EUROPEAN RESEARCH TOUR
BERLIN – COPENHAGEN – MALMÖ 2023

FINAL REPORT

CONTENTS

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building 4.0 crc

info@building40crc.org

www.building4pointzero.org

/building-4-0-crc

OUR DELEGATES

Name	Company	Title
CRC		
Prof. Mathew Aitchison	Building 4.0 CRC	CEO
Dr Bronwyn Evans	Building 4.0 CRC	Chairperson
Dr Duncan Maxwell	Building 4.0 CRC	Research Program Lead – Monash University
Dr Sara Omrani	Building 4.0 CRC	Research Program Lead – Queensland University of Technology
INDUSTRY		
Brendon Pope	Fleetwood Building Solutions	Head of Design and Innovation
Gavin Tonnet	Donovan Group	Company Director | Business Strategy & Product Innovation Leader
Marcio Casagranda	Verton Company	Business Development
Jen Williams	Property Council of Australia, Queensland Chapter	CEO
Dr Jingfeng Xu	ARUP Singapore	Principal, Digital Services
Ross Harding	Finding Infinity	Principal
UNIVERSITY		
Prof. Elizabeth Mossop	University of Technology Sydney	Dean of UTS School of Design and Architecture
Dr Lee-Anne Khor	Monash University Melbourne	Deputy Head of Department Architecture, Research
Prof. Tim Schork	Queensland University of Technology	Professor, School of Architecture and Built Environment, Faculty of Engineering
Nghia Tran	The University of Melbourne	PhD Student
Fernando Pavez	Monash University	PhD Student
GOVERNMENT AND NOT-FOR-PROFIT		
Daniel East	Inner West NSW Government	Acting Senior Manager – Strategic Planning
Gunika Singh	Inner West NSW Government	Team Leader Planning
Vince Berkhout	Tech Central Alliance	Manager, Land Use Planning, Sydney Metro City and South-west
Debra Berkhout	Tech Central Alliance	Place-based innovation and urban renewal specialist
Markus Westbury	Fisherman's Bend Precinct	Former CEO at CAP/ Collingwood Yards. Writer, Broadcaster, and Founder of Renew Australia.

EXECUTIVE SUMMARY

Key points

a. The delegates had the opportunity to compare **different approaches to large-scale sustainable urban redevelopment** projects by visiting 3 very different approaches to sustainable urban redevelopment, ranging from public to private–public partnership and entirely private. These 3 projects share features, such as transforming complex historical buildings into places focusing on sustainability and energy with mixed uses, including housing, commercial and research/education/incubation functions. All foresee a long timeframe for development and roll-out.

b. This study trip **highlighted the centrality of decarbonisation** as *the* built environment development decision-making driver. This prioritisation of carbon contrasts with the Australian built environment industry, which generally views decarbonisation as a constraint or barrier rather than an enabler of innovation. Across projects and companies visited in Germany, Denmark and Sweden, stakeholders prioritise decarbonisation and place it at the heart of bold visions and plans to respond to the urgency of global warming, allocating resources and acting in ways that clearly address the issue and deliver outcomes.

c. The **importance of partnerships and collaboration** was emphasised as key to project success. These exist between SMEs, start-ups, medium and large corporations; between public and private; business and science; and internally within companies and their employees. A comprehensive approach was adopted to address complex challenges, such as emissions reduction, innovation and digitalisation, by considering the entire value chain. Start-ups play a significant role in the innovation equation for governments and large corporations.

d. Like Australia, **housing affordability is a critical issue** for the sector. The countries visited presented a range of alternative housing development and management models that suggest new and innovative ways for Australia to learn from and explore in seeking more affordable forms of housing delivery. The relevance of housing associations, the key role of government in public subsidies, innovative financing solutions, and low-cost, adaptable design solutions were apparent from the visits made. Despite these efforts, Germany, for example, continues to face a significant housing shortage.

e. European built environment stakeholders have **a strong focus on innovation and digitalisation**. A quote from a visit to the Fraunhofer Institute (the German equivalent of the CSIRO) summarised the European attitude to sectoral innovation — "To achieve the climate goals ..., the construction industry must be rethought and radically revolutionised". To transform the sector, new digital tools and systems drive innovation and novel working methods across the building value chain.

f. This trip offered **a glimpse into the future of building**. This vision is demonstrated by digitally enabled approaches, industrialised with a manufacturing-style focus, where appropriate levels of value chain integration (vertically and/or horizontally) are utilised; and where development decisions are driven by a response to the urgent call to decarbonise the sector.

Figure 1. Delegates crossing the Inderhavnsbroen pedestrian and cycle bridge in Copenhagen

DAY 1 – BERLIN

Welcome Dinner at Hotel de Rome

Speaker: **Johanna Harvey**, Investment Director and Team Lead, Austrade

Johanna Harvey introduced the delegates to the current situation in Germany. She described energy provision as a central issue and one contributing to geo-political uncertainty. Coal is being reactivated, but there is resistance because of climate change; there is also resistance to nuclear power. Gas supplies are limited due to the Russian invasion of Ukraine. This situation has led the government to financially aid businesses with the increasing cost of electricity and high inflation.

Johanna also mentioned other context features:

- A considerable skills gap exists, with half a million job vacancies remaining unfilled. There is growing concern that the rise of artificial intelligence could lead to the obsolescence of traditional jobs for many people.
- The German Government is helping businesses to pay for the increasing cost of electricity and high inflation.
- In terms of Germany's trade focus and where investment is moving, there are 2 predominant topics: green hydrogen and quantum / space-manufacturing.
- German companies are unlikely to manufacture in Australia due to the small market. At the same time, the USA offers attractive financial incentives (e.g. the Inflation Reduction Act (IRA)) that hinder Australia's ability to compete for large German investments. For example, the USA has committed to providing USD 400 billion over the next 10 years as subsidies to support companies located in the USA. This investment positions the USA as a hub with abundant energy, minerals and all the necessary resources to scale up the production of key net zero technologies.

Johanna identified some opportunities and challenges for Australian businesses too:

- The German Government has considered opportunities for Australia to provide raw materials and critical minerals needed for the electric vehicle transition.
- Electric mobility is not growing as fast as expected due to public resistance towards electric vehicles.
- Australian companies have demonstrated proficiency in adopting innovations. They face the task of finding a suitable niche in Germany.
- Germany offers attractive incentives for electric cars and heat pumps, but the incentives for building retrofits are not yet sufficient.

Figure 2. An engaging introduction for delegates before a warm welcome dinner

DAY 2 – HANNOVER

Hannover Messe 2023

Figure 3. Access to Hannover Messe 2023

Visit 1: Siemens Guided Tour

Speaker: **Danny Ramsood**

The Building 4.0 delegates were given a 'VIP Tour' through Siemens' expansive exhibition space offering a detailed view through the exhibitions oriented towards digitalisation and construction technologies. The tour focused on the following technological trends:

- digital twins for the performance-focused detailed design of equipment
- automation using real-time monitoring connected to the digital twin
- artificial intelligence used on construction sites to detect personal protective equipment used by workers.

Visit 2: Decarbonisation Panel

"How technology and expertise can empower manufacturing to get a net-zero future"

Panellists:

- **Dr Kamila Flidr**, Altair Engineering
- **Dr-ing Frauke Reinders**, Phoenix contact electronics
- **Lisa Reethen**, Executive Board, Bosch Climate Solutions GmbH
- **Judith Wiese**, Chief People & Sustainability Officer, Siemens AG.

Panellists focused on the role of partnerships and collaboration in changing corporate environments to achieve net zero in manufacturing:

- A net-zero strategy needs operational KPIs and milestones, an operational plan to get there and a budget. A crucial starting point is to measure the carbon footprint, because it serves as a foundation identifying the most

impactful and cost-effective interventions. All companies must start with their own operations; this action will produce double-edged benefits because factories are the face of businesses. Customers want to see how the company does things. Employees and their everyday work must be involved early in the change strategy.

- Digitalisation is key to net zero, via cloud technology that can be accessed anywhere, and artificial intelligence.

- The whole supply chain must contribute to low carbon; it needs help and support from the company to access the required technology. "Every SME is an expert in their area, and their knowledge will help us find innovative solutions" (Kamila Flidr, Altair Eng).

- The business cases, costs and revenues for circular economy must be developed soon. Failure to act promptly will result in a significant gap between forward-thinking entities and the rest. "We need to get into the design of our products; the materials take two-thirds of our emissions" (Judith Wiese, Siemens).

- If a company doesn't start now, by 2024 it will be very, very hard to get into it (Lisa Reethen, Bosch).

Figure 4. Panel discussion on decarbonisation in industries

Visit 3: FlandersMake

Hosts:

- **Dirk Torfs**, Manager
- **Filip de Coninck**, Chief Valorisation Officer

FlandersMake supports the international competitiveness of companies in Flanders and helps attract foreign businesses. It promotes collaboration among SMEs, medium and large enterprises, and tech and social science (added value to people). FlandersMake supports SMEs and large manufacturing companies with industry-driven, pre-competitive and excellent research in 2 application domains:

- products: vehicles and machines
- production: assembly.

Based on high-tech research from 3 co-creation centres, the drone cluster EUKA and core labs at 5 Flemish universities, it actively supports manufacturing companies to develop and optimise their products and production processes via:

- research
- customised innovation
- testing and validation.

Link: https://www.flandersmake.be/en

Visit 4: VEDLioT (Very Efficient Deep Learning in Internet of Things)

Deep Mirror product: 'An intuitive interaction interface'

Host: **Christian Stollenwerk**, CoR-Lab, Bielefeld University

Contact: Nils Kucza, nkucza@techfak.uni-bielefeld.de

The primary goal of the VEDLioT toolchain is to optimise existing deep neural networks towards specific target hardware using the EmbeDL optimiser technology. This project is funded by the European Union and was developed through a collaboration of 6 universities and 6 industry partners:

Figure 5. Partners of VEDLioT

The Bielefeld Research + Innovation Campus (BRIC) is a local innovation ecosystem hub to promote cooperation between business and science. The ThinkTank OWL helps integrate SMEs and deep-tech spin-offs into cooperative formats with science, giving them easy access to cutting-edge research. Research-oriented companies can implement scientific projects on the Bielefeld campus and use the university's infrastructure. BRIC also welcomes non-university research institutions to settle on its campus, creating further impetus for innovative research cooperation.

Link: https://vedliot.eu/

Visit 5: IGUS – High performance polymers for motion

Igus Motion Plastics develops and manufactures factory low-cost automation solutions with bioplastics in Cologne, Germany.

These automation solutions are made from bioplastics containing mainly corn. As depicted in Figure 6, they claim to have affordable solutions for manufacturing automation.

Link: https://www.igus.com.au/

Figure 6. Igus showcase for bioplastic-based factory automation

Visit 6: IIP Ecosphere (Next Level Ecosphere for Intelligent Industrial Production)

Contact: Leibniz Universität Hannover, Research Center L3S. Appelstrasse 9a, 30167 Hannover.

IIP-Ecosphere is developing a novel artificial intelligence (AI) ecosystem that connects industry, service providers, associations and research. Their aim is to reach a next level of smart production, 'an innovative leap in self-optimization', to increase the productivity, flexibility, robustness and efficiency of production processes.

IIP-Ecosphere involves diverse stakeholders and has planned 2 ways for fostering collaboration:

- Regional Innovation Hubs (RIH) are organised around active incubators, start-up centres, multipliers, IT investors and IIP Ecosphere partners with a special focus on AI and production to accelerate innovation processes, promote the ecosystem's growth and promote exchange and dialogue. For example, manufacturing companies should be brought together with SMEs and start-ups to transfer ideas from think tanks and the AI accelerator.

- The IIP Communities of Practice (CoP working groups) unite companies and other interested parties to discuss current topics of the IIP Ecosphere, identify requirements, bring them into the Ecosphere, and influence the general discussion on these topics. In particular, the CoP will advance issues related to the legal framework, regulation and standardisation, as these aspects require a broader basis.
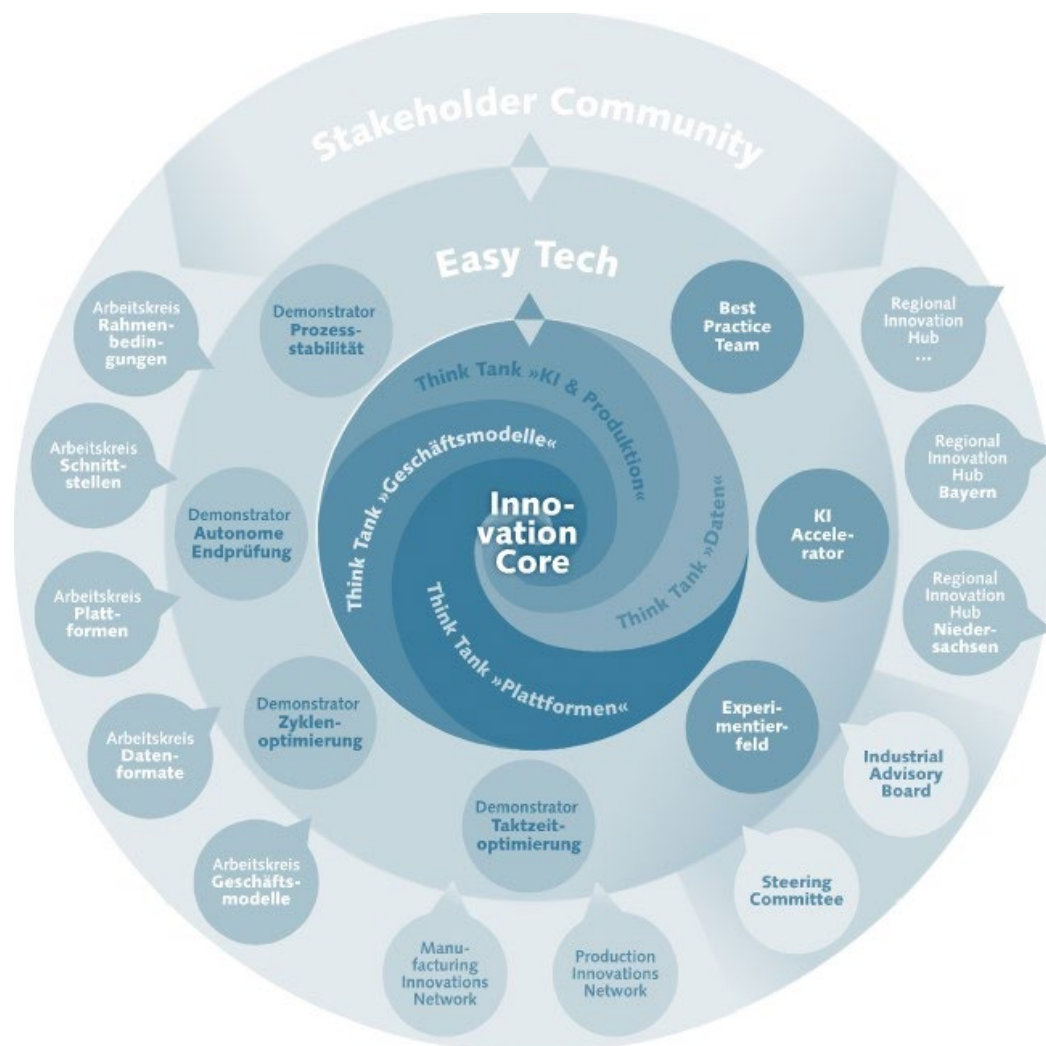

Figure 7. IIP Ecosphere regional innovation hubs and communities of practice

Link: https://www.iip-ecosphere.de/

DAY 3 – BERLIN

Morning visit (9:00–10:30)

R50 Cohousing Project

Host: **Prof. Christoph Schmidt**, Project architect and resident at R50

R50 Cohousing is a resident-funded Baugruppe (building group or Cohousing) development led by architects and finished in 2013. The project is located in Berlin's Kreuzberg neighbourhood at Ritterstrasse 50—hence R50.

Baugruppen are collectively built residential complexes where individuals own their units but share common spaces. This building is a new model typology for low-cost and affordable housing while offering a maximum capacity for adaptation and flexibility throughout its lifetime. The financing model required each family to get a loan from a specialised bank, but today the cooperatives get the loans as an organisation.

Project data:

Figure 8. R50 Cohousing Project

- 2,000 m^2 site cost €250,000 in 2010, now valued at €8 million
- Apartments ranging from 90–120 m^2 (average 105 m^2)
- Construction cost (including shared spaces): €6–7,000 (USD 2.700) per m^2 (20% cheaper than a unit in the same area)
- Minimum deposit requirements: 30% for each family.

It was developed and designed by the future residents and the architects, some of whom are also residents, in response to Berlin's affordable housing shortage after the city stopped building social housing in 2004. The plot was purchased from the municipality in a bidding process based not on price but on the quality of their residential concept. This process was pivotal to building affordably. Only half of the future residents were part of the building group when they bid for the land. The number of building group members guaranteed a loan from a bank. It was also influential during the application process for the plot, hence the importance of forming a building group before land acquisition. The communal agreement process took approx. 1.5 years.

The project comprises 19 private residential units alongside a double-height multipurpose space with the following shared spaces:

- guest room (130 m^2)
- laundry room (14 m^2)
- workshop (10 m^2)
- roof terrace with a summer kitchen (40 m^2)
- perimeter galleries as wraparound balconies (483 m^2)
- garden (1480 m^2).

Figure 9. The discussion inside the R50 communal areas

The architectural concept is based on a compact reinforced concrete skeleton that allows an open floor plan with one circulation and 2 service cores, an independent and well-insulated timber façade with double glazing, and suspended steel construction for the all-around balconies. The building is 30% more energy efficient than the German Energy Saving Regulations.

An intensive process of consultations, discussions and design contributed to developing each apartment and all additional community spaces. The structural framework determined the sizes of apartments, but each unit's floor plan was customised to individual needs and desires. According to Christoph, "Architects must make every apartment likeable and beautiful for every family". A collective approach to interior fittings was applied, but some surfaces were left unfinished to allow individual layouts of the apartments. As a result, all apartment layouts (i.e., location of the rooms, room numbers and sizes) are different.

Designing galleries with a wraparound form instead of creating subdivided private balconies was a collective decision. The perimeter galleries serve as balconies, secondary exterior circulation routes between apartments and scaffolding for the residents to maintain the wooden façades. Residents fix maintenance problems themselves and, by doing so, foster a sense of community.

"The community is so resilient; it's a village". Christoph suggests bringing together people with similar interests to form a community. This model works for single people, single parents, all types of families, etc. "We need new models of using instead of owning."

Links:

- https://www.archdaily.com/593154/r50-nil-cohousing-ifau-und-jesko-fezer-heide-and-von-beckerath
- https://www.kcrw.com/culture/shows/design-and-architecture/berlins-r50-baugruppe-is-a-model-of-living-affordably-collectively
- https://open.metu.edu.tr/bitstream/handle/11511/99686/sevket_deniz_gokce_march_thesis.pdf

Afternoon visit (12:00–14:00)

Siemensstadt Square

Concept: Berlin's district of the future

Hosts:

- **Maria Rossbander**, Program Officer
- **Sarah Tietze-Kamya**, Head of Marketing

Siemensstadt Square is a large redevelopment project involving private and public investments to revitalise the old Siemens factory and its surrounding neighbourhood. The project area comprises various spaces for apartments, office and commercial buildings, industrial production, retail and gastronomy, hotels, and social, cultural and public facilities. A central aspect is interwoven districts that promote exchange, vitality and creativity with a strong focus on sustainable development.

Project size:

- 73 ha
- total investment of € 3 billion.

Intended uses:

- 190,000 m^2 of industrial space
- 2,700 new housing units (apartments) and community facilities for over 30,000 people
- 1 new primary school
- 2 childcare facilities
- 420,000 m^2 of office space
- Social and cultural facilities, buildings for start-ups, cooperation partners and research institutions
- 200,000 m^2 of retail and restaurant space.

Figure 10. Artist's impression of Siemensstadt Square Project

Sustainability targets:

- Resource-efficient construction and later CO_2-neutral operation
- Green axes that allow walking, biking or self-driving cars
- District-wide energy optimisation of concepts for repurposing or resource-conserving reuse after dismantling
- New designs and manufacturing routines of additive components from the turbo machine industry or qualifying new high-performance alloys for gas turbines
- Careful handling of materials and raw materials following future-oriented, recyclable paths. Planned and built in an environmentally friendly manner, a Smart District is being created to demonstrate new recycling forms. The 'zero waste' principle for construction and operation is actively pursued in cooperation with other actors. Digitisation and social networking are helping to accelerate the transformation to a circular economy.
- During operation, energy consumption continuously optimised through monitoring, smart control and user information.

- DGNB (German Sustainable Building Council) honoured the planning with a pre-certificate as a particularly sustainable urban quarter for its CO_2-neutral operation plan.
- The project received a preliminary certificate as a particularly sustainable planned 'community' under the internationally established LEED (Leadership in Energy and Environmental Design) certification system.

Figure 11. Siemensstadt Square Project

Social and urban impact:

- Retrofit the old administration building into a museum open to the public and the old factory into an innovation campus, bringing together a collaboration with academia and other technology companies.

Figure 12. B4.0CRC delegates with Siemens' representatives

Links:

- https://www.siemensstadt.siemens.com/en/development/virtual-city/digital-twin
- https://www.henn.com/en/project/wb-siemensstadt-20
- https://braincity.berlin/en/stories/story/siemensstadt-20-research-and-industry-closely-linked
- https://www.ubm-development.com/magazin/en/smart-district-on-historic-site/

Berlin TXL – Tegel Projekt GmbH

Hosts:

- **Pia Sophia Laube**, Executive Assistant to Chief Executive Officer
- **Gudrun Sack**, Chief Executive Officer

Under the concepts of 'Making space for Berlin to grow', 'Berlin's most important economic and infrastructure project for the next 20 years' and '500 ha of future', the Berlin TXL project aims to build a green, equitable and productive city.

TXL is a publicly owned and controlled project, but it is protected from election cycles by making project governance as apolitical as possible. The projects stands on the 500-hectare site of the former Tegel airport. It will comprise:

- Berlin TXL (the former airport buildings)
- Urban Tech Republic: 202 ha for research, innovation and technology
- 150,000 m^2 building area
- Schumacher Quartier: 46 ha of the project area (29 ha on the former airport grounds) – mainly residential.
- Tegeler Stadtheide: 220 ha of nature and conservation area (mentioned 245 ha for green and recreation in the meeting)
- Cite Pasteur (TXL North): potential development of 4,000 apartments.

Figure 13. Tegel airport main building

The intended uses include:

- Residential areas: >9,000 residential units
- 200 ha green landscaped area
- Up to 1,000 large and small companies with 25,000 employees
- 5,000 Berlin University of Applied Sciences students in the former terminal building
- Innovation park focusing on what keeps the growing metropolises of the 21st century alive.

Economic impact:

- Will attract €8 billion of public and private investments over the next 20 years
- > €6 billion gross value added each year
- > €350 million in tax revenues each year
- 20,000 jobs in future-oriented industries
- "Urban technologies are researched, developed, produced, tested and exported here, where science and research meet industry and commerce, and start-ups meet investors."

Sustainability targets:

- An ambitious energy concept comprising:
  - The 'Low-Exergy Network': water-based, low temperature (40°C), open system, climate-neutral energy supply network that supplies the former airport with sustainable heating
  - Heating and cooling: provided by a district heating network powered by geothermal, industrial heat, sewers, and biogas
  - Heat exchangers and heat pumps in each building: smart-grid control system to control powerhouses, water heat, geothermal energy, biogas, photovoltaics, e-mobility (charging infrastructure), sector coupling (electricity, heat, cold), etc.
  - Powerhouses: plants for energy production, operational devices, and information centre
  - Waste heat: surplus heat from technical processes used for heating in winter and cooling in summer (cold as a byproduct of heat pumps)

- Geothermal energy: near-surface geothermal energy and seasonal thermal storage
- Photovoltaics: value added as a rental electricity model, conversion of surpluses via heat pumps into thermal energy for air conditioning and feeding into the public network
- E-mobility: charging infrastructure via mobility hubs located in the perimeter; special bidirectional charging management. Car-free streets, encouraging bicycle, e-bike and scooter use. Exploring the use of delivery robots for things like groceries
- Sector coupling (electricity, heat, cold): sectors electricity, heat supply, transport; conversion of surpluses via heat pumps (Power-To-Heat/Cold) in thermal energy; local storage in e-vehicles

- Future of Construction: smart, energy efficient buildings, ecofriendly materials (mainly timber) and emission-free construction process
- Mass timber: aiming for climate neutrality, all buildings to be built out of wood and materials from the local region. In the residential area, homes will be made of locally sourced wood and with green roofs.
- Animal-aided design: local native species provided help to thrive within the project. Smart nature: digital twin (data platform) including geo-data and sensoring of nature: rain, grass-cutting sheep output, etc.
- As part of a 'sponge city' concept, no rainwater will flow into sewers and will instead be retained, reused, soaked away or allowed to evaporate as a form of natural air cooling.

Social impact:

- Manage gentrification using social mixture via developing housing cooperatives. Housing units are not to be sold but are leased for 99 years. Approximately 35-40% share of subsidised rents.
- Commercial development, a 60-year lease
- The concept is part of the evaluation criteria for selecting developers.

Interim uses:

- Hangar used for concerts and festivals; daily hire for €80,000
- Start-ups currently using old airport offices
- Interim use of 'tent city' as vaccination hub and refugee temporary accommodation

Figure 14. The entire TXL project

Figure 15. Schumacher Quartier

Figure 16. Urban Tech Republic

Links:

- https://www.berlin.de/en/train-stations/1872399-2932875-airport-berlin-tegel-txl.en.html
- https://www.dezeen.com/2022/08/03/berlin-tegel-airport-redevelopment-technology-park-housing-complex/
- https://edition.cnn.com/travel/article/berlin-txl-tegel-airport-redevelopment-spc-intl/index.html

Evening visit (17:30–18:30)

Australian Embassy in Berlin

Audience with Ambassador: **Mr. Philip Green OAM**

Mr Philip Green described the current situation in Germany. The Russian invasion of Ukraine has changed the country, making it less economically buoyant than before. However, the country is engaging in strategic changes and maturely responding to the challenges, such as upgrading its security systems.

Economic relations with Australia are weakening despite Germany's increasing interest in Australasia. While Germany exports technology to Australia, Australian exports to Germany are mainly mining commodities. Other significant points of interest.

- Australia invests more in Germany than vice versa. Australia would not be perceived as a serious country for doing business.

- Germany stopped its dependence on Russian gas with no major disruption. The country is not in recession, but faces challenges in the medium term. Alternatives to Russian natural gas impose high costs.

- Russia's war with Ukraine has environmental impacts. Germany has had to bring coal-fired plants back online, but is pushing forward its energy transformation and commitment to climate action (largely profound and unaffected by the war).

- Germany needs to step up in the energy sector. Hence green hydrogen (H_2) and critical minerals are the main focus of future trade. Australia is well positioned to provide H_2.

- Distance is not a problem because it can be transported using methanol and other fuel cells as an H_2-carrier.

- Mr Green proposed an open question for discussion: what can Germany learn from Australia?

Figure 17. Discussion with the Australian Ambassador in Berlin

DAY 4 – BERLIN

Morning visit (09:00–10:30)

Fraunhofer IPK

Speaker: **Dr-Ing Holger Kohl**, Deputy Director, Fraunhofer-Institute for Production Systems and Design Technology (IPK)

Fraunhofer is a leading research institute (it may be considered equivalent to the Australian CSIRO) with 76 branches, all focused on industry. The meeting focused on the *Bauhütte 4.0* project that Franhufer IPK is developing for the TXL project. The aim of the research is to transform this large urban development into a CO_2 sink, instead of a CO_2 source.

Fraunhofer's approach to decarbonising urban development includes building with mass timber, cooperative planning and networking, and radical digitalisation of the entire value chain (from forest to the city). According to Dr-Ing Kohl, "To achieve the climate goals of Berlin State, the construction industry must be rethought and radically revolutionised". This vision for a wood-to-city value chain considers the following components:

- Forest-to-city value chain modelling

- Timber value chain networks – the networking of the regional and supra-regional timber construction industry is indispensable to meet the demand for urban timber buildings

- Radical digitalisation – urban housing construction in wood must become affordable and competitive. To this end, Bauhütte 4.0 is developing new digitalisation, networking and standardisation methods

- Crowd production (SMEs network) – Bauhütte 4.0 creates economic efficiency effects through crowd production and the connection of small digitally driven companies, regional timber construction companies and large anchor companies

- Cooperative planning – early involvement of timber construction companies creates economic efficiency through time savings and must use open standards and a standardised process.
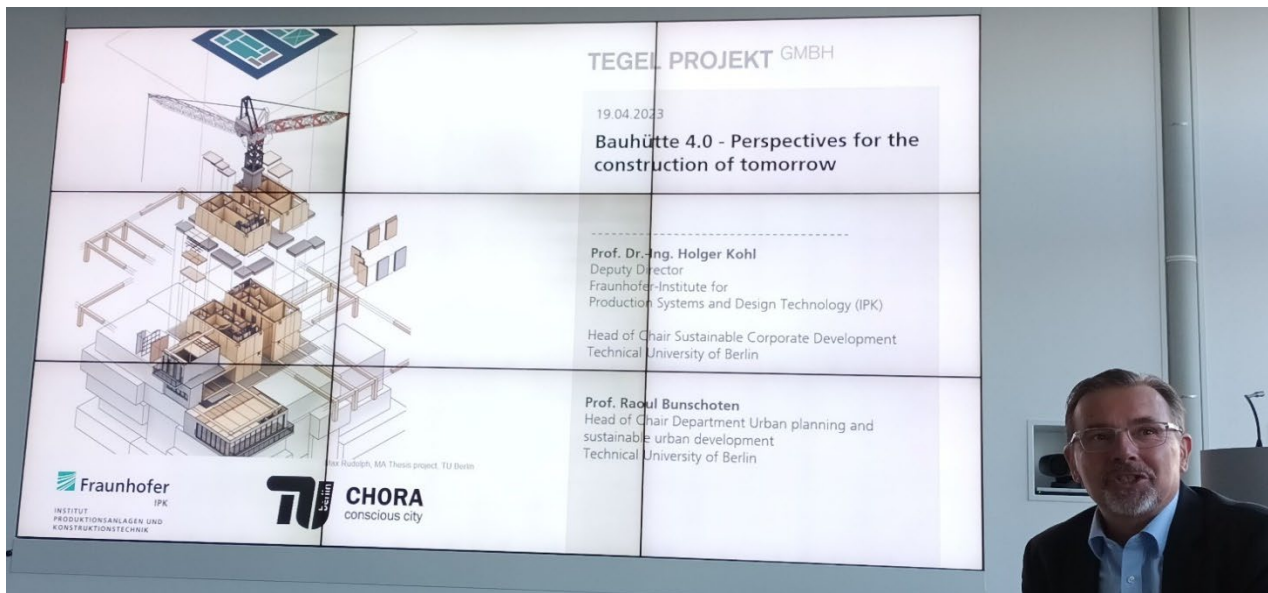
Figure 18. Presentation given by Dr-Ing Holger Kohl, Fraunhofer IPK

However, bringing different entities together to work as one integrated value chain supported by digital tech has several challenges yet to overcome:

- The European Union Green Deal and the call for a new Bauhaus – Europe will not be able to fulfil its emissions commitments if the construction sector does not radically transform and reduce its emissions. Although the targets are set, there is no comprehensive plan to reach the emissions targets.

- Housing shortage and affordability – Making construction cheaper is the biggest issue today. Construction of affordable housing is in a critical situation for rental cap, interest rates and supply issues. Every day construction becomes increasingly expensive and complex due to increasing regulations adding extra costs. German regulations do not specify particular material but can specify a specific outcome. Social housing should cost €6.5–9 per m^2 per monthly rental, but currently this cost is €16.

- Availability of regional (not imported) timber is key – The project needs to work with forest owners to transform current practices. Mass timber is 20% more expensive in Germany, and other countries are higher than that. Costs will reduce with economies of scale, but the current industry is far from there.

- Automating the value chain and the prefabrication process require a collaborative approach – Serial production along with a freedom for architects to create a beautiful city, not standardising building designs, is needed.

- A collaborative approach is required to fund small-scale prefabrication companies, but banks still pose a challenge.

- The general public and authorities still need to learn that living in a prefabricated timber building is good – The project must show that this model works.

Design and planning concepts developed by Fraunhofer:

- Configurator: a digital tool for use in the TXL project by the development coalition

- 3S approach: Sink–Storage–Substitution

- Serial, standardised design for production with no more than 3 alternatives available for each component

- The design database connected to each forest section so designers know if the materials are locally available

- Detailed LCA (Life Cycle Assessment) for each construction component

- Timber building system with all-timber joints (no steel) that can be disassembled. Interlocking timber joints with no steel is an interesting approach to ease disassembling. But not everything can be made of timber. Regarding the cost, the issue is not only material but also the labour cost.
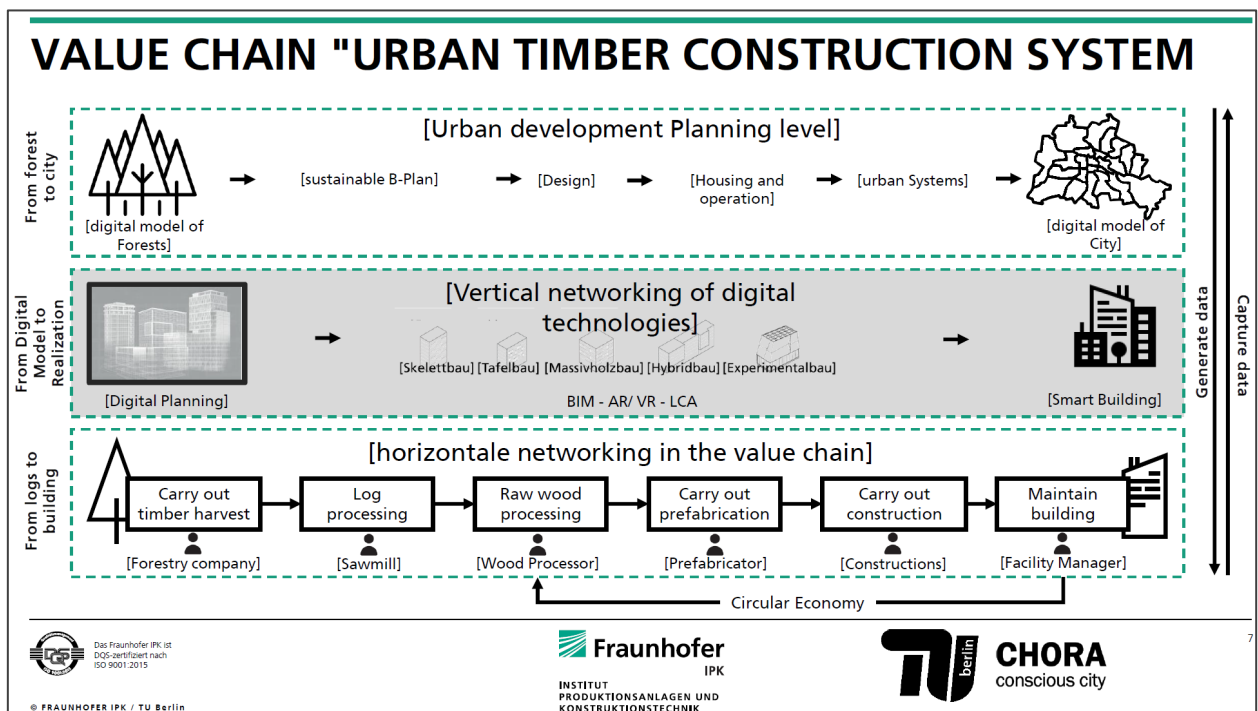

Figure 19. The forest-to-city urban timber approach

Link: https://www.ipk.fraunhofer.de/en.html

Gropyus

Host: **Philipp Erler**, Cofounder and CTO

Motto: "Creating sustainable living for everyone".

Gropyus was founded 4 years ago as "the first company worldwide to view the development of real estate as *a single* holistic product: From planning and design right through to manufacturing, construction and ultimately operation of the buildings, GROPYUS is for the first time delivering everything from a single source".

They claim to have Europe's most state-of-the-art construction production facility, using a highly automated process. The company has 2 focuses: digitalisation and conserving resources. Digitalisation includes a *smart living* operating system for building users.

Gropyus sees opportunities in the major challenges facing today, such as climate change and housing shortage, and identifies their value proposition by looking deeply into customers' problems to find solutions:

- Germany is not delivering even half the flats needed yearly. There is a projected deficit of 1 million homes; the annual supply is 200,000 but the demand is 400,000.

- Construction is the most emissions-intensive industry, accounting for 40% of global emissions. But, buildings can become carbon-positive by using timber frame elements and optimising material usage.

- Repeating standardised designs is not the future. Using digitalisation to optimise every single step while allowing customisation to architectural design is.

- The software platform automatically adds services needed and gives detailed data on every component in real time. It is the 'central source of truth'.

- Availability of labour is a huge challenge in Germany, hence the need for production automation.

- Funding prefab works is a challenge because 50% of the work is not onsite but happens in a factory.

Main features of the Gropyus solution:

- Gropyus controls hardware (building) and software in parallel because 'both sides are interlinked' and 'Autodesk took 20 years to get their level of market penetration'. The company has a business plan to franchise production systems. The key difference is to digitalise the value chain fully.

- The company offers customers a guaranteed price and demonstrably faster build.

- 'BOS' (Building Operating System) is an end-to-end digital value chain. This proprietary Digital Twin technology has more information than BIM (incl. embodied emissions, etc.) It starts with digital twin but goes beyond the standard: it knows every piece down to the screws. BOS provides a detailed view of what is in the buildings and the data can be provided to owners. The data structure needs to match the building lifecycle
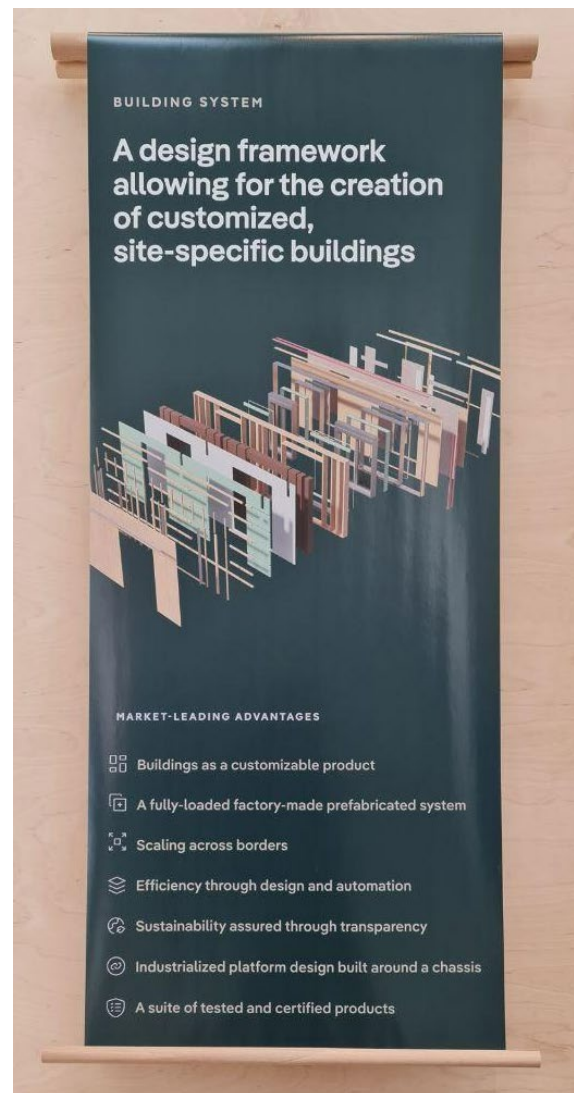

Figure 20. Gropyus banner

of 50 yrs. Material passports (designed elements prepared for circularity) are being prepared. Detailed models allow highly accurate fixed prices with certainty.

- The company has a design focus, as opposed to the monotonous history of industrialised buildings.
- Pre-designed systems allow the development of the building permit plans and files to be sent to the 40,000 m² production capacity.
- Components are easy to assemble; labour cost onsite is targeted to reduce by 10%.
- Products achieve 95% CO_2 reduction, down to 6.5 kg CO_2/m² (22% better than German 'Carbon-Positive', including the concrete basement). This is achieved by timber carbon sequestration and an optimised use of materials.
- Building elements are fire tested for 132 minutes.
- Construction cost is €200–250 (20 extra)/m², including PV on the roof.

Other notes about the Gropyus approach to prefabrication:

- The planned production in 2024 is 100,000 m² of product.
- Gropyus owns the factory but desires to be 'asset light' in the future.
- Legally, Gropyus acts as a general contractor.
- The Gropyus 'product' is certified similarly to the CE mark – a pre-approved, third-party certified product.
- Finance is a challenge because it flows from bank to developer to customer, but only when materials are assembled onsite. Gropyus is working hard to disrupt this financial logic.

Figure 21. The Gropyus presentation by Philipp Erler, Cofounder and CTO

Link: https://www.gropyus.com/

Behrens-Ufer

Hosts:

- **Thomas Mohr**, Cofounder and CEO
- **Dr Gregor Keck**, Communications Director

Under the concept of 'Self-sufficient energy supply and quality of life: A concept for the future', the Behrens-Ufer (BE-U) project sits within in the retrofit of a large heritage factory site to create a vibrant innovation, commercial and education precinct.

Behrens-Ufer is an entirely privately-owned and controlled project with the ambitious sustainability aim to make it 'as self-sufficient as possible'.

Total project size:

- Property size approx.: 100,000 m^2 (mentioned 110 ha in the presentation). This was one of Europe's largest industrial employment areas during the 20th century.
- Total gross floor area: >280,000 m^2
- Total leasable area: >230,000 m^2

Intended uses:

- Research, production, workshops and laboratory – life sciences, aligned industry and semiconductor producer.
- Commercial (office). Education (kinder and high school)
- Gastronomy, art galleries, event rooms
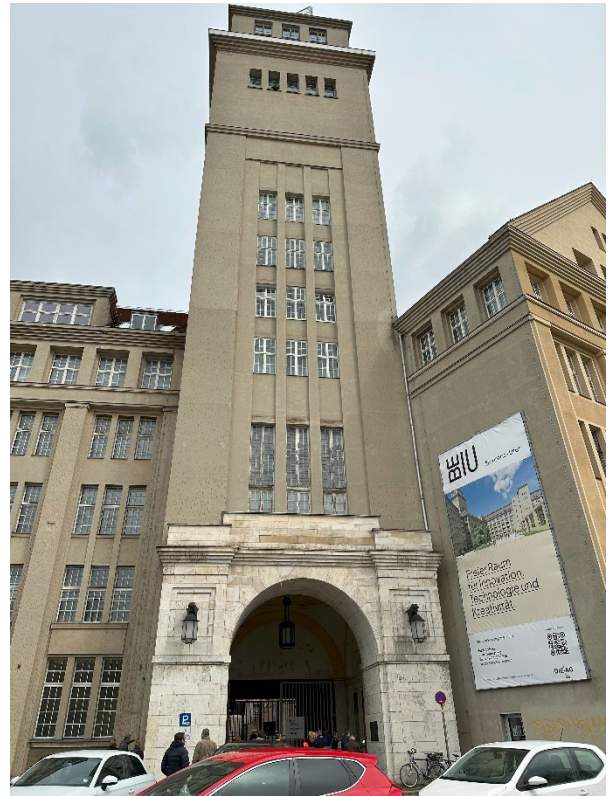- Studios, hotel (no housing)

Figure 22. Access to the main Behrens-Ufer building

Figure 23. Presentation in the main Behrens-Ufer building

Economic impact:

- Total investment: > €1.1 billion 100% private investment
- Cluster effect: semiconductor factory, university, access to the riverside, shops, restaurants, etc. (Business and technology, no housing)
- High renters (semiconductor factory) and low renters (shops, restaurants) to make things happen
- 10,000–15,000 people to be employed in the project

Sustainability targets:

- 97% of energy usage will be produced onsite using geothermal, photovoltaics and biogas (under development by GASAG Solution Plus). A no-utility-charge policy but a 'social charge' billing was mentioned with no further detail. The main energy-generating sources are:

    ○ Energy self-reliant using a 5 km deep geothermal plant (160 °C). Costs €55–70 million with a 10-year amortisation time. If this pilot project works, the Senate will replicate it to power other districts in the city.

Figure 24. The Behrens-Ufer heritage factory buildings

○ Biowaste will be treated to produce biogas. Combustion gas produces CO_2, which will be needed to feed the onsite farming (carbon-smart farming, carbon sequestration in soil).

○ Solar radiation is used to the maximum by combining BIPV (building-integrated-photovoltaic-cells) modules with thermal modules to provide heat and electricity. Using facades makes roofs available for open, green, walkable public areas.

• Low energy development due to:

○ Highly efficient construction (at least the DGNB Gold standard)

○ Heat pumps for heating and cooling.

○ Ice storage and a cold network

○ All new buildings proposed to be 100% timber construction

○ Water-bearing clay ceilings to provide natural air conditioning

○ Fibre optic lighting from roof to dark areas of floors

○ Plants on the rooftop can help drop 10°C in summer.

• Comprehensive recycling management to achieve various closed-loop systems that produce, use and recycle resources and valuable materials generated during on-site production

• Vertical farming, including mushroom cultivation and fish farming to provide a large part of the plant-based food required onsite

• Every possible renewable energy source is being considered, with the overriding goal of CO_2 neutrality using the highest possible proportion of locally generated renewable energy.

Social and urban impact:

• The Spree riverside promenade, roof gardens and green open spaces of the BE-U will be freely accessible to the public.

• There is a university next door with an applied science focus, thus establishing the semiconductor factory onsite.

• Educational facilities such as a school and kindergarten are proposed.

Main learnings:

• As a private development, BE-U has a role in demonstrating that energy independence can work and that it does not have to rely on government subsidies.

• Unlike Siemensstadt and Tegel Projekt, as a 100% private development, the team have more freedom (and economic imperatives) than other development models.

• It is a great example of a large real estate development that aims for the highest sustainability goals to be attractive for international investors and future-oriented high-paying renters.

Figure 25. Behrens-Ufer main building hall

Figure 26. Heritage factory visit during construction works

Figure 27. Artist's impression of the Behrens-Ufer development project

Link: https://be-u.berlin/en/concept/

DAY 5 – COPENHAGEN

Morning visit (09:00–12:30)

KADK: The Royal Danish Academy – Architecture, Design, Conservation

Session 1: CITA – Centre for Information Technology and Architecture

Speaker: **Associate Professor Paul Nicholas**, paul.nicholas@kglakademi.dk.

CITA Head: **Professor Mette Ramsgaard Thomsen**, Mette.Thomsen@kglakademi.dk

CITA has a team of 22 researchers working at the intersection of computation and architecture. Its focus is on digital fabrication and robotics, and simulation in response to sustainability needs:

- Looking at the interface between computational design and manufacturing
- Using computers to draw and design membrane structures: "In northern Europe, every architectural testing is computational".
- 3DCP technology: 3D concrete printing of biopolymers. Focus on new materials and using traditional materials in new ways
- From collagen, mycelium, and waste stream materials research into 3D printing
- 'Continual construction' project: maintenance of continually growing or decaying materials
- Focus across the digital chain: sensing, monitoring, tracking to robotics and Digifab
- Some work done with Danish companies on sensors and fabrication, production set out and worker interaction with materials
- ERC Project: Eco-metabolistic architecture, harvested–designed–living
- RawLam: Digital forestry and Sawmilling. All timber is CAT scanned to find bullet casings, splits and knots to inform milling.

Figure 28. 3D-printed research, organic composite materials

Session 2: CINARK – Centre for Industrialized Architecture

Hosts:

- **Dr Anne Beim**, Professor, Head of CINARK, Anne.Beim@kglakademi.dk
- **Pelle Munch-Petersen**, Associate Professor, pmun@kglakademi.dk
- **Dr Nini Leimand**, Associate Professor, nleim@kglakademi.dk
- **Henriette Ejstrup**, Assistant Professor, hejs@kglakademi.dk
- **Thorbjorn Lornberg**, PhD researcher, tlon@kglakademi.dk
- **Line Kjær Frederiksen**, PhD researcher, lfre@kglakademi.dk

CINARK aims to move beyond sustainability, and instead care about ecology and interconnectedness without making trade-offs. By developing ecologically responsible architecture towards absolute sustainable solutions, they foresee clear strategies for Danish architects to gain a strong international position. To achieve that vision, they focus on 3 areas:

- Process + product; Tectonics + structure
- Climate + comfort; Building practice
- Manufacturing.

CINARK sees their task as researching sustainable industrialised architecture, understanding the problems and potential of the building industry and architectural practice. Their research sub-themes are:

- Industrialised construction
- New supply chains
- Systemic thinking, e.g. Kasper Sánchez Vibæk researching 'Architectural System Structures'
- Tectonic alphabet: Developed by Søren Nielsen and developed in DfMA by Kasper Sánchez Vibæk; defines the core issue of building system connections. Tectonics: "creating a language for architects to talk about building technology holding architecture ethics and an effective way to direct and control resources in construction".

Figure 29. Construction materials made from waste straw

Research funding and publication is 50% government, 50% university, plus 30% relevant industry partners' work hours. Companies strive to participate in these projects because they want to be at the forefront of innovation. There are 3 research types:

- **Strategic**: theoretical and basic
- **Industrial**: Working with the brick industry since the 1980s. Deal with manufacturers, craft trades, and mortar manufacturers. Looking for the masonry of the future. Applied research with industry partners:
    - Wienerberger / MAXIT
    - Copenhagen Masonry Guilds Association
    - Lundgaard & Tranberg Architects
- **Experimental**: new materials and new processes, e.g.:
    - Søren Nielsen's 'Adaptive Tectonics'
    - AUTARKI demonstration CLT prototype project
    - Circular tectonics: 3 wall prototypes

- ○ MUDP project: 'Biogenic Construction' – how to build using biogenic materials such as straw, wood, clay and thatch. The project tests vertically thatched surfaces treated with mineral aggregates (clay) as a fire retardant
- ○ 'Material Knowledge' project: aimed to help architectural practices prepare for LCA reporting needs
- ○ Design with waste streams.

CINARK is currently applying 'Guerrilla Research'. It involves smaller funding sources and finding other smaller organisations willing to try new materials and strategies to do things. Instead of focusing on materials and technologies, it focuses on resources and ecology under the following principles:

- ● ecology: non-negotiable, interconnected
- ● simplicity: reduce complexity
- ● buildability: what can be made and impacts the industry.

CINARK created the 'Material Pyramid' (Buggeriets Materialpyramide), which features 60 of the most common materials. It is updated regularly with data from environmental product declarations (EPDs) and German databases; it also receives requests from material manufacturers to update or add their products. Since January 2023, projects larger than 1,000 m^2 must have an LCA (Life Cycle Assessment) declaration.

The ECOCOCON not-for-profit company was born from one of CINARK's research projects. This natural construction system consists of 40 cm thick panels characterised by:

- ● wood fibre layer providing air tightness
- ● airtight diffusion-open membrane that prevents heat loss and ensures humidity transfer
- ● straw insulation made with multidirectional press technology
- ● load-bearing twin stud frame from sustainable forestry
- ● custom-made dimensions to fit any building design
- ● a flat and homogeneous surface.

Figure 30. Discussion of construction materials research process

Session 3: KADK Architecture

Speaker: **Jakob Brandtberg Knudsen**. Dean, Royal Danish Academy – Architecture.

Motto: *Create – Collaborate – Change*

KADK understands architecture as science, art and practice: 'Create – collaborate – change' to solve real-world problems. Architectural education is given by understanding problems, proposing solutions, testing them through prototyping materials and structures, asking questions, and reflecting on the experience.

The key questions asked relate to relevance: How do we contribute to society? Why is this important? Regarding architecture's relevance to society: "*If architects stay aesthetically focused, they will become irrelevant. By working with manufacturers, we regain relevance in the industry*".

The focus on circularity also makes architecture relevant by bringing the whole industry to focus on rethinking design and building processes. Architects are part of the problem but can be part of the solution to climate change. KADK officially adopts the UN's Sustainable Development Goals in teaching.

Figure 31. The Dean's presentation at KADK

In the future, they expect to change from designing objects (cities, buildings, visual entities, etc.) to focusing on creating tools and instructions (such as design drawings) and services to others. This means understanding architecture and design as processes that do not stop but continue in an ecosystem where other designs, changing cultures, etc. and therefore continuously change – with or without the designer's involvement.

Figure 32. Construction materials subject to research and development at KADK

The experimental research projects undertaken in Asia and Africa speak of the power architecture can play in solving real-world problems, such as improving low-cost housing to improve public health. By applying a cross-disciplinary approach with medical researchers, the architecture team surveyed 15,000 houses in a 1-year controlled trial in tropical areas prone to malaria infection. Besides publishing in The Lancet and other health journals, this research shows industrialised architecture can contribute to a better quality of life for many people.

Links: https://royaldanishacademy.com/architecture2

Afternoon visit (13.00–17.00)

Session 1: Bloxhub

Host: **Martine R. Kildeby** Head of Strategic Partnerships, mki@bloxhub.org,

Bloxhub is a digital and physical cross-sector collaboration hub and platform working towards sustainable urbanisation. It is an umbrella organisation with over 350 member organisations all over the globe. They highlight the need for collaboration to solve today's challenges, and provide community spaces and global networks to foster cross-collaboration within their members to activate systemic solutions. Bloxhub:

- is a place where cross-sector businesses can engage, connect and expand their network towards sustainable urban systems
- is a promoter of collaboration, knowledge sharing in a global network, strategic partnerships, events (to meet people across sectors and as diverse as possible), science forums (connecting academia and industry) and urban partnerships
- is an organisation whose main KPI is to create impact by getting feedback from people involved and milestones in between (how many delegates/innovations) that matter to them
- provides services for members with a service fee but rejects companies unwilling to collaborate
- is 80% subsidised by Realdania (DKK 2 million in 2022)
- started with a Nordic focus, but has an increasingly global outlook.

Bloxhub understands cities as:

- systems (material flows, zero waste, longevity, repurposing, regenerative development, etc.)
- nature (urban greening and regeneration)
- communities (inclusion, happiness, community-based ownership models, wellbeing, democracy, etc.).

How to create an irresistible sustainable, urban future:

- partnerships and cross-sector and cross-border collaboration
- multifunctional solutions, the 'irresistible' sustainable society
- key elements for impact: responsible leadership and collaboration.

The Bloxhub model of collaboration:

- Engage a challenge owner (a city, corporation, organisation, etc.) with an urban challenge.
- Define and qualify the business strategic urban challenge and never put direct competitors around the same table to create a room of trust.
- Tailor matchmaking and partnerships by activating and handpicking from the Bloxhub community, local partners and global network.
- Mature ideas and explores opportunities via the Innovation room – a facilitated workshop.
- Learn from urban partnerships and provide insights, inspiration and tools to work strategically with sustainable urban development, generating innovative ideas, business potential, networks, competitive advantages and societal change.
- Host year-round activities to engage in networks and scaling activities (research, debates, political focus, scaling).

The business model:

- The challenge owner pays a fee.
- Introductions are made, workshops, etc.
- Bloxhub exits.

Links: https://bloxhub.org/

Figure 33. Bloxhub visit

Session 2: Creative Denmark

Host: **Christian Kierkegaard Michelsen**, Project Manager

Creative Denmark is a public–private not-for-profit (funded by the Danish Government and Realdania). Its aim is to position the Danish creative industry internationally, and connect international businesses, political organisations and corporations with Danish creative companies and solution providers. Its advisory board comprises Bloxhub, Danish Design Centre, Danish Architecture Centre and Design Denmark.

Creative Denmark works to promote the Danish creative industries, which produced DKK 276 billion in 2022. Other similar organisations are:

- Digital Hub Denmark
- Healthcare Denmark
- State of Green
- Food Nation.

Link: https://www.creativedenmark.com/

Session 3: Danish Architecture Center

The Danish Architecture Center (DAC) promotes architecture, provides education for children, runs exhibitions, produces podcasts and encourages a broad audience. For example, 200+ people gather for architectural debates in DAC every Tuesday. DAC exhibits the history of Danish architecture and surprises the public with a 40 m, 4-storey spiral slide.

UNESCO chose Copenhagen to be the World Capital of Architecture in 2023. One of the most remarkable recent architectural landmarks is Coppenhill (Amager Bakke in Danish), a waste-to-energy plant with a ski slope on top, a hiking trail and a climbing wall. Copenhill has become a symbol of Copenhagen's efforts to become a carbon-neutral city. It integrates a practical function (disposing of waste and creating energy) with a recreational dimension that makes sustainability attractive. It also integrates functions that would normally be kept separate. It is listed in the National Geographic list of 2021 destinations on the rise and CNN's Earth Day round-up of sustainable projects and has received national and international awards.

Figure 34. Coppenhill. Source: https://www.archdaily.com/tag/awards/page/5

Links:
- https://dac.dk/en
- https://www.creativedenmark.com/cases/big-innovation-and-the-search-for-hope

Session 4: Copenhagen Walking Guided Tour

Speaker: **Lisa Beck**, Planner at Copenhagen City

The delegates were guided from the BLOX building for a short walk and talk about Copenhagen as one of the most bicycle-friendly cities in the world. In fact, biking is the main commuting mode: 60% of commuters bike to work in Copenhagen because the infrastructure makes it easy to commute. One of those examples is the Lille Langebro pedestrian and cycling bridge.

The walk finished at the Cirkelbroen (the Circle Bridge, see Figure 35) whose unique architecture honours nautical heritage and encourages self-awareness. This structure was designed by Danish-Icelandic artist Olafur Eliasson. The central part swings open horizontally when larger boats need to pass through. Around 5,000 cyclists, joggers and walkers use the bridge daily to cross the mouth of the Christianshavn's Canal.

Figure 35. Cirkelbroen (The Circle Bridge)
Source: https://www.archdaily.com/772411/cirkelbroen-bridge-studio-olafur-eliasson

Link: https://www.archdaily.com/772411/cirkelbroen-bridge-studio-olafur-eliasson

DAY 6 – MALMÖ

BOKLOK

Hosts:

- **Karin Uvelius Fegler**, Customer Offering Project Leader
- **Jan Egerstedt**, Head of Product Development
- **Emil Björk**, BIM strategist

The first project was built in 1996; 15,000 homes have been built since. They are currently building 1,000+ homes per year in Finland, Norway, Sweden and the UK with the same logic but subtle adaptations.

Figure 36. Presentations at Boklok's headquarters

Boklok concept follows 3 steps:

- Target segment: For example, the client that most needs help in Sweden is a single nurse with 1 child. In the UK, it's a couple with no children. Customer identification process:
  - What can they afford?
  - What are their priorities?
  - What do they value in their home? (e.g. in Norway there is a 5+ m^2 external storage rule but average homes are smaller (99 m^2) due to higher costs; in the UK there are no external corridors but a double loaded corridor; in Finland it is the classic offering with sauna included but under questioning and testing).
  - Where do they want to live? ("Our plots are where the bus ends").
  - Demographics.
- Product development: Boklok defines itself as a 'Product Company' instead of a project company.
- Established production system and supply chain: Manufacturing and logistics are integrated. Automation is increasing production capacity, after 20 years of process improvement. The factory is a moving line. Outside of Sweden, delivery is done through partners and the supplier's systems but quality control relies upon Boklok. 85% of the project is completed in the factory. After foundations are prepared, there is a 3–4 day assembly time on site. Factory throughput is 42 modules per week. Boklok achieves 30% higher cost productivity than Business-As-Usual (helped by outer suburban sites too).

Product offering features:

- Affordability focus: product at lower cost than comparable offerings and competition. Sales at 22,000 Kr per m^2 (now 30,000–35,000 Kr)
- 2-year defects warranty period; 2–10 year 'evidence-required' period
- Digital customer survey feedback and data capture
- Climate neutral company by 2030: product, process and digital as means to achieve climate goals; solar PV panels have been standard since 2018
- Common facilities for bike parking, waste management, common storage, etc.
- Funding:
    - Private housing associations – a new ownership model
    - People get a loan directly from the bank, and the housing association gets a different loan.

Figure 37. The delegates visiting a recently completed housing development by Boklok

Link: https://www.boklok.com/global/

Swedish Research and Innovation

Linköping University

Speaker: **Martin Rudberg**, Professor of Construction Logistics, Head of Unit,
martin.rudberg@liu.se

- Supply chain and logistics management in the built environment
- Digital transformation of construction sites
- Master in digital construction management

Link: https://liu.se/en/research/construction-logistics

Lulea Technical University

Speaker: **Lars Stehn**, Professor and Head of Construction Management and Building Technology Subject, lars.stehn@ltu.se

- Research insights from 30 years of experience.
- R&D recipe = R&D&I (innovation) → "Academia helps the industry make more money"
- Cooperation is essential for competitiveness
- "Knowledge management is not so valued by the industry"

Link: https://www.ltu.se/research/subjects/Byggproduktion-och-teknik?l=en

NCC Group – Agile Innovation Management

Speaker: **Claes Henschel**, Digital Innovation Manager at NCC Group Research and Innovation,
claes.henschel@ncc.se

Purpose of digital innovation: "*Prepare NCC for the future and create value through new digital solutions*" ("*in the least digitalised and one of the most conservative industries*").

Traditional development is incremental. Agile Development is simple and rapid:

- Create a vision.
- Create an Agile Board of to-do tasks using a Kanban board.
- Evaluate.
- Create new ideas.

Innovation management book suggestion: *Crossing The Chasm*, by Geoffrey A. Moore.

The NCC Business Model Innovation: "Joint Venture Lite", a royalty scheme

Links:
- https://www.ncc.com/
- https://www.ncc.com/about-ncc/about-the-group/our-rd/ - Research, Development and Innovation

Proptechcore

Speaker: **Patrik Johansson**

Proptechcore is a Swedish collective of proptech start-ups focusing on decarbonisation. Tools leverage artificial intelligence (AI) and neural networks for fetching and managing real estate data. The main applications are:

- Solutions over the built environment lifecycle, together with an ecosystem of real estate owners, real estate developers, operational companies, installation companies and Internet-of-Things (IoT) companies
- Digital technology for decarbonisation compliance using open insights and AI
- Use of federated learning in buildings (all machines learn from every other's experiences), to give building users visibility and knowledge of carbon impacts. Machine learning AI and neural networks need structured, contextualised data as 'food' to work.

You can get a 20% reduction in energy use by knowing how much you use and when, your peak, etc.

Links: https://proptechcore.com/

BRINJA

Speaker: **Javier de Leon**

Brinja is a technology start-up that helps companies reduce costs and improve safety, efficiency and sustainability on construction sites. It develops technology to read live data from the work environment to make it accessible on mobile apps.

Brinja offers a user-oriented approach instead of technology-oriented, aiming to improve communication between people and infrastructure. It focuses on quality control, energy optimisation and worker safety.

The radar reflector for worker safety was presented. This device automates control of lighting, safety alarms and safety distance of workers in construction sites.

Link: https://en.brinja.se/

Figure 38. Presentation by Javier de Leon, Brinja

Swanholm Smart Alert Vest

Speaker: **Claes Henschel**, Digital Innovation Manager at NCC Group Research and Innovation, claes.henschel@ncc.se

Swanholm's Smart Alert Vest is a Smart Wearable high visibility vest for construction workers. It is the result of a joint partnership between Swanholm (vest developer) and NCC as client. This product belongs to both companies, as a partnered spinoff.

The vest detects and alarms coworkers when a worker falls and doesn't stand up. It uses artificial intelligence to detect and trigger alarms, as well as other platform solutions: accelerometer, Bluetooth connection with smartphones, edge AI, and sensors integrated into a vest or jacket.

Figure 39. Presentation by Claes Henshel, NCC

Figure 40. Swanholm Smart Alert Vest
Source: https://www.hackster.io/news/swanholm-tech-s-connected-safety-vest-is-a-wearable-tinyml-lifesaver-c472f6ac8d17

Links:
- https://swanholmtech.com/
- https://www.hackster.io/news/swanholm-tech-s-connected-safety-vest-is-a-wearable-tinyml-lifesaver-c472f6ac8d17