LUT University

LUT CIVIL ENGINEERING

Vision and core competencies by FAST EXPERT TEAMS

CONTENTS

1. WHY LUT CIVIL ENGINEERING?

1.1. Where it all began

Climate change and different global and regional crises create a need for systemic understanding of the questions of growth, reconstruction and infrastructure development. Digital transformation, need for increased energy efficiency, circular economy, user involvement and demographic change are important drivers challenging traditional ways of operating construction and real estate business. This complex transformation requires understanding of technical, economical and societal impacts on the built environment.

LUT initiated the idea of new discipline in civil engineering based on understanding of these questions of built environment. We build on our expertise related to other infrastructural systems such as energy, electric and information networks and water management, as well as business models and processes. The needs of industry have been consulted. Our approach is aligned with LUT 2030 strategy to tackle global challenges and to build a sustainable future.

1.2. LUT civil engineering core areas

Description of LUT Civil Engineering research focus (September 2025) was the starting point for the Fast Expert Teams' work:

LUT Civil Engineering is creating a world where the built environment thrives and people flourish. That requires technology-driven growth, trailblazing business models, and the seamless integration of different infrastructure systems.

LUT produces new knowledge with its internationally impactful scientific research, providing a foundation for innovations in technology, building products, systems, and processes. We understand what it takes to build sustainable and safe living environments and a resilient society.

We are focusing on the following core areas:

Technology-driven growth

- Innovations emerging from scientific research enable technology-driven international growth in the construction industry.
- New materials and intelligent systems transform buildings and urban areas into reservoirs – or even producers – of energy and material.
- Automated construction, digitalisation, and multi-industry products and services open up international business opportunities.

Business transformation

- Sustainability challenges, the holistic nature of the built environment, and the role of end users create demand for trailblazing business models.
- Growing sustainability and resilience requirements and increasingly international property ownership are transforming value chains and the roles of both owners and users.
- The viability of the evolving construction and real estate business is essential for societal well-being and sustainable solutions.

Infrastructure resilience

- Infrastructure safety relies on the successful integration of complex systems.
- The development of future communities hinges on a systemic understanding of land use, material flows, transportation, energy systems, water services, and digital networks.
- A new level of professional competence is essential in evaluating the impacts of sustainable development principles and executing structured decision-making.

2. FAST EXPERT TEAMS THEMES

We invited 70 knowledgeable experts from industry, academia, government and public sector to join a temporary online knowledge community (Fast Expert Teams[1]) to discuss the needs for the future of built environment and to co-create a vision for the LUT Civil Engineering research and education. These Finnish and international experts were working in eight teams. Each team was given a theme to discuss and to bring their perspective. This journey was carried through in March 2026. During the four weeks we worked in the online community to co-create guidelines for LUT Civil Engineering.

[1]Blomqvist, K. (2026). Fast Expert Teams. A new way to collaborate. LUT Scientific and Expertise Publications, 147, ISBN: 978-952-412-422-5

2.1. Investment intelligence

Investment intelligence to ensure technically, ecologically, economically and socially sustainable built environment.

Vision

Educating the next generation of built environment professionals with competence in lifecycle assessments, skills in navigating multi-actor networks, and ability to fulfil societal needs within planetary boundaries.

Starting point

We need to shift from siloed expertise toward transdisciplinary thinking. Systems thinking, collaboration and empathy enable future professionals to operate effectively in multi-actor networks. Growing role of digitalization and artificial intelligence (AI) calls for conceptual and strategic capabilities, complementing traditional technical skills.

Critical insights

Academia must remain forward-looking, but it cannot lose connection to current real-world requirements. Achieving this balance requires ongoing dialogue with industry and openness to emerging trends, including technological disruption, environmental challenges, and potential shifts in global development patterns.

Recommendations

Create an education and research collaboration model that combines strong theoretical foundations with practical, industry-aligned capability building.

- Integrate core knowledge areas such as life cycle thinking, sustainability, economics, and systems thinking.
- Develop competencies in investment analysis, leadership, digital solutions such as AI and digital twins, as well as regulatory frameworks.
- Embed project-based learning, internships, and industry collaboration as essential components of education.
- Strengthen partnerships with industry, cities, public, and third sector actors.
- Position within a Nordic and EU context, while attracting global talent and acknowledging diverse career pathways.

... renovations can often lead to a better impact in a form of greater circularity, lower material intensity, better use of existing infrastructure and thus reduced total emissions (than construction and acquisition on new buildings)"

— Rakli's statement to the EU Commission regarding the development of EU taxonomy 12/2025

2.2. Living as a service

Housing, living and everyday life as a service.

Vision

Flexible living services integrating technology, sustainability, and collaboration for resilient communities.

Starting point

We understand living as a dynamic system that integrates spaces for living, working, and social interaction, reflecting ongoing societal changes. Interconnected systems shape the housing sector. Flexible living services and the development of resilient and adaptable communities emerge from the integration of technology, sustainability, and collaboration. The starting points are the lifecycle, needs, and diversity of people.

Critical insights

Complexity navigation requires continuous awareness of global megatrends and weak signals, changes in lifestyles, demographics, urbanization, and the growing importance of care, community, and aging in societies. Support solutions that simultaneously serve individual needs, strengthen local communities and respect planetary boundaries.

Recommendations

Foster integration rather than expansion. Embed digitalization and sustainability for a holistic and multidisciplinary learning experience. Continuously address different dimensions, such as existing versus new buildings and public versus private roles.

- Strengthen systems integration and sustainable design competencies.
- Embed data-driven design, digitalization, and real-life experimentation.
- Promote multidisciplinary collaboration across fields and stakeholders.
- Develop communication, collaboration, and an innovation mindset.
- Emphasize user-centric thinking to create solutions that are both practical and meaningful.
- Expand partnerships with industry, public sector, and third-sector organizations

...all these megatrends are important, but as well tracking these weak signals driving change in nature, in lifestyles, in technology and in society, and for living as a service, it is important to take care of individuals, take care of the local community and take care of the planet and planetary boundaries."

— Team 2 presentation 23.3.2026

2.3. Smart, safe and secure

Intelligent, safe and mobile urban environment 2045.

Vision

Urban planning should take the different voices in society into account. Defense must be future-proof, tech-enabled, collaborative, deterrence and designed for rapid response and resilience. Mobility development is built on accessibility and resiliency to future change.

Starting point

We foster multi-perspective futures thinking. Complex societal challenges cannot be captured through a single viewpoint. Three complementary perspectives with an approach of systems-level thinking, combining technology, sustainability, and human-centered design are included: urban planning and user experience, defense and security, and mobility systems.

Critical insights

The most important insight is the need to balance engineering fundamentals with continuous adaptation to rapid technological and geopolitical change. Future professionals must be prepared for emerging security challenges, increasing need for self-sufficiency and international collaboration, and rapid evolution in technology, mobility, and urban systems.

Recommendations

Create environments that are safe, accessible, resilient, and adaptable. Strengthen education and research through integration, collaboration, and real-world relevance. Focus on educating future makers.

- Develop core engineering competencies (materials, structures, infrastructure) alongside emerging technologies.
- Emphasize automation, digitalization, and smart infrastructure, while ensuring sustainability and circular economy principles.
- Focus on accessible, efficient, and low-emission transport systems and integration of autonomous, electric, and multimodal transport.
- Build open collaboration platforms connecting students, academia, industry, and public actors.
- Integrate real-life projects and industry input, especially in critical sectors like defense and mobility.
- Expand understanding of user diversity, including multicultural and changing societal needs.

Safe for an 8-year-old and accessible for an 80-year-old."

— City of Turku, by Team 3, 23.3.2026

2.4. Information management

Built environment information management models for strengthening societal safety and resilience.

Vision

Empowering future skills, data, and technologies to shape sustainable, inclusive, and resilient civil engineering. Future skills for data-driven civil engineering mean using and combining existing data in sustainable and inclusive way. Good civil engineers include safety, resilience, and responsibility as core principles.

Starting point

We understand information as a key resource that must be responsibly managed. Physical and digital infrastructures are increasingly interconnected. Holistic thinking includes technical aspects, as well as societal, environmental, and governance dimensions.

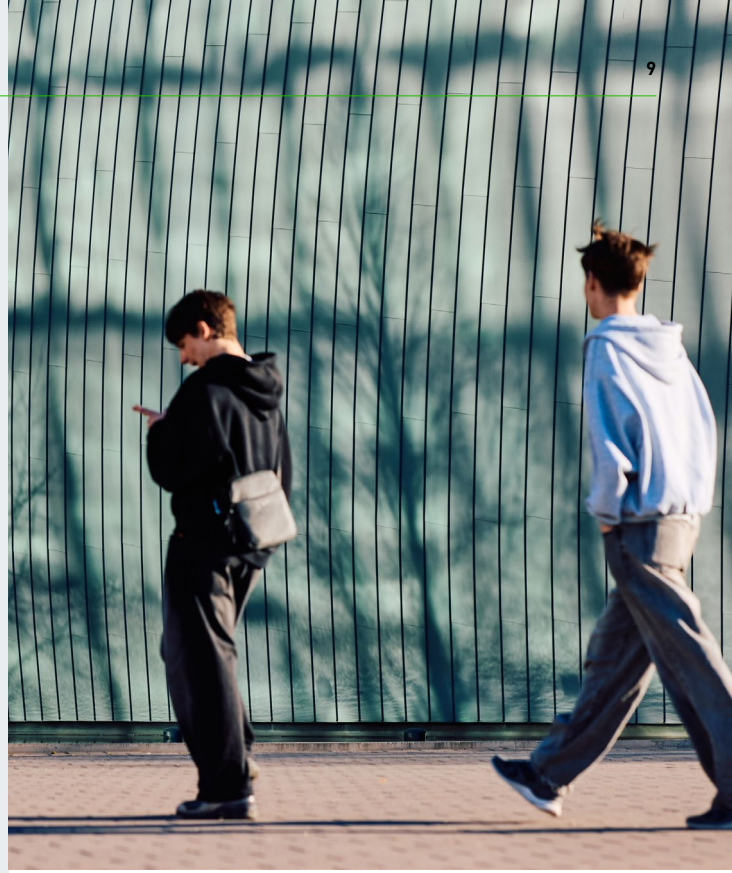
Critical insights

We need future makers who can shape a desired future—one that integrates digital and physical systems while serving people, communities, and the planet. Data is a societal responsibility, and questions of data ownership, governance, security, and ethics must be addressed alongside technological development.

Recommendations

Embed information management through integration and capability building. Leverage data, digital technologies, and AI to support sustainable, inclusive, and resilient systems.

- Strengthen the data literacy and digital engineering skills as core competencies.
- Develop understanding of data governance, ownership, regulation, and interoperability of information.
- Embed critical thinking to evaluate data quality, biases, and ethical implications.
- Promote AI and data-driven decision-making for planning, design, and lifecycle management, including human and ethical aspects.
- Foster interdisciplinary collaboration between engineering, data science, and societal domains.
- Encourage platform-based collaboration and digital working environments.
- Build capabilities that support using data to anticipate, simulate, and optimize systems (e.g. digital twins), creating value from data across the full lifecycle of the built environment and adopting a continuous learning mindset to keep up with rapid technological change.
- Ensure strong collaboration with industry across the full lifecycle, technology and data companies, as well as public sector, regulatory bodies and international academic partners.



Closing the gap between technological change and social change is an increasingly major business opportunity - as well as a huge societal challenge!"

— Tuomas Syrjänen, Futurice

2.5. Global markets

Global quantitative and geographical development in building and construction as an opportunity for business growth

Vision

LUT Civil Engineering is a globally original scientific research and teaching department focusing on Nordic perspective reporting locally mastered knowhow to help the mass industry with the present sustainability and productivity challenges.

Starting point

We aim to bridge global differences to solve shared challenges. We can position Nordic expertise as a globally relevant, exportable model, that combines sustainability and climate responsibility, advanced technologies, such as prefabrication, digitalization and AI, as well as human-centered and equitable values.

Critical insights

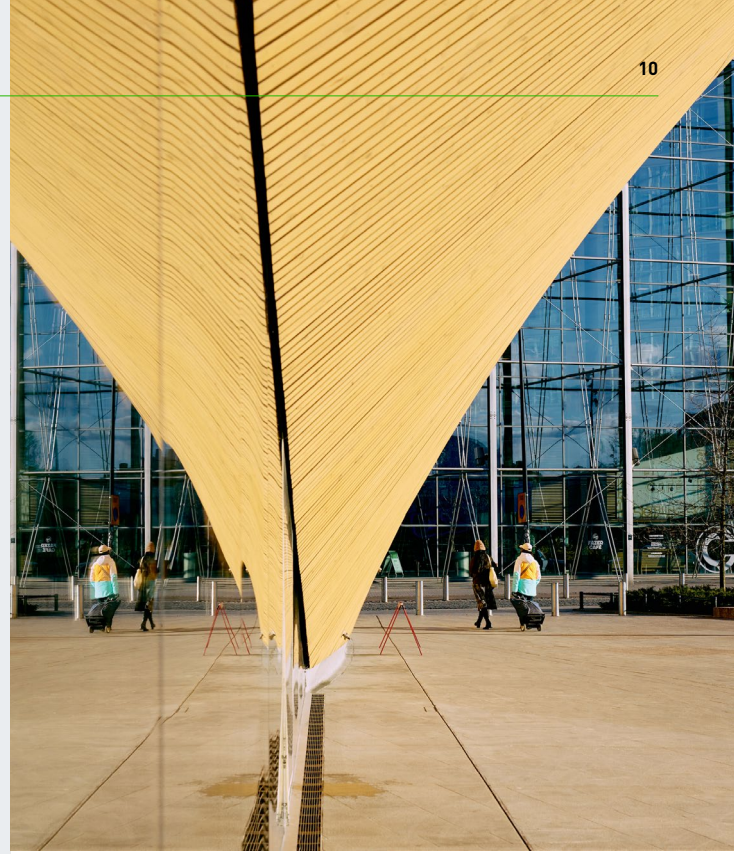
Local excellence must translate into global impact. Strong partnerships between industry and research organizations globally are essential. Nordic universities have shared values and strengths, Asian institutions have access to growth markets and talent. New professionals can create and adapt solutions to different regional contexts and make a worldwide contribution. Leveraging renovation and renewal and using ESDG principles as measurable outcomes is a key to success.

Recommendations

Make a strategic shift toward specialization and international collaboration. Collaborate with other universities to cover basic engineering education, freeing resources for advanced focus areas. Move beyond local approach and languages towards more international and accessible solutions.

Specialize in:

- Sustainable materials and circular economy.
- Energy systems and zero-emission solutions.
- Productivity improvements through prefabrication and digitalization.
- New business models.
- Hands-on learning, including full-scale testing, real-life piloting and experimental learning by doing -environments.



We did not talk too much about other digital infra, like data centers, although those are hugely growing currently. It will play a role increasingly going forward and shall not be forgotten."

— Team 5 wild cards.

2.6. Carbon management

Carbon capture and storage as force of change.

Vision

Carbon Management Engineering education and research. CO_2 (both biogenic and fossil) is treated as natural resource.

Starting point

We reframe carbon as a resource and a system-level challenge. The built environment has the potential to function as both a carbon sink (storing carbon in materials and ecosystems) and a carbon stock (long-term storage within infrastructure). No single technology—such as CCS—can solve climate challenges alone, but a systemic approach is essential.

Critical insights

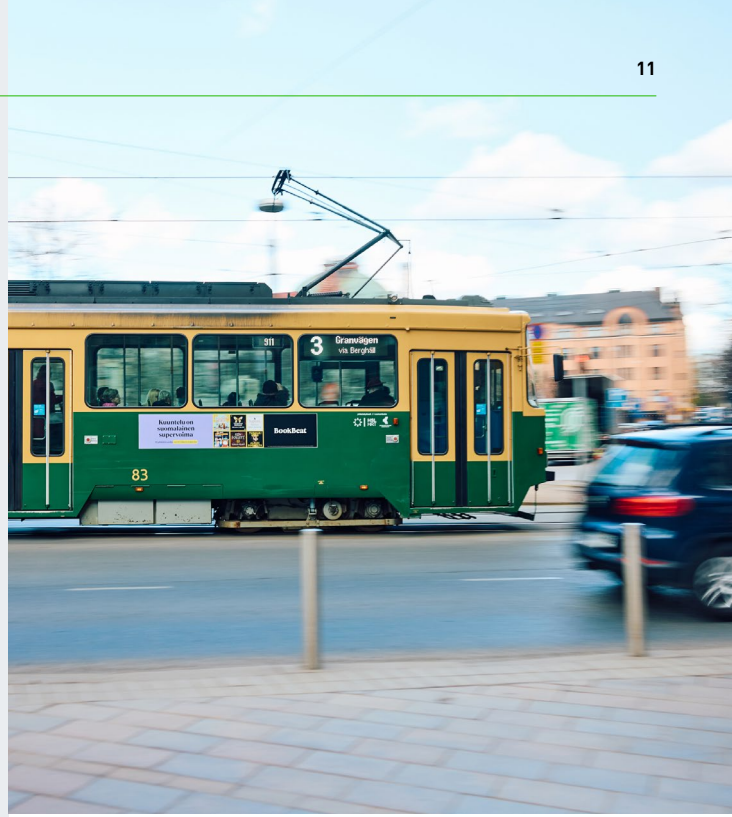
We should avoid over-reliance on single technological solutions. Carbon management must be approached as a complex system problem, requiring a mix of technological, natural, and societal solutions and awareness of unintended consequences. Have a clear distinction between education, aligned with current industry needs, and research, pushing boundaries and exploring new solutions. Seeing carbon as a managed resource across systems, supports solutions that contribute to a climate-resilient built environment beyond short-term fixes.

Recommendations

Go beyond traditional engineering. Balance technological innovation with critical thinking. Understand carbon flows across the built environment lifecycle.

Apply critical evaluation of technologies and develop innovative, scalable solutions that combine multiple approaches:

- Nature-based solutions (e.g. carbon sequestration through ecosystems).
- Material innovation, especially in timber and bio-based materials.
- Treating carbon as part of a lifecycle system, requiring lifecycle assessment (LCA) and carbon accounting and tracking.
- Strengthen interdisciplinary collaboration, extending beyond STEM to life sciences, behavioral sciences and humanities.



Opportunity for Finland is to move from exporting raw timber to creating high-value, carbon-storing building solutions. Providing novel ideas on carbon market formation and monetization could strongly increase LUT reputation and international influence."

— Team 6 Wild cards.

2.7. Building practices 2050

Building practices in 2050.

Vision

Comprehensive approach to sustainable circular and digital construction. Improving quality of living for end-users and added value of construction methods and practices. Leading the transition towards a circular, digital and human-centered built environment.

Starting point

We work towards a sustainable, circular, and digital built environment that improves quality of life for end users. Preparing for building practices in 2050, the challenge is making long-term decisions today. A key principle is achieving a balanced and pragmatic approach, including signing the right materials in the right place and zero waste principle, promoting hybrid construction solutions, prioritizing retrofits and renovation and ensuring economic viability of sustainable solutions.

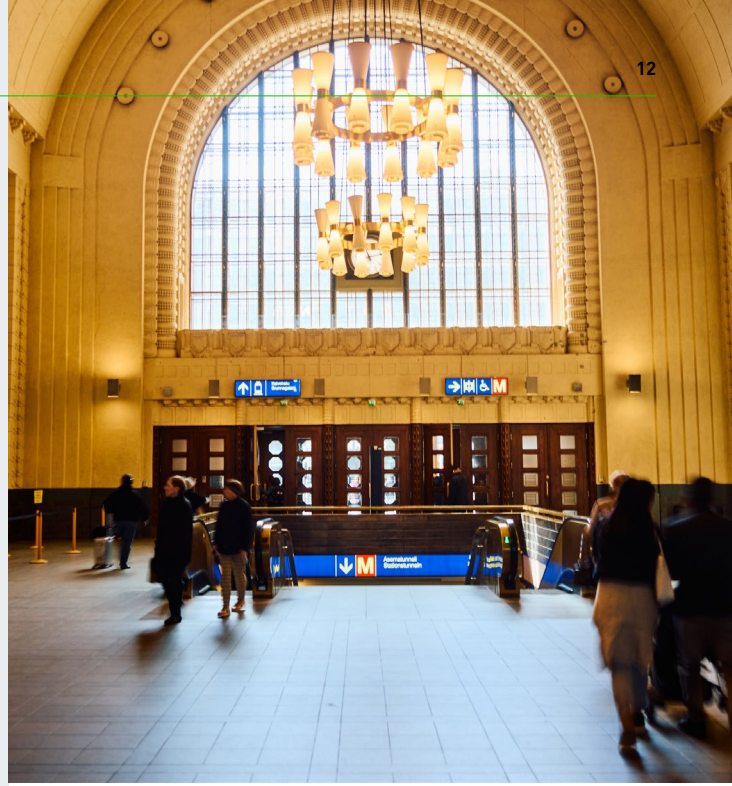
Critical insights

Long-term sustainability goals must be bridged with present-day implementation. We must also remember history and judge existing buildings as benchmark examples. This requires alignment with major frameworks such as EU zero-emission building targets and renovation and energy-efficiency strategies. Transition toward circular and human centered construction requires new business models, contracting approaches, and value chains.

Recommendations

Strengthen education and research through integration of skills, systems, and industry. Align research with real company needs, engage companies through projects, internships, and guest lectures and leverage regional ecosystems.

- Maintain strong core engineering knowledge (materials, mechanics, structural design).
- Combine engineering, economics, and innovation to enable new business models, contracting models and product value chains.
- Expand capabilities in leadership, communication, stakeholder management, circular economy, and product lifecycle thinking.
- Develop advanced design competencies alongside systems level understanding.



Paradigm change from separated BIM models to joint BIM-models with gradually increasing information content has a huge economic potential reducing manual labor drastically in design. Recognizing business potential in value-adding rather than time-consuming is a gamechanger in the coming."

— Team 7 Wild card

2.8. Energy and materials

Buildings as active participants in energy and material systems.

Vision

The built environment acts as a decentralized, active platform that integrates energy, materials, and users to enable sustainable and resilient living.

Starting point

We balance technological innovation with real-world applicability, emphasize autonomy, adaptability, and resilience. The goal should be an active, decentralized, and sustainable built environment that supports user activities in both normal and exceptional conditions. Key principles include:

- User-centered design: Empowering users to actively control or interact with building performance when needed.
- Connected systems: Buildings integrated with broader infrastructures to enable energy flexibility, demand response, and resource efficiency.
- Impact-driven development: Combining local piloting with global knowledge exchange to implement sustainable solutions effectively.
- Collaboration and interdisciplinarity: Fostering co-development with industry, users, and academic partners across disciplines.

Recommendations

Build multi-sector partnerships with industry, academia, and social/behavioral sciences. Test and validate innovations locally while learning from global best practices. Use international knowledge exchange to strengthen regional solutions while integrating global insights.

Core Knowledge:

- Integrated building energy and resource systems.
- Digital tools including BIM, digital twins, and lifecycle data analysis.
- Sustainable, circular construction materials and matter flows.
- Holistic understanding of systems thinking and cross-disciplinary impacts.

Capabilities:

- Interdisciplinary and system-oriented problem solving.
- Skills in collaboration, integration, and understanding totality.
- Ability to translate knowledge into practical, user-centered solutions.

Critical insights

Energy, materials, and systemic integration must work together with societal and environmental changes. Preferable solutions should tackle problems in several interconnected areas and benefit them all. Future-proof the built environment in the face of evolving global and regional dynamics by balancing local and regional implementation with global information exchange. Plan for diverse environmental impacts across regions; adapting to aging populations, changing household sizes, and migration-driven diversity and leveraging energy/material systems to create sustainable, adaptable, and human-centered solutions.

3. DIAMONDS AND WILD CARDS

After the teams had each co-created a vision for their specific theme, they were asked to think highlights (diamonds and wild cards) from their four-week work and connect these to the three core areas of LUT Civil Engineering profile.

The composition of wild cards

Technology-Driven Growth

- Emphasize solutions that prioritize user experience and adaptability to user needs.
- Build on systemic carbon management.
- Integrate physical and digital worlds and use digital twins and smart infrastructure to improve operational efficiency and decision-making.

Business Transformation

- Develop soft skills such as communication, collaboration and working practices that support open innovation.
- Transfer local excellence into global impact with best international partners possible.
- Create flexible and adaptive frameworks such as test-beds, living labs or innovation ecosystems.

Infrastructure Resilience

- Design dual-use systems ensuring robust and versatile infrastructure.
- Incorporate ecological approaches and nature-based solutions.
- Understand how international data dynamics influences local infrastructure decisions and strategic planning.

The discussions during the journey also clarified some basic approaches and insights. The Fast Expert Teams community created a common understanding of the fundamentals on which LUT will build the new LUT Civil Engineering program research and education activities.

Education

The engineer of the future must be analytical, ethical, collaborative, and capable of systems thinking.

Interdisciplinary approach, future-making skills and digital and sustainability approaches have to be integrated in the core competencies.

Theoretical foundation and practical, industry-aligned capability building should be combined.

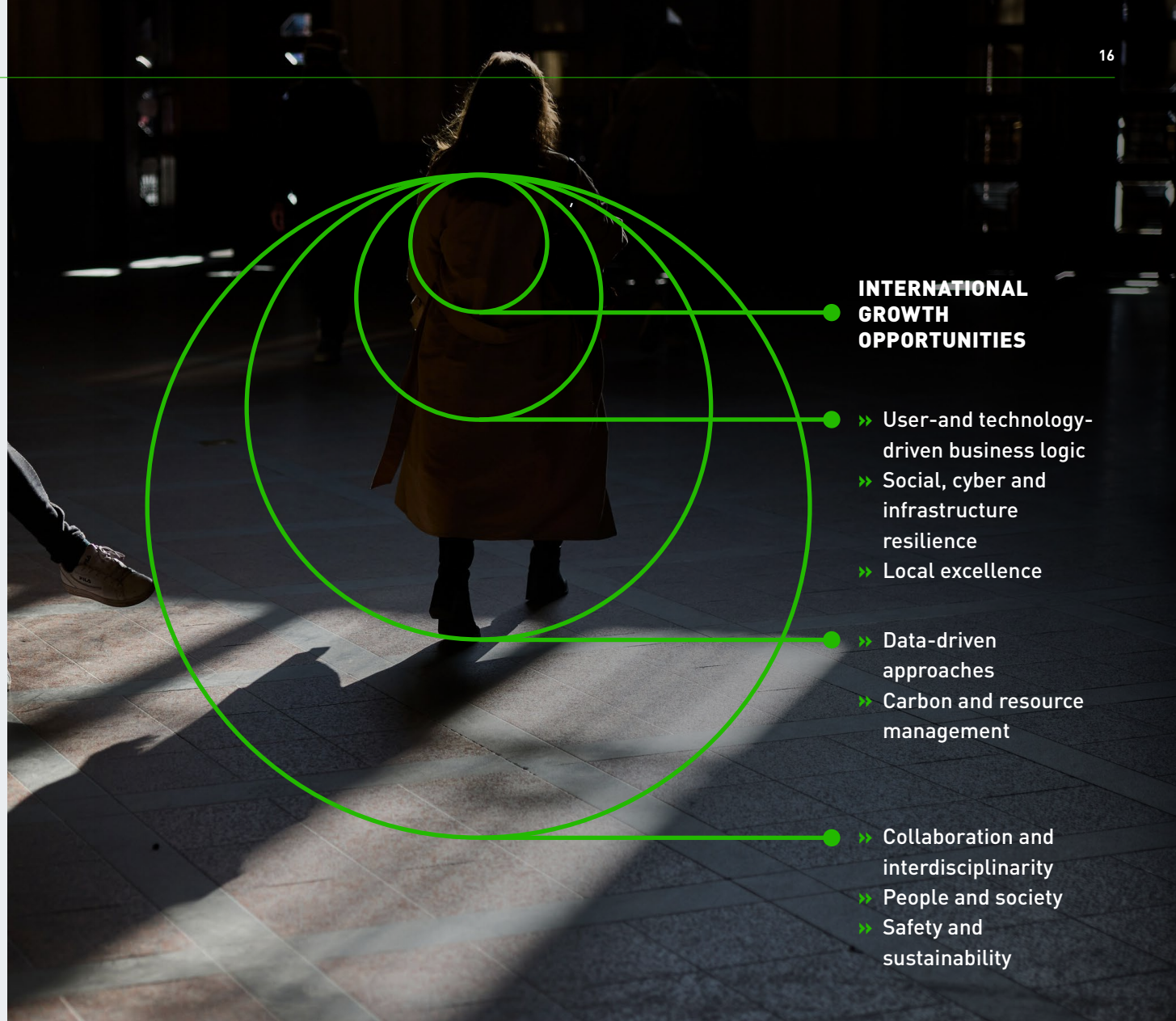
Fundaments

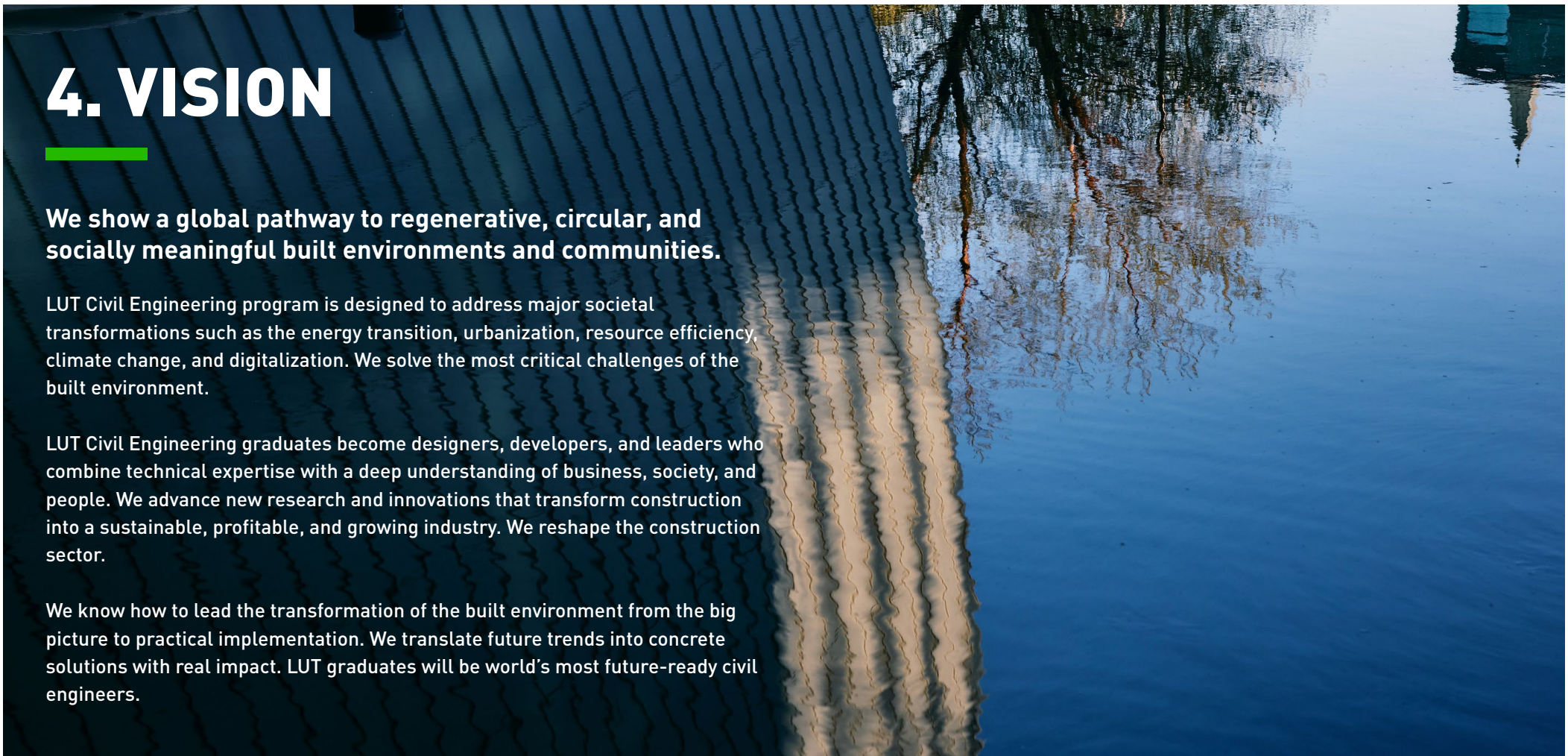
Technology creates multidimensional value when it is operated by and for the people, has a business logic and operates within planetary boundaries.

The foundation of the new construction industry is based on collaboration, interdisciplinarity, data-driven approaches and carbon and resource management.

We should address resilience as a multidimensional concept that encompasses physical infrastructure durability as well as social and cyber resilience.

Local excellence creates international growth opportunities.





4. VISION

We show a global pathway to regenerative, circular, and socially meaningful built environments and communities.

LUT Civil Engineering program is designed to address major societal transformations such as the energy transition, urbanization, resource efficiency, climate change, and digitalization. We solve the most critical challenges of the built environment.

LUT Civil Engineering graduates become designers, developers, and leaders who combine technical expertise with a deep understanding of business, society, and people. We advance new research and innovations that transform construction into a sustainable, profitable, and growing industry. We reshape the construction sector.

We know how to lead the transformation of the built environment from the big picture to practical implementation. We translate future trends into concrete solutions with real impact. LUT graduates will be world's most future-ready civil engineers.

5. ACKNOWLEDGEMENTS

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