified with seawater, and desert re-vegetation. What we found was that those three have some very interesting synergies between them. They actually work better together than they do individually. We built a version of this in Qatar and this was opened during the climate change talks in 2012. We managed to produce crops with half the amount of freshwater throughout the summer months, half the amount of freshwater compared to conventional approaches.

We really pushed this idea of ecosystems models.

One of my colleagues developed a tool that easily connects different technologies from resources such as sunlight, seawater, and carbon dioxide to produce more of what we need (biomass, oxygen, electricity, crops, materials). It will show you technologies that are under-utilised, and that's a sign that you can add something to the system to create more value. Then you can press play and see how the tool functions and see what the flows are. You can even try cutting one of those links. If the whole system goes into breakdown, then that's a sign that you need to add duplication or redundancy or buffering to make it more resilient. This allows us to get closer to the highly productive zero-waste solar-powered ways in which natural systems work. I believe this is the kind of complexity that we really need to embrace if we're going to make progress with the shift towards regenerative design and to get closer to the way that biology operates, and with improvements in digital design tools, it should be easier to do this.

Alongside twiddling with all the technical knobs trying to refine that, we made a note of what was happening to the biodiversity.

In an infographic, we made a note of birds, mammals, and insects on a site.

On the very first day plants came to the site, we had the first birds.

Very shortly after that, we had the first insects, grasshoppers, crickets, and then a month later we had the first butterflies. Bear in mind, this was a long way from the nearest significant patch of planting.

As the plants got more established, we had other types of birds and more insects.

Then we had a bit of a problem with rats, but we were still getting more birds and insects.

Then we had mice to deal with as well, but still more birds and insects.

Then we had a feral cat,
which was quite handy
because the number of rats
and mice started going down.

More birds including
some quite rare ones;
more waghite-tails,
rufous-tailed shrikes,
tris, and insects were
spotted on site.

Three days after
the algae ponds
were filled, we had
the first dragonflies.

Eventually, we had the
first indigenous mammal.
It's called a Jerboa, so it's like
a little hopping kangaroo and
it leaves very distinctive tracks.
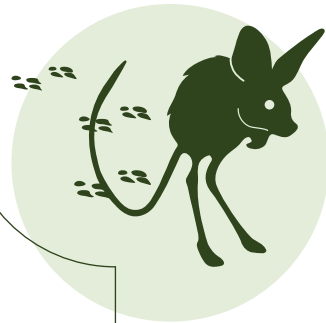
Nature does have an amazing capacity to recover if you can create the right conditions. It's going to be so much easier to make progress if we can do this with nature rather than to it or for it or whatever.

This image (Figure 9) shows how much difference just one pair of beavers can make to a landscape that was largely ravaged by forest fires. Where the beavers have intervened, it's still an abundant system.

Figure 9 Beavers, with a historically wide habitat range across North America and Europe, are keystone species described as 'ecosystem engineers'. Their alterations to the landscape, in the form of dams and lodges, create wetlands and ecosystem niches that support many other species, and may even build a forest's resistance to fire.

Figure 10 The glass sponge Euplectella aspergillum – made from silica at ambient temperature and pressure with five or more levels of hierarchy

"

To finish, I just want to say a few words about this amazing organism (Figure 10). This is called a glass sponge. It lives in quite deep ocean water, and it has evolved to make this beautiful lattice structure which is incredibly efficient. It's made entirely out of locally available materials, calcium, silica, and so on assembled at ambient temperature and pressure. They're glass fibers with higher optical quality than human-made glass fibers – each of those goes down into the seabed and it terminates in a cluster of lenses. Those lenses gather light from bioluminescent bacteria in the seabed and it conducts that light up the organism to put on a kind of lighting display that draws food to the organism.

I think this shows the things that we ought to be learning from nature. How to make materials with an absolute fraction of the resource input using local resources, how to make stunningly beautiful efficient structures, and how to foster symbiotic relationships. Above all, I think this points to a new relationship with the rest of the living world.

Rather than seeing nature as something separate from us and as something to be plundered for resources, we can see it as a source of wonder and as a source of some of the best solutions to help us make progress in ultimately getting to that point where we are participating as nature and co-evolving as nature.

Minimising Novel Entities: Construction Product Selection Respecting Planetary Boundaries

Martha Lewis

Head of Materials, Henning Larsen

As Head of Materials at Henning Larsen, Martha has established an office-wide material database identifying healthy, ethical, and environmentally tenable materials.

The Disconnect

As I was exiting my apartment one morning, I noticed the school next door renovating the playground. In front of our entryway, there were three huge barrels marked with human health hazard, danger and flammable warning symbols (Figure 1). I thought, "That's interesting. What's happening on this playground, which the elementary school kids are still using for recess?" Being the safety data sheet nerd that I am, I took some photos and double-checked the product in the barrels. It's a substance that gets mixed with rubber to form a flexible surface. The hazard codes in the safety data sheet indicated that the product has potential to cause cancer (H350) and may damage the fertility of an unborn child (H360).

This illustrates the extreme disconnect that exists in the design process. Ironically, the product is labeled a safety surface for playgrounds. Who wouldn't want to spec a safety surface? The issue is that designers often are only concerned with one phase in a product's lifecycle, the use-phase. Designers have disturbingly little understanding of the impacts and consequences in other life cycle phases such as production and end-of-life. In fast-paced design processes there is little time for research, and documentation that promises a final product with excellent shock absorption, making it a safe landing surface for children, seems like an obvious choice.

Figure 1 Barrels marked with human health hazard, danger and flammable warning symbols

But what about the other stages of this product's lifecycle?	What about the production of this chemical and impact on the surrounding neighbourhoods?	What about the workers who were mixing and pouring without any protective gear?	What about the children who are playing next to this, breathing in the fumes, which are also indicated with the hazard code "harmful if inhaled"?

This is in the center of Copenhagen, on a school day and the regulations are not being followed for handling highly problematic substances. More importantly, it's time to question the continued use of substances of very high concern.

The Planetary Boundaries

Novel entities are part of the very interesting work from the Stockholm Resilience Centre, defining the nine planetary boundaries as shown in Figure 2. [1]

The Safe Operating Space (in green) or the planet's boundary is the limit we must not breach, as it jeopardises future humanity.

Figure 2 Planetary Boundaries

Novel Entities

The grouping "novel entities" includes the following three entities, all of which are not part of the earth's existing strata, hence the name "novel" entities:

1. Synthetically manufactured chemicals:
   for example hazardous chemicals

2. Heavy metals used in human processes:
   for example, lead in paints or cadmium in color pigment.

3. Microplastics and plastics:
   elements of global planetary pollution that are not part of the other eight planetary boundaries.

Researchers at the Stockholm Resilience Centre quantified novel entities in the January 2022 report [2] and warned that they pose a serious threat to the earth's safe operating space. According to the report, global chemical production has increased 50-fold since 1950, and it's projected to triple again by 2050 compared to 2010. The United Nation's environmental panel issued a report in 2019 acknowledging that the UN goals for reducing global chemical usage for 2020 could not be achieved, and that the 2030 goals were already in jeopardy. [3] This information is highly relevant to the construction sector, because the sector consumes 28% of global chemical production making it the number one end market for chemical consumption [3].
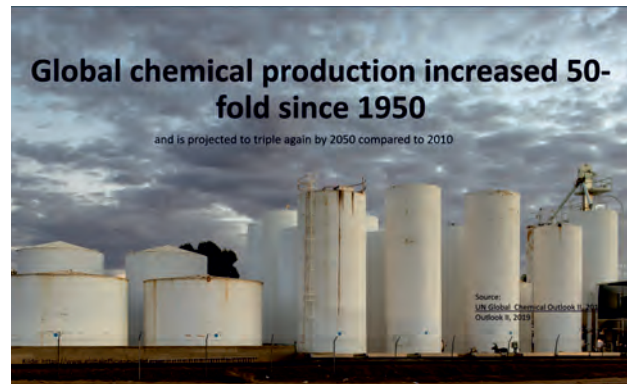
Figure 3 Stockholm Resilience Centre Report 2022

Another pollutant, plastics, also has high consumption in the industry; figures from 2018 indicate 19.7% of the plastics used in the EU are used in the construction sector [4]. The problem of microplastics and plastic waste in our industry is significant. A recent report reveals that a staggering 58% of microplastic leaked into the ocean is from paint [5]. Previous studies suggested that the percentage of microplastic in oceans was relatively low. However, this study reveals that the presence of paint in oceans is far higher than previously understood, with architectural paint being a significant contributor. Raising awareness, advocating, and presenting people with facts, numbers, and statistics is an important catalyst for inspiring behavioral change. The EA paint report serves as an excellent example of raising awareness and prompting action.

Hazardous Chemical Usage

Similarly, in the building sector, we need to examine data that indicates the hazardous substance usage patterns within the construction industry.

By doing so, we can highlight the prevalence of hazardous substances in the EU and encourage the adoption of safer alternatives.

There is an interesting reporting database in the Nordic countries called SPIN, Substances and Preparations in Nordic Countries. Chemical usage is reported by individual substance under the relevant category, including a dozen different chemical usage categories in construction-relevant areas. This data coupled with the EU red list, Substances of Very High Concern (SVHC), and the Danish red list, List over Undesirable Substances (LOUS), indicates a high level of hazardous substances actually in use in Nordic construction products.

For example the category "adhesives and binding agents" (shown in blue) indicates a high usage of substances of very high concern in all four Nordic countries. Other categories in Figure 4 include "construction materials" (shown in green) and "non-agricultural pesticides and preserves" (shown in dark purple). Data from Denmark indicates over 17,000 tons of substances that are considered of very high concern were used in production of building products in 2020. It's not looking better in Sweden. Finland is showing some interesting developments over five years with strong reductions. Norway has been fluctuating up and down. In general, there's a slight indication of a downward trend in the usage of SVHC and LOUS in the construction sector; nevertheless, the usage of substances of high concern in construction related usage categories remains over 10,000 tons per year in all countries in 2020.

Tons per year of SVHC & LOUS Substances
Declared in Construction Products

Distribution Norway (NO)

Distribution Finland (FI)

Distribution Sweden (SE)

Distribution Denmark (DK)

Legend:
- Surface treatment
- Paints, lacquers and varnished
- Solvents
- Non-agricultural pesticides and perservatives
- Fillers
- Constuction materials
- Adhesives, binding agents
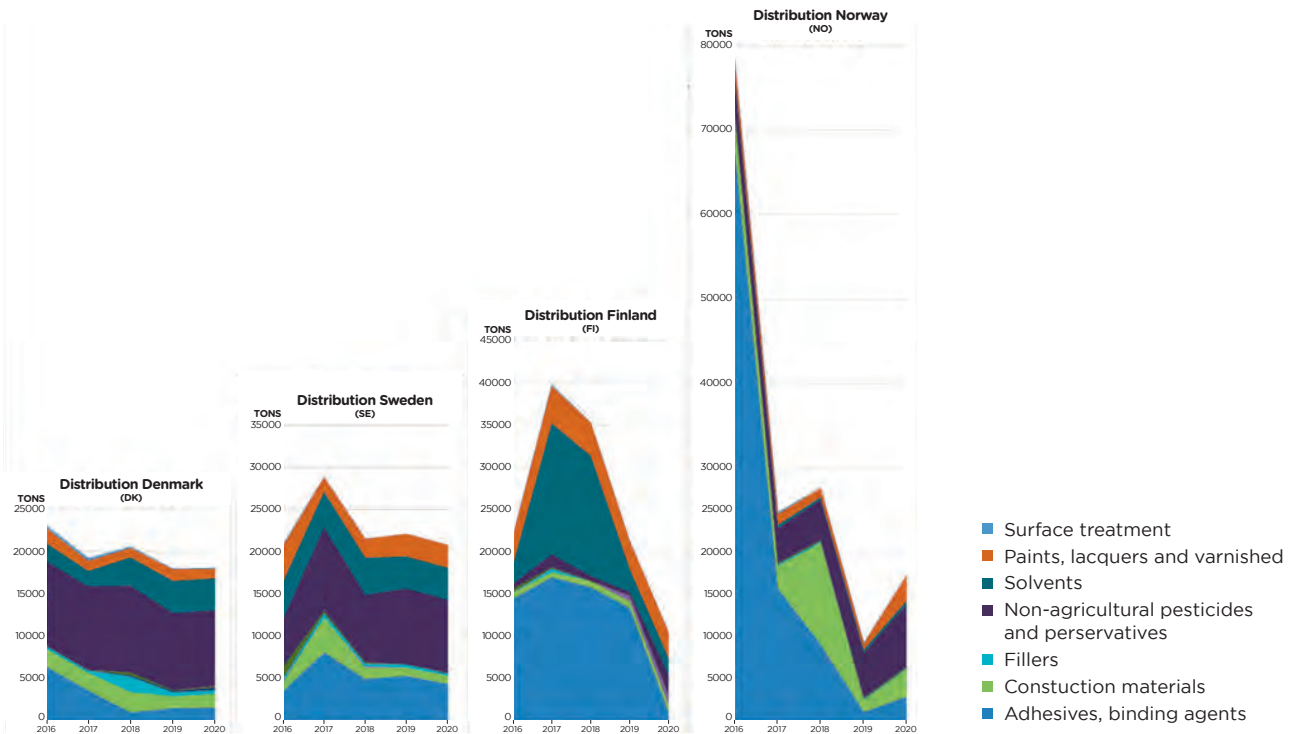
Figure 4 Construction category usage data from SPIN showing tons per year of Substances of Very High Concern (SVHC) and Undesirable Substances (LOUS) used in the Nordic countries

The Living Building Challenges (LBC) Red List has 5,770 different substances, the vast majority are not yet included on European red lists. Mapping the LBC Red List with the declared usage in construction categories from the SPIN database indicates an even higher annual usage of hazardous substances in the Nordic Countries. Figure 5 indicates around 22,000 tons of LBC Red List substances were used in construction products in Denmark in 2020; see for example bisphenol A (in light green) and added formaldehyde (in dark green). In Sweden, there are chlorinated polymers (in dark blue). These are all substances that have serious health and environmental consequences, for example they are carcinogenic, mutagenic, toxic to reproduction, or toxic to aquatic life with long-lasting effects.

Tons per year of LBC Red List Substances
Declared in Construction Products
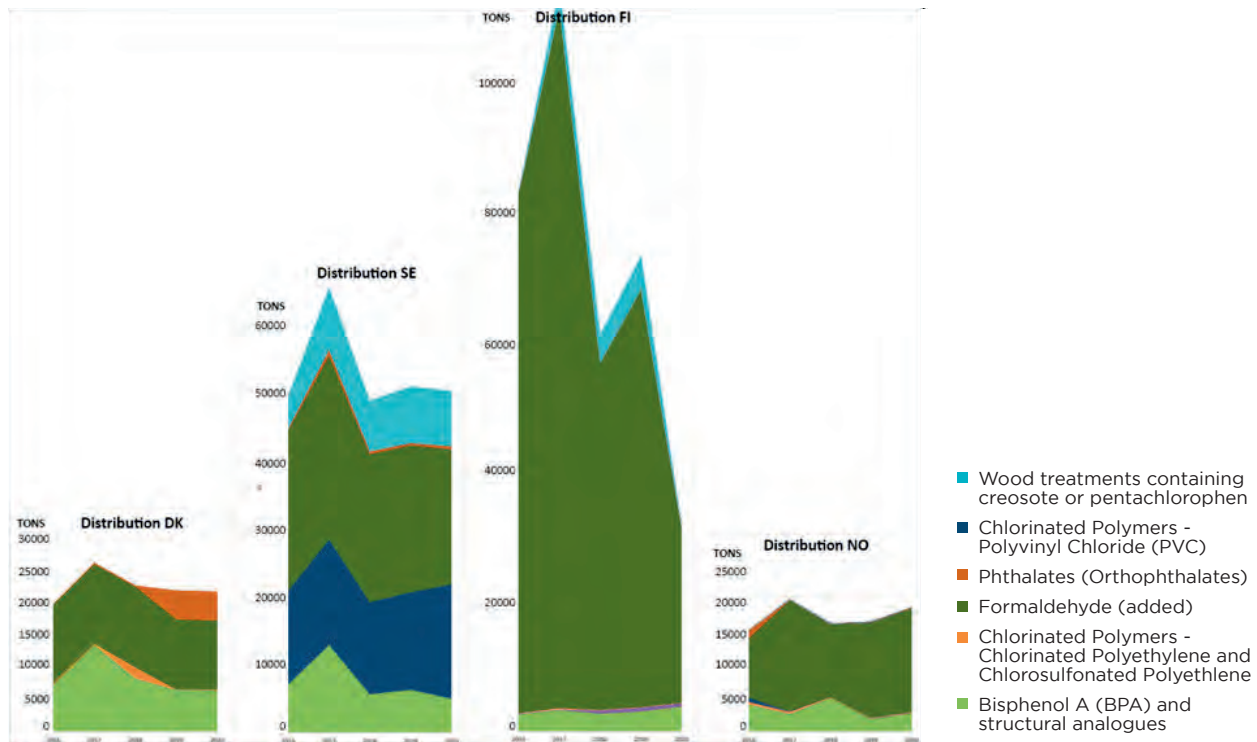
Figure 5 Construction category usage data from SPIN showing tons per year of Living Building Challenges (LBC) Red List substances

Use of PFAS in construction products
Used in paints, adhesives, flame retardants

PFAS Usage in Construction Products in Tons
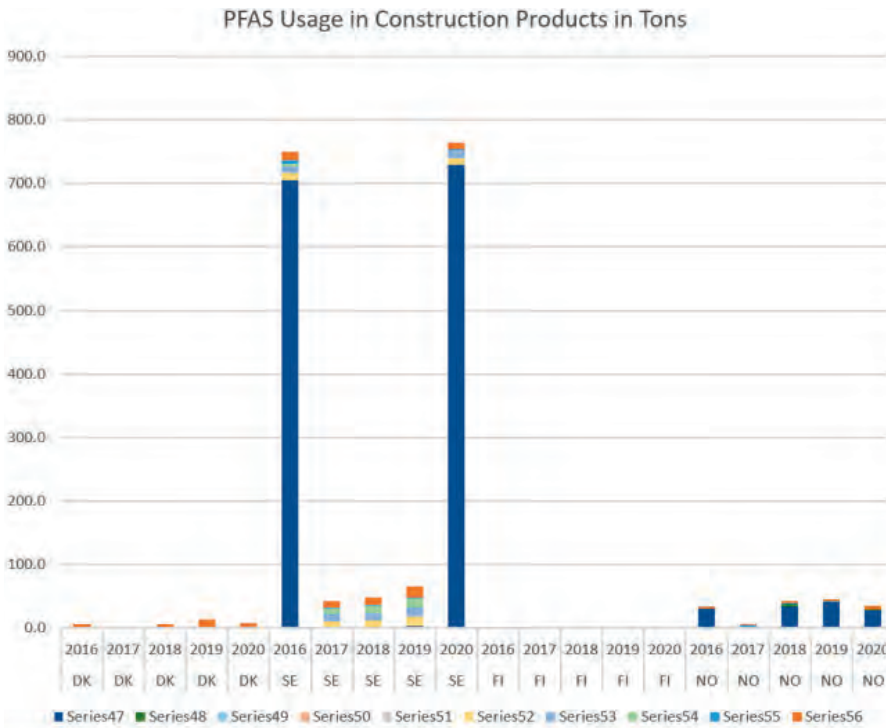
- Increased risk of kidney or testicular cancer
- Increased cholesterol levels
- Decreased vaccine response in children
- Changes in liver enzymes
- Increased risk of high blood pressure or pre-eclampsia in pregnant women
- Small decreases in infant birth weights

Figure 6 Per and Polyfluoroalkyl Substances (PFAS) in construction products

The use of Per and Polyfluoroalkyl Substances (PFAS) in construction products is an area where legislation is lagging. Figure 6 indicates a mapping of PFAS identified on the LBC Red List and the annual usage declaration from SPIN database [6] in the four Nordic countries.

These LBC PFAS are heavily used in Sweden while Finland does not use them at all. Denmark's usage fluctuates at low levels. Norway's usage is around 40 tons per year, with only minor fluctuations over the five years. PFAS are found in many construction products such as:

| **Binders** | **Adhesives** | **Surface treatments** | **Flame retardants** |

How to Navigate?

As a design practitioner, it's difficult to tackle certain issues without proper regulation and transparency. One way to voluntarily address it is to follow the criteria in a building certification system.

However, a study which maps the substances targeted by five different certification systems with the hazardous substances actually in use in construction products in the respective countries indicates that four of the five certification systems are not effectively targeting the relevant hazardous substances.

Figure 7 [7] shows data from 2017. In Denmark, there were around 20,000 tons of substances of very high concern used in construction products; however, only 3% of these (by volume) could have been targeted in a DGNB screening, the other 97% are not included in the DGNB screening criteria. This target percentage is a bit higher in Finland, due to the fact that LEED requirements cite a different scope of substances than DGNB. In Finnish projects, you could target about 16% (by volume) of the hazardous substances that were used in 2017 in Finland.

Certification systems are NOT screening for the hazardous chemicals in use in Nordic Countires

CONSTRUCTION: TONS of HAZARDOUS CHEMICALS IN 2017

■ Not targeted by national building certification
■ Targeted by national building certification
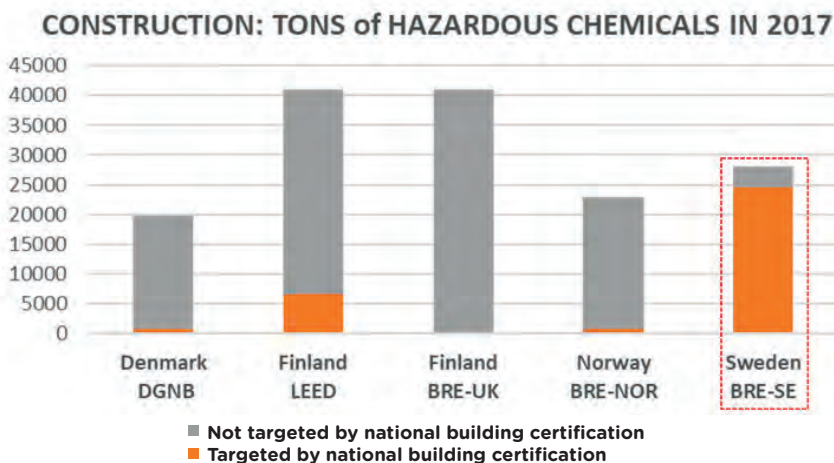
Figure 7 Screening for Hazardous Chemicals in 2017, Lewis 2020.

The targeting percentage for Sweden is radically different because of the way that consultants are asked to screen projects. BREEAM-SE does not include a screening based on a long list of problematic substances, rather the screening is based on the undesirable hazardous property. Hence, products that have hazardous properties indicating, for example, carcinogenic, mutagenic, or toxic to reproduction are not acceptable. Screening for these properties is actually a very interesting way to target a wider group of hazardous chemicals. The important question is, how do we as practitioners navigate this when we don't have the information we need, the knowledge we need, and in many cases, we're simply not aware of the consequences.

To reference the playground story, the point of departure for many practitioners is "Okay, specifying this product is fine in the use phase, that's where my responsibility lies. We'll also abide by all regulations dictating worker safety. That's part of the legal apparatus within which we operate." This approach may respect the existing legal framework; however, it is by no means respecting the safe operating space of the planet. As designers, we need to think about communities that are impacted at the site of production of these chemicals. We should think about impact potential, if these products were to be reused or reused in another process or reheated and then reconstituted for future circular reuse. We should not be specifying products that release toxic fumes should the building catch fire. Clients should be encouraged to require no hazardous properties in substances in construction products.

Eliminate substances in products based on properties
Target the undesireble in project specifications

Phase-out properties as defined by the Swedish Chemicals Agency

Property	Classification according to the CLP regulation for determination of the intrinsic properties	Maximum concentration
Carcinogenic	(Carcinogenicity, Category 1A and 1B) **H350:** May cause cancer...*	0.1%
Mutagenic	(Germ cell mutagenicity, Category 1A and 1B) **H340:** May cause genetic defects...*	0.1%
Toxic to reproduction	(Reproductive toxicity, Category 1A and 1B) **H360:** May damage fertility or the unborn child...*	0.3%
Endocrine disrupter	Substances classified in categories 1 and 2 in the EDs database (List from the European commission available at http://ec.europa.eu/environment/archives/docum/pdf/bkh_annex_01.pdf)	0.1%
Particularly hazardous metals (Cd, Hg, Pb)	Mercury, cadmium, lead and compounds of these metals are all phase-out substances. Specific criteria are not because the presence of these metals is enough.	Cd 0.01% Hg 0.1% Pb 0.1%
PBT/vPvB – Persistent, Bioaccumulating. Toxic/very persistent, very Bioaccumulating	Criteria available at www.kemi.se	0.1%
Ozone-depleting substances (0.1%)	(Hazardous to the ozone layer) **EUH059:** Hazardous to the ozone layer **H420:** Harms public health and the environment by destroying ozone in the upper atmosphere	0.1%

Figure 8 Eliminate based on properties (BREEAM-SE 2017, Version 1.1 aligned with the Swedish Chemicals Agency recommendations)

On the left of Figure 8 [8] are phase-out properties of substances such as carcinogenic, mutagenic, toxic to reproduction, endocrine disruptors, particularly hazardous heavy metals, cadmium, lead, persistent bioaccumulating toxins, etc. On the right, are the risk-reduction properties.

This is a condensed way of specifying a project's restrictions on the most hazardous properties in construction product mixtures and articles. Specifying is essential, followed by an active screening procedure. The contractors must also be involved and screen safety data sheets (SDS) to ensure that phase-out or risk properties are not present in products on site.

Risk-reduction properties defined by the Swedish Chemicals Agency

Property	Classification according to the CLP regulation for determination of the intrinsic properties	Maximum concentration
Very high acute toxicity	(Acute toxicity, Category 1 and 2) **H330:** Fatal if inhaled **H310:** Fatal in contact with skin **H300:** Fatal if swallowed (Specific target organ toxicity after single exposure) **H370:** Cause damage to organs* and **	1%
Allergenic	(Respiratory or skin sensitisation Category 1, 1A and 1B) **H334:** May cause allergy or asthma symptoms or breathing difficulties if inhaled. **H317:** May cause an allergic skin reaction	**H334:** 0.2% **H317:** 1%
High chronic toxicity	(Specific target organ toxicity after repeated exposure) **H372:** Cause damage to organs through prolonged or repeated exposure* and **	1%
Mutagenic (1%)	(Germ cell mutagenicity, Category 2) **H341:** Suspected of causing genetic defects...*	1%
Environmentally hazardous, long-term effects	(Hazardous to the aquatic environment, Chronic category 1 and 4) **H410:** Very toxic to aquatic life with long lasting effects **H413:** May cause long lasting harmful effects to aquatic life	**H410:** 2.5% **H413:** 25%

Product documentation such as the legally required SDS supports practitioners by detailing content, in particular chemical content. However, SDS are required for mixtures (for example, paints) but not for articles (for example, wall boards). To have the necessary transparency for all construction products, designers need information regarding the content of articles as well as mixtures. This is available in the voluntary product health declarations coming out of the US (The Health Product Declaration, HPD) or Sweden (the now over 25 years old, Building Product Declaration). The Living Building Challenge has a fine product declaration called the Declare Label, which identifies the product's contents and the associated hazard phases.

Education and Awareness

In general, we need to raise our level of knowledge particularly for the chemical classes such as PFAS where legislation is excruciatingly slow. Since government regulations do not prohibit PFAS in building products in a timely manner, the consultant should advocate for specifying requirements and screening construction projects for PFAS.

I recommend an extremely well-written report called 'Building a Better World: Eliminating Unnecessary PFAS in Building Materials developed by the Green Science Policy Institute in 2021 [9]. It's what practitioners need, in order to have a better understanding of PFAS in various construction products. It's particularly useful for those seeking to identify substitute materials which have similar performance qualities.

Paints and Microplastics

Paints and microplastics have a large impact on the planetary boundary system novel entities. 48% of global paint-related plastic pollution is from architectural paints. [5] These are architectural paints that have a plastic binder or a polymer-based binder, for example, acrylic or latex paints, paints that came in as a second generation of so-called healthy paints. They are water-based and replaced the paints with high solvent content.

Paints can potentially impact the environment in all life-cycle phases. There are impacts from production of the paint, application of paint, wear and tear in the use phase, and the end of life of paint, whether it's sent to the landfill, recycled, dumped or incinerated. 33% of all plastic architectural paints are leaked to lands and waterways at the end of life. This amounts to 3,573 kilotons of leakage per year.

It's that thin little layer, but it apparently has huge consequences. If you could do just one thing differently to take a step in the right direction, it would be to reassess what paints you're specifying in your project.

Instead of specifying the usual suspects, such as latex and acrylic, look instead at alternatives such as linseed oil, clay paints, lime paints, and silicate paints. Try and identify the binder of the paint to see if it's a plastic or polymer binder.

Decarbonisation

In order to achieve a true transformation, we need to make some radical changes and reassess our material economy.

Decarbonisation is a crucial issue and for many years we have had the luxury of extracting and using mineral-based materials. We need to reevaluate our reliance on a mineral-material economy and embrace a more bio-based material [10] economy for a more sustainable future.

100 to 150 years ago, there were historical building techniques which forwent the use of substances of very high concern. For example, how was straw protected from fire before flame retardants? We need to be inspired by our historical traditions.

--- from extractive to biobased

Figure 9 Biobased materials

The Triple Bottom Line

The Triple Bottom Line Venn diagram depicts a desired balance between people-planet-profit, between the social, economic, and environmental aspects of sustainability. We have become accustomed to this Venn diagram when considering sustainable certification for buildings - for example, in Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Methodology (BREEAM) or Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB). We must acknowledge that this approach is not delivering sustainable projects, rather it serves to justify the continuous and egregious breaches of the planetary boundaries; therefore, we need to reassess this diagram.

It really needs to look more like Figure 10 [11], where we prioritise the planet over the other two aspects. Respect for the environment must be an absolute priority in our projects. By doing so, we can work towards sustainable solutions that not only safeguard the planet, but also ensure long-term prosperity for us and future generations.

Reassess the triple bottom line:

People

Prosperity
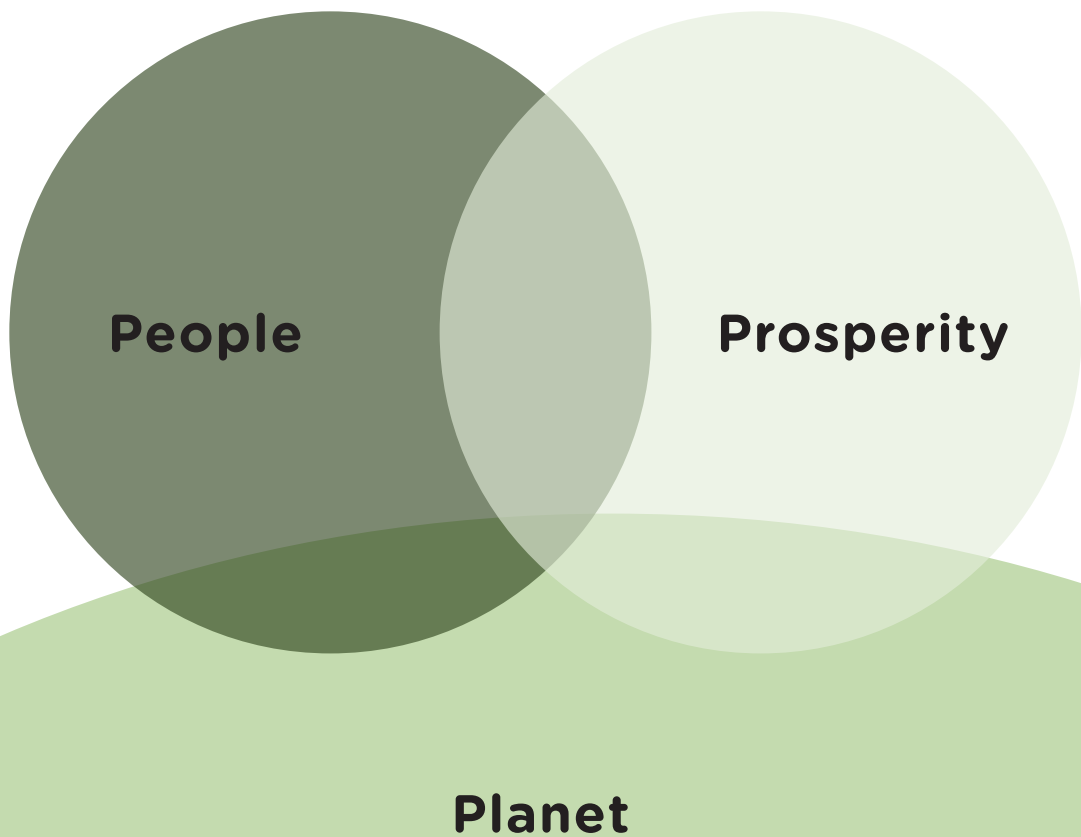
Planet

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[11] Lewis M. (2021) Reassess the Triple Bottom Line to Prioritise the Planet.

Figure 10 Reassess the
Triple Bottom Line to prioritise the Planet

Panel
Discussion

Nirmal Kishnani (Moderator)
Micheal Pawlyn
Martha Lewis
Neel Strøbæk

[Nirmal] Thank you guys, and welcome back. I really enjoyed every one of your presentations and if I could just take a minute to broadly summarise some of the key points that came out of what was presented today. So, Ken Yeang, presented us with a manual of constructed ecosystems, how we integrate ecosystems into the fabric of architecture and urbanism. Michael, I really liked the fact that you presented a multi-scalar perspective on biologically inspired materials and forms, and what you think are the value propositions and benefits that emerge from a bio-centric approach to design.

Martha, immense challenges in the material economy, how it is, by virtue of its size, fundamentally at odds with ecological systems at the planetary scale, and how this then ties back to choices that we make in the construction sector. My own presentation was a bit like Michael's. We talked about regenerative design, I talked about it in the context of Asia, and that this was an underlying force in the projects that I showed that it was an active integration of the ecological and the human in the interest of creating new capitals, human, social, and financial capital. Let's kick around a few ideas following what we talked about. I'm going to start with Neel, only because you didn't have a presentation.

Neel, what does Ramboll make of all of this? You are in the business of delivering solutions. You have a footprint, meaning you are in places as diverse as India and Denmark, developing and developed worlds. How would project teams incorporate ideas and regenerative design or take on board questions of material readiness as a part of what they do? What are the low-hanging fruits here?

[Neel] I think, the low-hanging fruit here is I hear that everybody is actually on board with this journey. If you look at a company like Ramboll, which has worked with tradition and sustainability for many, many years, and also in our new strategy, it has that as a center. I think that the low-hanging fruit is actually that all people more or less are on board, and that they want really to do good. In this context, I think we have used also the Bill Reed explanation about doing less harm, doing more good. I think that has really taken off. Everybody understands what it is, they understand it's not only a Net Zero journey.

What they also understand is that there are things we won't do, there is a red line on the left-hand side, there is a red line to both on projects we won't do. Also interested in the building sector, the materials, and things that we don't want to do and particularly, I would actually like to highlight our buildings, people who are normally seen as the most conservative, I would say, as the construction sector is normally seen as the most conservative. I think both our architects and building designers are super much on and they're actively leading the regenerative design journey in Ramboll I would say.
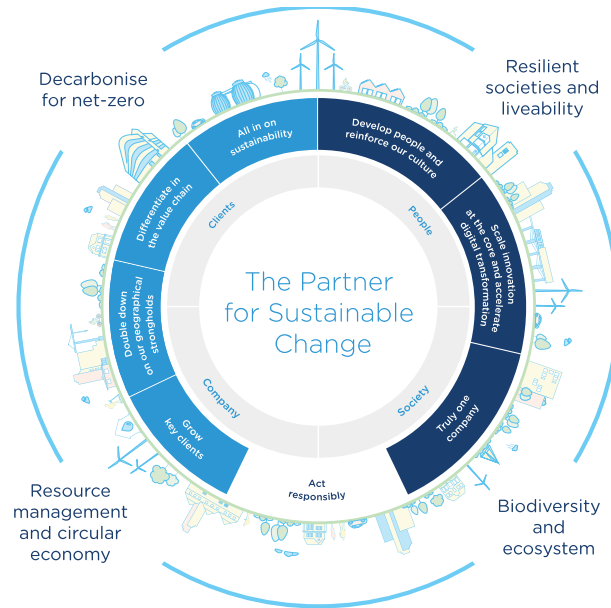
Ramboll's four Unifying Sustainability Themes

[Nirmal] If I could just extend that question to Martha, what are the low-hanging fruits of what you talked about the novel entities? I mean, one of the takeaways was paint, for example, that's a clear choice. If you had to pick three things that you absolutely have to think about, that are no-brainers, what would they be?

[Martha] Reduce concrete usage and reduce steel usage and increase bio-based materials. I don't know if you want to count that as one, but if we take that as one, then number two would be to up your education so that you can lower your hazardous substance consumption in building projects. Number three would be to re-align our vision so that we use other drivers and not just aesthetics, as architects have a tendency to do.

[Nirmal] Michael, I want to talk to you about regeneration because when I was writing my book, Ecopuncture about regeneration, it hit me that it wasn't just about what we do at the drawing board about the choices we make about the aesthetic aspects of a project or the functionality of it, but it's an ecosystem within which we operate.

What is the value chain here of getting regenerative design done? Who takes the lead do you think?

[Micheal] That's quite a multifaceted question, I'll do my best to answer it. Who takes the lead? I think it's important that the teams are led by people who are actually good at integrative thinking. Architects can be good at that, they can be terrible. In our book Flourish, which I co-wrote with Sarah Ichioka, we put forward an alternative to the slightly old-fashioned idea of architecture's egotistical superhero. In that old, perhaps slightly simplistic, but still with a grain of truth to it and that old model, you would sometimes get an iconic architect who would do a sexy sketch on the back of an envelope and then expect the rest of the team to just make it happen.

A much more inclusive and inspiring model, I think, is the idea of the architect as a conductor. Benjamin Zander, in his TED talk, talks about how a conductor doesn't make a sound but relies instead for their power on making other people powerful and unifying that into a cohesive result. That's the role that I think a design team leader should aspire to, to try and draw the best out of the team. Nirmal, you are also asking about the cost and value side of things, or were you going to come back to that?

[Nirmal] Yes, we can start on that as well, if you like. How do we frame the question of cost and who benefits from this and who pays for it?

[Micheal] I actually think it's important that we challenge existing, maladaptive approaches. When I say challenge I mean, as deliberately as possible without anger or aggression. I think it's perfectly reasonable if someone says, what's the cost, or value proposition for this? I think it's perfectly reasonable to say, well, can you tell me what the cost-benefit analysis is for causing large parts of the tropics to be inhabitable and large numbers of developing societies to collapse? These aren't comfortable questions. The answers aren't necessarily straightforward but one way or another, we do need to develop solutions, that deliver long-term value.

I've often been able to lead teams that produce results that are much cheaper in the long term, they just cost slightly more upfront. We may need to adjust our economic perspectives to accommodate that.

[Nirmal] That's a fair comment that so much of what happens across the world is speculative, isn't it? Somebody builds and somebody else operates. Neel, you wanted to say something?

[Neel] Yes, can I just say that, I think also it depends on where you are in the world. I think that at least the more professional developers and I'm not talking small housing or anything like that, but you could say, developers of large buildings, office buildings and blocks and whatever, they can see that more, you could say, traditional sustainable, low-carbon housing, even with the greenery and all this stuff, it's actually easier to rent out and people are there for a longer time, they also want to pay more. I think it's, of course, depending on what part of society you're in. I would say that in the Nordics, we have shifted from having a very local building market to now have an international building market. What we saw with the international developers coming in, was that they had a completely different view on the quality of the buildings because they see maybe a complete different business case, than the little local developer here in this little small country. I think I'm not so afraid of the cost, I'm more afraid of the chopped-up value chain that we have, how can we influence the value chain? How can we make sure that the material producers are actually producing materials that we will use that they also have a business case, to be honest, I can't really overlook how all these different business cases in the different parts of the value chain are adding up to one business case.

That's why I think that it's necessary that we actually connect the value chain so that you can get the experience that we want to have. I don't know, Martha would you like to comment on that?

[Nirmal] Would you like to comment on that?

[Martha] It's such a valid question about costs and I think that Michael has a fantastic point about what is cost. Broaden the definition of what the true cost is by including the social economic burden of environmental degradation is an extraordinarily valuable approach to thinking about what we're actually doing. The other aspect of cost is that there's always this assumption that if you are investing in better materials, they will cost more. One of the key factors of cost is if you simply build less or less square meters, that is to say, we build smaller spaces and work with overlapping functions and multiple users. This is a very direct way of reducing costs. I'd like to put that out on the table as well. I know in Denmark we're very focused on, for example, our embodied carbon impacts per square meter because that's how it's coming into the new building regulations. However, it's not just a question about reducing per square meter. We also need to be reducing the square meters that we're building.

Singapore Ang Mo Kio Bishan Park

[Nirmal] I'll be the spanner in the works here because I operate in a highly speculative environment where developers tend to take a very short-term view, of course. The argument that the green building movement has made, in the last 15, 20 years, is that there's great payback for this: 'If you go green or you do the right things, there is some kind of an incentive to the developer or the occupants that translates into a benefit.' Now, that may be true for some things, but there are other things – ecosystems for instance, what Ken Yeang was talking about – how do we quantify the cost of that? It's very difficult to do that in part because the party that pays is not the party that benefits. It is a bigger benefit. When Michael, you say that we're talking about planetary cost. The developer in Vietnam is going to argue back with you and say, I'm sorry, I'm here to make money in the next five years.

How do you frame cost and value in these environments? Anyone?

[Neel] I think it's very difficult because you could say, the ecology as such is for a common good, or it's supposed to be for a common good. It's under whatever state regulation, national legislation, on nature conservation, biodiversity conservation as we see here in Europe, and similar systems in other places. It's not the little developer. I think that we need, and that's one of my main points here in this that I also try to exercise inside my company, is that we actually have to have a stronger advocacy for ecology. We have actually to have it, I think it's super that you could say that architects have taken it up.

We have worked a lot through it and have also decided on Blue-Green infrastructure stuff that we are doing very well on. I think that it still always comes back to what is the business case. If we talk about Blue-Green infrastructure, stormwater management, and so on, then of course you can always have the business case that it's less expensive than building big concrete infrastructure for storm water protection.

> "
> I still think that this is about ecology. Who's actually the advocate for ecology? We need to think very hard about that, because ecology is for the common good. It's not something you can take in your pockets and walk around with.

Neel Strobaeke

[Nirmal] Michael, please.

[Michael] What I was going to say is that I think there's a golden opportunity at the beginning of a project to raise the level of ambition. There are certain tools that Sarah and I talk about in our book and I can summarise them very briefly now. One of those is about encouraging people to think over a longer-term timescale and think about what it means to be a good ancestor. If you couple that with a description of the difference between sustainable and regenerative and I'm thinking of an early brainstorming workshop at which the client and the whole team are present right at the beginning of a project.

If you encourage them to think about what it means to be a good ancestor and you explain the difference between sustainable and regenerative, I think there are fairly few clients that would say that they want to be degenerative, that that is their purpose in life. If they do, then, that might be the time to conclude that it's going to be impossible to do a regenerative project with this client, with these starting assumptions. Maybe ask yourself, whether you really want to lend your good name as an architect or an engineer or ecologist or whatever, to their projects, because it may be that they don't deserve it and maybe you've got better things to do with your time.

I think we do need to start challenging these situations and do our best to influence them early on when the opportunity exists.

[Nirmal] I think that the case study that you showed in your presentation about biophilia was a really interesting one – it suggests there is an 8% acceleration of recovery rates. The thing that we're missing in this conversation is how the things that we do in the name of regeneration have financial implications. It's a question of time horizon, isn't it? The projects that I've studied in Asia are very interesting for that very reason that many of them are private developer-led. You think that they wouldn't be interested in regenerative thinking because it's birds and bees and tree-hugging nonsense. Actually, they see this as a way of creating future capital for themselves.

The value of the property goes up because it's next to a park, so there is a value proposition here. What's missing is the exchange rate of capitals. We talk about financial, social, and human capitals, but we just don't know how to convert them. It's like having currency exchange rates. If we had more research into that would be really interesting.

Martha, I thought your presentation was truly exceptional, but a little scary in that this seems to be such an endemic problem, such a deep-rooted problem in the way that we build buildings and the materials that we choose. You talk about the stage of spec writing and we need to be more aware. To be honest, I think that in places like India and Vietnam, this is not relevant because there are no mandatory disclosure requirements placed on manufacturers in these places. Even if they promise you one thing, what they're going to deliver is completely different.

I think it'd be a good thing for practitioners to be more aware of the risk posed by material choices, but really, is that where it needs to start? Where does this conversation begin?

Unboxing carbon provides the tools to understand and quantify materials' embodied carbon.

[Martha] I would say it begins with schoolchildren. Currently, we're teaching a course called unboxing carbon, trying to raise the literacy of architects. We've even had a round of teenage girls through Ramboll trying to encourage STEM careers and they've also taken part in the course. I think that Neel, you hit on something that's very essential for moving forward and that is that you say this is the common good. This word common is extraordinarily important because instead of appointing one group of people with a responsibility, we have to have a common responsibility.

This common responsibility starts in the way that we interact with the younger generations and the knowledge that we can convey in terms of what choices exist and how we approach the design and the built environment with much better information. We need to start very young. You're right, we can't wait for the spec phase of a project, but a lot of this is not just a decision about material. It's a much larger decision about should we even be building, can we refuse to do this project because it simply makes no biological or ecological sense to do this? Can we refuse to build new, but encourage, perhaps a transformation project instead? Can we refuse to build the entirety of a basement?

Can we reduce the program? All of these critical analyses have to happen all the way through from the moment that the architects are called into dialogue with a client. I feel that it's a huge dialogue that needs to start from the very beginning. If we're extraordinarily proactive, we're starting it on a societal level by making these very difficult choices and dilemmas that we have within our industry are clear to a much larger population.

[Neel] Yes. Actually, I'm relatively hopeful with all this, I have to say maybe I'm a bit naive, coming from the place I'm coming from, but I'm still a bit-- I'm actually hopeful because I can see that the younger generation, if you take a company like ours with 18,000 people, we have a large contingency of young people who are thinking completely different than we are and probably are also themselves by self-studies or through the education they have, are thinking much more about doing more good and to actually do things.

I can just mention from the transport sector, we have a number of people who don't want to be part of the project where they build new roads. The first time I saw it, I asked. What is this? But they say, "Why should we build more roads?" They're very climate-conscious. They say, "We have the roads we have, we can improve them."

I suppose also from the buildings, I haven't heard yet about that, but it could be that people will not like to work on projects where you are using hazardous chemicals or whatever and doing everything they can, actually to take them out. Also, this means that we in the private sector, as a design consulting company, actually also have to say that we strive for this. We strive for a limit to embodied carbon in our projects. We strive for this and that.

I think that's something that we can do because it's good as a company to do this, but it's also something that we are more or less led to do by our younger colleagues, I would say. I have actually quite a big hope. I'm not very familiar with the architecture business. I have to say I'm an engineer by training myself, but I think that the architecture schools here also have a big responsibility in conveying that message so that the people coming out of architecture schools all over the world, go into practice, and actually do the things that do good instead of doing more harm.

Refurbishment is, of course, one of the things that may be difficult for starchitects because of large, iconic buildings and maybe more. I know that our structural engineers like to work with complicated new structures instead of maybe looking at old stuff, but that's, of course, the dilemma.

[Nirmal] That's a great segue to the question that I had on training of architects. Actually, I think really, we were talking about a whole new breed of experts coming at the table.

If we're going to do regenerative right, do we need an ecologist at the table? Do we need somebody with biological knowledge or to your point, Neel, should we be treating architects, landscape architects and engineers differently? What do you think, Michael? Is biomimicry a part of the curriculum anywhere in the world?

[Micheal] It is and the number of schools that are offering that is definitely increasing. I've noticed more of an increase in architecture schools offering regenerative design courses, which will include biomimicry and I'm quite happy with that. That's fine. To your point about whether we've got the right people sitting around the table, well, Janine Benyus, who's one of the best-known advocates of biomimicry, she has a very good line on this. She says, "The typical involvement of a biologist or an ecologist in a building project is that they're brought in to do the body count once the design is largely complete." It's sadly, quite true, though now less than it used to be.

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What we really need is to bring those perspectives in very early on, where they can actually shape a much better holistic solution.

Michael Pawlyn

[Nirmal] Wolfgang Kessling, who was a physicist working out of Munich in Germany, is a climate engineer. He talks about how he needs to get to a point where he becomes irrelevant because he's a specialist who goes into projects and advises project teams on how to deliver low-energy, high-comfort solutions. He says that if all this is going to be one project at a time done by his firm, then that's not enough. It's got to be something that trickles into the culture of making and doing. We've got to find a way to work without the Janines and the Wolfgangs of the world. What do you think?

[Micheal] I partly agree. The thing is, our understanding of the nature of the problem is moving forward the whole time. While I like the aspiration of getting to the point where everyone understands this stuff so that we don't need experts like Wolfgang, I think we'll just find the next boundaries. Where we've got to get to eventually is a really stretched target. There's still scope for a lot of expertise from people who are good at taking a strategic and integrated view, and I think that's going to continue for quite a long time yet.

Levels of Engagement with the Environmental Agenda

Awareness + Advocacy + Action + Organisation + Policy Makers + Legislation

Awareness + Advocacy + Action + Organisation + Policy Makers

Awareness + Advocacy + Action + Organisation

Awareness + Advocacy + Action

Awareness + Advocacy

Awareness

Ignorance

Denial
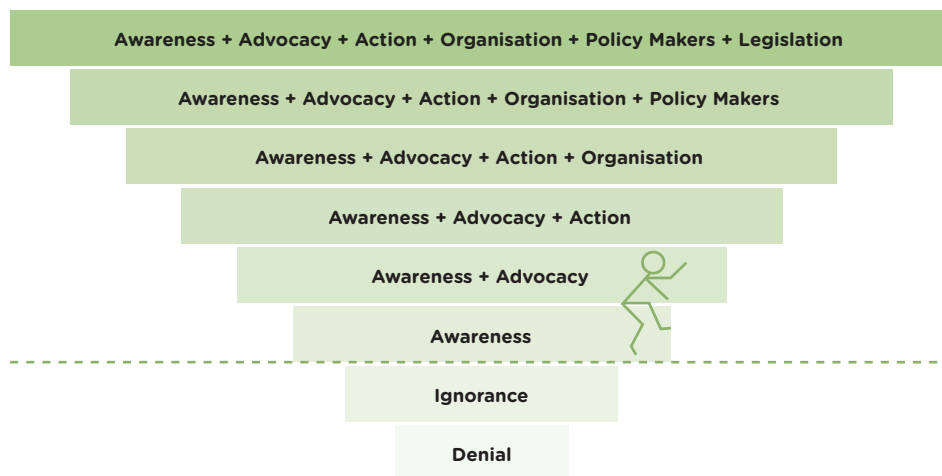
Expanding agency with the different layers of engagement with the Environmental Agenda

[Nirmal] Last question and this goes out to everyone. How far away are we from this? Maybe just to start with you, Michael... are words like biophilia and biomimicry becoming part of the vocabulary? Are they actually making an impact on the drawing board?

[Micheal] I think they are. It's important that they are seen as part of a bigger shift, which involves a rethinking of our role as humans. One thing is for sure, our kids are not going to thank us for just being wealth creators if it's at the expense of their future. We need to think of ourselves more as co-enablers of the flourishing of all life for all time. That's what Sarah and I put forward in the conclusion to our book.

[Nirmal] Martha, how far are we?

[Martha]

We are looking at an absolute need to implement radical change immediately and that's an enormous task.

We have to constantly remind ourselves of why we're doing it by listening to the IPCC scientists, by looking at the reports coming out on planetary boundaries from the Stockholm Resilience Centre, and understanding that continuing on our egregious path of consumption and pollution is not an option. It's not going to be especially easy for our industry. I'm not seeing the necessary radical change yet.

[Nirmal] Neel, as a practitioner, how far out?

[Neel] I think that we are well on the way to understanding what we're talking about, that there is something called regenerative design. There's something about regeneration. As I started to say, they do less harm. Obviously, they do more good things, I think that is something that has been, at least in our company, picked up tremendously fast from everybody talking about sustainability last year, to everybody now talking about regeneration. Of course, also fired up by the building's people and particularly through Dr. Hossein. I think that the uptake of this is super. I don't think that we need to wait until we know everything because we will never know everything anyway. Our biggest task is actually to convince our clients. It is also feeding back to that we actually are able to talk about it with our clients. If you're not comfortable to, I don't really know what it is and of course, you will not take it up. It is about convincing our clients the biggest task for Ramboll actually, it's also in our strategy that we need to talk to your clients about this. You could say back to the question, if the clients are not really in for it then, of course, the question is, is that then a client that we will also have tomorrow? I think it's if we can convince them. Convincing is super important for us. This is also what we are training our people to actually understand what it is.

[Nirmal] Brilliant. Thank you so much, everyone. That was a great conversation. I thank you all for your presentations and for what I thought was a really lively and provocative conversation. Thank you.
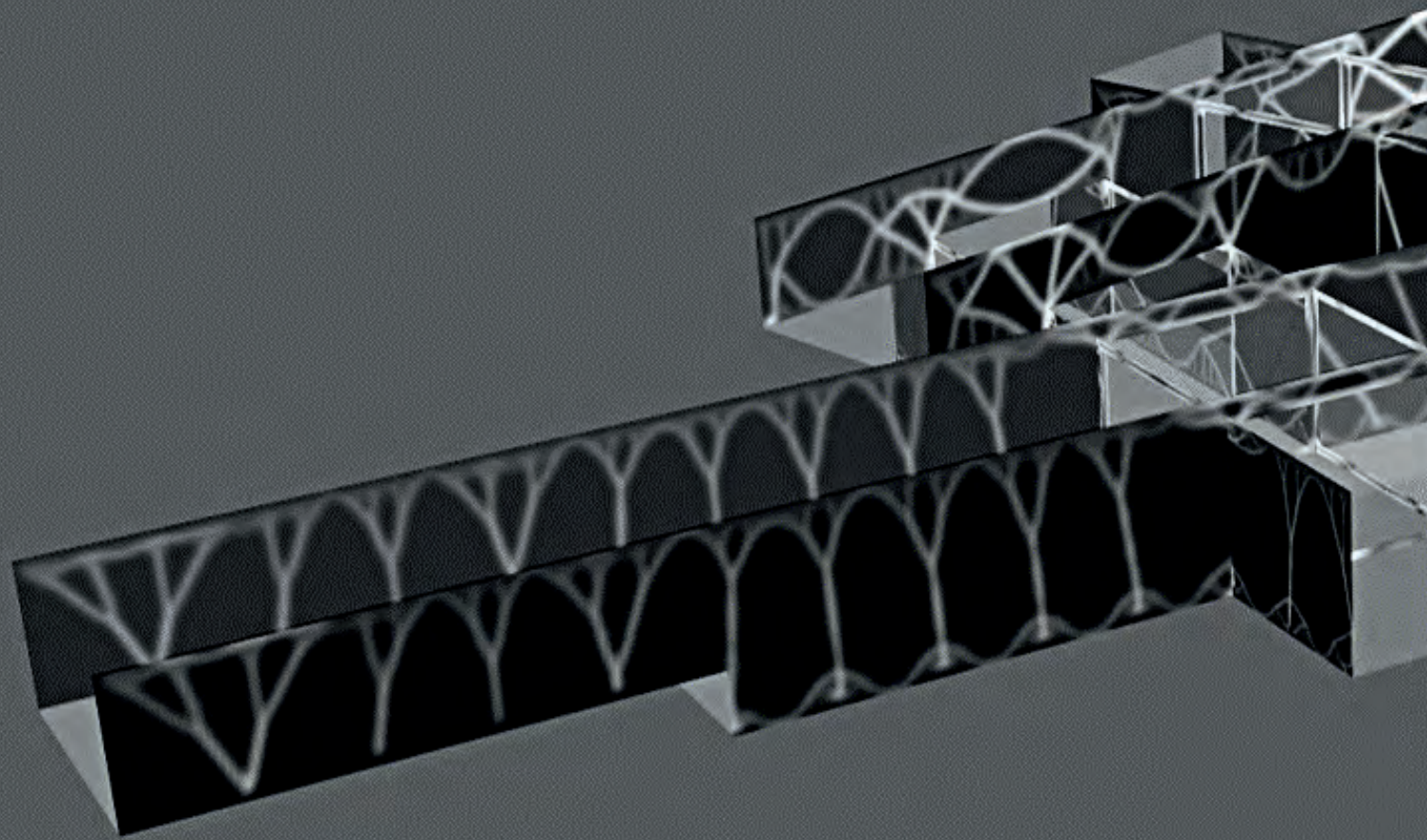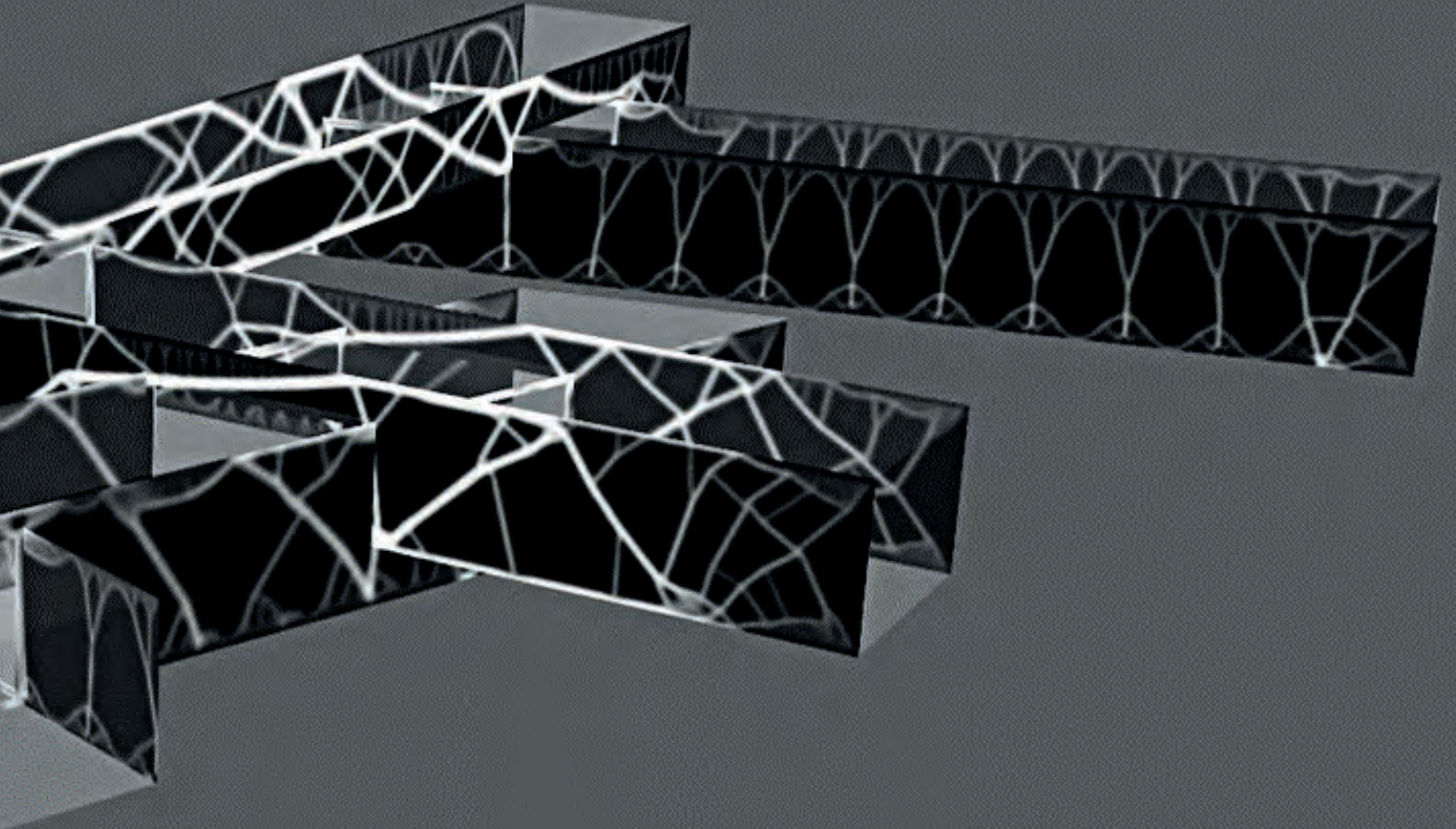
Getting Close To The Mind Of Nature...

Session C

Design x Technology

True innovation comes from working with augmented design, augmenting our capabilities with that of the machine. In augmented design, powerful machines, hardware and software are no longer mere tools in the hands of the designer, but potential collaborators for developing and exploring new ideas. Technology, which empowered humans to control and exploit nature, and marked the beginning of our disintegration with the natural environment, can now paradoxically enable designers, engineers and architects to integrate the built environment with the natural environment.

Provocation on Design x Technology

Richard Hassell

Founding Director, WOHA Architects

Richard Hassell is the co-Founding Director of WOHA, an internationally recognised architectural practice based in Singapore. Richard leads its project teams in design execution and contract implementation of innovative private and institutional works.

The following is a collection of thoughts which is not a particularly linear narrative. I've just put together some responses to this idea and some things I've been thinking about lately.

We are at the cusp of AI changing our relationship with technology in a profound way. The impact of knowledge work has previously been in improved tools which enhance our content creation. But now we're facing the fact that AI can generate our creative content also.

This is very disturbing. This fear of the impact of technology is something that's been with us for a long time. Horror movies like Frankenstein although schlocky and funny, I think really encapsulates this fear that the technology that we are creating may end up going in directions that we didn't anticipate and lead us down a dark path.

I'll talk about a few things today. Augmented design, complex systems, and whether as designers we embody complexity, or we represent it, or both. I'll look at the relationship between AI and design, and lastly, I will just share some thoughts about a positive viewpoint that maybe we're approaching an ecology of intelligence.

Augmented design is where we are at the moment, where AI is giving us a whole range of exciting tools, where we can apply our traditional design methodology but take it in new directions or go a lot further than we used to be able to.

We're at the stage where mostly what we do as designers can now be replicated by an algorithm, even highly personal artistic styles. The question is why we need humans to develop these styles, can AI just generate new styles and we choose the ones we like? Can we all become a bit more like curators? What happens when we also outsource the selection of styles to the AI? Do we still have a role in this process?

This is something that happened recently where a British engineer developed a robot that he called Ai-Da after Ada Lovelace. It's a robot that can draw and paint very much like a human can. I think for a lot of us, this is something very disturbing - to see that robots and AI are starting to be deployed into the human creative sphere.

There are many aspects of filters on every phone and app, but here we're looking at the one that comes with Photoshop. They have some neural filters which apply artificial intelligence to bring a style from an image across to a photograph. I just feed the robotic artist's image through some of these filters.

For example, an image can be altered in the style of Edvard Munch or Cézanne or even in the style of *The Matrix*. These are all quite crude but effective illustrations of technology, which is already probably quite out of date already. In some ways, augmented design is a creative condition that we're working through at the moment, but it's basically already over.

While there may be a decade or two of convulsions, we're really already in the death throes of traditional design.

Recently, an artist won a competition with a painting that he'd developed using Midjourney, an artificial intelligence software that creates surreal and beautiful images. He declared it, so it wasn't a secret that he used the software, but it created a bit of an uproar online. It's a very evocative and beautiful image, in my opinion.

We've been looking at AI within WOHA. We've used Midjourney to create various architectural moods or scenarios. It creates something just from a sentence, it assembles images for you which you can choose from and then enhance, add further directions or split choices and move towards a visual evocation of what you intended by the sentence. These are quite eye-catching and effective in architectural communication. You could easily imagine developing a competition scheme or a design around these kinds of images.

The worrying thing is that perhaps, at the moment we, the architects, are coming up with a sentence for the AI to use, but we could just as easily imagine our client coming up with the sentence - or perhaps a bank's artificial intelligence coming up with the sentence, which would come up with the architecture that would then be delivered through some robotic fabrication process. You could start cutting humans out of the process almost altogether.

I'll just step back a little bit and look at how we got to our focus on systems, because there are some interesting books and theories that have led us here and could be interesting for you to look at.

Steps to An Ecology of Mind
by Gregory Bateson

The first one is by Gregory Bateson, a really interesting academic and practitioner who crossed many fields from psychology to ecology through art and cybernetics. He was very interested in this idea of systems thinking and different domains of knowledge and how they might map across onto each other and how our minds and our intelligence are actually part of nature.

The computational power of computers in the 1970s and 80s and 90s developed this field of complexity which allowed us to start modeling really complex things such as weather or climate patterns, or cloud formations, or any process that fed back on itself through feedback loops.

These calculations were impossible before computers allowed us to accelerate the speed of computing so we could create results fast enough that we could use them in our work and lives. This understanding of systems that underlie all of the universe and nature as well as our own technologies have become a theory of everything that crosses through all the different domains.

A Web of Meaning by Jeremy Lent

A very interesting recent book by Jeremy Lent looks at the philosophical, ethical and moral meanings behind these interlinked systems. This is an investigation into how this fresh understanding of our position in the universe can generate very profound, meaningful insights which start to cross over into issues of religion and the spirit.

Computational capacity helped us understand complexity and model it. Now AI is starting to model what goes on in our minds. The really interesting thing is that a model can never map precisely one-for-one what is going on in the thing that it's modeling.

Even tiny differences in the algorithms between our meat minds, our carbon minds, and the silicon minds of computers will create new meaning, new ethics, and new philosophy. I don't think we're ready at all for the implications of this.

I'll make another jump now to intelligence and complex systems and design and think about what it might look like if we are designing through a process of artificial intelligence, through iteration, through designs that evolve through complex feedback loops, and I think there'll be very soon a moment when we don't know what's going on under the hood. It's comparable to buying a modern car where you no longer can tinker with the carburetor or the radiator. It's becoming a very complex entity, which the normal person in the street really can't figure it out at all.

Here's an image of a cell produced by Digizyme (referring to a 3D rendering of a eukaryotic cell). It's modeling what's going on inside a cell at a molecular level - I think this is where computational design will lead us. The subject of this image is carbon-based, while our AI-based evolved designs will be silicon and other compounds or maybe hybrids of silicon and carbon-based nano engineering. It looks beautiful, but it is almost impossible to understand and while you can zoom in and pull apart certain elements and figure out how they're working, the way all these components are interacting together in a highly complex system is beyond human understanding, so we will start needing to just trust that what's happening inside black boxes is delivering what we want.

Here's an image from Terry Gilliam's Brazil (1985 film) (referring to a still from Brazil). It's a brilliant film from the mid-eighties. It explores many of these ideas about where technology is leading us, where complexity takes us, and how much control we have over our environment once we give up a lot of control to highly complex systems.

This embodied complexity that evolves from processes and feedback loops will rapidly exceed our capacity to understand it, and designing may become more about the criteria for success. As designers we would then be imposing fitness just like in evolution and picking winners and letting solutions iteratively evolve, but I think the big question is can we maintain our control over the outcomes once the system becomes self-referential with its own internal loops?

As the God-like deciders of what may be good or not good, we may be cut out of the loop in the future and the system will start running itself for itself and we can only watch it - potentially in dismay.

Another jump now to how as designers we need to deal with this complexity that's emerging through artificial intelligence and technology. We not only use technology, but as human designers who are still designing, there's a role for expressing our understanding of our world through the use of metaphor and analogy. Something I've been personally interested in, is the question of what the aesthetics of this complexity are. What are the aesthetics of iterative design solutions?

I'll just bring you through a few things that I've been playing with as a bit of a break from the bleak interpretation of where technology might take us.

Figure 1 Fractally organised complex patterns on a wall panel

This is a wall panel I designed shown in Figure 1, which was very simple but had the potential to make fractally organised complex patterns. It's based on working with extremely simple components to express a complex system through the placement of those components. This is something I've been following through different architectural elements and using design algorithms to grow these fields of patterns that do not follow periodic pattern making but create a periodic or non-periodic pattern.
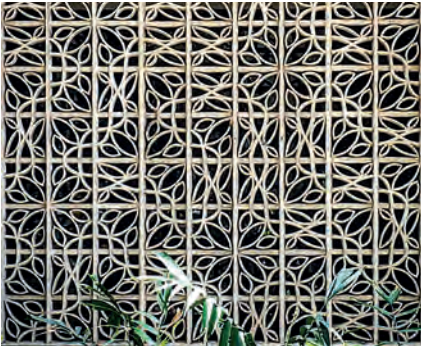
Figure 2 Screen project in Mumbai

Figure 3 Two tiles creating an endless pattern

Figure 4 shows a Pavilion in Paris

This (Figure 3) is a tile designed for a cafe, so this uses just two basic tiles. One is the reverse of the other, but the pattern creates an endless branching creeper, which never begins or ends.

This (Figure 4) is a pavilion. Working on the design, I still really love to use my hands, so this is something I'm interested in, which is the intersection of drawing and technology. The screen is based on one of those patterns you saw before where there's a front and a back and the patterns are operating independently. It's the same tile that's reversed and we made an organically clad screened pavilion for a product show, and interestingly when you get the shadows through the screen, or through blinds, it really evokes the feeling of being in a complex nature.
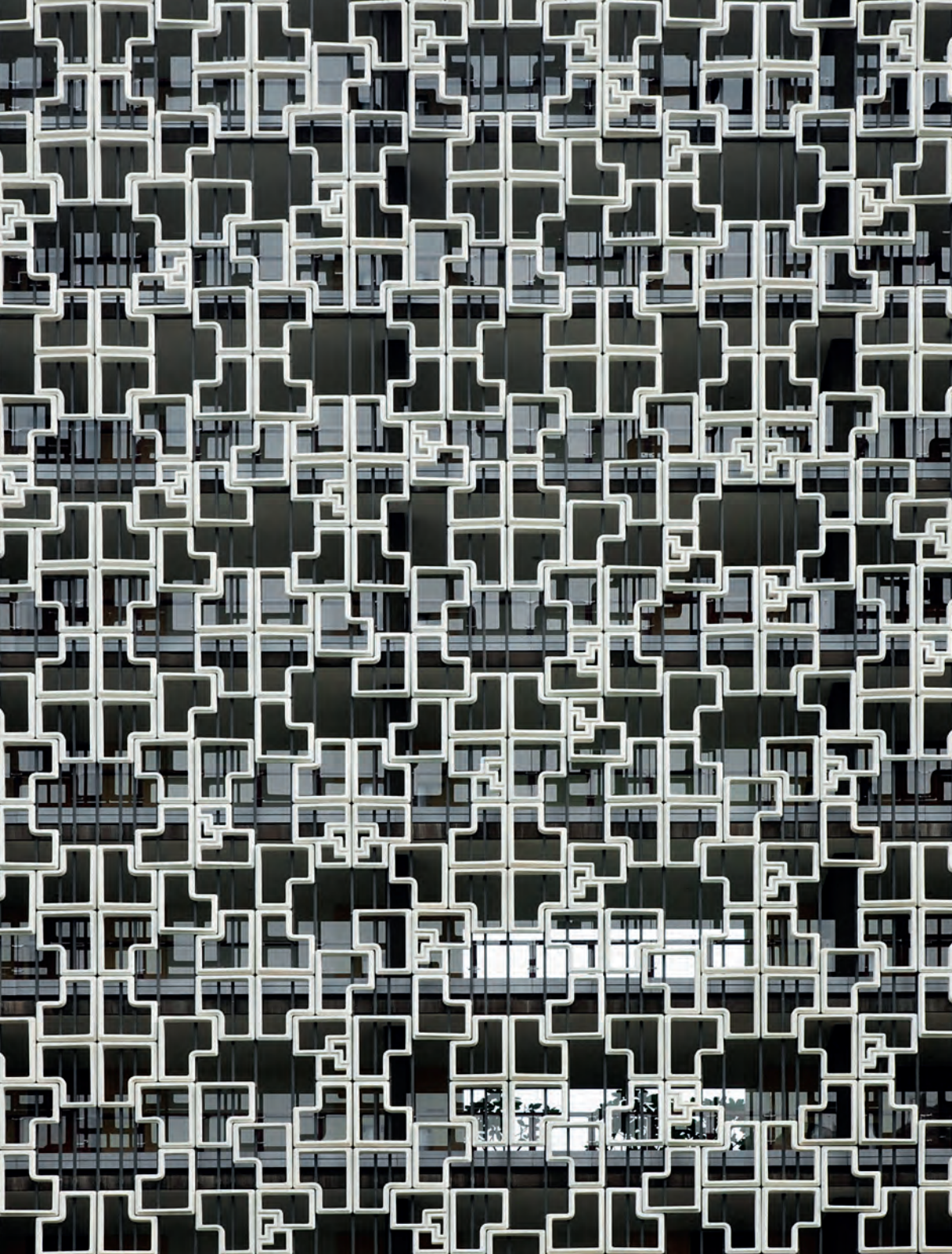
Figure 5 Periodic tiling.
InterContinental Sanya Resort

Figure 5 is one of the examples of self-similar periodic tilings where you can generate patches of tiles that have this quality, and I play with tessellation. Another example is a series of frogs that can only be tiled together in an aperiodic way, the same geometry we applied to a facade on a project in China. These are quite interesting because they're design explorations that connect back to traditional screens, but also talk about the present, where we are now, where we have an understanding of complex tilings and fractals and periodic organisations.

Lastly, I'm just finishing up with a couple of little sketches I was doing as I was thinking through this issue. I think this is where we are at the moment with AI and design - and I think it's not a particularly exciting future. At the moment we have a novelty loop that feeds out to consumption, and my nightmare is that AI easily takes over the role of the designer in terms of coming up with novelty through randomised variation or combination of pre-existing elements. By combining them in different ways, it could easily share these out through the attention economies, like TikTok and Instagram, and then the measurement of the reaction to these becomes basically the fitness criteria that I mentioned before: Whatever gets the most enthusiastic reaction would then be fed to a black box process, which would output products built by robots and sent out by fulfillment centers to be fed to consumers.

At the same time, this new product goes back to the novelty loop and gets improved, changed, restyled, or combined with something else and that just keeps going. As you can see in my little diagram, I've called it the "ex-designer" because I think we are no longer needed in this process. We are just scrolling on our phones and liking the things that we see and then occasionally ordering them to be delivered to us and paid for on the universal income that we all need to receive because none of us have jobs anymore.

I think we're pretty much here already and we can feel our role changing and becoming just reactors or curators, and our agency is slowly being depleted.

My more optimistic prediction is that we're moving towards an ecology of intelligence where artificial intelligence is becoming a new creature within this ecology, which is forcing us to adapt, but where in the end we move to a higher level of complexity and value through the introduction of this new intelligence into the universe.

Figure 6 The Ecology of Intelligence

With this little diagram in Figure 6, I was trying to figure out what I mean by all that, so I've shown here three intelligences. We've got human intelligence and artificial intelligence up the top and I've put cosmic intelligence down below. This one gives me a little bit of hope because I think each one has a domain and their interaction creates positive outcomes. Between human intelligence and cosmic intelligence that is where I see the sphere of everything that makes us human.

It's not just our intelligence, our ability to calculate or compute things, but also deeply human values or attributes such as kinship and love and reciprocity, wonder and awe, and our delight in the beauty of the natural world and our planet. I've put a little arrow at the side called thriving. We thrive when we're working together, our human intelligence together with the cosmic intelligence, or the Gaia viewpoint as I've called it.

Understanding our dependence on our planet earth and our love of nature, these things together create a condition of thriving. When human intelligence intersects with artificial intelligence, that's where the condition of delight arises. This is why we love our new technology, our new phones, the things we can do, the movies we can make, the architecture and engineering.

All these things are really to create a condition of delight at how we can use this power of computation to create things way beyond our ability as small mammals. I put delight in there because we just love to make things, we love to build things, we love to imagine things, and this can happen through artificial intelligence and technology.

Then there's another link between artificial intelligence and cosmic intelligence which is understanding. Until we had this power to compute, we couldn't really figure out what was going on inside atoms, inside the universe and planets. We couldn't even understand things around us like weather or climate or ecology.

This artificial intelligence interacting with cosmic intelligence gives us an understanding which we never had before.

I'm hoping in this new ecology of intelligence that there's a role in the intersection of these things for designs, and that the artificial intelligence cannot really totally remove us from the equation because love and kinship and reciprocity and biophilia are things that could be simulated but they have no point without the carbon-based human that they're wrapped in. So my optimistic viewpoint which I'll leave you with is that we're moving towards a new ecology of intelligence and this will inform the design of the future.

Digital Craftsmanship

Jakob Strømann-Andersen

Partner and Director, Henning Larsen

As Partner and Director of Innovation and Sustainability at Henning Larsen, Jakob's professional focus revolves around the interaction between engineering, architecture and modern technology.

Digital craftsmanship is a new way of integrating digital innovation and technology into the design and manufacturing process. I will show some cases of how we work with innovation at Henning Larsen.

Henning Larsen is a part of the Ramboll family. We head architecture, urbanism, and landscape within the Ramboll group. When we work with innovation and technology, we apply it across architecture, urbanism, and landscape design. That is where our DNA is. That is where we strive for design excellence, but also where we strive for driving innovation together with our partners and clients.

World of Volvo, Gothenburg, Sweden

All good presentations start with good storytelling, as with the story of the World of Volvo project sited in Gothenburg, Sweden. The idea with Volvo was not to showcase the car but to showcase mobility via a journey through the Swedish forest – an architectural project and design born from a compelling narrative.

Three timber columns come up from the ground, creating a room whereby the indoor and the outdoor merge. In Sweden, it is a room called *Allemansrätten*, meaning that everyone has the right to the landscape area. On this site, you can go camping without buying a ticket for the World of Volvo and be a part of the exhibition in the same way.

With digital craftsmanship, we developed the model with Grasshopper in Rhino. It's about optimising or refining how we give this very complex form a simple structure while minimising its resources. The new thing was that we worked directly with the manufacturer in Austria to optimise the structural form of the large timber columns. The best part of *real* craftsmanship is to see the *real* scale of the glulam columns out of the computer, which is quite beautiful. The World of Volvo is scheduled to open in the spring of 2024, so I invite all of you to join the opening.

Henning Larsen's Approach to Architecture

At Henning Larsen, we focus on the following areas in our approach to architecture:

Design Excellence

Purposeful design & buildability
Our design methodology and DNA

Sustainability

Decarbonisation, Livability, Circularity, and Biodiversity Sustainability as the design criteria.

Technology and data

With digitalisation, we measure our impact. To monitor and quantify the effect, we work with technology and data.

In terms of my background, I have been with Henning Larsen for around 15 years, but I am a trained engineer, so my right brain understands technology, data, algorithms, and numbers, while my left brain is better at understanding colours and drawings. I think that is also the DNA of Henning Larsen: we strive to measure what we do, document what we do, and bring in the newest knowledge to have a say in architecture.

Our buildings should have a voice, not just in a physical sense, but also in the political sphere.

Talking about responsibility, here is a report that came out just before summer:

World Economic Forum Global Risks Report 2022
The World Needs Positive Change
Top 10 Global Risks by Severity Over the next 10 years:

1. Climate Action Failure

2. Extreme Weather

3. Biodiversity loss

4. Social cohesion erosion

5. Livelihood crisis

6. Infectious diseases

7. Human environmental damage

8. Natural resource crisis

9. Debt crisis

10. Geoeconomic confrontation

The items highlighted are areas where the building industry, architects, and engineers can significantly impact change for the better. These are the issues we need to address through design and documentation. To act on this, we need new ways of working together and new tools and methods.

Designing for a sustainable future requires new methods and tools

At Henning Larsen, we have a dedicated team specialising in applied innovation, working closely with our clients on research and development to prototype "smart" and sustainable components for our projects. We are also a team of what we call "nerdy" architects; architects who can code and who are computational designers.

We design together in one model, so design and performance go hand in hand. To do that, we need a tailor-made workflow and cannot rely on a standardised workflow. I think the building industry is quite behind all other industries in innovation. We see a need to craft our workflow in collaboration with architects, designers, and the client.

Applied innovation:

1. Lifecycle assessment - putting carbon at the front of design

2. Mobility - mobility studies with urban designers and understanding people flow

3. Data-driven design - about social behavior

4. Solar radiation analysis - microclimate

5. Resilient water solutions

6. Wind flow studies

7. Microclimate studies

8. Energy design studies

9. Smart path findings – On one project, we worked to find the quickest route for wheelchairs coming up from a landscape.

10. Generative design - We develop a lot of models (up to 10,000 different iterations), and then we evaluate the impact.

11. Urban noise simulations

12 Daylight and artificial light studies

13. Acoustics & virtual soundscape studies

14. Shared spaces (POE) evaluations

We develop small scripts and programming for each project to make sense and give quality. The output is not in numbers or graphs but is more integrated into the digital model and form findings.

Cases

Design with Virtual Acoustics

We renovated an existing building and extended it to create the new city hall in Uppsala, Sweden, along with a brand-new civic square. We created an urban plaza with a central console chamber which is a sculptural piece that also serves as an acoustic element. The concept of having an indoor-outdoor space is dynamic and lively, with students running around and people working. It's a vibrant space that serves as both a learning environment and a functional workspace.

The acoustics of a space are often influenced by usage and behavioral patterns, where some areas require more vibrancy while others need to be quieter. To simulate the acoustics of such spaces, we typically use a ray tracing-based simulation.

Figure 2 shows a ray tracing-based simulation featuring the tracing of a sound wave as it bounces around surfaces. The resulting signal includes TPs (time periods) and may vary depending on the vibration and sound absorption properties of the surfaces with enough gradual standards. In this simulation, you may be fortunate enough to hear some mobilisation of the sound. Although you hear the sound, you may not fully capture the experience of being in that space, roaming around and hearing the dynamic range of the sound.

Figure 3 shows a numeric algorithm for calculating sound propagation using a wave-based simulation. You can see how the wave-based simulation results in sound waves that curve around the corners like waves in the sea. We used a virtual reality headset to navigate a virtual environment to evaluate the acoustic design. We were able to change the sound absorption values of the walls and different sound sources to refine the design.

Figure 1 Uppsala City Hall, Sweden
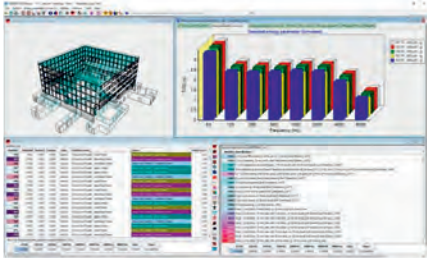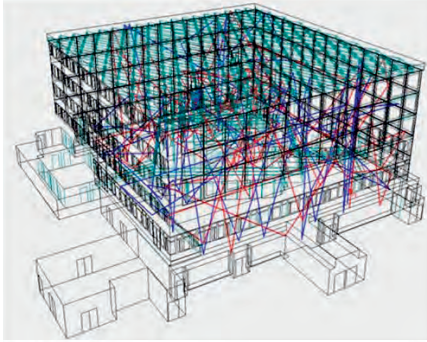
Figure 2 Virtual acoustics research of the Uppsala City Hall

$t = 29\,ms$
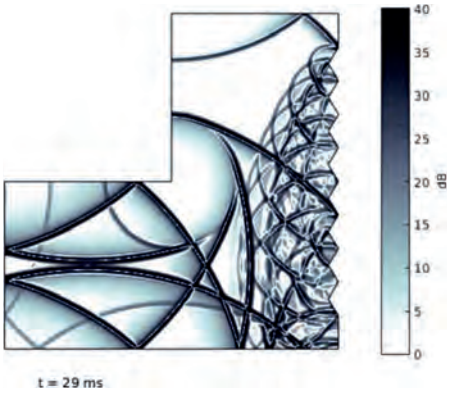
Figure 3 Wave Based Simulation

Figure 4 Sound paneling on the chamber

Design with Biomaterials

The next case study is more about biomaterials and how we can use them to drive a design from the very beginning. Although it's a small project, it's about testing with a focus on scalability. We test it on a small scale and then scale it up for our big projects (Figure 5).

Figure 6 shows a sketch of our 250 square meter extension for Feldballe School. At the outset, we made the decision to develop our own standards rather than relying on existing building standards.

Maybe some of you know the dogmas for the Danish movie industry by Lars von Trier and Thomas Vinterberg. Similarly we established five dogmas to follow in our work on Feldballe School as shown in Figure 7.

Figure 5 Feldballe School, construction photo

Figure 6 Feldballe School, sketch

Figure 7 Five dogmas to set a standard for a healthy, sustainable building

1. Use bio-based materials to sequester rather than emit carbon.

2. Design for disassembly, enabling the reuse of building components in the future.

3. Create a good indoor environment, balancing daylight with passive ventilation to lower operational energy consumption.

4. Create a building free of toxic chemicals, minimising off-gassing and ensuring clean production and processing procedures.

5. Use already-produced local materials to save resources and energy during manufacturing and transportation.

Let's look at bio-based construction. The goal was to develop an intuitive, hands-on method that would be easy for kids to understand.

Many kids are familiar with the food pyramid, which places healthy vegetables like cucumbers and carrots at the bottom, and red meat at the top. However, the food pyramid isn't just about health and well-being. It's also connected to CO_2 emissions.

To highlight this connection, we created a pyramid hierarchy for "upfront carbon" shown In Figure 8. We call this the "eight phases of carbon" constituting the extraction and manufacturing of the raw materials into a product.

THE BUILDING MATERIAL PYRAMID
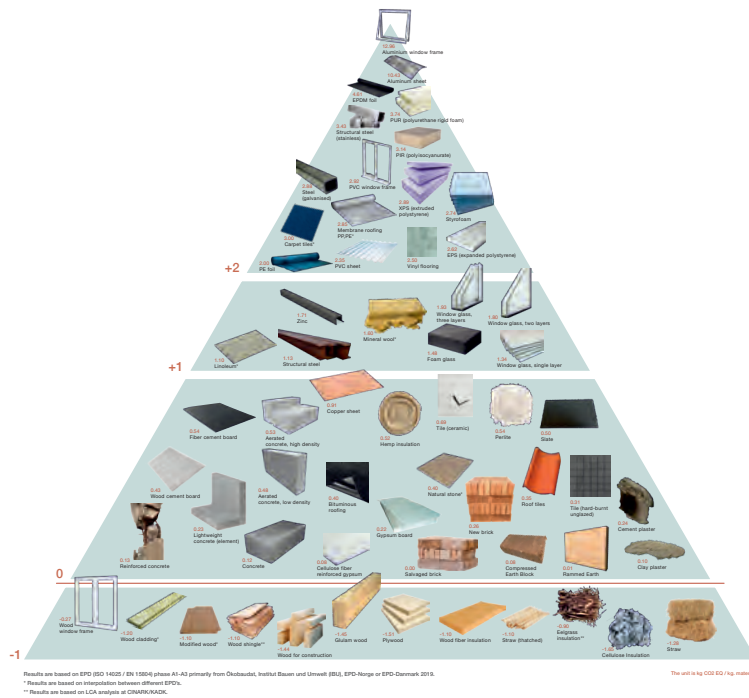
CONSIDER QUANTITIES   REFLECT ON LIFESPAN   THE DETAIL IS ESSENTIAL

Figure 8 The Building Material Pyramid

All the bio-based materials are at the bottom of the pyramid followed by steel, masonry and aluminum on top. It's important to recognise that we become what we eat, therefore we should be responsible for what we consume, and we should also take responsibility for what we build.

1kg of CO_2 equals

1kg of CO_2 equivalent

1kg of CO_2 equivalent

1kg of CO_2 equivalent

Three cucumbers
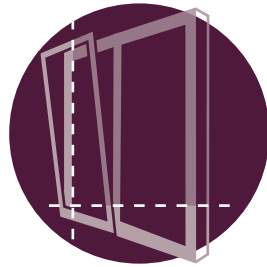
1/412 of a standard aluminum window*
(*Standard 2 panel aluminum triple glazed window measuring 1.4m²)
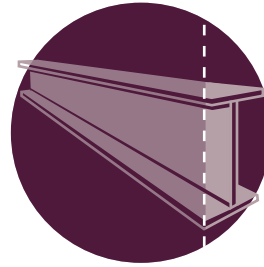
1/20 of a steel beam*
(*100mm width x 100mm height)
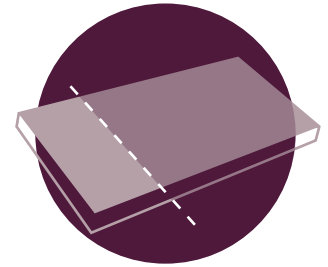
1/5 of a stone wool board
(2m x 1m x 100mm thick)

It's very direct and intuitive.

As we analysed the pyramid coming from that research, we noticed the straw at the bottom right-hand corner. Straw can absorb and capture the most carbon per cubic meter. A small handful of straw is equal to -1 kilogram of CO_2 captured in the biomaterial.

-1kg of CO_2 equals
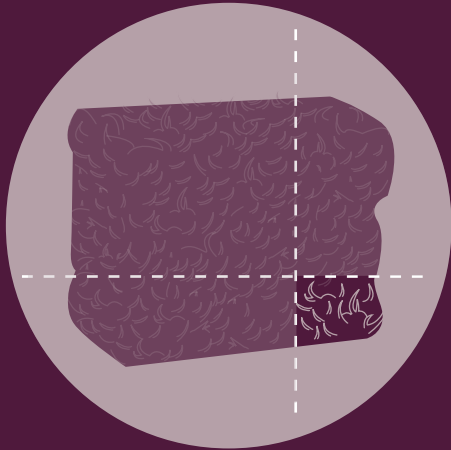
0.79kg straw bale

1kg of CO_2 equates to

Three cucumbers

One small handful of straw is equal to three cucumbers

Now we measure every old project in cucumbers. Our research development with the "Royal Danish Academy," (School of Architecture in Copenhagen) started with testing how we could incorporate straw into our designs. This led us to a dialogue with manufacturers about straw elements, specifically straw cassettes.

We took the knowledge we gained from working with straw elements and used it to develop a digital process for incorporating these materials into our designs: straw as an unconventional material becoming a more standardised one that we could bring into our digital modeling. With this new process, we were able to work more efficiently and effectively with straw elements and start building with them. For concrete and other materials with a big carbon impact that are typically not seen as innovative building materials, our goal was to limit their incorporation to a more technical design process.

When choosing biomaterials it is important to consider their durability and maintenance. The interior of the timber and straw construction is layered with clay, and on the exterior, wooden cladding was added to protect the wall from moisture damage. This approach allowed us to construct the walls of the building entirely out of bio-based materials.

We conducted a lifecycle assessment on this building and found that we were able to achieve a goal of 5kg CO_2/m^2 over a 50-year lifespan. For context – in January this year (2022), new requirements came out in Denmark stating that all buildings must have a maximum of 12 grams of CO_2e/m^2. Our building for Feldballe School not only meets this upcoming standard, but it also utilises bio-based materials.

As mentioned, we focus on the chemistry and toxicity of the building. The use of bio-based materials resulted in low toxicity levels. This was confirmed before the students moved into the chemistry lab, as the chemicals used during their classes pollute the air.

Digital Manufacturing

Digital manufacturing comes out of the idea of using new manufacturing technology to optimise our projects. Typically, when we talk about optimisation from an engineering point of view, the focus is on automating standardisation and streamlining production to increase efficiency and speed. If you look up the Wikipedia page about optimising, it would mention being an optimist and getting the most out of an outcome.

I believe that we should use technology to achieve the most quality, diversity, and architectural intent with the fewest amount of resources possible. With new technologies, we can achieve this goal. As humans, we have always been optimistic and this is reflected in the structure of our bodies. However, we have not been as good at living our lives as we have developed technology.

Figure 9 Low Carbon Concrete Pavilion

We are now seeing a new generation of technology that is more focused on robotics. Robots don't mind placing a brick 100 times in different ways or in the same way. This provides a new level of flexibility in our design process. Figure 9 shows a visualisation of a small case study project developed together with Ramboll and one of our good clients, AP Pension. It's a pavilion, a common house for a new neighbourhood in the city of Fredericia, Denmark.

It's around 250 to 280m². The emissions goal was to reduce the carbon footprint of concrete by exploring new technologies in the concrete industry. One of the technologies is additive manufacturing or 3D printing. The fins that wrap around the building were 3D printed and serve as load-bearing structures for the curved roof.

To achieve this (since there was no standard for it), we needed to invent our standards. So, we teamed up with the Technological Institute of Denmark and Ramboll. The core part of it was manufacturing and now we're doing a lot of 3D printing and prototyping.

The 3D-printed cases can be challenging to achieve on the first try. They may not look good or they may even fall apart. However, we are conducting load testing to improve the structural components. This process is possible because the project was designed entirely in a 3D Rhino model, allowing all the geometric and structural analyses to be performed in one place. The computational design team at Henning Larsen and Ramboll collaborated to run the structural analysis and refine the geometry in the model.

Figure 10 shows another project focused on 3D printing. It's a small pavilion born from explorations of using this technology to develop low-income row house typologies. By working with one contractor who sees the potential to optimize the building design process, the cost can be kept low. This is a new way of thinking about technology and there is great potential to scale it up in future projects. The row house is just the beginning.

In this project, we use 3D printing to create the core structure and the design of the slab is underway. The main idea is to push the walls of each consecutive row house back instead of positioning them all in a straight line. By working with the shape of the structural system, we can minimise the amount of concrete needed for the structure. This approach wouldn't be feasible with prefab elements, but it's possible with new technologies like additive design and 3D printing.

The ground level of the row house has a large living room and there are four rooms on top, making it suitable for a family with two to three kids. The curved structure also provides a view of nature from the entrance and the terraces. This design approach allows for new shapes and types of architecture that are more resource-efficient and cost-effective. The renderings of the row houses show what the future of apartment living could look like.

Technology is an enabler, not a replacement.

I think that's quite an important consideration, coming from the architectural industry - that sometimes we are afraid of technology. Technology can enable us to create more sustainable architecture with higher architectural quality.

Figure 10 A 3D printed rowhouse

Engineering focus

Robert Bamford

Associate Ramboll-Web Structures

As an Associate, Robert Bamford heads Web Structures' Future Design Studio developing and promoting cutting-edge parametrics and advanced computational design techniques.

"

We will be discussing the application of design and technology with an engineering focus, and the journey we have undertaken to study technology's use in geometry within structural engineering and other disciplines. And indeed, how technology is giving us a glimpse into the mind's eye of nature.

Nature is one of the greatest proponents of technology and design, and is, in fact, the master builder itself. Initially, we will examine design collaborators who use technology and how we use new collaborative tools through computational design to replicate and attempt to achieve some of the capabilities that Mother Nature has long understood.

These heat maps shown in Figure 1 are unfolded elevations of a high-rise building, created using a process called topological optimisation. Essentially, we place material where it works best. This is, of course, one of nature's building blocks, designing with a minimum of material while maximising freedom of form. These new processes, which have become more widely available lately, help us to define geometry with greater freedom. These unwrapped elevations were used in a competition, utilising branching strategies, tie strategies, catenary, and arching. We employed almost every trick in the book.
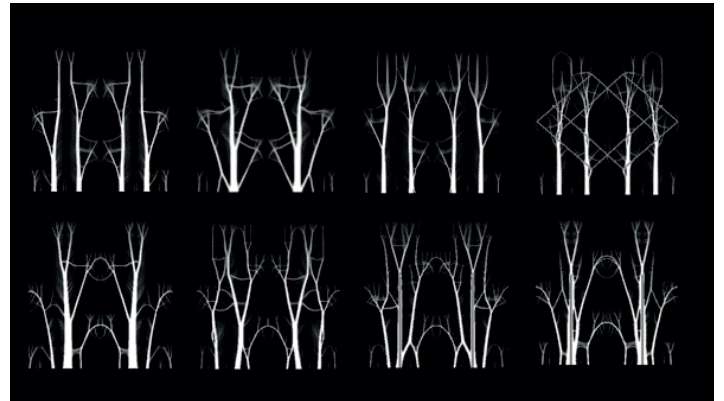
Figure 1 Topological optimisation heat maps of unfolded elevations of a high-rise building

432 Park Avenue
Topological Study

| Selected heat map | Selected heat map with framing | 3D wire frame | 3D wire frame (front view) | ETABS optimised 3D (sky-view) | ETABS optimised 3D (street-view) | Frame design |
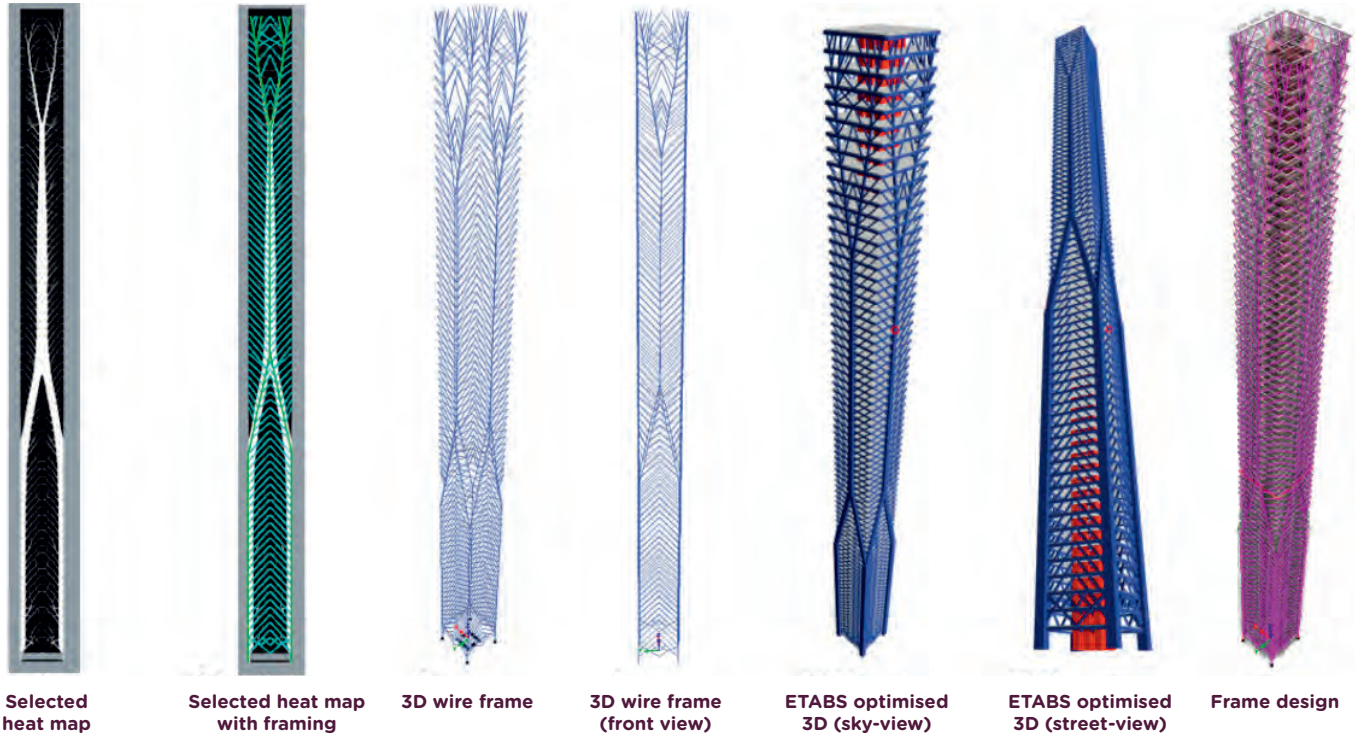
Figure 2 Topological optimisation heat map 432 Park Avenue in New York

As we started developing these geometric strategies, we carried out a case study on a recent building, 432 Park Avenue in New York, which is super tall and super skinny high-rise with an advanced and highly sophisticated structure shown in Figure 2. However, it is very orthogonal and cartesian, with straight lines and right angles everywhere. We wanted to investigate the potential for applying some of nature's strategies to such a tower. We applied the process of creating a topological optimisation heat map on the facades while keeping all the internal structure identical to the original design.

Then, we recreated the framing around the heat map, analysed and compared it. We found that we achieved incredible performance enhancement, with two-thirds improvement to the lateral performance of the tower, making it much stiffer. Additionally, we achieved a slight reduction in the structural mass of about 7.5%. It appears that by using nature's strategies, we can enhance performance with less material, achieving greater economy to create something that becomes more performative.

Clearly, the topologically optimised geometry is more complex than in the previous design, but advancements in digital fabrication and additive manufacturing are unlocking the potential for such geometric complexities. Once we started to investigate and develop our strategies to control geometry, we discovered a field of design optimisation or geometric optimisation where we can effectively manipulate geometry and control it using desirable objectives.
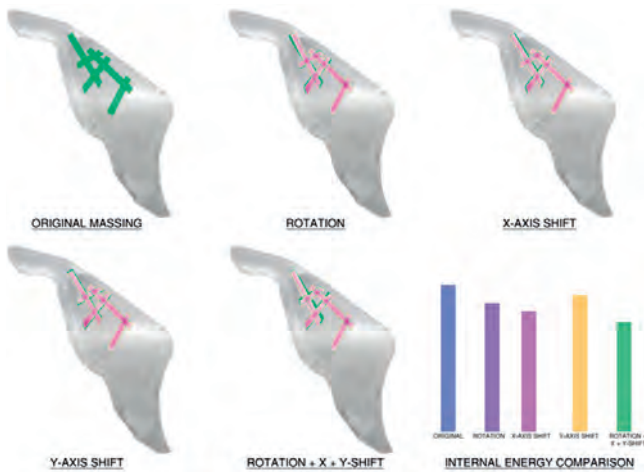
Figure 3 Geometric Optimisation

The geometry of the building mass in Figure 3, which contains very large cantilevers and long-span elements. We manipulate its geometry by tweaking the arrangement of the architectural massing, not moving them much but finding small geometric changes that provide large structural gains.

This includes shifting the adjustment bars on the bottom-right corner in Figure 3 such as rotating the top-left corner or the top-right corner in the X direction, by small proportions of the overall architecture.

What we find is that through small shifts, we can achieve very substantial gains. In this case, we could reduce the energy required by the building structure by about a quarter. This will reflect how much material is needed for the design, reducing carbon emissions, and cost.

Multi-objective Optimisation
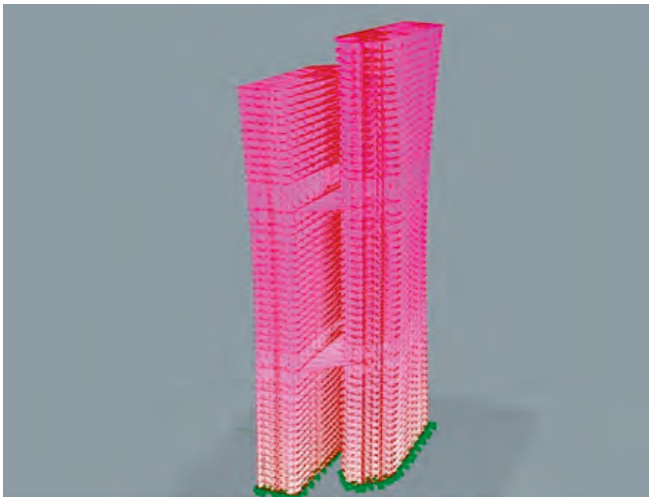
Figure 4 Multiple objective optimisation of 8 Conlay in Kuala Lumpur

We also developed multiple objective optimisation strategies in this journey of geometry. This is 8 Conlay in Kuala Lumpur in Figure 4, which will become the world's tallest twisted twin towers. We used computational design to achieve multiple objectives, incorporating both nature's objectives and architectural goals, as well as client goals within this optimisation to encourage the twisting of the towers while still enabling the balancing of the structures for even load distribution at the base.

These multiple objective techniques often have the best tradeoff quality, allowing us to find the best mutual solution for opposing objectives. We also developed techniques and strategies that allowed us to delve deep into form-finding and very nonlinear structures.

ADVANCED FORMFINDING

Figure 5 Paper sculpture in London

Simulated Reality
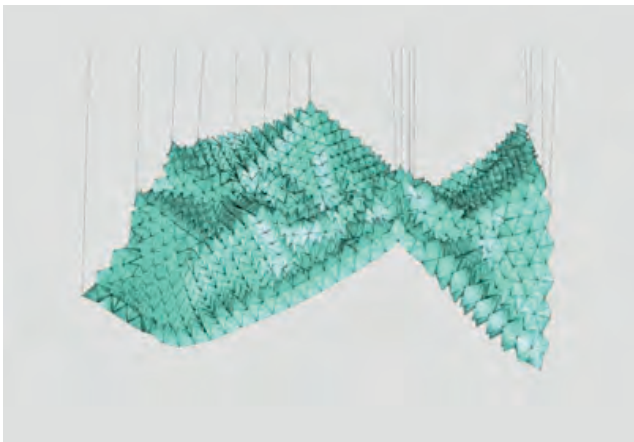
Figure 6 Form-finding simulation for a Paper sculpture

This next example is at the smaller end of the scale. Figure 5 is a paper sculpture in London. We developed an approach called simulated reality where we built physical test models to assess the real performance of the sculpture.

Then we tuned the computational design model as shown in Figure 6 to the physical results. We used this simulation to control this very nonlinear form-finding structure.

Once we had a final geometry, we exported it and analysed it, checking the stress at all of the interfaces between something like a few thousand paper tetrahedral units or Sonobe units, confirming that we did not need to glue them together; they could hold themselves just by friction.

We have also developed strategies that can inform a structure through, Newtonian principles, gravity well processes, some using physical guides or physical principles to develop the form-finding for a structure on a larger scale, incorporating other aspects of nature.

Gravity Wells
Airport Roof (Perspective Render)
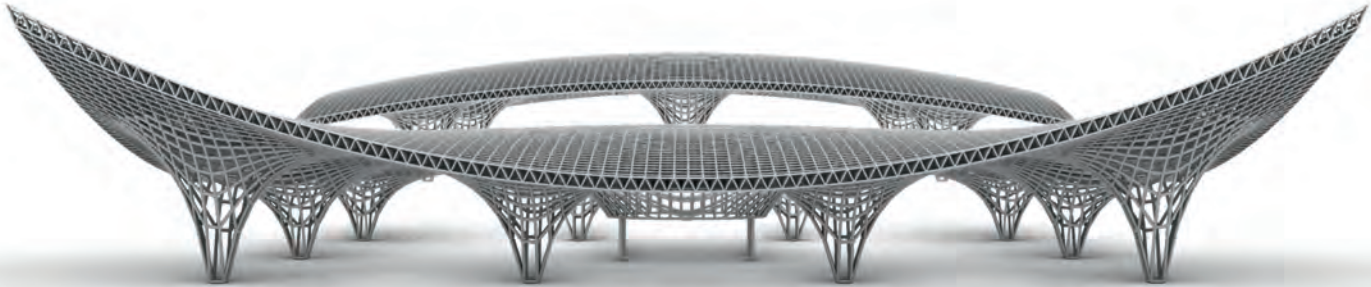
Figure 7 Form finding the geometry of an airport roof

For an airport roof shown in Figure 7, we use the principle of a gravity well to create these mega funnels that provide arching between the supports, enabling a long span and subsequent integration with MEP strategies. This allows for a simple parametric definition, but with underlying structural engineering intelligence. We can also encode additional layers of intelligence within the form finding. As you can see, the struts are adjusted based on certain rules.

This sort of form-finding approach can also be very complex and develop into far smarter techniques rather than a single-layer definition approach. We optimise the geometry as we're form-finding it.
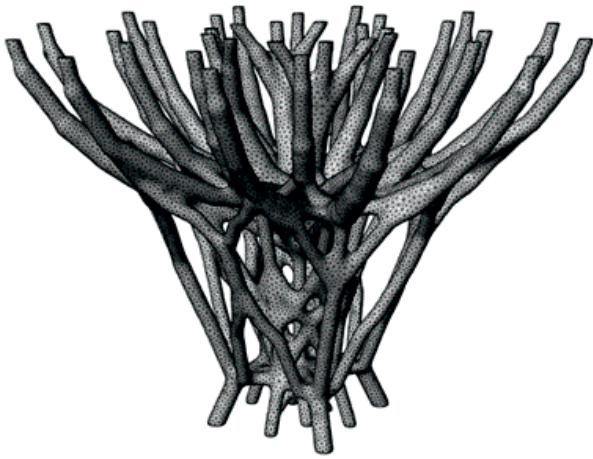
Figure 8 Structural Neurology - Meshed

On a smaller scale, we take inspiration from multi-noded structures, such as structural neurology as shown in Figure 8. We develop strategies that encourage multi-nodded structures to benefit strength and minimise material behavior. We took inspiration from Frei Otto, who carried out wet wool thread experiments in the 1990's and recreated the spirit and certainly the results using computational design tactics. We were able to recreate the process and apply it to far more complex boundary conditions, developing forms that have an initial logic to them but then develop into almost coral-like structures.
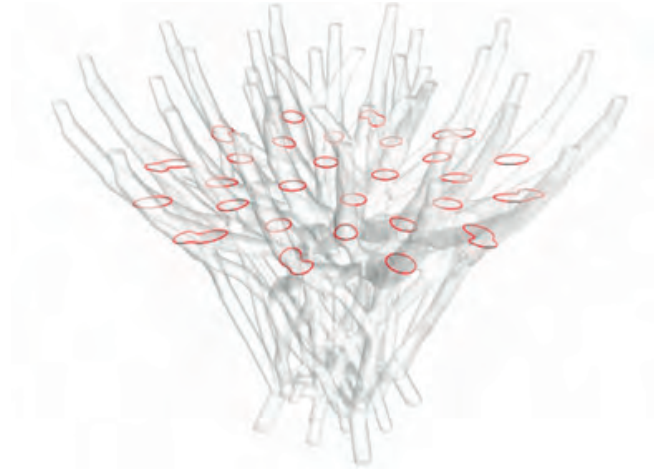
Figure 9 Structural Neurology - 3D Printed

On top of the form-found structure, which is a minimum energy structure, we can also apply other tactics, such as geometric optimisation to minimise energy. You can see how it encourages the curvature of the top branches. We then carry out analyses and put this together into a workflow, post-processing those results into a mesh, which creates this form used for testing complex 3D printing processes.

As you can see in Figure 9, despite the structure's 3D appearance being very complicated, on plan, there's an underlying regularity to all the structures. We believe that the ability to encode logic within designs and manipulate geometry to find complex but efficient forms is the cutting edge of technology.

Neurological Framing
Perspective render

Figure 10 Tree-like canopy structures

We have used this approach in other structures and competitions to create pseudo tree-like canopy structures.

These structures as shown in Figure 10 have the appearance of a branching or leaf-like arrangement. We believe that these tools and tactics are getting us closer to the mind of nature. Being able to design and reach solutions using modern tools that allow us to achieve similar results to how nature would grow a structure is an advancement that was impossible only a few years ago. Within this whole process of research, development, applying new tactics, creating new concepts, and applying technology to them, we develop workflows that enable us to streamline how we approach projects.

This is a workflow for computational design for the engine to drive speed, consistency, and a single geometric platform. Effectively, the Digimetric workflow enables us to generate geometry on a single platform in Rhino Grasshopper, export that geometry, and import it back to add additional details to the same geometric set.

Digimetric Workflow

1. Parametric Definition
2. Concept Studies
3. Structural Analytics
4. Geometric Refinement
5. CFD Simulation
6. Structural Optimisation
7. Drawing Production
8. BIM Model Generation
9. Construction Simulation

Within that same platform, we can also create drawings and export to BIM, etc. The time savings and consistency of the data are very important in this process. The step beyond this workflow, what we call holographic design, is the ability within the computational design platform to go further into analytics and detailing so that everything can be handled in a computational design space. We achieved this in a competition where we were able to develop the structure, carry out the analysis, and create an overall developed structural package fully coordinated with the architectural geometry at a super early stage.

This informative approach and the ability to apply construction-stage details to concepts rapidly enables us to inform clients and architects about the implications of choices and possibilities at a time when adjustments can be made to the overall design. Aside from capabilities, the potential in technology enabling us to inform decision-makers at a super early stage is part and parcel of the development of design at this stage. Through the intersection of design with technology from an engineer's perspective, we're starting to get a glimpse into the mind of nature.

Panel
Discussion

Ruth Norman-Johnson (Moderator)
Lars Ostenfeld Riemann
Richard Hassell
Jakob Strømann-Andersen
Robert Bamford

[Ruth] Thank you, Robert, for that great presentation. We'll now move on to the panel discussions. I'll invite all of our speakers back to the stage, and joining us will be Lars Ostenfeld Riemann. Lars is an old hand in Ramboll with 25 years of experience. Lars has had the opportunity to work on a number of the most challenging and innovative building projects in the world, pushing the boundaries of both sustainability and digital design. Welcome, Lars. Thanks for joining us.

[Lars] Thank you.

[Ruth] I'd like to start referring back to something that Rob and Richard both referenced.

You both showed how technology now allows us to understand and replicate nature in designs which has never before been possible.

Rob, you showed how this can drive efficiency in materials, creating more sustainable buildings, but my question to you all is,

how do you think this approach will impact people that interact with buildings? Do you ultimately think this is going to be a positive or a negative impact in the long term?

Can I start with you, Richard?
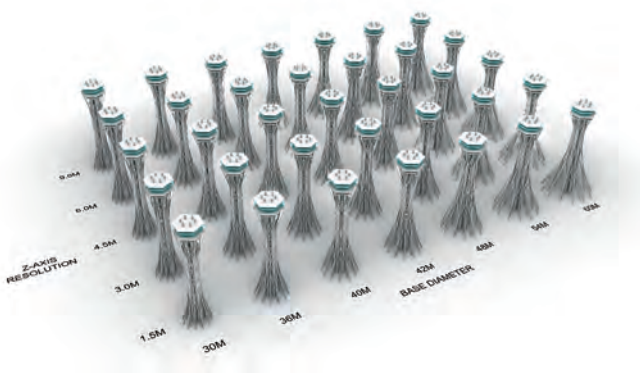
Generative Design: The transformative potentials of Generative Design were harnessed in this proposal for an Air Traffic Control Tower, showcasing dynamic adaptability through base diameter and z-axis resolution. Unlocking innovative form and function through computational creativity

[Richard] Well, there's a lot of research that biophilia actually has many benefits. There's an initial positive response, but there's also a creepy response as well that we can get with some nature patterns - that trypophobia insect fractal thing -triggers some other in-built reaction. I think that's something quite interesting. We've been playing with some of these aspects in our work and even in some art I work on and it's quite a fine line. They're both reactions that are instinctive by our relationship with nature already.

It's interesting that engineering and adopting these processes can evoke the same reactions that nature does. In general, I think we should be very positive. It's interesting because it seems to be not so much a cultural brain that's activated, but something much deeper, a sort of animal limbic brain stem or something that creates these reactions. That is something quite new in design in some ways and could be very interesting to study and work with.

[Ruth] Interesting. Jakob, do you have anything to add there?

[Jakob] No. I just have a question for Richard.

When people come and experience your buildings, is there a cultural difference in how they experience it and how they experience nature? Do you see it in this way or is there any understanding of that?

[Richard] Yes, we've seen some aspects of it. When we were designing some of these projects, we had a hypothesis that a very large object that's a building is quite intimidating because it implies there's a large bureaucracy or there's a powerful organisation behind it. If there's a large lump of construction expressed as a mountain or a landscape, you have a different reaction to it, it becomes something that's there and you want to explore.

We've really seen that happen with the Parkroyal Collection Pickering, for instance, because it's near our office. We observe a lot of tourists who see it for the first time and their first reaction is, "Ooh, I want to get up there. That looks like I'd love to be up there amongst the trees and see what it's like." They go towards the building and a lot of them actually go in and say, "Can I go up to the garden level and experience it?" I think that we have anecdotal evidence that there's quite a different relationship to a large planted object than there is to a large granite building, for instance.

[Jakob] I think I had the same experience when I saw your building. I come from Denmark, where it is so flat and often gray. When I saw that green mountain, my first thought was, 'I want to get up there to experience that building for myself.' I think it's very cultural - when you are attracted to something you don't have. I also think that's a great understanding of how nature and the built environment can be cultural.

PARKROYAL Collection Pickering

[Lars] If I can add, I think any building that is some element of biophilic design or some biomimicry and shapes is more exciting than traditional straight up straight lines building. I'm not doubting that future architecture will be much more inspiring and will make people wonder more and make people more comfortable and happier. I think it has that secondary effect.

[Richard] There is a scale aspect to biophilic forms, because we've been playing with certain things and we realised there can be an aspect of the monstrous. We're used to a certain scale of nature and elements that is we have an inbuilt sense of the natural size of something. If you have something that's particularly large and has this natural aspect to it, it quickly becomes grotesque or monstrous, and then you recoil from it. It's like if you're inside a giant serpent or if you are in something that feels like an enormous tree but you're shrunk down to the size of an ant, it does something strange to the way you react to it. I think they're all interesting things to explore.

Oasia Hotel Downtown

[Robert] I think, as we can see behind Richard's background, (referring to Richard's green wall zoom background) shown very nicely, all of the angles are natural. There are no straight lines and there are no right angles. Through these processes and tools, which are effectively still in their teenage years, if not quite their infancy, we have established that we can find efficiency in these natural forms. I think we will start to find more of a blend of transition between the old-school built environment of rectilinear extrusions and the more natural shapes.

I think as fabrication technology evolves and catches up with the level of design technology, it will enable the fabrication of more complex shapes with better economy, so that cost drivers do not force everything to be designed as rectangles. I believe this will result in a more blended and engaging built environment. I appreciate Lars's use of the word "comfortable", as I think we will find greater comfort in the built environment of the future.

[Jakob] Robert, I have a question.

Do you think they will create the same reaction when you work with structurally optimised roof shapes that imitate nature?

Does that give the same understanding of nature as Richard's projects, a leaf, or - looking back to Pier Luigi Nervi - how the structural logic of forces reacts in concrete and steel? Do you think that can create the same reaction from people as real nature? Have you experienced that with some of your projects?

[Robert] I think it really depends on the design direction and how far we can drive aesthetics through efficiency. The aesthetics of efficiency is a topic that excites me. How do things look when efficiency drives everything? Sometimes, it depends on the intent of the starting envelope. Sometimes designs can turn out looking very natural when we drive these processes through them, very comfortable.

Other times they can look quite alien. It turns out there's not much difference between alien and natural in terms of engineering design. In terms of how we appreciate the two, there's a strong difference in emotion. From an engineering force in geometry, the two are very similar. How we respond is something that only time will tell.

We look at what reactions it elicits when we study these designs. Sometimes people react by saying these designs look like a flame, smoke, or fire. Some people see forests or X-rays, and others see trees, even when looking at the same image. It's almost like a Rorschach test. It's an interesting topic.
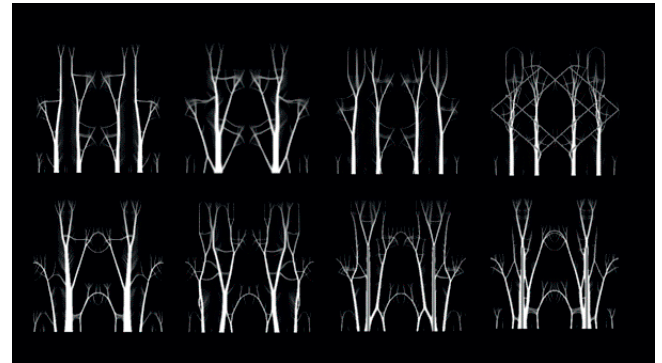
Topological Optimisation: Unlocking natural efficiency for an unwrapped elevation of a high-rise building façade structure

[Richard] I think with those forms, the reactions will change over time, because when we're confronted with new forms that don't come with cultural baggage, we start reacting individually and some people react one way or another, but as time goes on and the forms became associated with certain things, you learn to have a shared reaction with the rest of the culture. That's quite hard to predict, because that aspect of alien that you talked about is where you detect that there's order and organisation in something, but it's not familiar. It feels like it came from an alien civilisation. If you grew up around those things and you see them as human creations, you would just think it's a cultural object that you recognise and understand.

[Ruth] That brings us on nicely I think to one of my thoughts I had when I watched your presentations was that, historically, a number of you said, "We wouldn't have been able to understand these kind of forms and shapes, let alone draw them and replicate them, let alone build them." I want to pick up on what you were just saying, Robert, about how technology is moving forward.

Jakob, you showed us a number of ways that technology is being adopted in the construction of buildings. Do you think that technology adoption in that construction is keeping up with the evolution of what we can design and what we can create? Where do you think the next steps will be there to actually make these forms a reality and to change the landscape in which we will live and interact? Can I start with you, Jakob?

[Jakob] Yes. There is this discussion in our studio. There has been a tradition of architects being a bit afraid of technology - that it is pushing us away from "real craftsmanship." Technology is a tool to get us back to the building site or to what we call "digital craftsmanship." It's a new kind of craftsmanship: an understanding of how things can be manufactured through robotics or digital manufacturing methods. It can bring a new way of designing into our studio.

It's much like coming back to the building site to understand how things are manufactured and taking more ownership of it. I think from our perspective, this new technology is not making the architect more alien. In fact, this new technology makes the architect more hands-on, one-to-one, bringing architectural ideas back to the studios and taking more ownership of whole value chains.

In the building industry, we have been so fragmentised as architects design, and engineers produce structural analyses. I know, all-around, the screen today is trying to merge those value chains. The industry is very divided and separate. Actually, new technologies can make the design process more streamlined and integrated. I think there is great potential.

I think it also needs to be described, translated, and shown in cases because I understand that technology is something we should be aware is not a tradition of architectural studios. I don't know, Robert, maybe I can put the word back to you.

[Robert] Yes, I am happy to continue.
I completely agree that one of the great strengths of computational design is its ability to integrate constructability considerations at an early stage in the design process. As you mentioned, Jakob, the design can be based on constructability criteria itself.

For example, we are currently working on Modern Methods of Construction (MMC) and developing workflows that take an architectural massing, whether it's complex or non-rectilinear, and algorithmically slice it into modules to maximise repetition and ensure that the volumes are suitable for transportation requirements.

This is just one example of how an integrated workflow can be created. Instead of the traditional approach of designing first and then passing it to a contractor who may find it inefficient or require substantial changes, computational design allows for an informative approach where the entire construction process is considered from start to finish at an early stage, and designs are based on driving criteria. I believe this is a very powerful tool.

[Lars] Yes, I was just saying, you almost have to decide how you're going to fabricate the components before you start the design because it's one of the main criteria.

When I look at, for example, 3D printing, it's a technology searching for a purpose. In the beginning, 3D printing didn't make any sense because we were still designing straight lines, so straight walls, and why would you 3D print those?

Once you start designing more connected shapes, then 3D printing starts becoming relevant. If you have that technology at your disposal from the outset, then you can also do your design to fit the manufacturing technology.

[Robert] It will be an easier day for us when additive manufacturing and 3D printing have the capability and cost to produce building products competitively. At the moment, we end up doing a lot of work to post-rationalise complex designs in meaningful ways with a bespoke modularity process. I think 3D printing is going to be an absolute game-changer when it becomes competitive with what we call traditional or even advanced construction techniques that we have. It will bring a new level of capability, for sure.

[Jakob] I just have a comment.

[Ruth] Go for it, Jakob.

3D concrete printing

[Jakob] I fully agree with Lars that the things we see with 3D printing are like traditional houses with doors and windows. That is not the way to go.

We need to rethink the way we design with 3D printing and technology. We should continue to change and rethink aesthetic expression, pushing the boundaries of architecture. I agree with Robert. To do this, we need to understand the technology before understanding the design.

If there's a robot that assembling bricks on a construction site, it doesn't concern different types of bricks. However, by incorporating this methodology into our design, we can create more diverse facades of higher quality.

I think that with this understanding of going back to the building site and exploring innovative manufacturing methods such as 3D printing and robotic manufacturing, we can incorporate these insights into the design process. This approach enables us to create new forms we haven't explored previously and ensures a higher level of quality and a more intricate aesthetic.

[Richard] I was just going to say, I think it's really a difficult transition for the market. It almost needs a starting-from-scratch business that may totally replace normal contracting, where a building is, designed, developed and built by 3D manufacturing, where the whole chain can be re-engineered within a single entity. Because at the moment, there are many processes, divisions of responsibility, regulations, and the legal aspects that make it really difficult to implement this sort of thing.

I'm imagining that it could be one of these huge industry disruptors where companies that start 3D printing accommodation, single-story, end up becoming the new multinational engineering company that does enormous infrastructure projects, just because it's impossible for the other market to disassemble itself and put it back together in a way that works with these methods.

[Lars] Yes, I fully agree with that. In the EU, for example, there is a regulation in place that has been almost conserving. It's been protecting traditional methods and harming innovation. As a result, because this was recognised a few years ago, there is a new regulation that has come out that is about innovation, procurement, and how you are allowed to not procure in the same way as in the past if you have an innovation objective.

I don't know about the rest of the world, but obviously, you cannot just go out and find 10 different contractors who can 3D print a building. You have only one leading contractor who can do it maybe. You might not even have that, but then you have to develop the technology or develop the setup to deliver a certain ambition that you have, a certain design. It's going to be really a disruptive thing going forward.

[Robert] We'll need some brave clients too.

[Lars] Yes.

[Richard] Yes. This one. I think the client's probably going to be the guy with the machine.

[Robert] Yes.

[Ruth] Okay. There are some big challenges to that adoption and to some fundamental changes we're talking about there to our industry processes and our procurement and all those factors, but there's a statement you said in your presentation, Richard, where you said we have to start trusting the black box.

We are inherently a risk-averse industry. We're looking for certainty. The consequences of failure are significant even on just one project. As an industry, how do you think we will and can overcome these fears associated with adopting technology?

Richard, I'll just start with you.

[Richard] Yeah. I think it's a real challenge, not only trusting the black box but also, in some ways, the disappearance of authorship from design is also something really threatening and difficult to deal with. My presentation had a strong thread of that in it. We end up having a relation to the black box like we do to nature. When we look out at a garden, there's all kinds of things happening there at the atomic level and the cellular level that we still know nothing about, but we have become used to the fact that it's a kind of reliable process we've built-in variation but we have a sense of what's going on and we trust the outcome. And you know, like the sun rising every day, no one knew how that happened for a long time. But you get used to it and there will be some kind of process like that where there are trustworthy procedures with testable outcomes and we just get used to there being a bit of a mystery.

[Ruth] Rob do you want to comment on this? Some of the forms, structures and approaches you take are quite unique. So how do you help people get to those new concepts, new ideas, new thinking?

[Robert] I think fundamentally, people do trust buildings. You know the codes of practice that have been established for a very long time. People expect their buildings to do what they're designed to do to the point that people almost don't really realise how buildings are designed. And even when I explain what my job is to friends and people outside the industry, they might come back and say, "Oh, so you're an architect?" It's like, no, it's slightly different. So the engineering of buildings in itself is kind of almost so trusted that people don't realise it happens, which I always find interesting.

But I think in terms of some of the form-finding and more complex, sort of geometric work that we do, I see this as an additional layer of design work that precedes all of the standards and all of the other checks that would normally happen. So, in effect, it's additional layers of testing everything that we do. All of the geometries that we discover or end up with still go through the same process. Part of that process has been to find very good ways of being able to export models into geometric models and industry-standard software that has been used for a long time and is the most reputable and trusted platform for building design across the globe.

So, in terms of the analytics, the complexity is much more in the constructability of things at this point and that's where I think we're seeing the hardest transition. I think maybe about maybe five years ago or a bit more, I think that it was probably the time when an architect could probably draw any shape and they'd approach an engineer and ask, "This is what we're after, can you design it?" And the engineer would have to simplify the design so they could analyse it. But around about five years ago, I would say somewhere around there, is when engineers caught up. So, at that point, I remember telling people, "Any shape you draw, we can analyse it now. We don't need to simplify it, we can analyse it. It doesn't mean it's going to work, but we can analyse it."

I think the next step is where the constructability aspects come in, so that any shape can be constructed and competitively costed. I just see these processes as additional layers of security almost. We're still using the same processes to validate structures that we were using beforehand. It's just that we've added more design intelligence preceding that process.
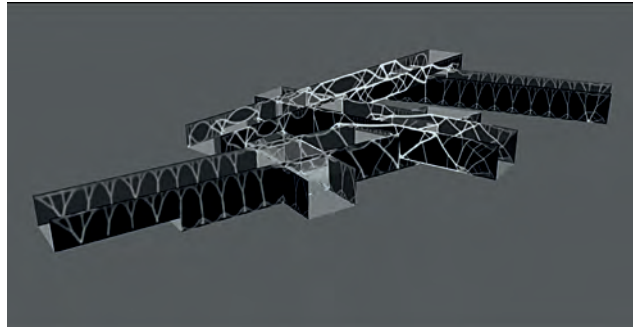
Topological optimisation

[Richard] But Robert I can imagine a scenario in the future with so many multi-factor things being pumped into the programs and you know Midjourney being hooked up to biomorphic structural design.

Say you threw in a whole lot of hazard analysis too, like planes being flown into the building and other hazards that would also be factored into the design parameters. I could imagine in the end you would look at a plan and go "I have no idea what that thing is for". Maybe if you unpicked all the processes you would discover the mystery element derived from the plane hazard and so this element had been enormously enlarged. But at first glance the plan would be incomprehensible because it was based on so many complex parameters. And at that point I think we would start to lose any sense that we understood the building as we as professionals do now.

[Robert] I agree with that. I think fundamentally, we still need to have a very strong concept in our designs. Computational design, as described by Richard, doesn't sound like a good outcome if it results in real-time adaptation without understanding why things are done for certain reasons. That would be unfavorable. However, one of the great uses of computational design is being able to distill very clean and clear concepts that use more complicated geometry to achieve them, but they have an underlying simple logic and concept.

Over the last few years, going on this computational design journey through structures, we found that our concepts have become much purer, more distilled, and more aligned with the architectural vision. Sometimes, the architectural vision aligns with the structural concept, and I think that always helps.

[Lars] I think this is where engineering and architecture has to kind of come together and be developed as one. Being a structural engineer, I can see there's a lot of learning that we have to go through and if you look back in time you know there were thick books written about just how to design a concrete beam or a steel beam and now we have to design something and there will be a lot of knowledge. I think one principle that we have to that is healthy to apply is kind of the hierarchy of structures. So if you are designing a very big structure you first design the basic mega structure. As you said, Rob, it's something that is simple and you can understand as an engineer so you trust that this is designed in a way that will work and then you design the secondary items, and the search area items and so on so there is a higher altitude that you understand each of them.

[Ruth] Jakob do you have any thoughts on this? How do you see your clients overcoming the challenges that come with adopting this technology?

[Jakob] We are very much looking into what we call 'regenerative design.' Robert is saying we set a lot of parameters, and then we make the algorithm come up with the answers. However, the algorithm does not come up with the answers. It comes up with a span of solutions (about 10,000 different solutions). We tell our clients that algorithms do not come up with answers - they instead offer design directions.

Clients like an overview they can pull in one step - whether that be more square meters or volume changes into new possibilities where they can benchmark the business case with every iteration. They often prioritise the ability to quickly assess and request more square meters, leading to a transformation into a new concept allowing them to effectively benchmark the business case by considering various iterations. I think this is the way forward – using those algorithms and technology to get an overview to understand the business case, parameters, and risks in projects.

That is how we use regenerative design, and parametric design is not to find the optimised answers. It is not always necessary to agree with the optimised solution, as it may be challenging for anyone to explain why it is the most optimised one. We must document and understand the underlying concept. No one has to agree with Robert because if you find the optimised answer, no one can explain why this is the most optimised one – we need to store it and put a concept behind it.

"

Technology can help understand parameters and how they affect the environment, the business case, and the risks. From my perspective, I see technology as something we should not be afraid of. We should use it to create better and more sustainable architecture.

Jakob Strømann-Andersen

[Ruth] Brilliant, I think that makes it very approachable.

We Shall Not Cease From Exploration...

Session D

Design
x Ethos

In order to collaborate as professionals, we need a process that regulates the relationship between the different parties; a process that can be driven by purposeful design. This process should start by listening. Listening to the needs of the clients and the society at large, then combining technical expertise with a creative attitude and competence to develop design systems that surpass the ordinary. Creativity requires rigour and hard work. It is energised by exemplary competence and by a disruptive attitude which encourages one to question the status quo and to explore new ideas. This is how a design-centric culture and ethos is created everywhere; from small design studios to large design-oriented corporations.
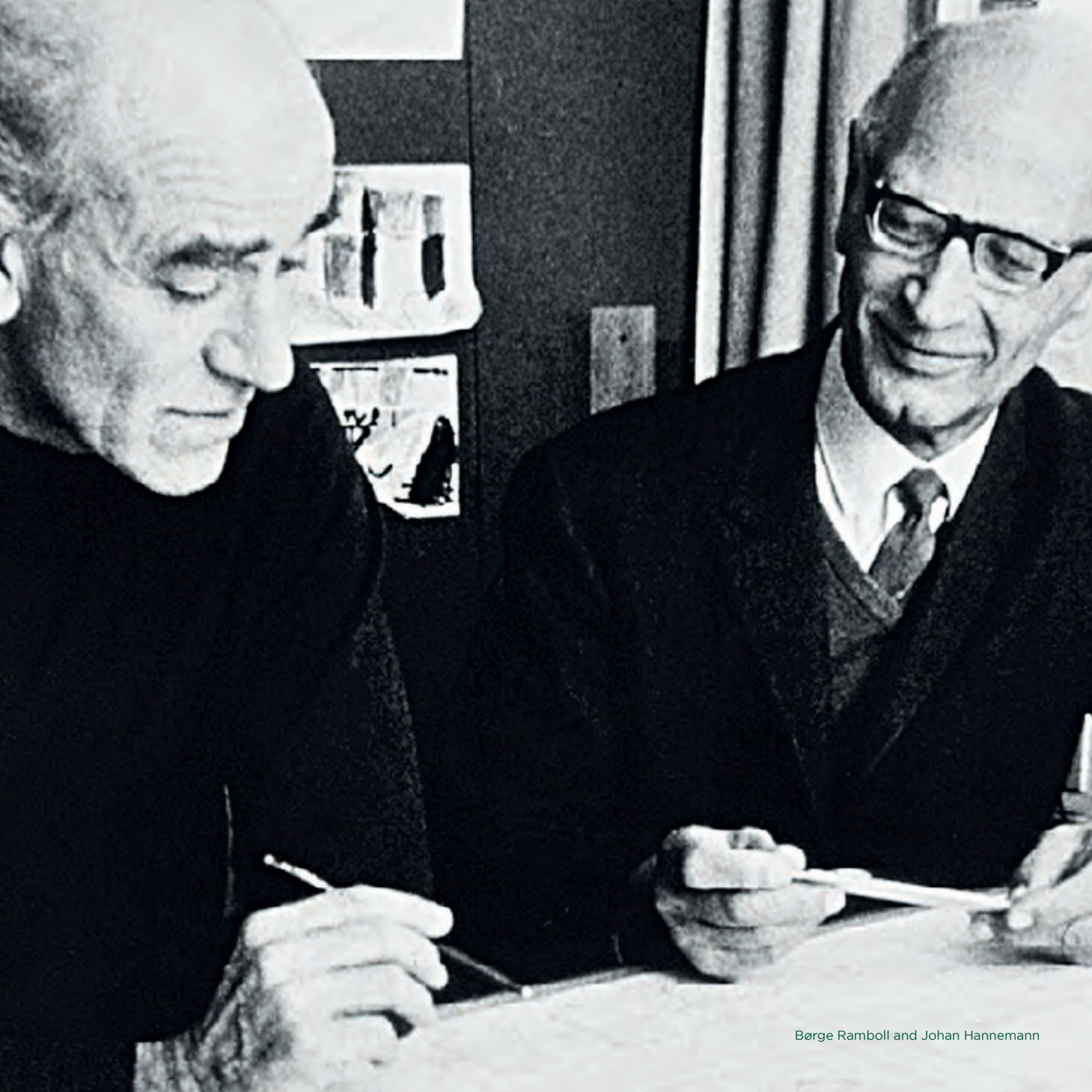
Børge Ramboll and Johan Hannemann

Scandinavian
Design Heritage

Louis Becker

Global Design Principal, Henning Larsen

Louis Becker has played an integral role in the internationalisation of Henning Larsen and remains a driving force behind the vision of expanding the practice's global impact.

Henning Larsen's Ethos

For Henning Larsen, architecture is fundamentally about staging human interaction. This means that we are designing the backdrop of what people are doing, how they meet, and how they live. This is important as a fundamental way of looking at architecture.

Our design community is global and diverse with people around the world. However, we have a unique blend of cultures present in Copenhagen that enriches our design culture with different perspectives and ideas. The Scandinavian way of life is deeply embedded in our approach to architecture and sustainability.

Our roots are firmly planted in Copenhagen, and it's more than just a physical location. It's a way of life. Our upbringing in Denmark has heavily influenced our design philosophy, as we were raised in a society where design permeates every aspect of our daily life, from the culinary ware we use to bridges and city planning. This fundamental appreciation for quality of the society has been instilled in us since our earliest days in kindergarten.

Connecting communities

At the heart of our design ethos is a commitment to fostering connected communities, which is one of the core values that we strive to bring to every project we undertake. Figure 1 is a city hall, in the Faroe Islands far off in the Atlantic that connects two different municipalities into one. The city hall goes across the stream.

Figure 1 Eystur Town Hall, Faroe Islands

Facilitating the unexpected

We enjoy designing for the unexpected, and it is unexpected that this is a rooftop of a museum in Figure 2. Since the opening of this museum, we have more kids on that roof than visitors in the museum.

Figure 2 Moesgaard Museum Aarhus, Denmark

Designing at eye level

We strive to design with a focus on the local context, taking into account the cultures and places we design in. For example in Figure 3, in Toronto, where we are currently developing a master plan, we are conscious of the climate conditions that shape the city, including the harsh winters and beautiful summers.

Figure 3 East harbour masterplan Toronto, Canada

Figure 4 Bastille Opera Extension Paris, France

Figure 5 Harp Reykjavik Concert Hall and Conference Center Reykjavik, Iceland

Openness instead of opening hours

In order to create welcoming spaces, we aim to design at eye level and encourage accessibility for all visitors, regardless of whether they have a ticket or not. Our goal is to signal an invitation to the wider community, fostering a sense of belonging and connection. Figure 4 shows the Bastille Opera in Paris.

Creating destinations

Architecture can create captivating destinations that become vibrant hotspots for human activity. An example of this is shown in Figure 5 the Harp Reykjavik Concert Hall and Conference Center Reykjavik, in Iceland.

In Henning Larsen, we have three different professions or tracks in our practice:

Architecture

Urbanism

Landscape

We truly believe that a successful project encompasses these three components.

We have engineers, PhDs and architects working together collaboratively. 12 years ago, we started this program which currently comprises of 22 full-time researchers specialising in architectural landscape and urbanism. The fusion of these disciplines is paramount, as they collaborate side by side in the studios around the world. This integration yields a distinct and unique approach to architecture.

When commencing a project, we prioritise examining the microclimate as a crucial factor. While we also consider other aspects, understanding the microclimate holds significant importance in our design process.

Starting with the microclimate

We participated in a competition in Germany, where we were presented with a masterplan. Upon examining it, we quickly realised its flaws as it accelerated the winds and made the area really uncomfortable to stay during winter. In response, we redesigned the whole thing for the competition, presented our findings to the client and we got selected as the winning scheme for the project.

Upfront Embodied Carbon

Currently, our team, including Henning Larsen, Ramboll, and other esteemed colleagues from around the world, is actively engaged in carbon-focused work. Understanding and implementing carbon-conscious practices has been a learning process for all of us. As an example, we have a collaborative project in Copenhagen with Ramboll that has a carbon reduction of 70%. It utilises wood construction over traditional concrete structure. It is important to understand the upfront embodied carbon even during the early design phase of a project.

A nature-centered remake of the office typology

Our approach involves integrating biodiversity not only within buildings but also on, in, and around them. In a project in France, we explored different office typologies that draw inspiration from nature.

It's about scaling

We actively engage in numerous research projects to improve and expand our knowledge. One important aspect that arises in our discussions is the need for scalability in our work. If our ideas and practices are limited to small-scale applications, they may not hold significant relevance as a practice overall. Therefore, we strive to ensure that our approaches and solutions have the potential to be implemented on a larger scale, enabling us to make a meaningful impact in our field.

For instance, when testing materials like walls made of straw and clay, we envision their applicability in modular construction for much larger projects, spanning an area of 100,000 square meters. By adopting this perspective, we can assess the feasibility and long-term potential of such solutions, ensuring they align with our commitment to impactful and scalable designs.

3D Printing

We extensively embrace technology in our work. What really fascinates me is how it has brought architects back to having a close relationship with the construction site and the construction process. For many years, technology has kind of taken us away, as we would deliver computer files that somebody else has reviewed and changed. The final version of something that was built, has been put through a couple of iterations where the architects were not directly involved. However, things have changed and now we are the ones directly working on the print files directly, which grants us a direct responsibility and influence over the construction site.

The project I am referring to is located in Copenhagen and involves the construction of social and affordable housing. The curves of the walls and the tactile elements that we envision for this project would never have been possible in a traditional affordable housing development. However, with the utilisation of robots and 3D printing techniques, we now have the opportunity to pursue these design options. It is truly amazing, as it opens up countless opportunities for all of us involved in the field.

Methodology
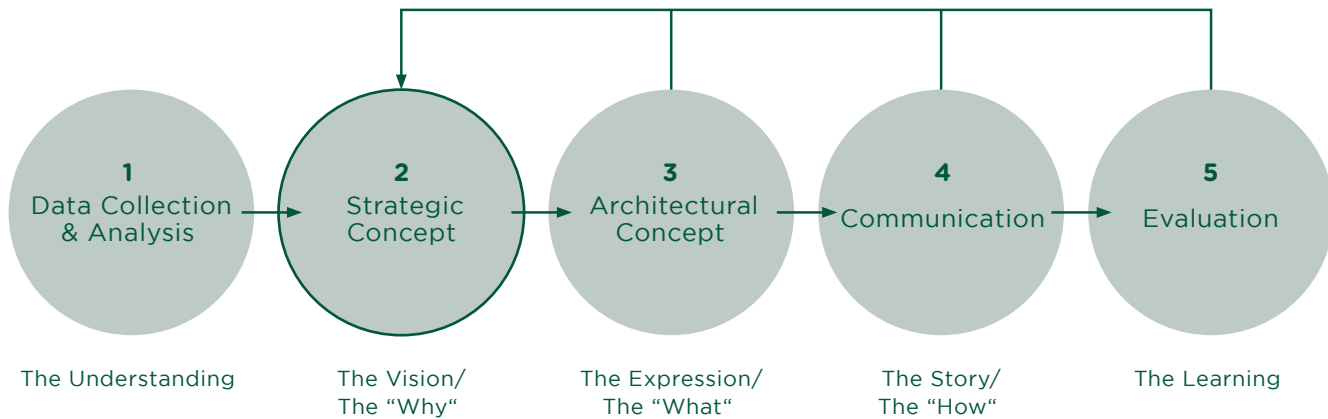
Many years ago, we faced a challenging situation when we lost approximately 12 competitions in one row. It was an incredibly tough experience and we were perplexed because we believed our projects were outstanding. However, we discovered that while a lot of the projects were architecturally impressive, they failed to address or incorporate the specific requirements outlined in the brief.

To address this issue, we devised a design method where our designers ensure a comprehensive understanding of the project's essence. The Strategic Concept is what really nails the whole project even before considering the design, architecture, landscape, or urbanism. This emphasis is crucial. Moreover, it serves as a means of collecting data, utilising it effectively, focusing and prioritising the crucial elements. This approach allows us to make numerous decisions prior to commencing the actual design process.

New Faculty Working Environment

Verify the overall sqft

Create the Marketplace

Economy

Connecting the Business School to Cincinnati

The Strategic Concept for a University

New Learning Spaces

"Campus Hierarchy": Creating a new Plaza

LEED Platinum vs Gold

Solve traffic issues on site

This is a strategic concept that was developed for a business school in Cincinnati, Ohio where we had issues with the budget. After winning the competition we collaborated and designed with the university. It garnered unanimous agreement, with everyone committing to its implementation. The results were truly remarkable. We managed to secure the necessary funds and restructured the entire project brief accordingly. This approach led to significantly improved efficiency and optimal utilisation of available spaces. What made this endeavor particularly successful was the high level of involvement from both the client and the end users, including Ramboll. We fostered an open and transparent process that encouraged active participation and collaboration.

Our primary objective is to balance among three key aspects.

Artistic Quality

Knowledge

Professionalism
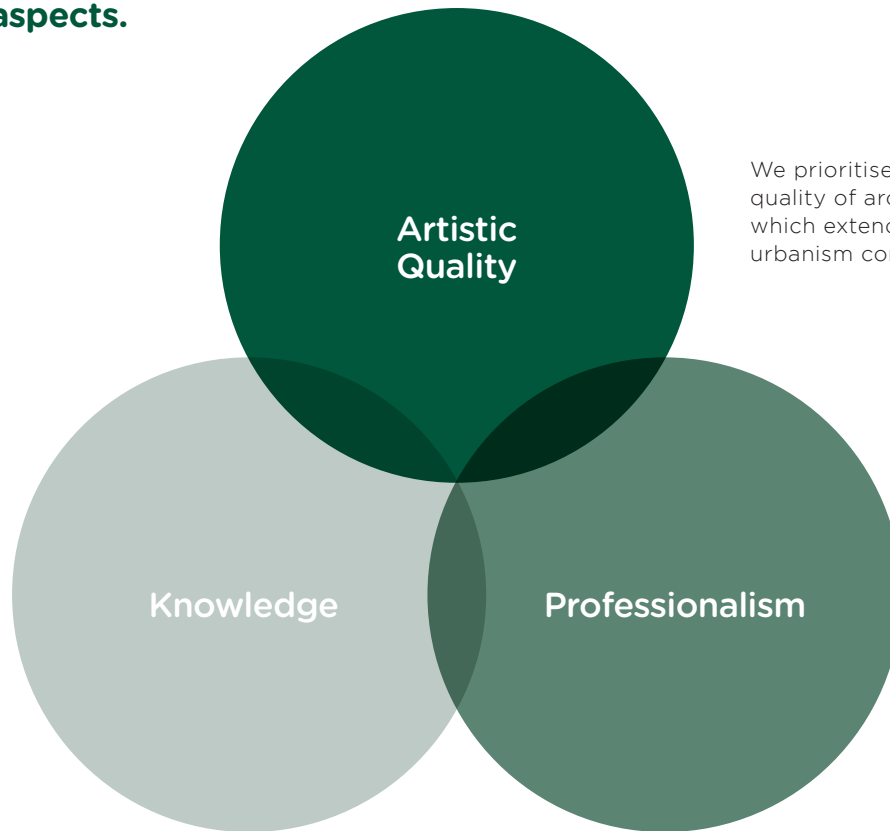
We prioritise the aesthetic quality of architectural design, which extends to landscape and urbanism considerations.

We ensure that our work is infused with knowledge, drawing from our research team, as well as valuable partnerships and collaborations. This enables us to stay well-informed and up-to-date in our approach.

We place great emphasis on delivering projects in a highly professional manner. We recognise the importance of not only excelling in architectural design but also having the necessary input and knowledge to support our designs effectively. Internally, we prioritise ongoing discussions to maintain balance and give proper attention to all three aspects. Our focus is on evaluating the integration of these elements and assessing our progress towards meeting our goals. This continuous evaluation allows us to uphold our commitment to excellence in every aspect of our work.

Figure 6 Cockle Bay Park, Sydney, Australia

Projects

I would like to showcase three different project typologies, each of which shares a common characteristic: they are all large-scale projects. While we genuinely appreciate and cherish small-scale projects, there is a distinct recognition that large-scale undertakings have the potential to make a profound impact.

Our current aspiration involves a small church in Copenhagen; however, we recognise that such projects may not yield significant societal transformations. It is through monumental endeavors that we truly shape and improve people's lives. Therefore, if we desire to assume responsibility for design on a Henning Larsen Ramboll scale, it is imperative that we direct our efforts towards substantial projects.

Cockle Bay Park, Sydney, Australia

This competition centered around constructing a significantly large-scale tower in the densely populated Central Business District (CBD) of Sydney, the capital city The site itself immediately caught our attention, prompting us to ponder how we could incorporate a building in such a location. To tackle this challenge, we extensively examined the existing context of Sydney and dedicated time to comprehend the community's deep attachment to the city's historic quarter.

The essence of old Sydney, which captivated us, was its distinct smaller scale, resembling a place like Italy. In contrast to the towering structures seen in New York, we recognised the importance of delivering a big tower while preserving a meaningful urban scale and fabric that contributes positively to the city. Our approach involved integrating a village or small town typology at the base, with the tower emerging harmoniously as an integral part of the cityscape. Additionally, we prioritised the inclusion of park-like green spaces that seamlessly extended from the ground and grew alongside the project as it reached towards the sky.

Environmental Strategies

We had some ambitions in sustainability:

- Biophilic & Environmentally Designed
- Green roofs
- Social activity & creating a community
- Sea water cooling
- Solar Photovoltaics
- Waste management with a high focus on organics
- Water management collecting water – Park + cooling towers

In a competition, we spent most of our time designing the podium or the village scale of the project. The main focus was on promoting diversity. The aim was to create spaces that offered opportunities for hiding, sitting, dancing, and meeting friends.

With the pleasant climate in Sydney, it was easy to create a mixture of both indoor and outdoor spaces.

Additionally, we incorporated a motorway, which runs just below the park to the edge of the building. By placing the park on the top of the motorway, we enabled access for people coming from the city center to simply walk up to the park, eliminating the need to cross a large motorway.

The focal point of this project is the eye level, which we extensively tested the project and the building meets both the ambition and expectation of what constitutes a pleasant environment. This is one of them from the waterside and inside, it's about these places where you have a F&B (food and beverage) but you also have open public spaces without any commercial use, and then combined with the shops and retail further. It offers a combination of F&B establishments, open public spaces free from commercial use and additional retail options.

The parkscape plays a crucial role in the overall design. On one side you have the waterfront and the village-scale buildings while the park provides a quieter atmosphere. By placing the park on top of the motorway, this city space transforms into a remarkably pleasant and serene area. It becomes an ideal spot to sit, enjoy a coffee, meet friends, and spend a leisurely Saturday afternoon in the shade of the trees.

Wolfsburg Connect, Wolsburg, Germany

The total area of this project is 284,000 square meters, with the first phase covering 100,000 square meters. It is an extension of the city of Wolfsburg, located next to the Volkswagen factory and it is divided by a canal.

The objective is to enhance the quality of Wolfsburg, establish new facilities for Volkswagen and transform this region into an attractive destination near Berlin. Currently, the site comprises a vast area predominantly occupied by cars, serving as parking space for up to 8,000 vehicles. Adjacent to the canal stands the factory, featuring an impressive uninterrupted 1.3-kilometer-long facade. With a workforce of 72,000 individuals, it holds a prominent position as a significant workplace within Europe.

This is about revitalising and transforming a city. Adjacent to it, we can observe an impressive project, the Phaeno building, designed by Zaha Hadid Architects. It is situated in the station area. Through extensive testing and research, we soon realised the necessity of constructing a bridge to connect to the other side. In the mornings, countless individuals traverse Nordhoff-Strasse, a street that sees more traffic than even the renowned Champs-Élysées in Paris, France.

It's a neighbourhood that has been created, forming a complete community while also connected to the prominent street known as Porschestrasse. Naturally, the automobile plays a significant role here. The Beatle, known as Keyvany in German, embodies the essence of this place, reflecting its prominence during the 1960s in the city. It also pays homage to that era and embraces its legacy. Our design process was driven by immersive experiences, envisioning moments of tranquility and envisioning individuals as they go about their day in this vibrant environment.

One of the primary challenges faced by companies like Volkswagen is attracting young talent, especially when their large facility is located far from the city center. In this case, the distance from any city center poses an additional obstacle, requiring the creation of attractions that make it reasonably appealing for young people to reside there, even if only during the week. To address this, we developed a composition of interconnected buildings, designed with a strong emphasis on maximising daylight conditions. This includes multiple hotels, extensive parking facilities, and numerous offices that are all interconnected. The overarching goal is to create an environment where the city opens up, fostering a sense of openness and accessibility for all.

Figure 7 Wolfsburg Connect, Wolsburg, Germany

Figure 8 Innovation Valley

Innovation Valley

This project showcases various workspace sections on the upper floors. It serves as a hub for collaboration between larger corporations and smaller enterprises. The ground floors are designed to be open and accommodating, housing both food and beverage establishments as well as companies such as Volkswagen. Additionally, it provides a home for smaller companies situated adjacent to the prominent one on the opposite side of the canal. There is a big tower located next to the station and bridge. As the station is a listed building, careful consideration is given to integrate the design harmoniously with its presence, which is precisely what we strive to achieve.

Extensive effort, creative thinking, and careful planning have been dedicated to maximising our sustainability agenda within this project. First and foremost, the wood structure of the building holds great importance. It incorporates tiers that align with the size of the grid and column structure, among other considerations. Another crucial aspect is the ventilation system, which has been carefully designed. Our aim is to maximise the potential of each element within the project. Inside, the atmosphere is distinct from the traditional Volkswagen setup. It embraces a wooden structure, creating an open and inviting ambiance. Collaboration and sharing are encouraged, while specific areas are secured with swipe cards to safeguard sensitive company designs. Essentially, it embodies a more open-source approach to contemporary work practices.

We collaborated with an exceptional London-based company on this endeavor. One aspect that exemplifies our approach is the transformation of parking spaces, reflecting their quote "From not missing much to not to be missed."

World of Volvo Gothenburg, Sweden

This is the brand headquarters for Volvo in Gothenburg, Sweden, and it is currently undergoing construction. We are in the final stages and expect to open within the next year. This project is of grand proportions, featuring a massive 100-meter circular roof that covers the expansive exhibition area where cars, trucks, and large construction machines are showcased. During the competition phase, our primary focus was to deeply grasp the essence of the Volvo spirit which was all about security. The core principle of Volvo cars lies in ensuring your safety not only within the vehicle but also in its surroundings. Proximity alerts, braking systems, and other safety features are incorporated to provide a secure driving experience. Safety forms the foundation of Volvo cars, outweighing considerations of coolness or design.

In our approach, we aimed to comprehend the unique morphology of the city of Gothenburg and how the inclusion of forests and nature, which hold significant importance in Swedish culture, could be seamlessly integrated into the project. In Sweden, there's concept known as Allemansrätten, which means the right to be everywhere in nature. As long as one respects the property and surroundings, they have the privilege of setting up a tent, exploring cliffs, seasides, or wandering through the woods. Taking inspiration from this, our design incorporated a prominent round roof and positioned the building on top of a hill. The existing sloping terrain naturally influenced the project. Our vision involved bringing elements of the forest and woods into the urban fabric of Gothenburg, considering its vast size. Additionally, the exterior area includes an exhibition space for showcasing cars, particularly emphasising the affection car enthusiasts have for vintage models. This experience in Sweden extends beyond merely observing new car models; it also becomes an opportunity to delve into Swedish history and explore the industrial heritage intertwined with Volvo's legacy.

When observing the upper side of the structure, it looks like an art exhibition center overlooking a view of the sea. Upon entering, visitors are greeted by big levels of space which displays the cars. The early stages of the design process prioritised the incorporation of the wood structure, which greatly contributed to the desired ambiance and aesthetic of the project.

One of the remarkable aspects of this project is the integration of technology, particularly Revit and Grasshopper. This has allowed us to redefine our approach to core design and generate detailed design files used to fabricate the impressive elements. As the fabrication takes place in Austria due to the availability of advanced machinery, it provided us with a unique opportunity to reclaim a sense of proximity to the construction site and immerse ourselves in the tactile experience of working with the materials. For the young architects in our studio, this represents an absolute dream scenario, being actively involved in the design process and witnessing their creations come to life directly on the construction site.

These are the glulam beams in Figure 10 hoisted up and mounted at the construction site. Presently, we are progressing by installing facades to witness the overall effect. A lot of good stuff is happening.

Figure 9 World of Volvo Gothenburg, Sweden

Figure 10 Glulam Beams of World of Volvo Gothenburg, Sweden

Reflection on Building Foster + Partners' Design Culture

Jonathan Parr

Senior Partner, Foster + Partners

Jonathan Parr has more than 30 years of project experience, working extensively in Asia on signature airports, complex mixed-use, infrastructure, high-end residential, offices and luxury hotels.

Figure 1 Foster Projects

"
When Hossein and I talked about doing this talk,

I thought what would be interesting is to share a project which in many ways sums up a lot of the challenges that architects and designers have over their careers. That is dealing with time and trying to design something which is timeless.

The project which I'm going to share with you today in the new city of Lusail, which is slightly to the north of Doha, is one which in many ways is part of our Foster family of unique designs that are truly located in their place.

Inspired by sometimes the client itself, often the location, and in this particular case, by the climate.

The images that I'm showing you in Figure 1, in my choice of foster projects, is that each and every one of them is unique. They're all different and that's something which we're incredibly proud of. Something which with each project is a constant but highly rewarding challenge. Some of them are perhaps more well-known to some of you viewers. The Apple Campus at the top left is very much a world icon. For those who have traveled to China pre-COVID, you would've entered into our fabulous Beijing airport scheme.

Figure 2 Visualisation of Lusail

For Lusail. Lusail was a vision for a city. It is a vision for a city which has made a huge impact on the existing town of Doha. As we all know, any of you who have traveled and worked in the Middle East, the rate of progress there is truly phenomenal. This is evident when comparing any two photographs of the Doha, Qatar skyline, taken just a decade apart, demonstrating the unbelievable growth of this fantastic city.

For us, the project started in 2006 when we were asked to create a vision for a new city, the new city of Lusail. It was an amazing challenge because we didn't really have a highly developed brief. Lusail was to be the centerpiece of a new governmental city. It needed a landmark on a city scale. To us, it was also very important that we create places for people with spaces and places, creating a real human destination. Between 2006 and today, a great deal has happened.
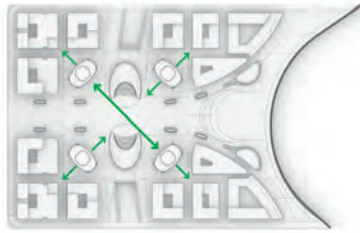
**Orientation of views and base
of the towers**

- *Towers spaced further apart to
  minimise overlooking*
- *Increased privacy*
- *Better views*
- *Views are not compromised by
  base rotation in morpthed option*
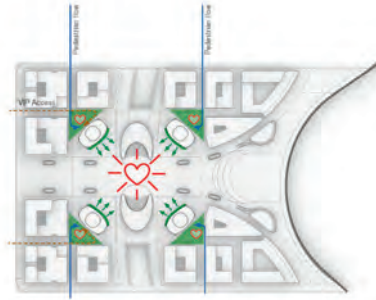
'Central heart'

- *Creating a 'central heart' and
  semi private courtyards*
- *Towers' long façade face 'heart'*
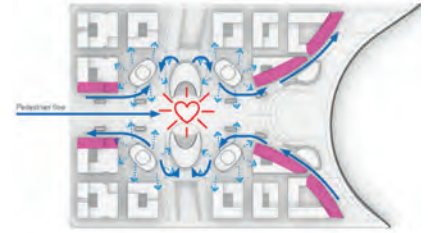
Circulation, flows and views

- *Enhanced ciculation and flows*
- *Enhancing views to the outside*

Figure 3 Orientation of the Lusail Towers

The three diagrams in Figure 3 very much summed up the orientation of the towers, that at the base they would face one another and begin to define a space. They would then create a central heart and each one would have its own individual landscape base, forming an entrance and drop-off. If you look at the right-hand diagram, by the time the towers had twisted to their ultimate height they would face away from one another. The orientation was a key driver and that overlooking between the towers was minimised.

The issue was that between those early days and almost where we are now, a whole host of other twisting-form towers came into being. Our original idea which predated all of these, was something which we thought would need to be further questioned. The reason why I'm saying this is that a passage of time occurred between 2006 and between the time when Qatar announced its successful bid for the World Cup. With the awarding of the World Cup, the need for these towers for Lusail became even more pressing.

We were re-engaged by the client in 2018, to realise that early concept. For us, it was an opportunity to then bring in our new and further developed sense of integrated design within the practice. Design development that we would undertake would be married between architecture, engineering, every discipline of engineering, landscaping, project management, acoustics, and so with a very key focus on sustainability. Also, bearing in mind by this stage that we have been successful in securing the design works for the stadium itself at the tail end of the Boulevard, which I mentioned earlier.

Our projects highlighted the beginning and end of a ceremonial route. We had a very short space in when to develop the design because the World Cup obviously was upon us in 2022. As I sit here recording this today, I have just returned from the site and we have less than five weeks to go. Another main difference between the original concept and the final vision was that originally we had one client, but when we picked up our pens again to deliver the final works, we had four.

Managing the aspirations of those four clients within one overall vision was rewarding, but quite a challenge. We also had to deal with a much more realistically defined construction budget and we also had a much more defined time scale.

Structure
Morph-Pairing the Strong Axis with the Biggest Sail Area
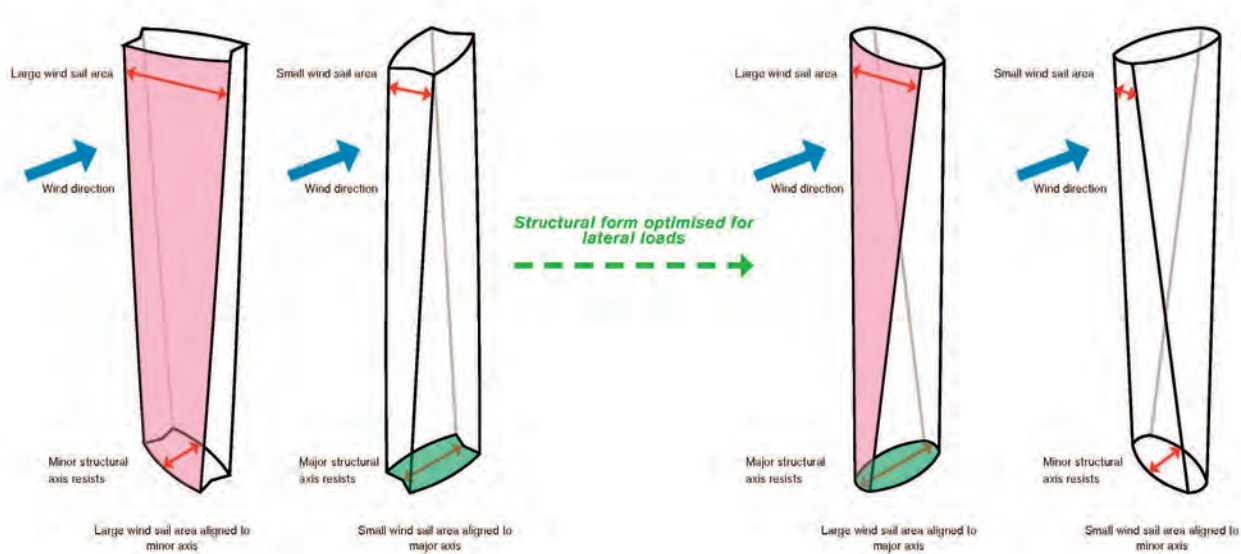
Figure 4 Original twisting design (left image) Morph scheme (right image)

The images I'm showing you now on Figure 4 on the left-hand side, this was the original twisting design, which had a whole number of pros and cons, and on the right is our ultimate scheme, which we refer to as the Morph scheme, which also had a series of pros and cons. Overall however, we felt that the Morph scheme was much more buildable, ultimately quicker, cheaper to build, but importantly had a number of key advantages in terms of construction. Also, importantly we felt it could be realised in the time which we were available.

The initial twisting form had certain limitations in the amount that the building could actually rotate as it ascended, required a network of diagonal members, all of which contributed to an external, shading solution.

Our final scheme, which we have built today, the Morph scheme is about simplifying the structure, but still retains the key drivers of creating a heart, at the base. Rotating the towers so they face away from one another and creating a landmark that is visible from a distance.

Together with the podium buildings, which are small buildings at the base of the towers, we created a true place now integrated completely with the LRT system and addressing the grand plaza, which is in front of the corniche, which links Lusail north and south to its neighbours. In detail, looking at one of the towers with all projects, there were the inevitable design changes and another key component of our integrated team was the ability to absorb change.

The client was very keen on supporting the original concept as far as possible, but we all knew that as the design developed, there would be the need for changes. Within our office, within our team of highly talented scriptwriters, we developed our own system of communication between the various disciplines so that when design changes did happen, we were able to respond in a super quick period.

That was something which I think allowed us to deliver the project in a way which in the original days of the first concept, we probably wouldn't have been able to do. It's interesting how time has passed and our skillsets have increased, allowing us to deliver the original vision in an even better way. We were, as I say, responsible for all matters of engineering, and our structural teams were given a number of challenges. One of which was to work with the local construction capabilities of the country. Steel as a building material is not something which is terribly common in Qatar.

Concrete is by far the normal chosen material. We felt that for 70-story buildings however, which is what the tall ones eventually settled at, that steel was the correct solution. It is a composite series of structural elements and is married to a very impressive, very extensive basement system. In terms of the four towers, they are complemented by these low-level podium buildings that provide support services.

This diagram in Figure 5 explains how the center core is diminishing in footprint as it ascends, as it has less structural work to do.

Structure
Morph
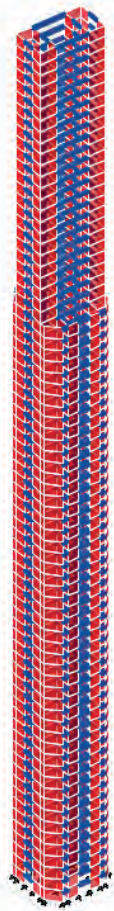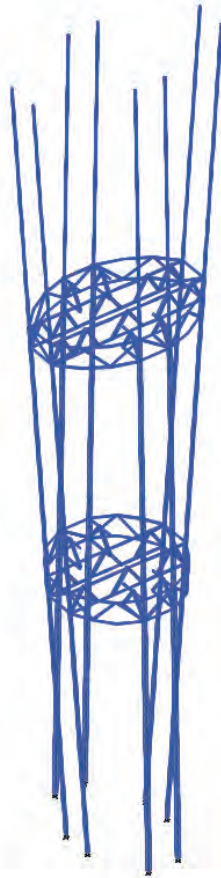
Core **Outrigger system & belt trusses** **Columns** **Morphed scheme**
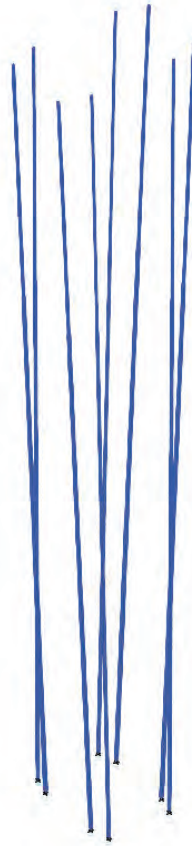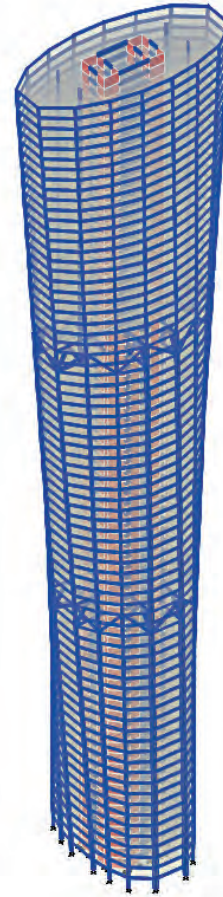
Figure 5 Reducing footprint of the center core

The core is linked via outrigger systems to belt trusses through the columns to form this overall skeleton, which allows the building to morph. It morphs a full 90 degrees, which is an improvement over the original concept scheme, which was only something like 30 to 40 degrees. The point I was making earlier is that this simplified system allows us to realise the original concept even more strongly. You would expect and indeed we did a whole number of wind tunnel tests.

Structure
Wind Tunnel Testing – Results

Accelerated Flow　　**Wake Interference**
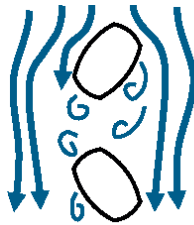
Critical Wind Direction
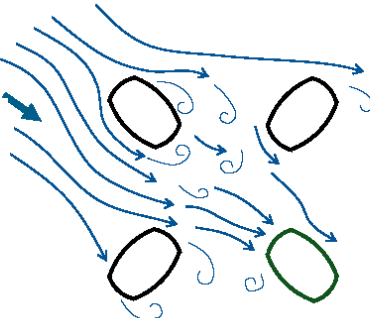
Accelerated Turbulent Flow

Figure 6 Lusail Wind Tunnel Test Results

This was where the design of the facade system, which in many ways is the inspiration behind the project, where these two components in Figure 6 had to be married. The facade system is one which is completely influenced by climate. The gentle scrolling texture, that works its way up the face of the towers is all about protecting the glass to allow a controlled amount of daylight into the floorplates, protecting them from the sun so that energy consumption is minimised as energy gains within the building are minimised.

What was interesting was their undulating texture of the towers had a benefit, as their rough texture broke up the wind patterns, therefore reducing wind loading, which was an interesting phenomenon, which was something that we then further exploited. Because we then tried to increase the projection of this texture to further reduce the wind loading. You'll notice also that this texture wraps over the top of the towers because as four objects, they were always seen as four pieces of a holistic sculptural composition and the lower towers are visible from the upper towers.

The fifth elevation is incredibly important to maintain a consistency, as the flight path into Doha passes by these towers, in fact, all four roofs would be visible from any landing or departing aircraft. A few diagrams here to show how, at the level of design development, we ultimately went for a design and build contract. As a team, we were conscious that in order to secure a realistic price, but also give the contract with as much information as possible to begin with, we would have to do a lot of work perhaps beyond a design-build scenario in order to make sure that what was to be realised was the most cost-effective possible. The facade itself as I say is one which is self-shading.

Facade Design Development
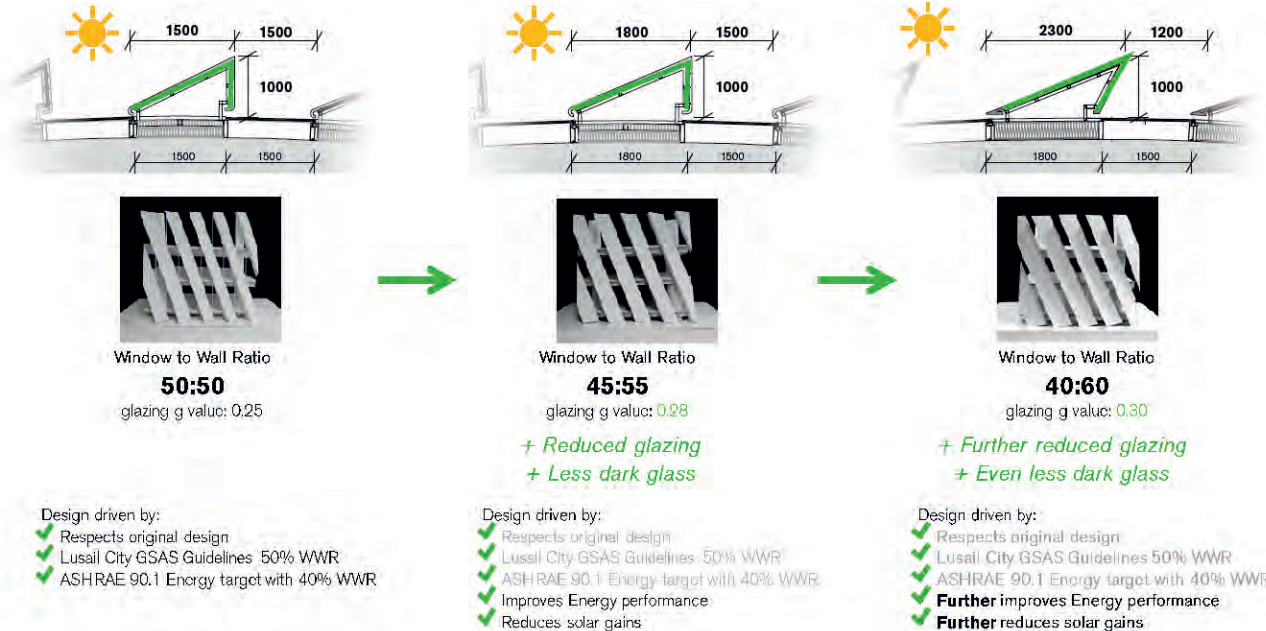
Figure 7 Façade Design Development

The green profile that you see here in Figure 7 is a projecting cladding element finished in a natural marine grade aluminum, which has the task of shading the glass to its right. Over the design development period, we were experimenting with different proportions of glass to solid and indeed a slightly different profile to this shading element. It's the one on the right which we finally adopted, which has the benefit of increasing the proportion of solid that is visible.

When you look at the towers, many angles look almost solid in form, which is something we are incredibly delighted to see. There are so many all-glass towers around the world and in these extreme climates, one could question do they really make sense. This for us was a real passion that sustainability and working with climate as a driver should be embodied in the final design, which is the point I was making at the beginning that all of our products around the world are inspired by clients or locations so that they've become completely unique. This was how we ensured that the Lusail Towers would do that at Doha.

During the design development, we wanted to maximise repetition wherever possible with the geometry of the facade. There is a very small proportion of truly curved glass panels within the facade. There is a greater but limited proportion of glass which is cold bent and there is a greater part which is flat. All of the aluminum fins are made up of flat sheets.

A great deal of thought and care was undertaken by our team to ensure that that balance of time and money would mean that the client's budget was spent wisely. This would also mean that we would investigate mockups at full-size scale. We studied and fabricated a number of full scale mock-ups. Early mock-ups were more focused on the proportion of solid to glass. The client was a little concerned in the early days that these projecting fins could restrict the views.

Once the full-size mockup was assembled, they understood the passion that we had and agreed that it was the right thing to do. We also had to satisfy people that this technology of cold bending, which is not new nor especially revolutionary, but it's something which many clients have never come across. With the chosen fabrication company (a Doha-based company), we demonstrated to the whole client team that cold bending could be done to the panels.

Which brought us to a set of employer's requirements, the deliverables and a series of visualisations, at the end of a very intensive design period. Here you see the four towers. This is if you're looking up the Boulevard with looking towards the East with visuals which we thought could be as realistic as possible. We very much wanted this shimmering texture, this shimmering sensation for the towers. What was amazing was that forward a number of years, this is the reality and I think we got it right.

As the scheme is so symmetrical based on the Boulevard, there was a moment when we wondered whether perhaps the shading should be mirrored because it's a formal composition. But science and working with the climate was always the strongest driver. So all the towers are equally self-shaded. That shading is creating amazing spaces within the tower. In terms of designing a project from the inside out, we were always mindful of that. This terracotta panelling is also echoing the projecting thin form and creating these amazing corridor spaces where the sunlight changing throughout the day casts beautiful shadows on walls and floors alike. That texture is taken down to ground level so that the veil if you like, is completely enveloping from top to bottom and gives these gentle glimpses into the main lobbies between the fins.

Set them amongst landscaped individual courtyards, which I mentioned at the beginning, there's quite a human scale to these tremendously tall towers.

Figure 8 Lusail façade texture

Figure 8 is an image that we took just a few weeks ago that this texture, which is very much part of the shading design. You can see how it deals with the curved corners and how it wraps over the top of the tower so that it truly is an all-encompassing skin. Equal in size in terms of GFA to the towers or the podium buildings, the podium buildings were inspired by Qatari architecture to create human spaces, wonderfully shaded and navigable throughout the year.

Figure 9 Visualisation of walkable spaces

This was an early visualisation in Figure 9, which was about creating walkable spaces, human-scale inspired by Qatari architecture, to contrast with the tower, but both components, the towers and the podiums are designed with the environment in mind. That's why you see a limited number of deeply recessed and self-shaded windows. In terms of the technology, something which we're also very passionate about and highly respected for, we investigated ultra-high-performance concrete, which has fantastic thermal properties, is lightweight and a wonderful balance between a solid heavy facade that doesn't impose greatly on the structure of the podium buildings. With local contracting companies, we did many experiments to push this material as far as we could in terms of its technological abilities. Also, its tone, the white color that you see there is the natural self-finish of the panel. It's highly durable and minimal in long-term maintenance. The street image which I just showed you, has a concept of a number of blocks and an entrance sequence, which is very much inspired by the local architectural ideas that a landscaped courtyard is at the heart of a traditional house.

We developed scenes of varying roof levels to create multiple decks from which people could view the outside world from within the buildings. Each cluster divided into nine was then further developed with facades projecting, sometimes recessed from one another to afford views up and down the streets. It's very much a humanistic approach to creating spaces. That was incredibly important to us both daytime and nighttime. The podium buildings are all entered by a low-level courtyard. There's a traditional way of entering buildings from a shaded central space that leads into the actual accommodation itself. These will be delightfully landscaped, controlled amounts of water features, creating a formal entrance into the podium buildings themselves.

The typical glass box was absolutely not what we would use for the form of the plug-in buildings. They were always in the very, very early conversations to be as solid as possible. Perhaps with a limited number of roof terraces, which would be heavily shaded, minimal daylighting, that would come through a system of windows, but to only have something in the order of 20 to 30% of glazing.

Something quite different, but absolutely inspired by the climate. The shaded roofs would then afford views over the towers on the landscape and beyond. They would in themselves be landscaped. The ultra-high performance concrete provides a finish to external walls, internal walls, and soffit. A completely continuous surface to wrap around and throughout buildings, gives a real sense of integrity to the design. The landscaping itself was very much to be using as many drought-resistant species as possible to allow that landscape to contribute to shaded spaces.

Qatar does have as you would expect a hot climate for many months of the year. If you were to travel there now and as I say, I was there last week, it's lovely. Though there is a real range in temperature and humidity, this landscaping was all about trying to make the spaces habitable throughout the year.

The project is rapidly being prepared to be part of the host series of celebrations for the World Cup. The spaces are providing that sense of community. They really will be places for people to enjoy this new city of Lusail. There's a mixture of formal central Boulevard with individual entrances, the towers, to the left and to the right.

We're delighted that the vision that we had all those years ago for this city of Lusail, is now reaching a conclusion.

Lighting is also finally now being able to be tested. We always had an aspiration that the four towers would form a sculptural composition. It's not about a single building, it's about a unique collection of four forms. The need to display graphics and different color themes is being experimented upon. As I give this talk, it's a constant development. We're very happy with the way in which this lighting is being realised, its projected lighting, as opposed to LEDs within the facades. So the shadows that give the eye the reassurance that it is a curved form is very much a deliberate design intention.

Which leads me to my closing slide, which is how the towers were envisaged all those years ago as a punctuation point to a Grand Boulevard.

This is the reality of the project as I make this talk. You can see how the shimmering form in Figure 10 that I mentioned at the beginning is very much a part of the expression of the towers, the deep shading. In fact, this view here is one of those where the tower almost looked completely solid.

At the base hopefully, you can make out those low-level podium buildings which are part of the gift to the city.

Figure 10 Lusail Towers

Reflection on Building ZHA's Company's Design Culture

Michele Pasca Di Magliano

Director, Zaha Hadid Architects

Michele Pasca di Magliano specialises in residential-led and high-rise development, working also on a variety of exhibition schemes, as well as selected furniture and interiors products.

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Zaha Hadid Architects is an employee-owned company. We've had a gift from the late Zaha Hadid back in 2016 and we're a collective of individuals, architects, and designers, all passionate about design and architecture. We're lucky enough to work globally. As you know, we work in different locations around the globe, spanning from Australia to North America to Europe, which is our motherland and where our main office is.

A significant part of our work is nowadays in the Far East, mainly, China, Singapore, and Southeast Asia region.

What I would like to say before talking about the projects we do is what motivates us and why we do them. Why do we think that architecture has a link with the way society is organised. In a way, architecture hasn't moved much over the years and over the generations has certain geometries, certain design languages, and certain social structures that has stayed in place throughout the centuries.

This fascination kept going and was picked up by modernist architecture and was decoded into functionalist architecture, where we try to fit everything, departments, and boxes, and trying to make our lives organised by architecture.

Let's say, there was a utopian vision of a city organised with such rigorous architecture. But then there is the evidence that something that was considered an avant-garde vision for a future city became the reality of the city today. That reality moved away from that rigor and that organisation and became on the opposite side of things, almost as a paradox, something quite chaotic. That is where we started to realise that society nowadays is far more complex than what you can put into a box, into a category, and has far greater demands.

From that point of view, thinking about architecture just in terms of responding with iconic buildings and great design, sometimes is just not enough. More and more, there is this self-canceling effect where architectural icons get overlaid over other icons. In the end, you end up with a monotonous continuation of urban sprawl, which where you can't even tell whether we're looking at Tokyo, looking at Moscow, or looking at London.

One of the few things that helps us recognise that a picture was taken in London is the only natural element in there, and it's the River Thames. Which leads to where we're going with this, we are going with the idea that we can break away from some of the rigors of modernness and introducing a new rigor which is far more powerful, far more malleable, and can respond to a much more complex need of contemporary architecture, contemporary society, where we build buildings to enable the future, to enable life to flow, to prosper, to react where different systems, different colors, different elements can be combined with each other, can overlay, can feed off each other. Then let's say the human being living on it, adapts and finds almost a blueprint for them for civilisation to happen.

This idea of living in symbiosis with nature is something that has been there for many, many years. It was fairly successful until we tried to control nature. We didn't let nature drive architecture. When we talk about the contemporary society, when we talk about the level of networking that we currently facing, we need to look at the ability of natural systems to organise very complex phenomenon. From our point of view, there is a great fascination in understanding these elements, understanding these forms, and moving beyond some prescribed solutions for different challenges, but looking at location focus, responses, where we are looking at specific areas around the earth, specific cities, specific challenges, specific needs for the flow of people, for aggregation of people, and how we are going to help them to come together and participate in the contemporary social life. This could come in as an airport, as a museum, as a restaurant, as a place of work, place of cultural building exhibition, or even a residential project. Then that can move beyond the individual building and be brought over to the idea that we don't try to focus on the single individual elements. We try to create almost recipes for different problems and different architectural projects.

The challenge becomes the starting point, but then, the project becomes a seed that mutates according to different local parameters. This allows us to generate a great range of solutions. It says something about the level of participation that we have within the company, in the design process where everyone has the opportunity to come up with ideas and solutions, embrace each other to create a great range of diversity of possible solutions.

Guangzhou Opera House

Some of the initial projects were this Guangzhou Opera House. It's our first venture into China, it's a cultural building where we were inspired by nature and by the shapes of nature.

The idea of an opera house was to bring the user back into nature when they are entering the house where the indoor becomes the outdoor. Nature is a concept in itself.

We design these elements with a mouse, with a computer system, with 3D printing, quick modeling, mouse-to-model, hand sketches, and internal design presentations, where we come together as a team and we use our collective expertise as a 500-strong practice to give each other ideas, possible solutions, and the best possible crit to our own proposals.

Figure 1 Guangzhou Opera House

Dongdaemun Design Plaza

Some projects may be unusual, or unexpected, but they broaden up what architecture can be and can do and broaden up the perception of a city.

Specific projects like the Dongdaemun Design Plaza, in Seoul have become almost the symbol of a new era for the city of Seoul. Rejuvenating the Dongdaemun area on the day and night scenes and becoming the centre of the new fashion district for Seoul. It is an area where most of the photoshoots take place, a place to display the production, and it is a fashion district.

Figure 2 Dongdaemun Design Plaza, Seoul, Korea

Advancing with Technology

Nowadays, the company has progressed and a lot of this development is bottom-up. What we see is that we want to absorb what society throws at us. We want to challenge on one end the builders in the construction industry to move away from certain procedures and certain repetitive processes. At the same time, we want to embrace the digital revolution.

We want to embrace robotic revolution which is a great generator of new possibilities. We've been going through a lot of in-house experimentations trying to use new ways of designing, digitalising, and bringing architecture to life. A lot of it gets done through quick projects like pavilions, but also through larger-scale elements, where we'll rethink the way we design and produce elements.

Like for 3D Printing, we can use the immense technological advancement of robotic printing to just use materials in the most effective way to greatly reduce the cost of basic materials, replacing the way the elements we produce, and bring it down to zero. Things like transportation costs, packaging costs, or accessing material that needs to be removed from buildings.

In recent years, architecture can have its own life, even without coming to full fruition of the construction. The idea of the metaverse is a place that we can design. For example, digital operation is something we've been using on different levels, on one end, to help us create projects and visualise projects before they get built.

It enables us to get input from future buyers and future users of our projects, where they can go in and customise. For example, in a project, you can go in and customise the physical façade, customise the size of rooms and people can pre-select what gets built. Breaking down the development of work of discourse and extending that to the end users.

On the other hand, creating architecture as an array of possible systems that can be assembled. In a digital environment that is then purely utilised by avatars in a quasi-alternative space, which is just an extension of our current life, nowadays.

Going back to the idea of the designs, there are certain principles and certain elements that we try to establish. They became a link throughout all our projects. These links really have to do with what I call volumetric articulation so that buildings can do different things, as you get to different levels. They can be part of a larger system. You have different sessions and area partition within buildings. That will take a lot of attention and what is the common spaces, spaces where people come together, we want to encourage those areas, whether it's outside or inside the building, creating internal voids, which encourages a sense of awareness, a sense of understanding what's going on, on different levels of a building, and having a perception of the outside world from within, from the inside.

Sometimes these voids can even literally go through the buildings and across and connect in two different areas of the outside and with the framework.

One-North Masterplan

The very, very first project that we'll talk about today is a project in Singapore, it's a master plan that is partially completed, nowadays. What we tried to do at the time was to reimagine a piece of the city as an extension of nature. Not crazy, just saying that architecture comes with a rigid grid, establishing itself, but creating a second nature for occupation. That was a project that was designed almost 20 years ago.
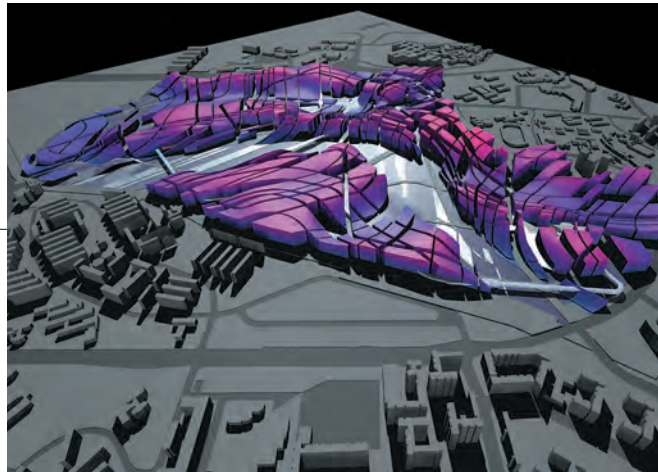
Unicorn Island Masterplan

On a similar scale, is a large master plan, which is currently under construction in Chengdu in China. We wanted to create a second nature. We wanted to create a design system that could respond to different needs and different users, from landscape to buildings, to power, to residential, to offices.

We've been using a lot of analysis methods to test the design, form the design, enhance the intelligence of the design, think about the future users, and how this system of ellipses can be enriched, and be calculated by different areas of landscaping, sport facilities, wet areas.

Then going down to buildings, you can see how they're imagined to be properly benefiting users. We used some profiling for different people who would inhabit the master plan and think about daily life in the office. How would they come in, what will they need? That creates then a whole scenario of how this whole master plan, will come into play. This cluster of buildings comes together towards the center and towards the hive.

King Abdullah Petroleum Studies and Research Centre

Another project where we use technology to respond to needs, was the King Abdullah Petroleum Studies and Research Center in Riyadh, building for Saudi Aramco.

In this case, one of the big challenges for us was trying to create a LEED platinum building in the middle of the desert, in Saudi.

The team studied the microclimate of the oasis and created buffer spaces, which are small courtyards that are highly sheltered where the sun doesn't burn them. These courtyard temperatures are slightly lower than the outside temperature.

We can insulate the building and then create this sheltered courtyard. From there, that's where we collect air and cool individual buildings. The shading and inclination are studied to help keep the sun out of the spaces.

Figure 6 Investcorp Building Oxford

Investcorp Building

On a totally different scale of our interesting projects. This is a building in Oxford University. It won a prize for conservation. We found that, in a way, it's ironic and very interesting how it was appreciated that the best way to preserve St. Antony's College was known to replicate the English heritage style of the housing accommodations. However, by creating something that is totally different, at the same time highly respectful to the existing building by almost disappearing behind this blurred mirror face. It provides a different level of facilities for the students with a large opening to engage with the outdoors and the gardens.

Heydar Aliyev Center

The way complexity can help us resolve some of the challenges of complex networks society of today is beautifully and elegantly demonstrated with the Baku project. We have three different programs together; cultural, a library, and a theatre.

The roof gently undulates and covers all of its different zones. The flexibility of this complex architecture allows us to express the landscape, express the building as a form of, at the same time, accommodate, seamlessly, different programmatic needs. A building that can be used 24 hours a day, seven days a week for different user groups.

Some of the projects we're currently working on, we're looking at new ways of combining office spaces with common facilities and linking different departments.

Guangzhou Infinitus Plaza

In this case, for the Infinitus Plaza in Guangzhou we have an 80-meter-long bridge – that connects different parts of the building. Bringing this idea of complexity and the richness which brings to the inside areas and the façade that helps to screen the sun off.

Figure 7 Heydar Aliyev Centre, Baku, Azerbaijian

Figure 8 OPPO headquarters, Guangzhou, China

OPPO headquarters

A new take on the same thing, is the OPPO headquarters in Guangzhou. We have three different bubbles nicely connected to each other, but then, blocked by these common buildings in a way this idea of a different program being sealed by a single geometry.

Tower C in Shenzhen Bay Super Headquarters Base

More recently, we've been involved in a project where we were asked by the city of Shenzhen to develop a landscape and public facility. To develop not just from the podium but the middle areas of the building. It creates opportunities to create sky bridges and tall connections between these two super tall towers and additional functions or facilities for the city.

We conducted a lot of studies on facade orientation, ventilation, and distance from the seating areas of people to the facade. A lot of intelligence in the planning of the buildings, in the building itself, to the point that we then moved on to the simulation of the users. We started bringing the users back into the project where the individual heads of departments and staff members can perceive the building as it's being designed. We then received feedback on the easiness of navigating through the space and the new workplace.

Panel Discussion

Hossein Rezai-Jorabi (Moderator)
Louis Becker
Michele Pasca di Magliano
Philippa Spence

[Hossein] Thank you, Michele, for that presentation. Also, I thank Jonathan and Louis for the earlier presentation. I really enjoyed the work that you put together. I really appreciate your participation in this inaugural Ramboll Design Excellence forum. I now invite you to join me on a panel discussion together with our very own Philippa Spence for 30 to 40 minutes of panel discussion. In the way of introduction, I just tell you a little bit about Philippa. Philippa is the managing director of Ramboll in the UK.

She's a recognised industry expert and a senior leader with a background in delivering complex sustainability, environmental, and social projects for clients across a multitude of sectors. I really thank you very much, Philippa, to join us. I know you have a very, very busy schedule. Going onto our panel discussion, I would like to start by saying how privileged I feel to be able to say that I've actually worked with all three of you and of course, with Philippa as a colleague, but with all three of you on the diamond phase of projects.

Either on real projects that we have delivered together or on competition designs or competition entries or competition winning entries. With Jonathan, for the past 20 years, since the early days of projects in The Troika in Malaysia and Capella in Singapore, and the family of very tall buildings that we developed in KL. With Michele, for the past maybe seven or eight years, and as recently as a couple of weeks ago, when he was in Singapore and our teams were having a coordination meeting on a museum project that was a competition-winning entry here.

Louis, in the past three years, but as he was presenting the images that were conjured up in my mind were the two or three weeks of very intense work that our teams did together. Do you remember that competition in India where we were all egging each other on and motivating each other to do more and to push more and stuff? I think I find that experience very, very enriching and I really thank you very much for being who you are and for being here. Maybe I shall start with a question to Philippa, who hasn't presented, so that we have a little bit of a balance in terms of work.

I know how keen you are, Philippa, on regenerative thinking, regenerative worldview, regenerative design, and the experience that we had a couple of months ago in London, we spent about one and a half hours on the topic with about 10 other colleagues and how we went away. A little bit confused, a little bit thinking about the topic, et cetera. Now, I also know that you are one of the proponents of our design excellence initiative, which is meant to be bringing some elements of uniformity in the work that we produce across the 5,000 people in the buildings of Ramboll and eventually in the 18,000 people that we are.

I just wondered whether you can share with us a little bit about how do we embed our ethos into our business and our everyday work in your experience. How have you done it?

[Philippa] It's a great pleasure and a privilege to join all of you and thank you. I thought this was a great question and a great topic on ethos. It's interesting because ethos is the thing that actually really drives the decisions that we make and what we prioritise as a business. Our mission is to create sustainable societies where people in nature flourish. With that comes a very clear focus on regenerative design, focusing on the 1.5-degree ambition, circularity, and so on. The 'how' is very, very interesting. We'll start with one of the key pieces.

It's actually storytelling and that is telling the story of our founders. Hannemann and Ramboll and the ethic that they started with, which was this real desire to make a difference post-World War II to being able to design to reconstruct Europe and the passion with which they delivered the desire to give back to society. Now that's a story we tell everybody who joins the business and they know that they're receiving the baton to continue that work.

The second piece in the how is actually about being a learning organisation. A learning organisation is hard to achieve, but when we are at our best, it's about passing great good practice and learning swiftly and efficiently. A learning organisation is one that can create knowledge, that can acquire knowledge, and importantly, can transfer knowledge at scale. That is something in Ramboll we're very good at, but we work hard to be able to do it. That means that the ethos, plus the practicality of actually transferring all that information, that knowledge, and that passion means that we can actually achieve regenerative design and the thinking that goes behind that, right across the piece.

Just to finish on that, for me, it's about the head, the heart, and the hands.

The head,
the logic, why as Ramboll we focus so much on sustainability.

The heart,
which is about hiring people who share that passion, and

The hands,
which is about arming people with tools, the methods, and the ability to then be able to take that into their work.

[Hossein] Thank you very much. Thank you for that beautiful representation of what we are about within Ramboll and what our ethos and what our ambitions are.

[Hossein] Michele, you were the last to present. Maybe I post one question for you. I love the sense of optimism and the possibility that existed, that came through your presentation. I don't mean it in a flippant way, but I want to ask you one question, which I'm sure you've been asked many times. That's an easy one, you've had an answer. That is, what do you guys dislike about the right angle?

What's wrong with 90 degrees that you guys so masterfully avoid every time you have the opportunity to do that? Why are you thinking about that profound question I put to you? Maybe as a follow-on question that is a little bit more serious.

What makes you guys so consistent in your work that not only people within the design community or our industry, but also public at large think that they can recognise a Zaha Hadid project? How do you guys do it?

[Michele] Thank you for your question and thank you, Philippa, for your inspiring words. I think it's a little bit of a myth, obviously, and Zaha famously said there are 360 degrees in the world, why stick to one? It has become a little bit of a recurring question. Since you asked, I think there's a good point about it, which is when you look at solutions from the first principle point of view, you actually have to take into account all possibilities.

I think the industry, and if you remember at the beginning of my presentation, I had this slide of the Forbidden City and then this slide of Le Corbusier's Ville Radiuese and saying everything was established on a 90 degrees angle. Actually, it was possibly too rigid to answer so many complexities, so many issues of society, and hence, it failed. Hence, architecture has moved on. I think all our colleagues in the room today have a knowledge that we need to move on to respond to different challenges because, for us, one of the key inspirations was obviously nature. We looked at how nature responds to basic questions of building up a tree or putting rocks, or assembling rocks together. Issues of statics, an issue of stability are answered by nature, and they're not answered by 90 degrees. There are some specific cases in which you can find very sharp angles, but most of the time, nature would go for the least resistant path. That's something we both worked on together on projects when we looked at how construction actually responds to performance and not only to what the industry wants us to do because it's easier to construct.

Unicorn Island Masterplan

Ultimately, you can think of the performance of the building from multiple points of view. It's not only statics. It's sheltering, it's shading. There are many opportunities where actually you can see the different shapes and different forms allow us to get a better reply. There are cases where if you have to do a bedroom, you need to fit a bed, you want to have a 90 degrees wall because you want to have a very efficient space in a small compact room to fit some standard-size furniture.

Most of the time, you can actually, once you get the certain scale, you actually find advantages in moving away from that 90 degrees angle. Sometimes the building that is easiest to build is not the one that performs at the best level. I think that is very important for us architects to say, that there is that pain during the design and the construction process, but then ultimately, as Louis said, we're building the backdrop for our society. You want to really create the optimal space for people to facilitate their daily life.

If you walk in a park, you never walk at 90 degrees angles. Why would you have to do that in a building? Our special comes from nature and that's really not in terms of bio mimicking or trying to reproduce nature, but really trying to find-- Even if you want simple solutions to complex problems. Sometimes, the only reason why you can attack some of our projects is because we don't have 90 degrees angles and that's pretty much it. I think it's a very good starting point for us. It's a very good question. The issue of consistency, I think it's more about method.

It's more about the way you work and the way the team actually answers questions, rather than having a specific formal agenda. I think all the panelists today, everyone has a huge array of projects. A lot of different designs, materials, and different approaches. Each of us is fairly recognisable in what we do because there is a certain way of working, a certain way of establishing design stages, creating, let's say the design concept as a contract between the client, the architect, and the consultants team and the engineers.

Eventually, the contractor's drawings becomes the legal document and how you evolve that drawing, it's obviously how you develop a building. That is part of our individual method. That's what I see in the level of consistency. We challenge the concept a lot in this office. We have a lot of alternative options. We compete with each other. Sometimes we have different teams proposing solutions for the same project. That allows a certain level of tension and consistency within the design we provide. That's what we try to do.

I think it's important to remember that these level of challenges are ever-changing because the resources again are scarce, the economic pressure is higher. Clients are more demanding. They have limited budgets. You have to put all of these things together and there is a piling up of challenges to the design team on how to respond. Yes, that's how we do it.

[Hossein] Sure. Yes. Thank you. Thank you, Michele, for that great answer. As you said, maybe not necessarily mimicking nature in the sense of visual mimicry, but something that is very close to the hearts of both Philippa and I. I know that's us trying to get close to the mind of nature, to the system that exists in nature so that we can introduce those into our projects and our design engineering work, et cetera, through that whole process of regenerative thinking. I appreciate that.

[Hossein] Louis, I recall a conversation that you and I had when you were sharing a very personal thing with me. I'm sure at that time, you didn't know that I would be sharing it with the public at large now, but I'm going to do that, if you don't mind. I recall you telling me about one of your experiences with the late Henning Larsen when you were young design architects. You're still young, but you were younger then and he would come and create your work and not everybody else's work to give some ideas and some advice.

Then the last thing was that as he was leaving, he would say, "Okay, now make it better," and he would just walk off. Do you remember that, the most uninstructive instruction, just make it better and he would walk off? Now what I see is that, as uninstructive as that may have been, you guys continue to make your work better. Not only on one project, one stage on another, but also one project on another. I've seen your latest competition-winning church in Copenhagen. I congratulate you on that.

It would be good for you to share with us a little bit about the processes and methodologies that you have in the office. You shared some of it in your presentation, but if you want to, how do you initiate a project? How do you protect the things to make things a little bit better every time?

[Louis] It's also difficult. Everyone around this table will know that. What happened was that when I started, we were only a small studio of 20 people and now we're a much bigger company. We discovered through the years that we had to have a common way of looking at things, which is not a prescriptive design idea, but much more like a process of getting there. Then, of course, there are the "ideas of the world," so to speak.

I spoke about it then in my talk – about how it is a terrible thing, losing 12 competitions in a row as an architect. Everybody knows that. There's something about this idea of establishing a shared language, such that it's not like you're conversing with someone in a foreign language and trying to communicate on the same level, but there's an understanding of where you are in the process. That has helped tremendously with projects, both in quality and the winning rate of competitions.

I think it's so fundamental that we, as architects, generate and make up an idea from the beginning as soon as we see a place, even before we know the brief – looking for the opportunities and potentials to make them a reality. On a lot of projects, there are more complex expectations involved.

We learned that if we spent a lot of time doing in-depth research, outlining aspirations and ambitions, there's a chance to design on a different basis. This part has nothing to do with how projects look. Of course, when you come to the design process, it's difficult not to design something in the family or like something we discuss; it's part of a broader discussion. Each project is just one position in an extended discourse. It's not like it's totally standalone. Although we proclaim that this product is entirely unique - and after two more years, one can find elements from other sources. In any artistic production, there is always an inspiration that influences the work. However, to really dig deep into the essence and hone in on it with design skills has been a big thing. What you said, Michele, was inspiring talking about nature and a park. You wouldn't walk a straight line.

I believe questioning things is fundamental to our thinking.

For example, just examining the prevalence of square boxes in Germany's architectural master plans, results in square buildings and facades. The squareness of it all raises a discussion that goes beyond individual architects or offices. It stems from a larger discourse among many professionals.

On a similar note, I think it's common that we have this in each of our studios as a smaller version of this discourse. Our goal is to maximise the freedom in design work, prioritising the discussion of its qualifications, meaning, and impact on the location and context. We try to shy away from being too prescriptive when evaluating designs during pinup sessions.

[Hossein] Great, thank you.

[Michele] It's interesting you mentioned the German competitions. We actually do competitions in Germany. No one knows about it because we lost every single one of them. I think we did probably 13 in the past 5 years and we lost every single one, and now we have a name. When we look at new projects, we say, "This is a German competition, they're going to invite 20 architects. We're not going to win, but we should go because we should try and surely we're going to lose." It doesn't matter, we're still going in for it. It's such a funny thing.

[Louis] What's so interesting is that if you talk to the non-architects of the country, they are longing for a more poetic way of doing things and much more, like the organic understanding of the city, of buildings and places. Germany has a fantastic tradition, as you mentioned. We have four project sites in Germany, but we are trying to push this hardline of rectangularity on all projects. Of course, you can't get rid of it, but you can push it out a bit at a time for progress. I know the feeling of losing a lot of competitions in Germany.

[Hossein] We've all lost a lot in Germany, that's correct, but we've also won a reasonable number.

[Hossein] Jonathan, thank you for your patience. You've been sitting there for like 23 minutes. Thank you. I appreciate your patience. One of the things about your work that I first noticed, this is like about 20 years ago, literally, was the rigor that went through everything you guys did in your thinking process and things.

What impressed me at that time, I still had this romantic notion that when you become a sort of brand designer and brand architect, you turn up in a room and tell the client, this is what you do. The guy says, why? You say it is because I think so. You guys produced so much work in support of your design ideas. Apart from the quality of your work, the quantity of drawings and studies and things that you would do. One of the things that is stuck in my mind was your relationship with material and the craftsmanship that was embedded in your design. You wouldn't design and tell this is going be built by someone else.

Is that something that you want to talk to us a little bit more about?

You would think about how your design might be built. You would fuse the possible building process into your design, then iterate the design and the building process.

The interaction might go on for a few rounds, where the two would develop a symbiotic relationship.
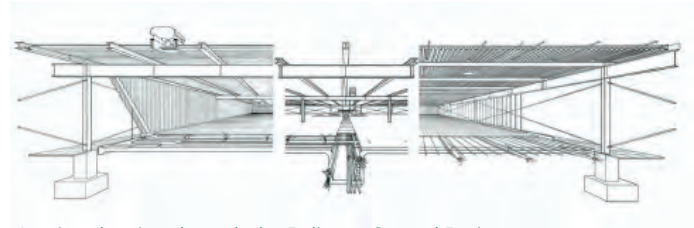
Section drawing through the Reliance Control Project, showing integration of Architecture, Structure and Services

[Jonathan] It's an interesting question. I think it probably has a number of answers. With that, any of that Norman's fashion, the very first project that we did, the Reliance Industries, there are lovely one-to-one hand-drawn details of a project, which in the mid-late '60s was pretty uncommon for an architect to be doing. That was probably imagined to be what the contractors did. There was a huge personal interest on his part. I think what's also interesting is in the very early days of the office, when it was just a handful of people, it was an integrated office.

There was an engineer within a team of architects. That passion for our architecture to be something which is, from the word, from the beginning, is integrated with the other prime disciplines, is an ethos which has stayed with us and similar to Louis, we never came up this way bigger than we were, 50, 60 years ago, obviously. That passion for an integrated way of designing is absolutely at the core of the business. I think also the language we-- we have what we call a design board. It's a way of ensuring that we have a house level of qualities and it's not about house style.

It's about ensuring that there's knowledge transfer. We have incredibly talented young people who joined us in their 20s. There are some of us who are approaching their 60s and we have people in their 70s. We have an immense range of experience. It's about sharing and transferring knowledge so those qualities we had many decades ago do not get lost when people ultimately leave the office. We have a way of sharing knowledge of reviewing projects so that over our many international offices, there is a level of consistency.

I think the point we made at the beginning about the involvement is to make sure that something which has conceded has been built. We are absolutely passionate about working with the industry and pulling in suppliers and contractors as early as possible within the process. To us, that involvement with those people who are going to build the product is something which should be embraced as quickly as possible. It always has been because otherwise, the drawings you are producing are perhaps just slightly not even. They need input from experienced suppliers and contractors.

Actually, we love doing that. The point you made that is I'm using the idea that you turn up to see your clients to say this is the way it's going to be because-- That's the tricky one because there's always the question of why. Why do I want you to think this way? It's a very simple question but sometimes it's hard to defend. We always try and have a reason for why we're doing what we're doing in logical ways and whether it's to be inspired by a particularly interesting work with the client brief or perhaps a characteristic of the location.

We do very much like to design things that are unique but belong to a place. Along the design journey, if we can have these moments of really solid influence, then it's a very-- maybe it's like a child's comfort blanket. It's something that you can rest back on. Say, we did it because of this, and together, we decided that this was the best way to do it. Making the point Michele made about options, doesn't have one answer. There's a right answer at the right time for the right set of circumstances.

At any time, it goes with change, then one big question, they answer but obviously, we have to work within the timeframe so decisions need to be made. Making a decision and sticking to it is quite a good idea because we can endlessly reexamine things. Sometimes that luxury of time is not a good thing, sometimes working in high pressure, short timeframe is actually a good thing because it evokes a team to make a good decision. I think the craftsmanship is something you love about working with materials.

You've always tried to find new materials. It's the quest of any architect to always be looking for how can we do things differently. Today, obviously, it's a low-carbon count sustainable agenda which is incredibly involved, more so than it ever. I think perhaps those are the sort of answers, I hope that touched on something to answer your question.

[Hossein] Yes, that's great. You mentioned your review sessions which I've been exposed to a number of times and how the protectors of the consistency share your experience. You've got a panel that reviews projects which happened across the board. You showed in the presentation how your buildings actually, when you look at the building, they looked different but there is that DNA through Foster's projects, that comes from the processes and the methodology you have. Louis shared the design methodology that they have. I know that they have a great robust one as well.

[Hossein] Michele, in the office, hence, I would have thought that the similarity that I've seen in your work and in your processes, I'm going to ask you separately later. Maybe a little bit controversial. If you're not happy to answer, I'm happy to move on but I'm going to ask Philippa one question now.

In our case, in Ramboll, we are a foundation-owned company, how do you think that has helped us differentiate from those who are not industry partners, we used to call them competitors, but in regenerative thinking, we call them industry partners who are not foundation-owned. How have you been able to protect some of the ambitions that you have because of the foundation ownership arrangement we have?

[Philippa] The foundation structure, which means that most of Ramboll, 97% is owned by the foundation for the express purpose of sustainability and longevity for our employees. That comes with a comeback to the topic of the day, the ethos, around investing back into our employees. It's very different. I've worked in many different forms of companies. I've worked in PLCs, I've worked in partnerships and now, in the foundation. It feels really different when you're in it because the ethos that comes with that foundation actually drives and allows people to have the mandate that goes back to the original Ramboll and Hannemann, the two wonderful.

One of whom was a humanitarian, the other of whom was an engineer, who had this great vision that then passed through the different generations, which I think is absolutely wonderful. Going back to then just a bit on the consistency question and particularly regenerative design, these are new areas for us, which means that actually, we've got to be very serious about making sure that we have good governance around it. We've been very specific about that. We take that topic seriously within Ramboll. We don't use the term regenerative design lightly.

We have a set of criteria that we have to pass if we're going to say that something actually is regenerative. We are very careful to be true to that. We even now have a Design Excellence Board that takes its inspiration if you like from this very session we're having, and that is one of the ways in which we apply that governance and be able to make sure that we are doing high-quality regenerative work, and we mean what we say and what we do.

[Hossein] Thank you. That is crucial. Governance on the use of these words. As I know that you're one of the proponents of that within Ramboll to make sure that these terms are not used casually and that they're not demeaned or devoided of their true meanings. We have a bit more time. I'm going to pose a question to Louis, but if you guys want to jump in and ask questions of each other as well, please do that.

Louis, one quick one before I ask a very personal question from each of you to finish up this panel of discussion, one of the things that I see, Louis, in your work, you didn't touch on in your presentation because of the short time that you had. You seem to have a very emotive and intimate connection with light. You talk about the spaces that you create. Providing the background to what happens. If it's like, for the people, you mentioned being prepared to be surprised by the way these spaces are used.

These are my words, but you said something else. You also have a very strong link with light in your work. Do you want to talk to us a little bit about that? Is it a consistent theme that runs through your projects or I have misunderstood you?

New Herlev Hospital, Copenhagen, Denmark

[Louis] No, not at all. No, no. There were so many things to say. I did do the full daylight discussion. Daylight is maybe the most prominent thing in the legacy of Henning Larsen. When I started at Henning Larsen many years ago, the first thing Henning said to me was, "You have to understand that the perception of space is understood as a naked person that stands in a room informed by daylight." I remember thinking this was a very complex concept to grasp as a young architect, but I think I got the point.

Sometimes, it is about how light forms spaces, but it's also about how it has been perceived and experienced by people in these spaces with light. Over many years, we worked with daylight and formed spaces based on the ratio of inside and outside.

Twelve to fifteen years ago, we started exploring daylight more scientifically with a research team. Today, we can quantify light and qualify light for what it really means in depth.

In educational institutions, a student's ability to learn is better with daylight. One of the things we found was that it is not the intensity of light, per se, but changes in daylight - during the day - that makes a difference.

On the same note, we have just finalised a research program where we have looked at the connection between daylight, artificial lighting, and noise in schools and kindergartens. In a kindergarten, it is common to think, "How can I survive with this noise level for five minutes?" What became evident is that there is a clear connection to how a space is lit, whether from the windows and openings to the outside or with artificial lighting. With artificial light, we can see that if you replace the traditional 300 lux outlining of the space for cleaning with focused light on small tables, kids lower their noise levels dramatically because they speak to each other and not to the space.

We've also initiated a research program for a big hospital project in Norway to understand recovery time after surgery. We want to show that there's a connection between patients' exposure to daylight and external views with quicker recovery time after surgery. It is a big thing here.

[Hossein] True. Thank you.

[Louis] I also want to say just one thing. One of these things that Jonathan was talking about is how generations have knowledge, how you transfer that to the next ones, it's one of these that is a little difficult. You somehow have to believe in it. You have to get on board to really work with it. We are trying to do that a lot with a young guy, especially in the early phases of a project in the design phase.

[Hossein] Thank you. That's great. I'm going to pose one question to both Michele and Jonathan, and do please feel free to disagree with me. What I found was, that while the external expression of your work and your projects can be somewhat different, definitely for the uninitiated, I find your projects and your work tend to be somewhat driven by environmental responsiveness. On every project that you have, environment is a big thing. You touched upon it in your presentations and I know how much you guys care about it.

Technology integration refers to how much you work with technology and also, in terms of purpose. Purposeful design is a big thing for us, for Philippa and me.

Environment, technology, and purpose — are they reading it correctly? Of course, then we all put together with a sense of rigor and with courage. Is there something that you want to add to that, disagree with me, agree with me?

[Michele] Is it something you think we have in common?

[Hossein] Yes.

[Michele] Is that your point?

[Hossein] Yes. I think there are things that you do together and then of course, there are points of departure. Hence your project outwardly looks different, but there are a lot of common grounds within.

[Michele] I think the challenges are there. They haven't changed. Society challenges. If anything, there are more challenges today. The responsibility of the architects is obviously to respond to those and to help the industry develop. I think Jonathan touched on it, on the idea of bringing in the builder on board early on and really helping promote the industry and the business. I think what unites us in this room today is the will to actually develop architecture as a professional as a business because, in many ways, I think it's still-- We had real pioneers, real works or practices, which are pioneers of contemporary architecture, that founded them.

We're now in a phase where we're actually trying to establish architecture as a proper profession. This means that you have peers that you compete with and you try to get better solutions and better responses, and you need that-

That's why we love London so much. We need that melting pot and that critical mass of great architecture design practices because we can all compete, and we can all look at each other's work.

Unless we have an occasion like today, normally, we just focus on our competitions, our projects, and our clients, but we always look at what each other is doing. I think that is a great way of naturally advancing. Competition helps.

[Hossein] Thank you.

[Michele] No doubt.

[Hossein] Fantastic. Jonathan, same question to you.

[Jonathan] I think the other thing I would add, I think you've also got to make sure that, particularly when you're working with commercial clients, that you're giving them great value for their money. If it's a residential design, it has to be highly efficient. The net to gross obviously is also something which is something which you have to bear in mind. Yes, all the points you mentioned are absolutely there in all of our work, but there are other things. I think we're always trying to find something which-- If it's residential, let's say, there's got to be some unique selling point if they're competing in a market.

What is it about their building that is better than their competitors? If it's offices, I think these days is absolutely-- How is it the most sustainable? There are a couple of projects that we're talking to people about at the moment, where are they saying, "Well, okay, this has lead numbers, fours, fives, sixes, this is interesting." What about number seven? We need to do more. I think it's also our responsibility to try and educate in the nicest possible sense and in the least condescending way to educate your clients because they look to us to give them something which they never expected they were going to get.

They look to us as professionals to give them something better than they had before. Those challenges are ever present. I suppose, in the world in which we live these days, without any doubt, I guess, you would say it's a moral responsibility to do that. We are a service industry and we need to provide our clients with the best possible service, whatever that may be. We all three companies here and yourselves are saying, we all do that.

I think it's excellent that we don't do it in the same way because life would be terribly boring. I suppose we would be out of a job. I think the more we continue to do things differently, the better.

[Hossein] Fantastic. Thank you for that answer.

[Hossein] I'm going to ask each of you one last question. If we can answer with one word, that's fine. If 10 words, that's also fine. This is the last session of today and this whole event that we have organised. We are obviously hoping to be repeating it next year and the year after, et cetera.

In the way of some inspiration for our future sessions, I know your occupation as architects, designers, thinkers, artists, engineers, managers, leaders, et cetera, in Philippa's case.

That is our occupation, what is your major preoccupation? What keeps you awake at night outside your immediate work?

Philippa? Sorry to put you on the spot.

[Philippa] That is a great question. I have enormous anxiety about how we are going to respond to the climate emergency, how we are responding. I mean that really genuinely. The challenge is so immense and it requires a level of collaboration, which we've never achieved or seen before. I'm also extremely optimistic that there's the will out there to do that.

[Hossein] Fantastic answer. That's great. Louis?

[Louis] I agree with Philippa. Appropriately responding to the climate emergency is the biggest priority. However, when looking at architecture, I'm very optimistic about this reconnection to craftsmanship through this discussion of sustainability and how technology plays a part in it. In my career, for the first time, we are getting closer to realising what we do and not drifting away. We have been through many years of developing digitalisation and now, we are honing in. I believe it gives us the chance to do something about these complex challenges and I agree the collaboration needs to be much, much stronger across.

[Hossein] Thank you. Jonathan, what keeps you awake?

[Jonathan] Thinking about you, obviously (laughs...). The first two points made, without a doubt, the most important because I assume we've all got children and the world of which we will impart them is something which we're all responsible for. Completely endorse what's being said. Maybe the other one is always we have to do something different. To do the same thing, again, you could possibly do it better. That's interesting. You could craft it more.

I think the interest is always coming up with a different way of doing the same thing, or a different way of doing a different thing because we are creative people. Innovation is perhaps something we need to be constantly thinking about.

[Hossein] Thank you. How about you, Michele?

[Michele] Share all the points and I have to say the children and the future generation is a key preoccupation for all of us. Establishing a true circular economy, I think in the construction industry, it's a great challenge for the future. I think that's really where we're going and where we're striving to go. Technology will help us in that direction.

I think that to me, is how to crack the imbalance between the construction of the new and the retention of the past, and especially now that Asia has built up so much, they will also have to face that challenge, learn the scars, and that will be very, very interesting how do we reuse.

[Hossein] On that note of creative anxiety, as it were, and the message that "if you don't have anxiety, you're not creating anything new". I thank you all, Philippa, Louis, Jonathan, Michele.

[Michele] Thank you Hossein.

[Hossein] and I wish you great weeks, months, and years ahead and look forward to seeing you soon.

Ramboll Hosts

Bjørn Tore Landsem

Director,
Buildings Ramboll Norway

Bjørn has worked at Rambøll since graduating as a Civil Engineer in 1996 and has been on Rambøll Foundation Board since 2013. As Buildings' Managing Director in Norway, he directs the largest projects within buildings, in addition to taking a leadership role in Norway.

Neel Strøbæk

Senior Group Director,
Sustainability & CR, Ramboll

Neel is an expert on sustainability. She has more than 25 years of experience in environment master planning and large-scale infrastructure development, and she is a specialist in stakeholder engagement, making for more sustainable and liveable cities and urban areas.

Lars Ostenfeld Riemann

Executive Director,
Ramboll Buildings

With 25 years of experience, Lars has had the opportunity to work with a number of the most challenging and innovate buildings projects in the world, pushing the boundaries for sustainability and digital design.

Rikke Bjerregaard Orry

Sustainability Director,
Ramboll Buildings

Rikke is one of the driving
forces in the development of
Sustainable Building Design
as a specialist discipline in
Rambøll, supporting Rambøll
employees in developing,
selling and delivering
Sustainability Services in
relation to buildings.

Ruth Norman-Johnson

Digitalisation Director,
Ramboll Buildings

Ruth drives innovative
approaches through her
project delivery, working
to develop tools and utilise
computational capability to
drive design efficiency and
improve Rambøll's digital
market offering.

Philippa Spence

Managing Director,
Ramboll UK

Philippa is a recognised
industry expert and senior
leader with a background
in delivering complex
sustainability, environmental
and social projects for clients
across a multitude of sectors.

Epilogue

the inaugural Ramboll design excellence forum (RDEF) has been a remarkable journey of introspection and collective wisdom, spanning two days filled with personal experiences, insightful discussions, a shared vision for climate, and nature-oriented approaches to the future. as we bid farewell to this transformative event, let us reflect on the profound lessons and inspirations we take with us.

across two day of the inaugural Ramboll design excellence forum we heard very personal experiences of two icons of the built environment. our very own professor hannemann and lord richard rogers whom we sadly lost only a couple of years ago.

throughout the forum, we delved into the complexities of urban systems and the vital dialogue between the urban and the rural; a dynamic that is essential to the core concept of a city where we reinforce our commitment to designing spaces that harmoniously blend nature-based systems with urban environments, enriching our cities now and in the future.

in session A on design x society, sarah's eloquent reminder of our agency encompassed the need to unlearn, relearn, and redefine the inclusive "we" to remain relevant in a world fraught with inequality and uncertainty. her call to removing barriers to knowledge and embracing humility and curiosity resonated deeply, igniting a promise of positive change.

lennart's heartfelt account of two iconic figures, professor hannemann and the late richard rogers, offered a poignant reminder of the lasting impact visionary individuals can have on shaping our cities and societies.

LadyWell Social Housing, Off-site Volumetric Housing

he discussed architecture's societal impact, business ethos, urban regeneration and innovative social housing using offsite construction.

stanislava's exploration of urban systems and the dialogue between urban and rural reminded us of the sophistication that is essential to cities, where nature and nature-based systems should harmoniously coexist. hers was a sobering reminder of an evident lack of sophistication in some of the new cities being conceived now across the globe.

bjorn tore's inspiring words illuminated the empowering potential of the ramboll's foundation-ownership structure and how this has enabled impactful initiatives worldwide.

in the masterfully moderated session by sarah, a shared vision of a climate-oriented approach for the present and immediate future emerged, emphasising the integration of nature-based systems into the fabric of cities.

in session B, hosted by Rikke, on design X environment, Ken Yeang, one of the pioneering figures in ecological highrise buildings, took us through the progress of the last 40 years or so on environmentally responsive urbanism, and on technology integration that has contributed to this. ecological design requires understanding and emulating natural ecosystems, leading to a harmonious integration of human-made environments, constructed ecosystems, and the natural environment.

nirmal ably took us through the environmental journey from sustainable and green development, through to ecologically sensitive, and regenerative design.

he shared how we have gone through shifts in paradigms of protecting nature (from us), to an appreciation of limits of nature. the 'green' and 'do less harm' movements have inflicted harm on our ecosystems to the extent of near-annihilation of biodiversity with the rampant increase in greenhouse gas emissions, shrinkage of forests, and polar ice.

on restoration and regeneration, on "doing more good" is the way to go...

many projects where these ideas have been successfully applied were also shared...

michael observed how nature and biology only use 11 elements of the periodic table to do the wonders that they do and how we ought to learn from the frugality with which nature builds, and move away from our wasteful practices by mimicking the processes which underpin nature.

he shared how seeing cities as constructed eco-systems where the waste from one process would be used in another adjacent process, and so on and so forth. how we need to know more about nature so we can work WITH nature rather than TO it.
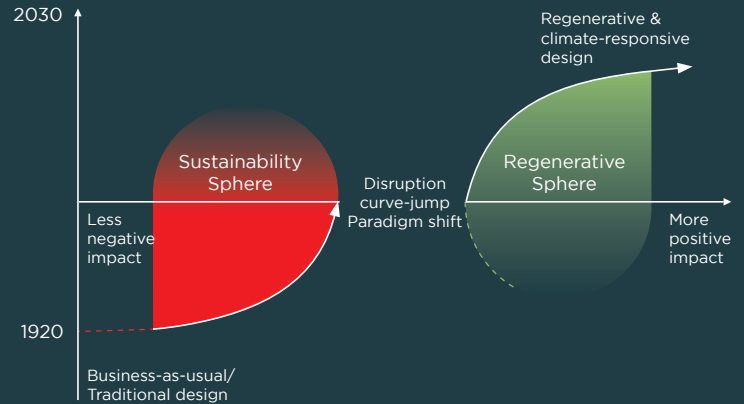
The paradigm-shift of Regenerative Design. (Inspired by Reed, 2007 and Craft et al, 2017)

martha reminded us of the very perilous journey we are on with harmful chemicals in our materials; harmful chemicals and novel entities which have already busted the planetary boundaries, but which tend to go below the radar of most regulatory processes!

she quipped on not only the oxymoronic name for such materials (novel!), but also the oxymoronic relationship between such harmful materials and the supposed safe environments we design for our kids and the unborn; the killer paint we are all specifying in our designs! perhaps we can plea to fellow architects and interior designers to reconsider the apparent love affair some of us have with paint ...

neel, my dear ramboll colleague, then added how we are all on board the regenerative and "doing more good" curve. how we are drawing our red line where the red zone on the left of the regenerative curve is. how we say emphatic NOs to environmentally harmful projects, regardless of revenue, profit or market share pressures! how we at ramboll value ecology, and how she finished with her characteristic and infectious optimism and positivity that runs through all that she does, how we value the human, social and other capitals over and above the monetary capital the current system tends to be obsessed with!

in session C hosted by ruth, richard's thought-provoking discourse on "design x technology" delved into the impact of artificial intelligence on creative content and the potential transformation of traditional design. as we stand at the precipice of an ever-changing world, his vision of an "ecology of intelligence" offers hope for harmonious coexistence between human ingenuity, artificial intelligence, and cosmic intelligence in shaping the future of design; perhaps a proposition by him to move from the artificial to augmented in the "A" of AI ...

robert discussed technology-rich design and workflow with an engineering focus, replicating nature's strategies for enhanced performance and efficiency. he shared how taking a glimpse into the mind of nature inspires new possibilities.

jakob's presentation on digital craftsmanship at henning larsen showcased innovative projects that integrated digital technology and sustainability principles. he shared how their focus on sustainability, technology, and data drives their design excellence. technology is viewed as an enabler, not a replacement, to achieving more sustainable and relevant architecture.

in the panel discussion, lars emphasised how technology can enhance craftsmanship, bring new design methods, and revolutionise the construction industry through innovative manufacturing. technology's impact on replicating nature in design and in integrating innovation in construction was also covered.

the forum culminated in the final session on design X ethos, where I discussed design and business ethos with 4 industry stalwarts.

louis shared how henning larsen's architectural ethos centres around creating spaces that foster human interaction, connecting diverse communities, and emphasising sustainability.

jonathan presented the ethos of creating unique and timeless architecture, as an attitude that is consistently pursued within foster and partners.

michele elaborated zaha hadid architect's design ethos, which sets to defy traditional architectural norms, and to craft nature-inspired structures that address the complexities of modern societies.

in the panel discussion, philippa highlighted the importance of storytelling, passing on the founders' ethics, and being a constantly learning organisation as one that Ramboll values and encourages.

a very interesting tendency emerged in the panel discussion, where despite differences in the design and representation of the architecture that comes out of these 3 firms, that their value for a design-based ethos, creates a tremendous amount of likeminded-ness in their approach to designing a built environment that is responsive to the ever-changing demands of the industry.

there is a profound respect for light, for craftsmanship, and for the environment in all their architecture. these are so masterfully embedded in their work, that similarities are not readily discernible.

hossein rezai-jorabi

as we part ways and return to our respective spheres of influence, let us carry the torch of agency and competence to address the challenges of our times. with technology as our ally, we can work together to shape a sustainable, equitable, and sophisticated world for generations to come. the spirit of collaboration and the shared vision we forged at the ramboll design excellence forum will continue to ignite positive change in our communities and beyond. together, we are poised to embark on a transformative journey of design excellence and purposeful action.

... and a final word:

a "systems" view of design

integrated design is best understood and explained with a "systems view of life/design".

a "systems view of life" is one that creates an eco-system. it is about seeing the connections that do exist in an eco-system, rather than having a myopic view of the process or parts thereof. integrated design is acknowledging that design and creative processes are indeed integrated into a "whole". it is "holistic". everything we do is part of a "system".

the contrast to this is a view of life that sees parts as disjointed, as mechanical, and unrelated. this view of life does not value the relationship between the constituent parts. in consultancy (in our case architecture and engineering), it does not see the value of design. it does not appreciate value creation. it just sees buildings and beams. it commoditises our work. it commoditises us in a race to the bottom.

systems are, by definition, collections of parts which have either evolved together over many years, like nature, or have been artificially designed and produced. in nature, we can see rain and clouds and thunder and oceans and mountains and trees and climate and the planet, as individual entities that exist in silos or see the connections between them. see how one event adversely or positively affects the other. and how the whole thing works in an integrated manner as an eco-system.

in contrast to natural systems, other systems may have been artificially "designed". the most intelligent systems are perhaps those using "bio-mimicry" and through learning from nature.

good systems comprise of good components which work in harmony to achieve the goals they have been designed for. good systems tend to offer more than the sum of their parts. good systems have hard components as well as soft components. they have strong parts as well as weak parts. you pull an apparently tiny component out of a system, you may run down the whole system. or you may adversely affect the performance of the entire system way too disproportionately compared to the apparent value and function of the component within the system. a washer or a gasket in a machine or in an engine can have a huge role in the overall performance. conversely, large components and apparently imposing parts of a system may not have as much importance attached to them when it comes to the functionality of the entire system.

good examples of a systems view of life and design are cars and machines. for example, it is almost universally accepted that a ferrari is a superior performing car compared to a fiat. the two cars work efficiently and effectively within the systems that belong to either of them. however, if one takes the engine of a fiat model and replaces it with the superior engine of a ferrari car, the resulting system will not function. this is despite the fact that one has "mechanically" replaced an inferior part with a "superior" one; in this case the engine.

in collaborative environments, high performing teams that apparently do not have many star players make good examples of the value of team and system building.

of engineers and architects

engineers and architects are trained differently. we bring different qualities to the table. you show an object to an engineer or a scientist, his immediate and default questions would be "what is it made of?", "how heavy is it?", "how does it work?", etc.

you show the same object to an architect, the default thinking and training would conjure up questions like: "what shape is it?", "how does it relate to other objects around it?", etc.

the engineer's default thinking is inwards into the object and properties that are inherently inside the object. in contrast, the architect's one is outwards, around the object and its context.

well-designed systems need both to create value beyond the sum total of the constituent parts, by putting these apparently opposing tendencies together into a whole.

we need our engineers to adopt the extrovert tendencies of design and architecture. at the same time, we need our architects to develop more curiosity about the inherent properties of the materials and shapes and forms with which they work. in ramboll, we are highly motivated and ambitious about moving towards a "systems view of design and consultancy".

to collaborate as professionals, we need a process that regulates the relationship between the different parties; a process that can be driven by purposeful design. the process should start by listening. deep listening to the needs of the clients and the society at large, then combining technical expertise with creative attitude and competence to develop design systems that surpass the ordinary. creativity requires rigor and hard work. it is energised by exemplary competence and by a disruptive attitude which encourages one to question the status quo and to explore new ideas. this is how a design-centric culture and ethos is created everywhere; from small design studios to large design-oriented corporations.

Canopy Shyness - Wisdom in Nature

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Live event in progress

Kuala Lumpur Group Viewing event

Final touches before live event
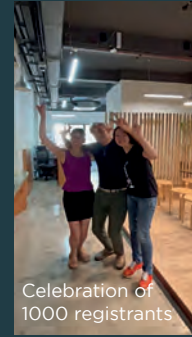
Celebration of 1000 registrants

Middle East Group Viewing event
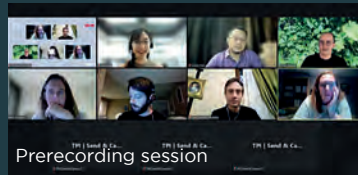
Prerecording session

Live production
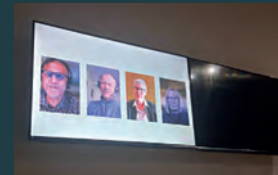
Singapore Group Viewing event

Prerecording session

Behind
The Scenes

RDEF in numbers

1
Sponsor

13
Speakers

8
Ramboll Hosts

8
Hours of Presentations

1,053
Registrants

618
Attendees On Day 1

437
Attendees On Day 2

2,327
Viewing Hours

1
Curator

DE
SIGN
EXCELLENCE
FORUM   2022
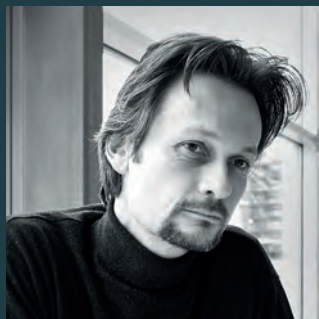
Credits

Host
Ramboll Buildings

Event Sponsor
Søren Brøndum, Ramboll

Speakers
Sarah Ichioka, Desire Lines
Lennart Grut, RSHP
Stanislava Boskovic, Imperial College London
Ken Yeang, Hamzah & Yeang
Nirmal Kishnani, National University of Singapore
Michael Pawlyn, Exploration Architecture
Martha Lewis, Henning Larsen
Richard Hassell, WOHA Architects
Jakob Strømann-Andersen, Henning Larsen
Robert Bamford, Ramboll-Web Structures
Louis Becker, Henning Larsen
Jonathan Parr, Foster + Partners
Michele Pasca di Magliano, Zaha Hadid Architects

Moderators and Panellists
Sarah Ichioka, Desire Lines
Nirmal Kishnani, National University of Singapore
Ruth Norman-Johnson, Ramboll
Bjørn Tore Landsem, Ramboll
Rikke Bjerregaard Orry, Ramboll
Neel Strøbæk, Ramboll
Lars Ostenfeld Riemann, Ramboll
Philippa Spence, Ramboll
Hossein Rezai-Jorabi, Ramboll

Photo Sources

RDEF22
on YouTube

2 Trailer Videos

RDEF22 Day 1 Trailer   RDEF22 Day 2 Trailer

The event has generated 23 clips
of individual presentations, panel
discussions, trailers, and summary
videos. These are available on
RambollGroup YouTube channel,
under RDEF22 playlist. Access
these through the QR code.

4 Summary Videos

Session A Summary   Session B Summary

Session C Summary   Session D Summary

RDEF22 YouTube Playlist

▶ @RambollGroup

17 Videos

Session A
Design X Society

Part 1/4 with Sarah Ichioka

Part 2/4 with Lennart Grut

Part 3/4 with
Stanislava Boskovic

Part 4/4 Panel Discussion

Session B
Design X Ecology

Part 1/5 with Ken Yeang

Part 2/5 with Nirmal Kishnani

Part 3/5 with Micheal Pawlyn

Part 4/5 with Martha Lewis

Part 5/5 Panel Discussion

Session A
Design X Technology

Part 1/4 with Richard Hassell

Part 2/4 with
Jakob Strømann-Andersen

Part 3/4 with Robert Bamford

Part 4/4 Panel Discussion

Session B
Design X Ethos

Part 1/4 with Louis Becker

Part 2/4 with Jonathan Parr

Part 3/4 with
Michele Pasca di Magliano

Part 4/4 Panel Discussion

Ramboll
Design Excellence
Publications

Edition No. 1
Creating value

January 2023

Edition No. 2
Design Excellence

February 2023

Edition No. 4
Regenerative Worldview

April 2023

Edition No. 5
In Praise of Retrofit

July 2023

Edition No. 3   March 2023
Ramboll Design System

Edition No. 6   September 2023
Augmented Intelligence

Ramboll is a global engineering, architecture and consultancy company founded in Denmark in 1945. Across the world, our 18,000 experts create sustainable solutions.

We combine local experience with a global knowledge base to create sustainable cities and societies, driving positive change for our clients, stakeholders and society. We enable our stakeholders to realise their goals and navigate the transition to a more sustainable future.

We call it:

Bright ideas.
Sustainable change.

"
We shall not cease
from exploration

and the end of
all our exploring

will be to arrive
where we started

and know the place
for the first time...

T.S. Eliot

RAMBOLL DESIGN EXCELLENCE 2022
This edition features the proceedings of the
inaugural Ramboll Design Excellence Forum
(RDEF22) which took place on the 27th and
28th of October 2022.

RDEF22 has been a remarkable journey of
introspection and collective wisdom, spanning
two days filled with personal experiences,
insightful discussions, and a shared vision
for climate, and nature-oriented approaches
to the future.

The overall theme of the forum was DESIGN.

The forum was framed around 4 sub-themes of
Design x Society, Design x Ecology,
Design x Technology, and Design x Ethos.

As we bid farewell to this transformative event,
let us reflect on the profound lessons and
inspirations we take with us.

This book is an open and honest embodiment
of all the knowledge, insight, wisdom, passion,
and ideas in DESIGN that were all so generously
shared by all participants.

Featuring

Søren Brøndum
Sarah Ichioka
Lennart Grut
Stanislava Boskovic
Ken Yeang
Nirmal Kishnani
Michael Pawlyn
Martha Lewis
Richard Hassell
Jakob Strømann-Andersen
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RAMBØLL