EU Climate and Smart City Missions: Universities Bridging Research & Education

Vol. 2 of Sourcebook Series

Building Capacity in Higher Education for Climate Change and Smart cities

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Readers and Community:

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About the Project SMARTEDUCG

Overview

The project "Academic Development through Bilateral Peer-Learning Activities on Mission-Oriented Innovation for Climate Neutral and Smart Cities" (SMARTEDUCG) is a pioneering initiative under the Institutional Cooperation Programme of EEA and Norway Grants. Spanning from August 2021 to July 2023, this project is a collaborative endeavor between the Czech Technical University in Prague (CTU) and the University of Stavanger (UiS).

Objectives

SMARTEDUCG aims to foster bilateral synergy among academic staff from diverse disciplines at CTU and UiS. The project focuses on enhancing education and research activities related to climate change and smart cities through an interdisciplinary approach. It organizes four Peer-Learning Activities (PLAs) to encourage knowledge sharing, co-creation of innovative teaching methodologies, and mission-oriented research goals.

Intellectual Outputs

The project was set to produce the following intellectual outputs:

- Sourcebook 1: Focuses on innovative teaching methods and curriculum integration related to climate change and smart cities.
- Sourcebook 2: Aims to enhance the synergy between higher education and research, providing frameworks for mission-oriented research.
- Sourcebook 3: Addresses innovative methodologies and digital tools for online education in the field of smart and sustainable cities.

Expected Outcomes

The project aims to equip academic staff with interdisciplinary skills essential for addressing Europe's grand societal challenges. It also seeks to modernize academic curricula by incorporating citizenship values and challenge-based research approaches. Young researchers will gain valuable skills in publication and grant writing, and the academic community will be better prepared for future initiatives.

Target Audience

The primary beneficiaries are early career researchers and lecturers at CTU and UiS, with secondary beneficiaries including senior lecturers and researchers.

Broader Impact

SMARTEDUCG aims to set the stage for deeper inter-institutional collaboration on education and research related to smart and sustainable cities, particularly within the Horizon Europe programme.

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Preface

In an era where the urgency of addressing climate change and the complexities of urbanization converge, the role of higher education and research becomes paramount. The second sourcebook in the SMARTEDUCG series, titled "Enhancement of Synergy between Higher Education and Research Approaches for Climate Change and Smart Cities," is a testament to this pivotal role. This sourcebook is a beacon, guiding academic institutions and researchers through the intricate maze of mission-oriented innovation, particularly within the realms of climate-neutral and smart cities.

Overview and Goals

The sourcebook is divided into two distinct yet interconnected parts. The first delves deep into the mission goals of the European Union concerning climate change and smart cities. It seeks to bridge the gap between these overarching goals and the research endeavours of European universities. By providing tangible examples from current research areas and equipping young researchers with the tools for effective publication and grant writing, this section is a treasure trove of knowledge and guidance. Furthermore, it introduces a robust framework for capacity building and a roadmap for fostering collaboration between European universities and external stakeholders. This collaboration is envisioned to address the pressing societal challenges posed by climate change and the quest for sustainable urban spaces.

The second part of the sourcebook emphasizes the symbiotic relationship between research and education. It explores how research can invigorate academic curricula and, conversely, how the educational landscape can inspire fresh research inquiries. In a world where challenges are

multifaceted, the synergy between education, research, and innovation becomes the linchpin for meaningful progress.

Organization and Features

Each section of the sourcebook is meticulously organized to offer readers a coherent understanding of the subject matter. From the exploration of mission goals to the intricacies of building synergies across disciplines, the content is both comprehensive and accessible. Real-world examples, frameworks, and actionable insights are interspersed throughout, ensuring that the sourcebook is not just informative but also actionable.

Target Audience and How to Use this Book

The second sourcebook in the SMARTEDUCG series is tailored to cater to a diverse audience, ranging from academic researchers and educators to policymakers and institutional leaders. Its content is meticulously structured to provide insights, frameworks, and best practices that can guide higher education institutions in enhancing their research activities and fostering synergy between education and research, especially in the realm of sustainable and smart cities.

For Academic Researchers: Chapters 1 through 7 delve deep into understanding the mission goals of the European Union, the pivotal role of universities in achieving these missions, and frameworks for initiatives in preparation for Horizon Europe proposals. These chapters also highlight best practices and successful examples, making them invaluable for researchers aiming to align their work with EU mission goals and for those seeking insights into international challenge-based research projects.

For Educators: Chapters 8 and 9 offer a unique perspective on how research activities can inspire academic curricula and how educational activities can, in turn, pave the way for new research goals. These chapters are particularly beneficial for educators looking to integrate cutting-edge research insights into their teaching methodologies and curricula.

For Policymakers and Institutional Leaders: Chapter 10 emphasizes the importance of synergy between education, research, and innovation across disciplines, providing a roadmap for fostering interdisciplinary collaboration and innovation. This chapter, along with the frameworks and best practices highlighted in earlier chapters, can serve as a blueprint for institutional reforms and policy decisions.

For All Readers: Chapter 11 wraps up the sourcebook with a look into the future, offering perspectives on the evolving landscape of higher education and research in the context of sustainable and smart cities. This chapter invites readers to reflect on the content of the sourcebook and envision the future trajectory of their institutions and research endeavours.

Navigating through this sourcebook, we invite you to delve into each chapter with an open perspective, relating the content to your distinct context and pondering how the presented insights and frameworks can be tailored to your specific needs. This sourcebook, rich in knowledge and guidance, is designed not just to inform but to inspire. Whether you're an early-career researcher, an experienced educator, or a decision-maker steering an institution, it aims to propel you towards transformative change in the interconnected realms of education and research.

While primarily crafted for the academic community, the sourcebook's reach is broad. It holds particular significance for early career researchers and educators in higher institutions. Yet, its depth and breadth make it indispensable for senior researchers, educators, and all those committed to the vision of climate-neutral and smart cities. For the wider academic community, especially those aligning with the Horizon Europe programme, this sourcebook stands as a pivotal reference.

To conclude, birthed from the collaborative essence of the SMARTEDUCG project between the Czech Technical University in Prague (CTU) and the University of Stavanger (UiS), this sourcebook is more than a mere guide. It embodies a call to action for academic institutions to forefront the solutions to contemporary challenges. In our journey through the intricate tapestry of the 21st century, may this sourcebook be your guiding light, illuminating the confluence of education, research, and innovation for the collective betterment.

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Part 1: EU's Climate and Smart City Missions

In the ever-evolving landscape of global challenges, the European Union (EU) has set forth ambitious mission goals, particularly emphasizing the creation of climate-neutral and smart cities. These goals are not just aspirational targets; they represent a collective commitment to address the pressing issues of climate change and urbanization, ensuring that our cities are sustainable, inclusive, and resilient.

What to Expect in Part 1

This section of the sourcebook delves deep into the intricacies of aligning research activities with these mission goals. As you navigate through Part 1, you will:

- **Gain a Comprehensive Understanding**: Before diving into the strategies and frameworks, it's crucial to have a clear grasp of the mission goals themselves. What does the EU envision when it talks about climate-neutral and smart cities? Why are these goals pivotal, and what implications do they hold for the future?
- **Discover the Role of Universities:** Academic institutions are not just centres of learning; they are powerhouses of research and innovation. You'll explore how universities, with their vast resources and expertise, can play a pivotal role in achieving the EU's mission goals.
- **Learn About Capacity Building:** How can universities enhance their capabilities to contribute effectively to these goals? This section will provide insights into building institutional capacities, both in terms of research and collaborative endeavours.

- **Benefit from Real-world Examples:** Theory is most effective when complemented with practice. You'll encounter best practices, case studies, and real-world examples of initiatives that have made a tangible difference.

A Glimpse into Chapter 1

As we commence this journey with Chapter 1, titled "Introduction and Understanding the mission goals within the climate-neutral and smart cities context," you will be introduced to the foundational concepts. This chapter serves as a primer, setting the stage for the subsequent chapters of part 1. It will elucidate the EU's mission goals in detail, providing context and highlighting their significance in the contemporary global scenario.

In essence, Part 1 is designed to equip you with the knowledge, strategies, and inspiration needed to align research endeavors with the EU's mission goals effectively. Whether you're an academician, a researcher, or a policymaker, the insights presented here will be invaluable in shaping research initiatives that are not only impactful but also aligned with the broader vision of creating sustainable urban futures.

Chapter 1: Introduction to EU Mission on Climate Neutral and Smart Cities

Dr. Ticiano Costa Jordão, Prof. Miroslav Svitek

The Horizon Europe programme, spearheaded by the European Union, champions research and innovation to address societal challenges, with a particular emphasis on climate change. A pivotal mission within this programme is the Mission on Climate-Neutral and Smart Cities, which seeks to expedite the transition of European cities to climate-neutral and smart entities. The mission's ultimate goal is to ensure all European cities are climate-neutral by 2050, a vision realized through fostering innovation, endorsing sustainable practices, and providing unwavering support to local authorities and stakeholders.

1.1. Understanding the Mission Goals

By 2030, the mission aspires to establish 100 climate-neutral and smart cities, setting a precedent for the entirety of Europe's urban areas to achieve climate neutrality by 2050 (European Commission, n.d.). This mission is anchored in three core pillars:

- **Climate neutrality:** Aiming to assist cities in achieving climate neutrality by 2030, this necessitates a holistic transformation across sectors, including energy, transport, and construction, with an emphasis on sustainable urban planning.
- **Smartness:** The mission endeavours to bolster the resilience and intelligence of cities, advocating for the adoption of innovative

technologies and solutions that optimize resource management, reduce emissions, and enhance the quality of life (MOSAIC, n.d.).

- **Cooperation:** The mission thrives on a culture of collaboration, weaving together cities, research institutions, businesses, and citizens. This collective approach is crucial for the mission's success (ERRIN, 2022).

The Climate-Neutral and Smart Cities Mission is a cornerstone of the European Green Deal, the EU's blueprint for achieving climate neutrality by 2050. As of April 2022, the mission has made significant strides. A commitment to climate neutrality is evident from the 377 cities across the EU and associated countries expressing interest. Of these, 100 cities have been handpicked by the Commission for the Cities Mission, a monumental step towards the mission's overarching goal (PERIN, n.d.).

These cities are now in the process of drafting Climate City Contracts, which will delineate their strategies for achieving climate neutrality across all sectors. This initiative will be a collaborative effort, involving citizens, research institutions, and the private sector.

With an earmarked investment of approximately €360 million for research and innovation actions related to the Mission between 2021 and 2023, the EU is solidifying its commitment to its climate and energy objectives. The commitments by the cities in the Climate City Contracts will serve as a catalyst for collaboration with various stakeholders, ensuring the mission's ambitious goals are met (ERRIN, 2022).

1.2. Benefits for the Selected Cities

The 100 cities integrated into this mission stand to reap numerous benefits, including:

- **Access to Funding:** The EU's substantial investment will support the development and execution of their Climate City Contracts.
- **Technical Support:** The Mission Platform, managed by NetZeroCities, will offer invaluable technical, regulatory, and financial guidance.
- **Collaboration and Networking:** Cities will have the opportunity to exchange knowledge and best practices with a diverse range of stakeholders.
- **Increased Visibility:** Participation in the mission will position cities as frontrunners in the transition to a climate-neutral and smart future.
- **Citizen Engagement:** Active citizen involvement in the Climate City Contracts will foster a sense of collective responsibility.

However, these cities will also encounter challenges, including securing additional funding, fostering innovation, ensuring cooperation, and maintaining political commitment.

1.3. Challenges for the Selected Cities

The 100 cities selected to participate in the EU Mission on climate-neutral and smart cities will face several challenges in achieving the mission's ambitious goals.

Some of the key challenges are as follows:

- **Investment:** Achieving climate neutrality requires significant investment in clean energy, energy-efficient buildings, sustainable transportation, and waste management (OECD, 2023). While the EU's investment is substantial, more funding will be essential for the comprehensive implementation of the plans developed by the selected cities.
- **Innovation:** Achieving climate neutrality will require innovative solutions and technologies. The selected cities will need to adopt and implement new and emerging technologies, such as renewable energy sources, smart grids, and electric vehicles, to reduce their carbon footprint. Innovation will also be required in urban planning and design, to ensure that cities are built and operated sustainably.
- **Cooperation:** Achieving climate neutrality is a complex task that requires collaboration and cooperation between different stakeholders, including citizens, businesses, and governments. The selected cities will need to engage with their citizens and stakeholders to develop plans that are tailored to their local contexts and priorities. They will also need to work closely with

national and regional authorities, as well as other cities, to share knowledge, experiences, and best practices.

- **Political will:** Achieving climate neutrality requires strong political will and leadership. The selected cities will need to have the support of their mayors and local governments, as well as national and regional authorities, to implement their plans and overcome any obstacles that may arise. Political will is also needed to ensure that the plans are implemented over the long term, beyond the current political cycles.

In summary, the selected cities will need to overcome these challenges and work collaboratively to achieve the ambitious goals of the EU Mission on climate-neutral and smart cities. The success of the Mission will depend on their ability to innovate, invest, cooperate and show strong political will.

Effective cooperation between research institutions, businesses, and citizens can help to ensure that the EU mission goals on climate-neutral and smart cities are achieved in a timely and effective manner. It can also help to create a more sustainable, resilient, and inclusive urban environment for all.

1.4. Means for Cooperation

Here are some ways in which this cooperation can be developed and maintained:

- **Collaboration on research and innovation**: Research institutions and businesses can work together to develop innovative solutions for achieving climate neutrality in cities. This can involve joint

research projects, knowledge-sharing, and the development of new technologies.

- **Public-private partnerships:** Public-private partnerships can bring together businesses, research institutions, and governments to work on specific projects related to the mission goals. These partnerships can help to leverage private investment and expertise, and to develop new business models for sustainable urban development.
- **Citizen participation:** Citizen participation is crucial for the success of the mission goals, as it ensures that the needs and priorities of local communities are considered. This can involve engaging citizens in the development of Climate City Contracts, seeking their feedback and ideas, and involving them in the implementation and monitoring of plans.
- **Capacity building:** Capacity building activities can help to develop the skills and knowledge of all stakeholders involved in the mission, including research institutions, businesses, and citizens. This can involve training programs, workshops, and other learning opportunities.
- **Networking and knowledge-sharing:** Networking and knowledge-sharing activities can facilitate collaboration and cooperation between stakeholders. This can involve events such as conferences, workshops, and online platforms, where stakeholders can exchange ideas, share best practices, and build relationships.

1.5. Means for Non-selected Cities to Cooperate

While only 100 cities have been selected to participate in the EU mission on climate-neutral and smart cities, there are still opportunities for non-selected cities and entities based in those cities to participate in projects aimed at achieving the mission goals on climate-neutral and smart cities. Here are some ways that non-selected cities and entities can participate:

- **Participate in consortia**: non-selected cities and entities based in those cities can participate in consortia that are applying for EU funding calls of Horizon Europe programme related to the mission goals on climate-neutral and smart cities. By joining forces with other organizations and cities, they can increase their chances of success and contribute to the achievement of the mission goals. These funding calls may cover a range of topics, such as energy efficiency, sustainable transport, or smart cities, and can be accessed through the Horizon Europe program.
- **Partner with selected cities:** non-selected cities and entities can partner with selected cities in joint projects that are aimed at achieving the mission goals. This can involve knowledge-sharing, technology transfer, and joint investment in innovative solutions for sustainable urban development. The calls within Horizon Europe programme related to this mission usually require a minimum number of selected cities in each applying consortium.
- **Participate in knowledge-sharing activities:** non-selected cities and entities can participate in knowledge-sharing activities organized by the Mission Platform managed by the project

NetZeroCities. These activities can provide opportunities to learn from the experiences of the selected cities and to exchange ideas and best practices.

By participating in these activities, non-selected cities and entities can still contribute to the achievement of the mission goals on climate-neutral and smart cities, even if they are not among the 100 selected cities. It is important to note that the mission is a collaborative effort that requires the participation of all stakeholders, and there are many ways for non-selected cities and entities to get involved.

1.6. Cooperation for Success

Effective collaboration between various stakeholders is pivotal for the mission's success. This can be facilitated through joint research projects, public-private partnerships, citizen engagement, capacity-building initiatives, and networking.

While the mission directly involves 100 cities, other cities and entities can still play a role. They can join consortia, collaborate with selected cities, or participate in knowledge-sharing activities organized by the Mission Platform (European Commission, n.d.).

Inspiring Projects and Initiatives

Several projects funded by both the Horizon Europe and Horizon 2020 programmes serve as beacons for this mission, including:

- **NetZeroCities:** A project focusing on developing a roadmap for cities to achieve climate neutrality by 2030.

  Website: https://netzerocities.eu/the-nzc-project/

- **REMOURBAN**: Aiming to retrofit urban areas to reduce their carbon footprint.

  Website: http://www.remourban.eu/

- **GreenCharge:** Concentrating on electrifying public transport systems in European cities.

  Website: https://www.greencharge2020.eu/

- **SCOREwater:** Aiming to enhance urban water management.

  Website: https://www.scorewater.eu/

- **SmartEnCity:** Developing a platform for cities to share data and best practices on energy efficiency.

  Website: http://smartencitynetwork.eu/

- **Intelligent Cities Challenge (ICC):** An EU initiative supporting cities in their green and digital transition.

  Website: https://www.intelligentcitieschallenge.eu/

- **Urban Innovative Actions:** Funding projects that innovate in areas like energy efficiency, mobility, and waste management.

  Website: https://www.uia-initiative.eu/en/knowledge-lab

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Chapter 2: Universities in the EU's Climate Mission: Bridging Research and Practice

Dr. Ticiano Costa Jordão, Prof. Miroslav Svitek, Dr. Marco Lamas

In the heart of Europe's ambitious journey towards a sustainable future lies the vision of transforming urban areas into climate-neutral cities. As the European Union (EU) champions this cause, universities, as hubs of innovation, research, and education, emerge as pivotal players in this transformative journey.

Drawing insights from a comprehensive study on the role of universities in the EU's climate mission (Leal Filho et al., 2022), it's evident that their multifaceted roles span from being hubs of research and knowledge creation to fostering community engagement and building international partnerships. As cities grapple with the challenges of sustainability and climate change, universities emerge as indispensable allies in this journey.

Before delving into the specifics, it's essential to outline the scope of our exploration. Five pivotal roles of European universities will be described in depth in the following sections of this chapter:

- Universities as Centres of Research and Knowledge Creation
- Innovation and Technological Advancements
- Community Engagement and Capacity Building
- Collaborative Networks and Partnerships
- Notable Contributions to Urban Climate Change Solutions

2.1. Universities as Centres of Research and Knowledge Creation

In the evolving landscape of urban sustainability, European universities stand as beacons of knowledge and innovation. Their contributions span across centuries, with a legacy of shaping thought, policy, and practice. As cities across Europe embark on the journey towards climate neutrality, the role of universities becomes even more pronounced. They not only provide the intellectual foundation but also the practical tools and strategies to navigate the complexities of this transformation.

European universities have a unique position at the crossroads of education, research, and innovation, serving both society and the economy. They play a critical role in achieving the European Education Area (EEA) and the European Research Area (ERA), promoting the European model in line with the EU's interests and values, such as the rule of law, human rights, and international norms and standards (European University Association, 2017).

Three key pillars underpin their contributions:

- **Tradition of Excellence:** European universities are renowned for their academic excellence and rigorous research, setting the gold standard in various disciplines.
- **Evidence-based Policymaking:** These institutions serve as vital sources of data, case studies, and empirical analyses, playing a crucial role in shaping sustainable urban strategies.
- **Interdisciplinary Research:** By harnessing expertise from diverse fields like urban planning, environmental science, social sciences, and engineering, universities address the multifaceted challenges of urban sustainability (Azeiteiro and Davim, 2021). Interdisciplinary

research is essential for developing innovative solutions to complex problems, and universities are uniquely positioned to foster such collaboration.

Universities have long been recognized as the bedrock of research, innovation, and knowledge dissemination, playing a vital role in advancing the Sustainable Development Goals (SDGs) (United Nations, 2015). Their unique position at the intersection of academia, industry, and society allows them to spearhead advancements in various fields, fostering environments that encourage critical thinking, exploration, and the pursuit of knowledge.

European universities have been at the forefront of many groundbreaking discoveries and innovations. Their rich history, combined with a commitment to excellence, positions them as global leaders in research and education.

For instance, the Czech Technical University in Prague (CTU), one of the oldest and largest technical institutions in Europe, has been instrumental in pioneering research in engineering, architecture, and information technology. Its contributions have not only advanced the academic community but have also had tangible impacts on industries and societies at large.

Similarly, the University of Stavanger in Norway is renowned for its research endeavours, particularly in areas related to energy, health, and social sciences. Given Norway's prominence in the energy sector, especially in oil and gas, the university plays a pivotal role in driving sustainable energy solutions and shaping the future of energy consumption and production.

Across Europe, numerous other universities are making significant strides in their respective domains. Whether it's the University of Cambridge's

advancements in medicine, the ETH Zurich's innovations in technology, or the University of Barcelona's research in humanities, European universities continue to push the boundaries of what's possible, contributing immensely to global knowledge and progress.

In the context of urban climate change mitigation and adaptation, universities face both challenges and opportunities. On the one hand, they may be constrained by limited resources, bureaucratic red tape, or a lack of alignment with government priorities (Wu and Shen, 2016). On the other hand, universities have a unique opportunity to play a leading role in urban sustainability by partnering with local governments, businesses, and community organizations to develop and implement sustainable solutions (European Commission, 2023).

2.2. Innovation and Technological Advancements

In the age of rapid technological advancements, universities have emerged as pivotal players in driving innovation and bridging the gap between theoretical knowledge and its real-world application. European universities, with their legacy of academic excellence, have been at the forefront of this transformation, leveraging state-of-the-art facilities, interdisciplinary research, and industry collaborations to foster an environment of innovation and technological advancements.

- **The Digital Transformation of Higher Education**: The integration of digital technologies and the Internet in higher education has significantly transformed the way knowledge is accessed, produced, and shared. Universities are now challenged with the task of customizing courses and programs based on learners' needs, expectations, and profiles. The concept of

'personalized learning' is becoming increasingly important, with students demanding education tailored to their individual goals and interests (Selwyn, 2020).

- **Universities as Incubators:** Academic institutions are hotbeds of innovation, fostering groundbreaking ideas through labs, workshops, and entrepreneurial hubs. For instance, Humboldt Innovation, an initiative highlighted in an OECD publication, has been instrumental in supporting more than 20 successful spin-offs and accompanying over 200 research projects, showcasing the potential of universities to act as catalysts for entrepreneurial ventures (OECD, 2009).
- **Industry Collaboration:** Universities bridge the chasm between academic research and its real-world applications by collaborating closely with industries. Their partnerships with the tech industry, in particular, have been instrumental in driving technological advancements in various sectors (Hill, 2020).
- **Sustainable Tech Development:** They are at the forefront of developing and testing sustainable technologies, ranging from renewable energy solutions to advanced urban planning tools. The 'ecological university' concept emphasizes a more integrated and interconnected relationship between universities and society, where all stakeholders collaboratively co-create knowledge (Barnet, 2018).

The rise of educational technology has necessitated a focus on innovation and strategic thinking. Universities must anticipate future trends, adapt their

business models, and ensure that educational experiences cater to students' unique needs (Govender, 2022). Technological innovations have reshaped the learning environment, making it more dynamic and accessible to students globally. This transformation has redefined education, especially with the shift towards remote learning.

As universities integrate more technology into their research activities and educational offerings, there's a pressing need to ensure that these technologies are used ethically. This is crucial to preserve the core principles and humanity of higher education.

In the rapidly evolving landscape of the 21st century, universities are no longer confined to the traditional roles of education and research. They have emerged as powerhouses of innovation and technological advancements, playing a pivotal role in shaping the future. European universities, with their rich legacy and forward-thinking approach, are at the forefront of this transformation.

Here are some examples of European universities driving innovation:

- **Czech Technical University in Prague (CTU):** One of Europe's oldest technical institutions, CTU has been a hub of innovation for centuries. The university is involved in advancements ranging from robotics to sustainable energy solutions, and its collaborations with industries have led to tangible societal impacts.
- **University of Stavanger (UiS)**: Positioned in Norway's energy capital, UiS is known for its research in offshore drilling, renewable energy, and smart grid technologies. Its interdisciplinary approach combines technical expertise with insights from social sciences and humanities.

- **KU Leuven:** As Europe's most innovative university, KU Leuven is renowned for its research output and collaborations with industries. The university has a rich history of pioneering research in nanotechnology, health sciences, and engineering.
- **University of Erlangen Nuremberg:** This German university is a powerhouse in materials sciences, engineering, and life sciences. Its collaborations with industries have led to advancements in medical technology and sustainable energy solutions.
- **University of Cambridge:** A world-leading institution, the University of Cambridge has been at the forefront of numerous technological breakthroughs. Its research in biotechnology, engineering, and computer science has had global implications.
- **EPFL - Swiss Federal Institute of Technology Lausanne**: EPFL is known for its cutting-edge research in engineering, life sciences, and computer science. The university's emphasis on interdisciplinary research has led to innovations in digital technology, sustainable energy, and health sciences.
- **University of Paris Sud - Paris 11:** This institution is a leader in mathematics, physics, and health sciences. Its research centers and collaborations with industries have resulted in advancements in pharmaceuticals, telecommunications, and sustainable technologies.
- **Technical University of Munich (TUM):** Renowned for its research in artificial intelligence, quantum technologies, and bioengineering, TUM has also fostered numerous successful start-ups through its entrepreneurial education programs.

- **Eindhoven University of Technology:** A leader in research on smart materials, photonics, and sustainable energy solutions. Its Brainport region is a testament to the university's innovative culture.
- **Polytechnic University of Catalonia (UPC):** Recognized for its advancements in aerospace, architecture, and telecommunication technologies, UPC's industry collaborations have resulted in global innovations.
- **Delft University of Technology (TU Delft):** Known for its tech incubators that nurture innovation and entrepreneurship, TU Delft provides start-ups with resources, mentorship, and a network to thrive in various technological domains.

In conclusion, European universities are not just centres of learning but are also crucibles of innovation. Their research, collaborations with industries, and emphasis on practical training ensure that they remain at the cutting edge of technological advancements, shaping the future and driving progress.

2.3. Community Engagement and Capacity Building

Universities play a multifaceted role in society, extending far beyond traditional academic pursuits. They are not just centres of learning but are deeply embedded in the fabric of the communities they inhabit. This integration is evident in various ways, from influencing local policies to tailoring educational programs to address pressing societal challenges. This section highlights some examples of these roles.

2.3.1. Universities as Community Anchors

Universities are more than just educational institutions; they are pillars of their communities. They have the potential to influence local policies, practices, and public sentiments, making them indispensable to the regions they serve. For instance, the University of Dayton has been an integral part of the Dayton region, contributing to its development and transformation (Spina, 2021). From aiding refugees during the city's devastating 1913 flood to revitalizing the downtown Dayton Arcade into an innovation hub, the university has consistently collaborated with local leaders to shape the community's future. Such universities go beyond mere town-gown relations, actively investing in initiatives that benefit both the institution and the community. They serve as true partners, addressing pressing needs, from economic development to urban education reform, and in the process, enriching the educational experience for their students. Another example is the Ghent University's involvement in the Ghent Living Lab, which actively collaborates with the city, citizens, and businesses to co-create innovative solutions for urban challenges (Ghent University, 2023; C3Places, 2021). Similarly, the Autonomous University of Barcelona (UAB) exemplifies the role of universities in community anchoring through its initiative, "The CORE." This initiative focuses on the smart and sustainable development of cities, fostering collaboration between researchers, students, public administrations, companies, and citizens to co-create region-specific solutions. The CORE serves as a platform for generating new knowledge and fostering initiatives that directly benefit the region, emphasizing UAB's commitment to sustainability, smart urban development, and community engagement (UCityLab, 2020). Another example is the EuroTeQ Engineering

University initiative, a collaboration of six leading European universities. This consortium emphasizes co-creating solutions with various stakeholders, fostering technological progress, and promoting societal cohesion, serving as a model for other universities and stakeholders across Europe (EuroTeQ, 2023).

2.3.2. Tailored Educational Programs

Universities are increasingly recognizing the importance of sustainability and are designing programs to nurture a workforce ready to champion the climate-neutral agenda. Such initiatives ensure that students are not only equipped with theoretical knowledge but also with the practical skills required to address contemporary challenges. One such notable program is the MSc Energy for Smart Cities offered by EIT InnoEnergy, a collaboration between top European universities and industries. This two-year master's program is jointly delivered by four leading European institutions, focusing on sustainable energy systems, innovative technologies, and entrepreneurship. Students gain hands-on experience through real-world projects and internships, studying in two different countries to benefit from diverse academic environments. Graduates from this program are well-equipped to drive innovation in the energy sector, with many venturing into leading companies, startups, or further research (EIT InnoEnergy, 2023). Another exemplary initiative is the dual-degree master program titled "Smart Cities" (Skolilova, 2023) initiated by the Faculty of Transportation Sciences of the Czech Technical University in Prague (CTU) in collaboration with the University of Texas of El Paso (UTEP). Furthermore, the University of Stavanger offers a Master in Energy, Environment and Society, which focuses on the challenges associated with the realization of the Paris Agreement and the UN Sustainable Development Goals, especially in the

context of energy. The program delves into the complexities of energy transitions, sustainable energy policies, and the geopolitics of energy, equipping students with the knowledge and skills to contribute to sustainable development strategies and solutions (University of Stavanger, 2023). Additionally, the EC2U Alliance offers a joint master degree on Sustainable Cities and Communities, emphasizing interdisciplinary approaches to urban sustainability and fostering collaboration among European universities to address the pressing challenges of urbanization (EC2U Alliance, 2023).

2.3.3. Community Outreach

Universities are increasingly engaging with the wider community to foster a culture of environmental consciousness. Through public seminars, workshops, and community-centric projects, they aim to instil a robust sense of environmental responsibility. The Anchor Institutions Task Force, a network of over 600 leaders, underscores the role of enduring organizations like universities and healthcare institutions in community and economic development. These anchor institutions, deeply rooted in their localities, are expected to actively participate in improving health and well-being in their surroundings (Columbia Climate School, 2016). For instance, health care organizations, such as universities and non-profit hospitals, being major employers in several communities, can significantly influence economic and residential growth. As they engage more in total population and community health, they become key collaborators in creating healthy environments where people live, work, learn, and play. By identifying the social determinants of health, these institutions can strategize to influence various conditions that affect health outcomes, from education to economic development to the

environment. An exemplar of such an anchor institution is the Children's Hospital of Philadelphia, which, through significant gifts and investments, has the potential to change the economic landscape of Philadelphia, hiring bright minds and reinvesting in a city in need of resources. In Europe, universities, such as those involved in the ENGAGE.EU alliance, are striving to address societal challenges by fostering active citizenship and promoting open science. They aim to empower communities through knowledge exchange, lifelong learning, and collaborative research (European Commission, 2020). The 4EU+ Alliance, comprising six comprehensive research universities, is another example of universities working together to enhance the quality of education and strengthen ties with their local communities. Their initiatives focus on fostering a culture of shared values, promoting active citizenship, and addressing global challenges (4EU+, 2023). The European Observatory for Community Engagement in Higher Education further emphasizes the importance of universities' role in community engagement, offering a platform for sharing best practices and promoting active collaboration between universities and their communities (EOCEHE, 2023). Such partnerships between anchor institutions and local organizations are vital for addressing challenges in localities and regions, ensuring that these institutions play a pivotal role in the social and economic development of the communities they serve (Olsen & Brewe, 2021; Bleach, 2021). Ghent, as previously mentioned, has taken a proactive approach in its journey to becoming a smart city. The city emphasizes the role of its citizens in its smart initiatives, suggesting that the foundation of a smart city lies in its smart populace. The Ghent Living Lab has

been serving as a platform to link the city's digital ambitions with the potential of its citizens.

In fact, universities are not mere academic institutions; they are dynamic entities that play a pivotal role in shaping the communities they inhabit. Through their various initiatives, they not only contribute to societal development but also ensure that their students are well-equipped to address the challenges of the future.

2.4. Collaborative Networks and Partnerships

European universities have a rich tradition of collaboration, actively participating in international research groups, partnerships, and networks. In recent years, the world has witnessed a surge in research partnerships between universities and business organizations.

This collaborative spirit is not just a historical artifact but a necessity in the current landscape of higher education. As highlighted by Lundy and Ladd (2020), regardless of the size or financial health of a higher learning institution, collaborations and partnerships can be more effective when certain strategies are employed. Those experts in higher education partnerships emphasize how financial challenges and changing market dynamics can offer universities significant opportunities to partner and even merge with institutions that align with their strategic vision for the future. Such collaborations go beyond mere agreements to share resources; they involve institutions coming together to redefine their future direction. The driving force behind this shift is the realization that the market cannot support the current number of institutions, especially with declining enrolments of students and rising costs. Following

such principles, different institutions can leverage their unique strengths and resource to provide better value to students.

On the other hand, Every Learner Everywhere, a collaborative network of 12 partner organizations, emphasizes that collaborative networks are not just about external partnerships. When universities and colleges focus on internal collaboration across departments, they can leverage the network advantage internally, leading to more holistic and impactful solutions to complex problems. Such an approach fosters open communication, active listening, and a shared understanding of each department's contribution to the overall mission of the institution (Every Learner Everywhere, 2021).

Here are some of the most relevant reasons why such partnerships are crucial for European universities as inspired by the remarks from McFee (2018):

- **Filling the Research Gap:** With businesses often limited by their organizational goals or budgets, they are reducing their expenditure on early-stage research. Universities are stepping in to fill this research gap, leveraging academic-business partnerships to secure funds for academic research, especially in scenarios with limited government support.
- **Global Impact with Local Relevance**: Universities leverage international collaborations to bring global best practices, lessons, and innovative solutions to local contexts. The European Universities Initiative and the European University Alliances are pioneering changes that will shape the future of higher education. These alliances are creating spaces for academic cooperation to collectively address grand challenges, emphasizing the importance

of collaboration and mobility of students and researchers across universities to boost innovation, diversity, and competitiveness (Genova & Rosetta, 2022). One exemplary alliance is the EuroTeQ Engineering University (2020), which emerges from the EuroTech Universities Alliance. Comprising six highly renowned European universities of science and technology, including the Czech Technical University in Prague (CTU), the alliance is anchored in diverse geographical and cultural contexts. Each partner university, with its unique ecosystem, provides added value and a competitive advantage to the EuroTeQ cooperation. The alliance shares a vision of equipping graduates with the necessary skills and competences relevant for shaping a sustainable future. They believe in addressing challenges through international, inter-institutional, and interdisciplinary diversity, and in preparing the future generation with transdisciplinary perspectives and holistic problem-solving approaches.

- **Facilitating Dialogue and Networking:** Universities play a pivotal role in fostering conversations between policymakers, industry leaders, civil society, and the general public. This ensures a holistic approach to sustainability. Effective academic-industry networking gives universities a competitive edge, preparing students for international careers, ensuring they remain competitive globally. Universities, through the European Universities alliances, play a pivotal role in fostering dialogue between various stakeholders. They develop and implement integrated long-term

joint strategies for education, research, and innovation, serving society at large. The alliances also promote deeper institutional cooperation, allowing students and staff to benefit from seamless mobility opportunities in European inter-university campuses. These campuses offer flexible and innovative curricula, promoting interdisciplinary and cross-sectoral approaches. Such initiatives not only enhance the academic experience but also ensure that students are equipped to address real-world challenges (European Education Area, n.d.).

- **Research Funds and Job Opportunities:** Partnerships provide universities with research funds and offer students job opportunities. Through collaborations, students access experiential learning, mentorships, and real-time industry jobs. Such partnerships also allow corporations to tap into a talent pool that aids in solving business challenges.
- **Promoting Innovation:** Collaboration between universities and businesses supports innovation. By working together, they can develop new commercially viable technologies and use academic insights to build more efficient business models.
- **Skill Development and Lifelong Learning:** University partnerships ensure students are equipped with relevant skills for the workplace, even post-graduation. Such collaborations allow for the free flow of ideas, ensuring that skills remain relevant as industries evolve.

- **Compatibility and Common Goals:** For university partnerships to be effective, there needs to be compatibility between the partners, working towards shared goals and missions. Effective communication and trust are paramount.

In essence, as cities across Europe strive to become climate-neutral and smart, universities stand as pillars of support. They guide, innovate, and collaborate, turning visions into reality. Whether it's through external partnerships or internal collaborations, the power of networks in higher education cannot be understated. They offer a pathway to not only survive but thrive in the ever-evolving landscape of higher education.

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Chapter 3: The Role of Universities in Mission-Oriented Research and Innovation: The case of University of Stavanger

Dr. Utku Ali Riza Alpaydin

3.1. Introduction

The grand societal challenges, such as climate change, migration, and aging population, that we face today require new ways of thinking in various domains, which triggered a pressing need to revisit the existing policies on innovation, research, science and technology (Wanzenböck et al., 2020). Thus, the objective of these policies has shifted from focusing solely on economic growth to include also tackling societal challenges. One recent approach, with its roots dating back to the 1960s and 1970s with a heavy emphasis on technological development, in this regard is the mission-oriented innovation policies (MOIPs) (Mazzucato, 2018). The current MOIPs prioritize societal challenge-led missions, which necessitate high levels of cross-sectoral and interdisciplinary collaboration, where different sections of the society should come together to work on devising viable solutions for humanity. OECD Policy Paper (2021) provides the following definition:

MOIPs are defined as a co-ordinated package of research and innovation policy and regulatory measures tailored specifically to address well-defined objectives related to a societal challenge, in a defined timeframe. These measures possibly span different stages of the innovation cycle from research to demonstration and market deployment, mix supply-push and demand-pull instruments, and cut across various policy fields, sectors and disciplines (OECD, 2021; emphasis added).

The societal problems that MOIPs are targeting to solve necessitate not only resources, but also a broad variety of competences and capabilities distributed across a very large landscape of actors, organizations, sectors and geographies. Sustainable solutions to these global problems can be developed by drawing on unique competences and pooling them through joint initiatives. However, ensuring collaboration for such initiatives is a daunting, yet manageable task. The interactions between universities, public organizations, private sector, and other civil society organizations are critical and need to be enhanced.

In the mission-oriented innovation systems and policies, universities and other HEIs play an institutional role mainly through the education of the workforce (Hekkert et al., 2020). However, and maybe more importantly, universities conduct cutting-edge research activities, which carry the potential to be further developed and used in various technological solutions. As OECD definition suggests, the innovation cycle for MOIPs starts with research at the laboratories and ends with the successful launch of technologies in the market. Therefore, with highly qualified researchers that possess expertise knowledge and relevant infrastructures that allow R&D, universities are one of the central actors of MOIPs.

Universities' role in MOIPs is not only limited to the provision of R&D services. Universities also stimulate the involvement of other relevant organizations not traditionally seen parts of R&D&I systems and activate them to be part of the solutions developed through various ways (Jansen et al., 2021). This role stems from the challenge-based approach underpinning the MOIPs. In this approach, relevant stakeholders are involved from the

beginning of the process. They take part in the definition of the problems targeted by the missions, and they become part of the solution by actively engaging in the research and solution development phases. The co-creation process involving multiple actors, sectors and organizations ensures that the aspirations and needs of the society are reflected in the challenges, technological solutions developed and the resulting innovation. Universities are well-equipped to apply such an approach specifically thanks to linkages with major parts of the society. Apart from their role as "neutral brokers" (Vallance et al., 2019) in collaborative activities, universities take part in regional networks and forums, establishing the necessary channels for realizing effective cross-sectoral collaborations. Additionally, the increasing utilization of challenge-based learning (CBL) in teaching practices at universities presents the opportunity for universities to play a significant role in MOIPs.

The rest of the study will examine how mission-oriented approach manifests itself at the University of Stavanger, Norway. The following section will focus on the mission-oriented research conducted at UiS by exploring the university mission-vision, the existing mission-oriented research structure and the support structure to facilitate the deepening of mission-oriented research activities. In the third section, the multi-stakeholder co-creation approach at UiS will be described by focusing on the educational offers and extra-curricular activities based on the challenge-based learning methodology.

3.2. Mission-oriented research at UiS

UiS mission and vision

UiS Strategy for 2030, established around the guiding principle of green transition, states three areas of priority: (1) energy, (2) health and welfare, and (3) learning for life. Two strategic ambitions support the overall strategy: (1) a good learning and working environment and (2) an open university. When examined in detail, it can be seen that UiS Strategy is aligned with the mission-oriented research and innovation agenda. By making "green transition" central, UiS puts its ambition to help solve major societal challenges by working collectively with external stakeholders. The strategy emphasizes that research directly related to sustainable development will be prioritized. UiS also aims to be a leader in challenge-based education and research where interdisciplinarity and cross-sectoral collaborations among diverse societal actors will be encouraged.

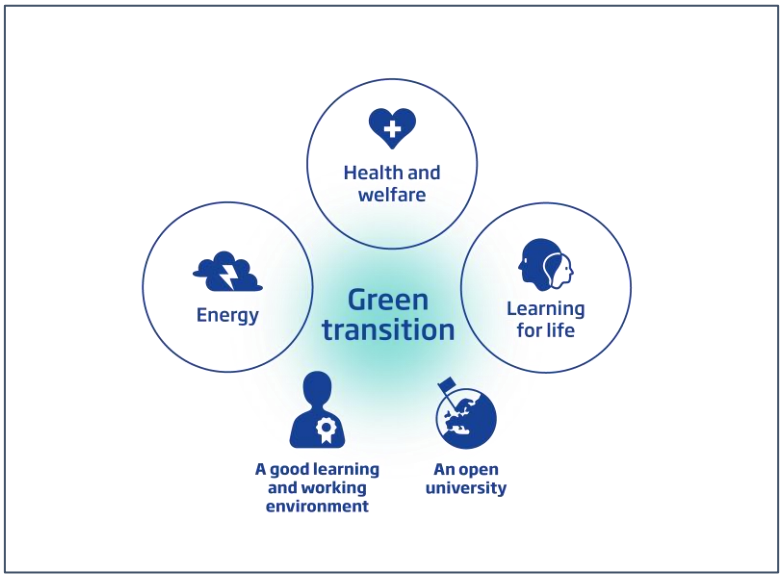

Figure 1. UiS Strategy for 2030

3.2. Relevant research centers/groups/projects

In line with the strategic approach that UiS adopts, there exist several initiatives that are directly related to mission-oriented research and innovation. The initiatives presented below are illustrative of how mission-oriented research and innovation is structured at UiS. However, UiS' engagement with mission-oriented research and innovation is not exclusively limited to the examples provided and covers many other research centers/groups and projects not mentioned here.

3.2.1 Ocean Technology Innovation Cluster Stavanger (OTICS)

With the goal of establishing UiS as one of the leading research institutions in Ocean Technology, OTICS is a research cluster focusing on the Mission Ocean. OTICS research areas cover Aquaculture Technology, Offshore and Subsea Technology, Offshore Wind and Fjord Crossings. OTICS researchers have deep collaboration with the external stakeholders, develop and implement several projects. Two examples illustrate how OTICS researchers contribute to the mission-oriented research activities. The first one is the Sustainable Aquaculture1 project funded by the Green Platform Initiative of the Research Council of Norway with a budget of approximately 10 million Euros. The project aims to use the vast expertise from the oil industry in order to improve fish welfare and decrease the climate footprint of offshore aquaculture industry through the whole value chain.

Recently, researchers affiliated with OTICS were able to secure funding for the establishment of "Center for Aquaculture Technology" at UiS. The objective of the project is to create a joint center for competence building and innovation within green value chains in aquaculture for business, the public sector and the research and education sector, with a focus on sustainable growth in value creation through reduction of the climate and environmental footprint at all stages.

OTICS affiliated researchers are heavily involved in the regional industrial clusters of Norwegian Offshore Wind and Stiim Aqua Cluster for Aquaculture illustrating their engagement with the major actors in the respective ecosystems.

3.2.2 Smart Sustainable Cities Research Network / Future Energy Hub

Smart Sustainable Cities Research Network is an interdisciplinary research network for smart sustainable urban development covering eight thematic research areas: Education and knowledge, Arts and culture, Safety, Climate and sustainability, Mobility and transport, Democracy and participation, Innovation and entrepreneurship, Data and telecommunications. As described in its title, the activities of this network are totally aligned with the Mission: Climate-Neutral and Smart Cities. The research conducted by researchers affiliated with

[1] https://www.uis.no/en/sustainability/100-million-for-a-more-climate-friendly-aquaculture-industry

this network also contributes to a great extent to Mission: Adaptation to Climate Change.

Future Energy Hub is a project and a co-creation arena run by the Smart Sustainable Cities Research Network with the objective of creating greener urban areas. It hosts an energy laboratory where new technologies are developed and tested in distributed renewable energy and energy efficiency in research projects conducted in collaboration with industry and other related stakeholders.

Smart Sustainable Cities Research Network and Future Energy Hub collaborates strongly with the Nordic Edge Cluster for smart and sustainable cities.

3.2.3 Sustainability and Circular Economy Research Cluster (ScERC)

Sustainability and Circular Economy Research Cluster (ScERC) is another initiative established in UiS in line with the goal of contributing to several EU Missions such as Mission Soil and Mission: Climate-Neutral and Smart Cities. ScERC largely focuses on the circular economy aspects of various eco-friendly technologies with sustainability context. It brings together researchers from the following research areas: resource recovery, bioenergy production and biomass valorization, carbon capture (biological and chemical), antimicrobial resistance in environment, sustainable green chemistry and sustainable assessments.

3.2.4 Centre for Resilience in Healthcare (SHARE) and HelseCampus Stavanger

SHARE – Centre for Resilience in Healthcare forms the largest research group studying quality and safety in healthcare in Norway. It is multidisciplinary in nature and comprises of around 80 researchers and practitioners. It has extensive links with relevant external stakeholders such as hospitals, municipalities and industry illustrating SHARE's cross-sectoral framework.

As a project affiliated with SHARE, Breast Cancer School project is a great example of mission-oriented research conducted at UiS. It has enhanced breast cancer survivors' quality of life based on patient participation and interaction with experts and peers.

HelseCampus Stavanger (Health Campus in English) is another initiative showcasing mission-oriented research at UiS serving as a co-creation platform for the healthcare sector in the region. It has strong links with the regional industrial cluster on health.

Both SHARE and HelseCampus have strong links with the Norwegian Smart Care Cluster.

Figure 2. Relevant Research Infrastructure linked to EU Missions

3.3 Mission-oriented research support at UiS

Mission-oriented research at UiS is significantly supported by the central administration. The organizational body responsible for this support is the External Funding Team. External Funding Team, hereafter EFT, is composed of seven (7) experienced advisers from two interrelated units: (1) Department of Research working under the Division for Research and (2) Department of Innovation and External Collaboration working under the Division for Innovation and Societal Engagement (See Figure 3 for the place of EFT within UiS organizational structure).

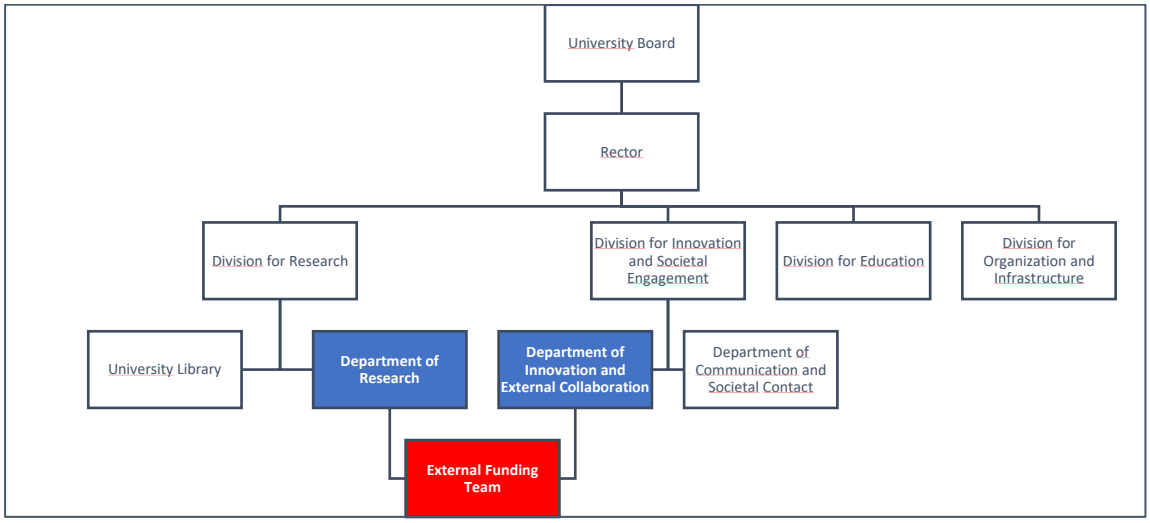

Figure 3. External Funding Team at UiS Organizational Chart

External Funding Team is mainly responsible for helping researchers to apply for research funding to regional, national, and international funds. They organize trainings, workshops and seminars on various topics related to proposal development and grant application. After the announcement of EU

Missions, the internal structure of EFT has been re-organized in order to reflect the mission-oriented approach. Therefore, advisers in EFT are placed along 5 missions as a matrix diagram. Each mission is taken up by at least 3 advisers. The objective of this restructuring is to mobilize the researchers to apply for EU funding, first and foremost to the calls under EU Missions and other funding opportunities under Horizon Europe Pillar II.

- Oceans: Ocean technology, aquaculture, energy, zero pollution, offshore wind (digitalization and security as horizontal areas)
- Climate Adaptation and Climate Neutrality
- Soil and food (covering circular economy)
- Health and welfare
- Culture and creativity

In line with the re-structuring towards mission-oriented research support structure, EFT has initially contacted relevant research groups and individual researchers who can take on the initiative in the respective fields. In addition, relevant external partners, such as industrial clusters, municipalities and public organizations, are identified and consulted. Several workshops and meetings have been organized to create a workplan for mobilization. EU positioning coordinators, working to mobilize researchers for EU funding located at each faculty, have been consulted for initiatives.

A certain amount of budget has been set aside by the university central administration in order to facilitate the process of mobilization around societal challenges to create multidisciplinary teams across various faculties. The budget can be used for different purposes. It can cover the costs for workshops and other co-creation activities with external stakeholders. It can be used for travel expenses allowing short visits for networking and meeting with potential consortium members in other countries. The main criteria to receive support is that the researchers should already aim at a certain societal challenge and indicate a possible relevant Horizon Europe call that they target to apply. Funding requests of researchers have been collected to allocate this support. After handling of the requests, several researchers were granted financial support for the realization of a series of events and activities.

3.4. Mission-oriented co-creation approach across UiS educational offers

Apart from the research support system established at UiS to enhance mission-oriented research activities, there are several other initiatives take that co-creation as their starting point for the mission-oriented approach. These initiatives include both curricular courses and extra-curricular activities, such as hackathons.

3.4.1. InGenious Program

At UiS, the mission-oriented approach within education manifests itself with the InGenious program, which is a challenge-based program for multidisciplinary student teams to solve challenges provided by external

stakeholders. It has been practiced for a couple of years as elective master's courses at the UiS Business School. From 2022/2023 academic year, the number of courses has reached to 5 (In total, three courses at Business school and two courses at the Faculty of Science and Technology). The list of courses offered by UiS is provided below in Table 1.

Table 1. Courses offered by InGenious program at UiS

	Course (Code)	Case Topics	Faculty	ECTS
1	Green Transition (IND 570 _1)	- Technical-economic analyses necessary to facilitate the green transition - Focus on renewable energy adoption and greenhouse gas reduction measures	Science and Technology	10
2	Digital Marketing (MØA109_1)	- How to promote your "green product" by social media, paid search marketing, display ad and digital strategy	UiS Business School	10
3	Sustainable Resource Recovery (MLJ660)	- Circular economy and its execution - Waste management	Science and Technology	10
4	Knowledge-based entrepreneurship (MSB415)	- Develop a sustainable business model - Business plan	UiS Business School	10
5	Business development and innovation: The firm perspective (MSB416)	- Strategies for innovation management - Develop solutions for international marketing - Increased productivity	UiS Business School	10

The process of challenge co-creation for InGenious courses is described in Figure 4. Initially, external partners are informed about the program through different channels – university social accounts, meetings, personal contacts, etc., – during June to August for fall semester and during October to December for spring semester. In the first stage, they should submit the challenge/case in the UiS Collaboration Portal (Samarbeidsportalen). Collaboration portal is a virtual interface designed to facilitate the interaction of external actors with UiS system (students, academics). Here, QH actors can upload their challenges to be addressed by UiS, which can be taken up either as a student project (Bachelor and Masters), InGenious program or as a research project.

The second step involves the "Science-Industry Talks", in which representatives from challenge providers meet up with the course teacher /coordinators and the InGenious program coordinator to specify the challenge at a suitable format for student take up. In the third step, speed dating sessions between the students and the industrial partners are organized. The main objective of these sessions is to make people familiarize themselves with the other parties, so that students can have a better overview of the challenges and the challenge providers while

deciding on the cases they would like to undertake. Students send application (CV, motivation letter and grades) and they will be selected based on educational background, grades and diversity of the team. Step 4 contains the seminars held by the course leaders (normal lecture sessions), and program coordinator (on different topics ranging from design thinking, sustainable SWOT analysis, business modelling and pitching techniques), visits to the case providers' facilities, workshops, and mentoring sessions with case providers. In this step, interdisciplinary student groups continue to work on the challenges by collecting detailed information about the case, company and start developing their recommendations. InGenious program provides all necessary tools to support students during the semester to have better overview on challenge and apply theory into practice. The courses finish with a final seminar where all student groups present their ideas about the challenges, their approach and recommendation they offer for the challenge providers in 5-10 minutes pitch talks. The student presentations are evaluated by a jury based on four criteria: Viability; Excellence; Sustainability and impact; and Presentation. The best student project receives an award together with the chance of continuing to develop their suggested solution with the case provider company.

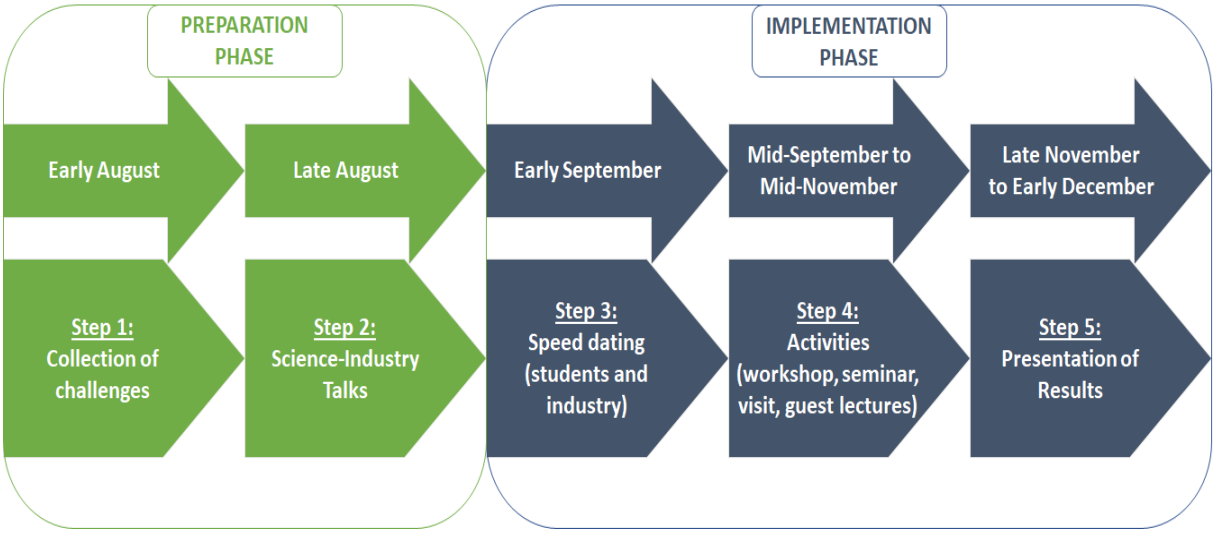

Figure 4. UiS InGenious Workflow for the 2022/2023 fall semester

3.4.2. Extra-curricular activities

The second way in which UiS is involved in co-creation in line with mission-oriented approach is through the organization several innovation challenge activities – such as hackathons – for students in collaboration with external challenge providers. In these activities, students try to solve a specific challenge within a domain in a limited amount of time, generally within 1-2 days since they are mainly held at the weekends.

The process of identifying potential challenge providers is guided by the choice of thematic challenge areas for the related Hackathon. In the case of the Open

Data Hackathon described in Table 2, public service providers such as Kolumbus, Stavanger municipality, were identified as having a key interest in the applications of Open Data for its citizens and were contacted.

The number of challenge providers have been between 3 and 5, with 3-4 being the number that has provided the best balance between enough challenges and having at least one team for each provider. After having identified potential challenge providers, the UiS typically has regular meetings to narrow down or expand the challenges to facilitate an open creative process. Preparations for the challenge presentations (ppt) during the first day of the event, are done by the challenge providers, but the UiS can assist should it be necessary. The participants are not given mentoring sessions or the opportunity to discuss the challenges with the providers before the event. They are available at certain time slots (approx. 3 hours) on day 2 and are encouraged to be available over e-mail through the weekend, though this is not mandatory or done by every challenge provider.

Firms are welcome to contact Hackathon teams after the event, should some of these projects be of interest. There have been several instances of firms and public service providers having meetings with Hackathon teams afterwards to discuss potential implementations of their concept. These meetings include elements like commercialization, mentoring, and potential for extended collaboration with the challenge providers.

Table 2. Innovation Challenge Activities organized by UiS between 2021-2023

	Event	Challenges	Collaborators / Challenge Providers	Dates
1	Sustainable Future Health Hackathon	- New and sustainable ideas for health in society.	- The Norwegian National Network for Responsible Innovation (AFINO) - NTNU	3 May 2023
2	Open Data Hackathon	- Effective use of open data in the face of challenges related to growth and sustainability.	- Stavanger municipality - Stavanger AI Lab - Nordic Edge Smart City Cluster - Research Network for Smart Sustainable Cities - Future Energy Hub - Start UiS	18-20 March 2022

3	Microsoft Hackathon	- Prevent and reduce digital footprint.	- Microsoft - Student organisation LED	20-21 October 2021
4	Future Energy and Autonomy Hack	- More sustainable solutions for the operation of data centers, considering the waste heat that such centers produce. - Reduce car use to UiS Campus, to use alternative means of transport that produce less emissions. - Better algorithms to interpret the drone images of important infrastructure far from people, such as power lines in the mountains.	- Lyse, the electricity company - Kolumbus AS, the transportation company - KVS Technologies	2-3 October 2021
5	Health Hackathon	- Societal challenges related to mental and physical health.	- Bouvet - Stavanger Municipality - Stavanger Tourist Association - Competence Center for Drug Research (KORFOR) at Stavanger University Hospital - SiS Sports Center - Student Organization at UiS	27-28 April 2021

3.5. Conclusion

This study has explored how mission-oriented research and innovation approach is operationalized and practiced at the University of Stavanger, Norway.

For universities to play an effective role in the mission-oriented research and innovation approach, there should be a clear direction at the central management level which is manifested through the vision, mission and strategy of the universities. At UiS, this is mainly achieved through Strategy for 2030 of which priority areas and strategic ambitions are built around the mission-oriented approach. The central theme of green transition and the priority areas of energy, health and welfare and learning for life connect well with several missions of the EU.

Universities' engagement with the mission-oriented research and innovation approach stems from their natural role in driving research activities. The organization of research centers, clusters, groups and projects within UiS along the lines of several EU missions illustrates a good example for how mission-oriented research can be organized internally within a university. The wide range of research centers and clusters covering several EU missions (oceans, climate neutrality, soil, cancer) contributes directly to the efforts towards solving societal challenges that missions target to eradicate. The linkages of the researchers ensure the participation of relevant stakeholders from different parts of the society envisioned in the mission-oriented approach.

UiS also actively supports mission-oriented research through various initiatives organized by External Funding Teams (EFT), trying to mobilize UiS researchers to conduct research on EU missions and to submit research grant proposals to various funding agencies. The internal restructuring of the EFT and small-scale internal grants provided to mission-oriented research groups and individual researchers illustrate the importance attached to stimulating mission-oriented research at UiS.

Universities can also contribute to missions through education and training activities. At UiS, this is exemplified by several curricular challenge-based courses and extra-curricular activities that take co-creation as their point of departure. InGenious program through the courses on different topics focuses on real-life challenges experienced by external stakeholders and channels these problems to be taken up by multidisciplinary student groups. In this way, it creates a feedback loop between the challenges and possible solutions in line with the mission-oriented approach. InGenious program obviously shows how the university curricula can be aligned with mission-oriented approach. And the courses on "Sustainable Resource Recovery" and "Green Transition" are great examples in this manner.

To summarize, universities can act as a neutral gathering point around which all relevant stakeholders can come together to work for finding sustainable solutions to the wicked problems of our society. They can connect the dots and play the role of a central node in the regional R&I ecosystems by mobilizing effective interdisciplinary and cross-sectoral collaborations. Universities can successfully fulfill the missions depicted for them in the mission-oriented research and innovation approach.

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Part 2: Strategies and Synergies in Climate-Neutral and Smart City Initiatives

Part 2 of this sourcebook, titled "Strategies and Synergies in Climate-Neutral and Smart City Initiatives," delves into the multifaceted approaches and collaborative efforts essential for fostering sustainable urban futures. This section not only showcases innovative practices and strategic frameworks but also highlights the pivotal role of academia in spearheading transformative projects and partnerships. The chapters in this part provide a comprehensive exploration of challenge-based research, strategic planning, and the synthesis of knowledge, all aimed at empowering stakeholders to navigate and contribute effectively to climate-neutral and smart city missions.

Chapter 4, "Experience with Challenge-Based and Mission-Driven Research and Innovation at the University of Stavanger," offers an in-depth analysis of the university's pioneering approaches to integrating research and education. This chapter presents case studies and reflections on the methodologies and outcomes of challenge-based learning, emphasizing its impact on fostering innovative thinking and problem-solving skills among students and researchers.

Chapter 5, "Working in an International Challenge-Based Research Project – The Case of Greencoin," narrates the journey of a cross-border research initiative focused on sustainable urban development. This chapter provides valuable insights into the complexities of international collaboration, project management, and the practical challenges and successes encountered by the Greencoin project team.

Chapter 6, "A Strategic Framework for HE Proposals: Navigating Climate-Neutral and Smart Cities Missions," serves as a guide for higher education institutions aiming to contribute effectively to climate-neutral and smart city missions. This chapter outlines a strategic framework for developing proposals, securing funding, and implementing projects that align with the overarching goals of sustainability and urban innovation.

Chapter 7, "Roadmap for Cooperation between European Universities and External Stakeholders," emphasizes the importance of building strong partnerships between academia and external entities, including industry, government, and community organizations. This chapter provides a roadmap for establishing and nurturing these collaborations, ensuring that the collective expertise and resources are leveraged to drive impactful urban transformations.

Chapter 8, "Synthesis and Pathways Forward: Empowering Academia in Shaping Sustainable, Smart Urban Futures," concludes Part 2 by synthesizing the insights and lessons learned from the preceding chapters. This chapter not only reflects on the current state of climate-neutral and smart city initiatives but also charts a course for future actions. It underscores the critical role of

academia in leading the charge towards sustainable urban development, advocating for a continued commitment to innovation, interdisciplinary collaboration, and community engagement.

Through these chapters, Part 2 of the sourcebook presents a cohesive narrative that underscores the significance of strategic, collaborative, and innovative approaches in realizing the vision of sustainable, smart urban futures. It serves as a vital resource for academics, researchers, practitioners, and policymakers striving to make meaningful contributions to the field of climate-neutral and smart cities.

Chapter 4: Experience with challenge-based and mission-driven research and innovation at the University of Stavanger

Assoc. Prof. Anders Riel Müller

This chapter is a reflection of my work as project lead for the Research Network for Smart Sustainable Cities at the University of Stavanger (UiS) since 2019. I was hired externally and had very little knowledge of the region when I began my work. The chapter is thus conceived as a critical reflection on my experiences from the past four years, on how to create a challenge-based and mission-oriented collaboration between academia and the private and public sectors. It is thus also part auto-biographical reflections on being an embedded and implicated actor in developing and strengthening inter-sectoral collaboration and intra-institutional trans-disciplinary research.

The University of Stavanger is located on the south-western coast of Norway in the Greater Stavanger Metropolitan region (henceforth Stavanger). Stavanger is the centre of Norwegian oil and gas activities in the North Sea and one of the wealthiest regions in Norway and Europe. The University of Stavanger is a relatively young institution that gained university status in 2004. The university is also the result of the merger of various, mainly vocationally oriented, higher education institutions in the region. Thus, the university has historically been closely associated with meeting the needs of industry and public sector in what became the fast-growing urban agglomeration in Norway since oil and gas as found in the North Sea in the 1960s. The engineering school (Now Faculty of Technical and Natural University) that was established to support the fledgling oil and gas sector remains a very important part of the university, but the university also has

significant activities in health sciences, education, social sciences and the humanities. Thus one can argue that the university has been responding to regional needs since its founding.

The focus on challenge-based research is very much the outcome of the university being a member of the European Consortium of Innovative Universities (ECIU). ECIU has been an important driver for promoting challenge-based education and research among its members and at the European level. In 2019 ECIU was granted funding to establish one of the first European Universities funded by the Erasmus+ programme based on challenge-based education. In 2020, ECIU received an additional grant from the EU Horizon2020 programme to launch the ECIU Smart European Regions Research Institute (SMART-ER). SMART-ER is a project that seeks to develop an ECIU-wide research institute that focuses on challenge-based research. Both the ECIU University and SMART-ER are working towards the UN Sustainable Development Goal 11 – Sustainable Cities and Communities.

The challenge-based approach fits neatly with the EU's new initiative on mission-oriented research and innovation agenda of the European Commission (Mazzucato 2018). With this new approach, the EU further emphasized the alignment of research and innovation policy and funding with what the EU has identified as the pressing global challenges of our time. The mission-oriented approach draws heavy inspiration from World War 2 and Cold War research and innovation policies in which public funds are directed towards providing solutions to grand societal challenges. It is of course important to note that directing funding towards grand societal challenges is not new in itself. The Horizon2020 programme did similarly through for

example the EU Smart Cities Lighthouse projects that sought to accelerate research, innovation, and adaptation of smart city solutions across Europe.

The reason for mentioning these various ECIU and EU programmes is because the region of Stavanger and the university have been greatly involved in responding to these European level policies. In 2015, the City of Stavanger, together with Eindhoeven in the Netherlands and Manchester in the UK, was awarded funding in the first round of EU Smart City Lighthouse projects. The Triangulum project was granted 25 million Euros from the Horizon 2020. For the city of Stavanger, this project was a first experience with large-scale and ambitious EU Research and Innovation projects. The University of Stavanger had a minor role in the project developing data monitoring and management solutions across the three cities. Despite a limited role in the project for the University, Triangulum led the university to try to organize research strategically towards grand challenges.

In 2018 the university decided to support strategic *research networks* at the university. Initially these networks were intended to strengthen the university's ability to draw in external funding from the national and EU levels in the context of a shifting funding landscape. Both the Research Council of Norway and the EU was shifting funding towards societal grand challenges and emphasizing greater collaboration across sectors. With only marginal success in obtaining prestigious research grants from research excellence funds (e.g., ERC and the Norwegian FRIPRO programme), these new opportunities related to more applied research and innovation activities were the target of the university's management. A research network at UiS is characterized by being 1. cross-disciplinary, i.e. involving researchers from

different disciplines, 2. cross-sectoral, i.e. involving external actors from civil society and/or the public and private sectors and 3. Oriented towards increasing research funding from the Research Council of Norway and the EU Horizon programme.

4.1. The Research Network for Smart Sustainable Cities

Following requests from regional industry and the public sector, the University of Stavanger established the Research Network for Smart Sustainable Cities in 2019. Four different faculties at the university also provided funding. The regional foundation *Universitetsfondet* (The University Fund) also granted 3 million NOK to the network for a total budget of 6 million NOK over a three-year period. The budget allowed for the hiring of a full-time project manager and a part-time administrative coordinator. The remaining funds were intended to foster greater inter-faculty collaboration and closer collaboration with regional stakeholders to attract further funding towards challenges related to SDG 11. Two regional collaborations were seen as particularly strategic. As a spin-off of the Triangulum project, Stavanger began to organize a smart city conference and Expo, Nordic Edge Expo. The Expo is organized by the Non-profit Nordic Edge that was established in 2016 to run the Expo and to support the emerging smart-city industry in the city. In 2017, the company received funding from Innovation Norway to establish a smart city industry cluster in Stavanger. That same year, the City of Stavanger established its own Smart City office that was to spearhead testing and evaluation of smart city tech that could improve municipal services and functions.

The Research network at UiS thus provided the third piece of a triple helix constellation (Etzkowitz 2008). The network was governed by a steering

group consisting of representatives from Nordic Edge, Smart City Stavanger, the non-profit association Grønn By, and four representatives from faculty and central leadership at UiS. The mandate was quite clear from the onset. Strengthen collaboration across sectors, mobilise researchers at UiS to get engaged in network activities and increase the number of external funding applications. To make the network as relevant and appealing as possible, the central research department announced six fully funded smart city PhD scholarships. These were allocated on a competitive basis to different faculties with requirements that the selected PhD projects were regionally relevant and interdisciplinary. By Mid-2019, the project manager had been hired and the recruitment of PhDs were in full swing.

The first six months were mainly spent on welcoming incoming PhD students, get better acquainted with researchers at the different faculties and the external stakeholders. The strategy and key performance indicators also began to take shape during this period. First and foremost, the network needed to strategically align research activities with the complex challenges defined by regional public and private sectors. Thus, the network had to be more responsive to societal needs than conventional research at the university. Secondly, the network should mobilise both researchers and regional stakeholders to apply for research and innovation funds externally. To achieve these two overarching targets, four strategic priorities were identified:

- Increase the active participation of UiS researchers in the network and encourage interdisciplinary collaboration to build an attractive research environment.
- Close dialogue and collaboration with key regional stakeholders.

- Build up a strategic project portfolio and develop professional project development and grant writing support.
- Strengthen international networks that enable UiS to position researchers for upcoming European funding calls.

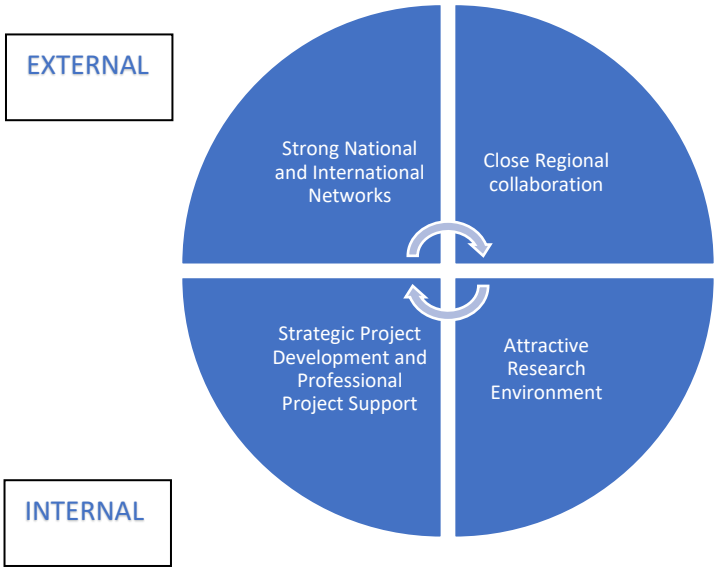

Figure3.1. Four strategic priority areas. Author's own illustration.

For each strategic priority area key performance indicators were developed to monitor if there was progress. It is important to note here that KPIs were subject to review every year and changes were made as the network developed. The strategic priorities however remained the same for the project duration. Thus, to summarize the Research Network for Smart Sustainable Cities came into life to respond to calls from the public and private sectors in Stavanger to support the efforts to make Stavanger a leader in smart sustainable urban development.

Although there was a regional triple helix constellation of regional industries, public sectors and academia, it has not been a straightforward task to strengthen collaboration and partnerships towards SDG 11. The three

sectors operate with different institutionalized logics and practices. This was further complicated buy the fact that the smart city initiative in Stavanger had dual aims of creating new export-oriented industries as well as providing better city services. These aims were envisioned as being mutually reinforcing, but in practice this was not always the case. One hand public government had concrete challenges they wanted solutions to, but they did not always match the interests of industries. Furthermore, as noted before, the three sectors do not operate according to the same logics and practices. The major differences can be seen in the temporal dimensions of operations as well as in requirements for validation.

For example, whereas researchers often operate on a mid- to long-term time horizon, both industry and public sector tended to focus on challenges in the short- to mid-term. Companies have products and services they want out on the market as soon as possible and cities have pressing problems they need to address. On the other hand, researchers tend to work with a longer multi-year horizon. Secondly, the city is weary of investing in unvalidated products and solutions since the first priority is delivering stable and reliable city services. Thirdly, researchers are rarely rewarded for external collaboration that does not lead to publications and thus have to be highly motivated to engage in collaboration that has an uncertain research output. The biggest challenge however, was to align the interests of all three sectors towards a common goal.

It would be hard to argue that all key stakeholders ever agreed to a single common goal, but there was agreement that getting familiar with each other and sustain continuous dialogue was important. As a result, the head of

the smart city office in Stavanger organized a weekly meeting that included municipalities and representatives from the Nordic Edge Smart City Cluster as well as the university. One key aspect of these meetings was an insistence from the head of the Stavanger Smart City to having meetings without a set agenda. This was not well received by all participants, but in hindsight these meetings were extremely important in identifying mutual challenges and getting to know how the other sectors operated. It was through these unstructured meetings that challenges were identified and ideas for new projects matured. Thus, the highly informal nature of these meetings was a breeding ground for finding mutual interests. One could perhaps argue that this seemed as not very strategic in nature, but building social relations of trust between stakeholders has proven extremely important for the development of future collaborations and it shows the value of allocating and prioritizing spaces to meet that are not too structured.

There was from the beginning an overall agreement that the city had to define the needs or companies could propose solutions to societal needs. This, however, does not always easily translate into challenge-based research. The key aspect of challenge-based research is that actors from across sectors come together to respond to *real-life* challenges (van Urk m.fl. 2022). Not all real-life challenges are however fit with research. First of all, a proper research question needs to be developed. If the challenge proposed by the public or private sector is too concrete and the time horizon too short, most researchers will not be able to find a suitable research idea. Furthermore, some in the social sciences and the humanities are more interested in following the projects as they unfold studying processes. This can provide valuable insights

into what makes a project fail or succeed, but we have encountered multiple occasions where this has been met with resistance from public and private sectors who are concerned or afraid of how they will be represented and therefore building trust as mentioned earlier is particularly important for this kind of research.

In short, challenge-based research requires alignment across sectors as illustrated in Figure 2. It is not merely about identifying real-life needs, but to identify real-life needs that needs scientific knowledge.

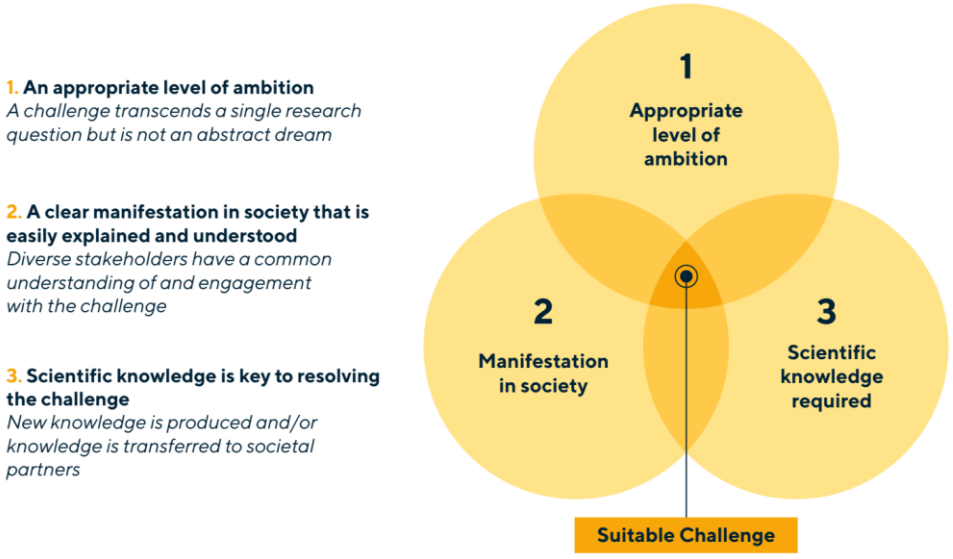

Figure 3.2. Characteristics of suitable challenges for research. Adapted from "Challenge-Based Research for a Stronger and More Sustainable Europe" by F. van Urk, M. van Steen, A. Brose, M. Schofield, J. Axelsson, G. Hughes, E. McGrath, & X. Ariño Vila, 2022, Brussels: European Consortium of Innovative Universities (ECIU).

This is an ongoing task that requires continuous dialogue and discussion across sectors. We as researchers have to be better at responding to real-life problems, but the private and public sectors also need to become better at identifying challenges that are suitable for research. Such as process of alignment is anything but simple. It requires allocation of time and resources to develop and most importantly of all, it requires all stakeholders to

understand when and where a challenge is suitable for cross-sectoral collaboration.

4.2. From challenge-based to mission-oriented research

Shifting from challenge-based research to mission-oriented research in our experience is mainly about a shift in scale and complexity. A mission, in the EU interpretation, starts not from the individual challenge, but rather from the mission goal. When the mission goal has been set, a process of *back-casting* occurs in which sub-missions are identified and underneath these sub-missions, a number of challenges can be identified complete the sub- and main mission. In short, one needs to work from the grand societal mission into addressing its constituent parts. In 2021, The City of Stavanger announced that it intended to apply to become part of the upcoming EU Mission on 100 Climate Neutral and Smart Cities by 2030. Initially, the work to prepare for the mission candidacy was headed by a different municipal department than the city's smart city office, but it drew heavily on the regional networks and relations developed between the municipality, industry and university.

Discussions around how to mobilize and organize regional stakeholders for the climate-neutral cities mission began between the municipality and the university. Following several meetings, it was proposed to form a regional secretariat and task force headed by the City of Stavanger, but with members from the major stakeholders in the region including the public waste company, the publicly owned utility company, industry associations, etc. The task force would set up challenges that would contribute to climate neutrality by 2030 and coordinate activities and collaboration. The initial ideas was to develop a portfolio of sub-missions (eg. Transport and

mobility, building renovation, green infrastructure, etc.) and then define key challenges within each sub-mission. Finally, the task force would be in charge of mobilising and developing regional consortia that would be able to take part in Horizon Europe mission calls and other relevant research and innovation calls that would enable or accelerate the progress towards achieving each sub-mission.

Stavanger was selected as one of 112 mission cities in the spring of 2022. The task force is not yet in operation as the city is working on the climate contract to the EU that provides the foundation for future activities. It has been agreed, that once the climate contract has been approved the task force will begin its work. At this time, this will most likely happen in 2024. It is thus pre-mature to assess whether this approach is appropriate, but it shows how years of work across sectors has enabled the region to position and mobilise for what the EU terms grand societal challenges.

One concrete major outcome came already in 2022 when Stavanger was chosen as one of six New European Bauhaus lighthouse demonstrator projects in early 2022. The New European Bauhaus is an EU initiative that seeks to address the cultural and aesthetic dimensions of reaching climate neutrality by 2030. The New European Bauhaus Stavanger (NEB-STAR) is a three-year 5 million ER project in which Stavanger will seek to demonstrate how the transition to climate-neutrality can be sustainable, beautiful and inclusive. Operating in two districts in Stavanger, the project seeks to leverage culture and inclusivity achieving climate neutral urban transformation. The project also includes the cities of Utrecht in the Netherlands and Prague in Czechia as sites for learning transfer. Whereas the project is still in an early

phase, it shows how the city, industry and academia have been able to mobilize fast for mission-oriented calls.

In 2023, the county of Rogaland, the region where Stavanger is the main city announced that it was chosen for the mission on climate adaptation. Here the university has also decided to play an important tole as knowledge partner. As with the mission on Climate-Neutral and Smart Cities it shows that regional actors are becoming better and better at broad-based mobilization towards EU missions that align with regional strategic priorities. It has required extensive and continuous engagement across sectors and whether or not it will achieve the mission goals of the EU remains to be seen - only time will tell. What is emerging as a general consensus is that it is time-consuming and often frustrating cross-sectoral collaboration and dialogue is essential for us to respond to the EU missions.

4.3. Conclusion

In this chapter, I have attempted to provide an account for how cross-sectoral collaboration has enabled a relatively small region in Europe to become part of two EU missions. To some extent, this may appear trivial, but I must emphasize the importance of cross-sectoral dialogue and collaboration. I also need to emphasize that although this seems quite straightforward, this is not so in practice. As I have argued earlier, the public, private and academic domains operate with different institutional logics, practices and time horizons. Finding the projects and initiatives where these align is a time-consuming process. There are still improvements to be made. From the perspective of the university, only a few researchers are directly involved in the two missions as we speak. How to get more researchers engaged and involved requires us to

address how researchers are rewarded for stakeholder engagement. As long as publications is the prime method of measuring research performance, only the most dedicated researchers will be willing to spend the time it takes to engage with external stakeholders.

There are still many obstacles that need to be overcome for this cross-sectoral collaboration needed for mission-oriented to be successful. Private industry and the public sector still have to learn to appreciate that even though research results are not directly applicable to solving concrete problems, it is however essential to addressing complex societal challenges. Similarly, researchers have show that their research is relevant and valuable to the public and private sectors. Finally, the mission-oriented research approach is not without its flaws and it remains to be seen whether it will be able to address the grand societal challenges of today and in the future. But if the EU and national funding agencies remain committed to the idea that mission-oriented research is the way forward, funding will require us to urgently mobilize and organize for this form of research approach.

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Chapter 5: Working in an international challenge-based research project – The case of Greencoin

Dr. Cristian Tosa

In a contemporary global landscape, tackling environmental concerns necessitates a holistic and collaborative approach. As top-down approaches are insufficient and sometimes ineffective, the solution consisting of a bottom-up approach can motivate, stimulate, and acknowledge favourable shifts in the behaviours of individuals. The implementation of incentive mechanisms that encourage environmentally friendly behaviours and facilitate and accompany the transition to a circular economic model represents a viable approach. This chapter outlines an innovative concept that arose from the partnership between Greencoin project partners. The two entities worked together to navigate the complex process of creating a research project proposal addressing a decentralized reward system for pro-environmental behaviour that involves the involvement of local administration and private entities.

5.1. Information on Greencoin project

Greencoin is financed by the PolNor IdeaLab (Cities for the Future: Services and Solutions) program. The Polish government's National Centre for Research and Development (NCBR) and Iceland, Liechtenstein, and Norway's EEA Funds provide €1.9 million towards the Greencoin project. How to get current and future urbanites to be green is the project's goal. The project proposes an interactive experiment in which individuals are rewarded for environmentally friendly conduct and establishes a marketplace where they can use their reward points to buy environmentally friendly goods and services. The system

recognizes green efforts in society and encourages communities to safeguard the environment by supporting and promoting environmentally friendly habits. Several complementing research institutions and non-governmental groups collaborated in this initiative. Oslo Metropolitan University and the University of Stavanger from Norway have joined Gdansk University of Technology, Warsaw School of Economics, Maria Grzegorzewska University, and the Polish non-governmental organization *Stowarzyszenie Inicjatywa Miasto* (City Initiative Association).

5.2. Greecoin project contribution to Global Challenges

Global production and consumption trends have been found to contribute significantly to a wide range of environmental issues including, but not limited to, air, water, and soil pollution, increased resource depletion, and adverse health impacts (Bleischwitz et al., 2018). Several planetary boundaries are now being exceeded due to human impacts on earth system processes, not only in terms of CO_2 emissions and climate change, but also in terms of land-use change, biodiversity loss, and chemical pollution (Hickel et al., 2022). It has been found that resource use accounts for more than 90% of the global environmental damage, with everyday common products relying on resources extracted from multiple countries (Steinmann et al., 2017). This indicates that products have significant environmental impacts throughout their life cycle, from the extraction of raw materials to final disposal (Gasper et al., 2019). Pursuing the United Nations Sustainable Development Goals on Sustainable Consumption and Production (UN, 2015) and advancing towards a more circular economy, the European Commission adopted measures on March 30, 2022, to ensure the creation and use of sustainable products (Commission and

Environment, 2022). Even so, it is argued that business interests have shifted the narrative from consumption volume to cleaner production, meaning that with sufficient innovation, consumption will cease to exert environmental pressure, and it can further expand without limit, such as the current business-as-usual (Gasper et al., 2019).

Greencoin project assumptions are laid out in Figure 1. These are Ecology – to support pro-environmental behaviour; Inclusiveness – the system is to be open and increase the accessibility to green solutions; Modernity – the system will be using digital coins using modern technologies; Universality – potential of applications across other geographical areas; Networking – the system brings together stakeholders involved in environmental and climate protection; Open Source – the software developed by the team will be open and freely available to the public (Radziszewski et al., 2021).

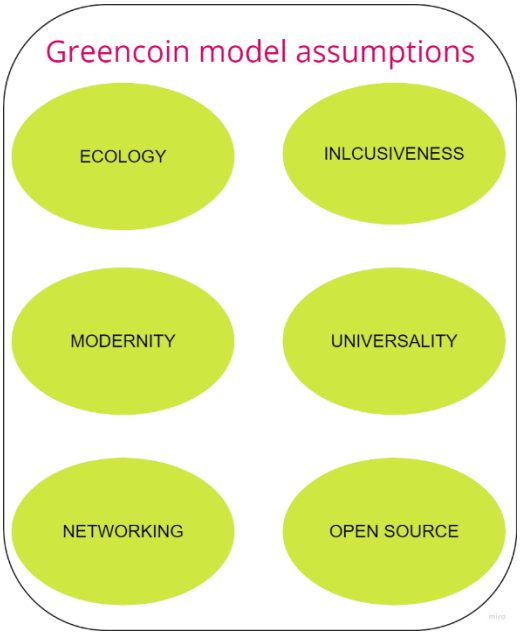

Figure 4.1. Greencoin functionalities. Author's own illustration.

The team behind the Greencoin initiative identified the problem as citizens' lack of access to green technologies and solutions, as well as the absence of behavioural change incentives. They proposed the following solution: *what if people who behave in an environmentally friendly way were given resources to spend on more green solutions, such as products, services, and technologies?* This would create a self-perpetuating mechanism to support sustainable behaviour, which is the core idea behind the Greencoin system (Radziszewski et al., 2021). The concept is represented in Figure 2.

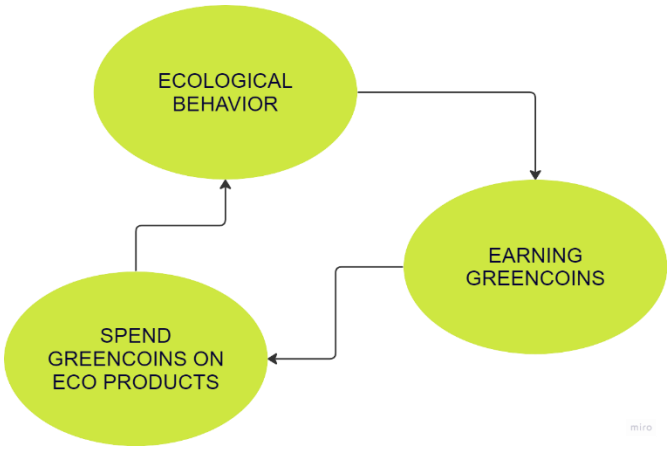

Figure 4.2. Greencoin concept. Author's own illustration.

5.3. Research approach for innovation in Climate Neutral and Smart Cities

The researchers participating in this study adhere to the operational, tactical, and strategic levels that make up mission-oriented research. The University of Stavanger, which oversees Work Package 3, as well as other related work packages in which it is a partner, includes tasks at each of the three levels that help achieve the research objectives set forth therein. The guiding principles and research objectives of the academic institution serve as a guide for researchers

at the strategic level. The guiding principles provide overarching direction for research efforts aimed at achieving goals consistent with the mission. At the tactical level, researchers are provided with an institutional framework that outlines the steps necessary to achieve specific goals within a specified time. This framework includes comprehensive timelines and instructions for completing tasks. At the operational level, researchers are given the autonomy to embark on the most appropriate path to optimize their productivity and results. Researchers integrate various activities into their broader activities, including networking, collaboration, personal development, and extensive research engagement.

The result of the collaboration between the project partners led to a comprehensive research approach. The framework is based on the interaction of *pro-environmental behaviour (PEB)*, *digital transformation (DT)*, and *circular economy (CE)*, as shown in Figure 3. This framework is intended to serve as an accelerator for the adoption of products and solutions for climate-neutral smart cities.

Adopting environmentally sustainable behaviour often requires individuals to make additional efforts such as modifying their daily routines for recycling, public transportation, or energy saving at home. People are motivated by various influences, as explained by Rogers in the theory of innovation diffusion (Rogers, 1962).

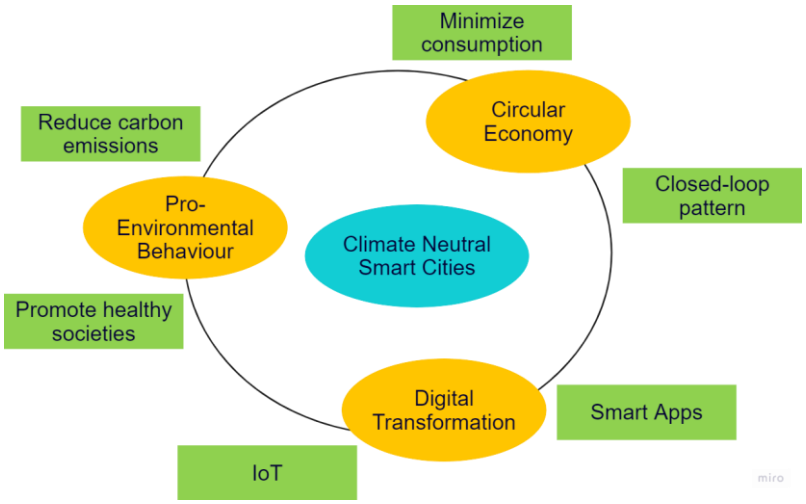

Figure 4.3. Conceptual framework. Source: WP3 team members.

Multiple adoption groups typically adopt innovations in a temporal order, with innovators and early adopters adopting the innovation first, followed by later adoption groups. Early adopters enthusiastically promote innovations, but most innovations fail to cross the separation between early and late adopters (Moore, 1991). For PEBs to be widely adopted, innovations must have tangible, concrete value and be easy to use. A key element related to innovation is the potential of DT in developing and integrating coherent policies across sectors (OECD, 2019). DT refers to the process of using digital technologies to create new or transform existing economic and social activities (OECD, 2019). Digital transformation has recently become a significant phenomenon, encompassing the profound changes taking place in society and industry through the use of digital technologies (Vial, 2019). Although digitalization has historically increased environmental impacts at local and planetary levels (Creutzig et al., 2022), CE provides a practical framework for implementing sustainable practices by promoting the efficient use of resources and minimizing waste. CE helps translate PEB into actionable strategies that reduce environmental

impacts. In this context, CE benefits from DT, as new technologies can enable more efficient resource management, waste tracking, and material reuse. Environmentally conscious behaviour is the foundation that encourages individuals and organizations to adopt sustainable practices and pave the way for a shift in thinking that prioritizes resource conservation, waste reduction, and environmental management.

5.4. Conclusions

This work offers an innovative approach to promoting pro-environmental behaviour by going beyond existing methods and developing new concepts for this mechanism. It suggests that a reward-based mechanism could be effective in adopting and encouraging pro-environmental behaviour. Future research should focus on designing and testing novel reward-based systems in a variety of settings, analysing their effectiveness, and developing best practices for their design and implementation.

At a practical level, this report highlights the benefits of integrating PEB, DT, and CE concepts into a reward-based system as a viable method for supporting sustainable practices and accelerating the transition to climate-neutral smart cities. Policymakers and practitioners can play an essential role in promoting sustainable behaviours and contributing to the global fight against climate change by carefully planning and executing these systems, considering cultural, demographic, and individual considerations.

Another impact lies in the collaborative and multidisciplinary nature of research activities. These are critical not only for addressing complicated challenges, but also for promoting sustainable behaviour and accelerating the transition to carbon-neutral smart cities. Researchers can develop and test

innovative reward systems that promote environmentally friendly behaviour by incorporating knowledge from environmental psychology, behavioural economics, information systems, and other relevant fields. It is critical to recognize and support collaboration and interdisciplinary research among academia, industry, government, and society, as they have the potential to provide significant benefits in terms of knowledge transfer, innovation, and impact, and to accelerate the adoption of sustainable practices through tailored and situationally aware reward systems.

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Chapter 6: A Strategic Framework for HE Proposals: Navigating Climate-Neutral and Smart Cities Missions

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In the face of global challenges, the European Union has set forth ambitious mission goals, particularly in the realms of climate neutrality and the development of smart cities. These goals, while visionary, require a concerted effort from various sectors, with academia playing a pivotal role. European universities, with their rich tradition of research and innovation, are uniquely positioned to drive this change, bridging the gap between theoretical knowledge and tangible societal impact.

This chapter of this sourcebook delved deep into the mission goals set within the context of climate-neutral and smart cities. It sought to provide clarity, offering a comprehensive understanding of these goals and their significance in the contemporary research landscape. But understanding is just the first step. The real challenge lies in integrating these mission goals into the diverse research areas explored by European universities. How can an institution, traditionally segmented into distinct disciplines, foster a holistic approach to such complex, interdisciplinary challenges?

To address this, we present in this chapter a theoretical example, illustrating potential pathways through which universities might embed these mission goals into their research ethos. These are not prescriptive solutions but rather conceptual frameworks, offering insights into how institutions can align their research endeavours with the EU's mission goals, especially within the Horizon Europe programme.

For young researchers aspiring to make a mark in this domain, the journey can be daunting. Beyond the intricacies of research, there's the challenge of effectively communicating one's findings, be it through publications or grant proposals. Recognizing this, this chapter of the sourcebook also offers insights and guidance on publication and grant writing, tailored specifically for research in the realm of climate change and smart cities.

However, the mission goals of the European Union cannot be achieved in isolation. Collaboration is the key as stated in chapter 2. Universities, while repositories of knowledge, need to engage with external stakeholders, from industries to civic bodies, to translate research into real-world impact. To this end, this chapter introduces a comprehensive framework. This framework, inspired by opportunities presented by European grants, charts a roadmap for fostering transdisciplinary collaborations between higher education institutions (HEIs) and external entities. It's a proactive approach, designed to equip universities to better address the multifaceted challenges posed by climate change and the quest for sustainable, smart cities.

The following framework offers a structured approach for European higher education institutions aspiring to actively participate in Horizon Europe's calls for proposals, specifically those aligned with the mission goal of climate-neutral and smart cities. While we illustrate this through the lens of a Faculty of Transportation Sciences at a European university taking a leadership role in the consortium, the framework's versatility allows for its adaptation and adoption by other faculties, both within and outside Europe. This is especially pertinent for faculties keen on addressing pressing societal

challenges like climate neutrality in the context of smart cities or climate change adaptation. Thus, this framework is not just a guide but also an inspiration for higher education institutions charting their course in research and innovation endeavors.

6.1. Example of a Call within Horizon Europe Programme related to EU Mission Goal on Climate-Neutral and Smart Cities

Title of the call: **Designing inclusive, safe, affordable and sustainable urban mobility**

Under the Horizon Europe Framework Programme, this call sought to accelerate the transition towards climate-neutral cities by promoting zero-emission, shared, active, and human-centric mobility. The initiative aimed to upscale innovative urban mobility solutions in diverse living labs across Europe, emphasizing safety, affordability, and sustainability.

Key Expected Outcomes:

- Advance the objectives of the Climate Neutral and Smart Cities Mission.
- Promote the uptake of innovative urban mobility solutions in at least four cities per project, ensuring geographic diversity.
- Implement solutions in a minimum of ten unsafe urban areas, utilizing innovative planning, design, and implementation strategies.
- Reassess public space quality to cater to diverse groups, such as women, children, the elderly, and people with disabilities.

- Address potential risks associated with increased cycling and e-scooter usage.
- Reallocate public space to different transport modes, reflecting local modal splits and supporting Vision Zero and zero-emission objectives.

Scope:

The call recognizes the multifaceted challenges Europe faces, from climate change and road safety stagnation to urbanization and air quality issues. However, it also identifies the potential of active mobility, especially walking and cycling, to address these challenges. The action supports local authorities in accelerating mobility changes, especially in the post-Covid-19 context, emphasizing the importance of allocating public space to bicycles, pedestrians, and public transport.

Projects should focus on:

- Collecting data on vulnerable road users.
- Identifying specific mobility and public space redesign needs.
- Providing guidance on infrastructure planning, emphasizing safety, security, accessibility, and digital tools.
- Collaborating with platforms like the SUMP coordination platform and ELTIS.
- Evaluating the effectiveness of local solutions in achieving policy objectives.

Mission Context:

This call is part of the Horizon Europe Work Programme 2021-2022, dedicated to the Climate-Neutral and Smart Cities Mission. It aims to support cities in achieving climate neutrality by 2030, offering benefits like reduced pollution, improved health, and enhanced urban greening. The actions funded will also contribute to various EU policies and initiatives, emphasizing the twin green and digital transitions.

6.2. Pre-Proposal Phase: Building the Consortium and Gathering Information

6.2.1. Consortium Formation and Alignment (Months 1-2)

- Identify and invite potential partner entities: other faculties, tech startups, innovation hubs, municipalities, local NGOs, civic associations, and enterprises.
- Organize initial consortium meetings to align visions, objectives, and expectations.
- Foster cooperation with faculties of Architecture, Electrical Engineering, Civil Engineering, and Environmental Sciences from various European universities.

6.2.2. Stakeholder Engagement and Needs Assessment (Months 3-4)

- Organize workshops and meetings with municipalities, civic associations, and enterprises to understand their specific needs, challenges, and goals.
- Collaborate with stakeholders to identify common objectives and areas of interest.

- Conduct a comprehensive needs assessment in selected municipalities, focusing on urban mobility, safety, and sustainability.

6.2.3. Information Gathering and Preliminary Research (Months 5-6)

- Gather data on current urban mobility patterns, challenges, and potential solutions.
- Research existing solutions and best practices in urban mobility, safety, and sustainability.
- Engage with local media outlets to gather insights on public perception and needs.

6.2.4 Proposal Drafting and Refinement (Months 7-8)

- Draft the initial project proposal, outlining objectives, expected outcomes, and methodologies.
- Collaborate with consortium partners to refine the proposal, incorporating feedback and insights.
- Ensure alignment with the objectives and requirements of the Horizon Europe call.

6.2.5 Proposal Submission (Month 9)

- Finalize the proposal, ensuring all requirements are met. Verify the checklist of documents the call.
- Submit the proposal to the Horizon Europe program before the deadline.

6.3. Detailed description of each phase of the proposed framework

6.3.1. Consortium Formation and Alignment (Months 1-2)

The initial phase, spanning the first two months, is pivotal in setting the foundation for the entire endeavour. It revolves around the formation of a robust consortium and ensuring alignment among its members. In our example this phase is spearheaded by the Faculty of Transportation Sciences (FTS) of a European University, which takes on the role of the primary coordinator and initiator.

To begin with, the FTS identifies potential partner entities that would bring diverse expertise and perspectives to the project. This selection process is meticulous, aiming to create a balanced consortium that encompasses academic institutions, tech startups, innovation hubs, municipalities, local NGOs, civic associations, and enterprises. Each of these entities is chosen based on their relevance to the project's objectives, their track record in similar initiatives, and their potential contribution to the consortium.

Once potential partners are identified, the FTS extends formal invitations to them, detailing the project's vision, objectives, and the role they are envisioned to play. This is followed by a series of initial consortium meetings, which serve multiple purposes. Firstly, they provide a platform for all partners to introduce themselves, share their expertise, and outline their preliminary thoughts on the project. Secondly, these meetings are crucial for aligning the visions and objectives of all partners. It's during these discussions that potential synergies are identified, and any overlapping or conflicting interests are addressed.

A significant aspect of these meetings is fostering inter-faculty cooperation. Recognizing the interdisciplinary nature of the project, the FTS actively encourages collaboration with faculties of Architecture, Electrical Engineering, Civil Engineering, and Environmental Sciences. Such collaborations are not just limited to the home institution but are expanded to include faculties from other European universities. This ensures a rich tapestry of knowledge and expertise, which is essential for the holistic approach the project demands.

The following are key considerations and steps in the consortium formation and alignment process:

- **Identify Core Expertise Needs:** Before reaching out to potential partners, it's crucial to understand the expertise and capabilities required to address the call's objectives. This ensures that the consortium has the necessary skills and knowledge to execute the project successfully (Horizon Europe NCP Portal, n.d.).
- **Leverage Existing Networks:** While it's essential to bring in new partners with specific expertise, leveraging existing collaborations can provide a foundation of trust and established working relationships. However, it's crucial not to limit the consortium to familiar partners only. Expanding the network can bring in fresh perspectives and innovative solutions (Enspire Science, n.d.).
- **Engage with Potential Partners Early:** Early engagement allows for a clear understanding of each partner's capabilities, expectations, and contributions. It also provides time to address any concerns or gaps in expertise (European Commission, n.d.).

- **Ensure Geographical Diversity: Horizon** Europe emphasizes the importance of geographical diversity in consortia. Including partners from various European countries can enhance the consortium's richness and ensure a broader impact (Horizon Europe NCP Portal, n.d.).
- **Define Roles and Responsibilities:** Clearly defining the roles and responsibilities of each partner ensures smooth project execution. It's essential to establish leadership roles, task allocations, and communication channels early on (EMDESK, n.d.).
- **Align with EU's Mission Goals:** The consortium should be in line with the EU's mission goals, especially when addressing societal challenges. This alignment ensures that the project's outcomes contribute to broader European objectives (Innovative Health Initiative [IHI], n.d.).
- **Consider Previous Collaborations:** Past collaborations can be an indicator of a successful working relationship. However, it's essential to evaluate the outcomes and impact of previous projects before considering partners for new proposals (Horizon Europe NCP Portal, n.d.).
- **Evaluate Potential Risks:** Every partnership comes with potential risks. Evaluating these risks, such as misalignment of objectives or potential conflicts, can help in making informed decisions (IHI, n.d.).
- **Ensure Commitment:** All consortium members should be committed to the project's objectives and be willing to invest the

necessary time and resources. This commitment is crucial for the project's success (EMDESK, n.d.).

In conclusion, forming a consortium is not just about gathering organizations together but ensuring that these organizations are the right fit for the project's objectives and can work cohesively towards a common goal. Leveraging tools like the partner search platforms provided by the European Commission and other entities can aid in this process (European Commission, n.d.; EMDESK, n.d.).

By the end of this phase, the consortium should have a clear understanding of each member's role, the collective objectives, and the roadmap for the subsequent phases. The alignment achieved during these two months lays the groundwork for a cohesive and collaborative approach, setting the stage for the project's success.

6.3.2. Stakeholder Engagement and Needs Assessment (Months 2-4)

Following the formation of a cohesive consortium, the next crucial step is to engage with a broader spectrum of stakeholders and conduct a comprehensive needs assessment. This phase, spanning from the second to the fourth month, is orchestrated to ensure that the project is rooted in real-world requirements and is responsive to the actual needs of the communities it aims to serve, echoing the emphasis placed by the European Union on stakeholder involvement in policymaking for enhanced legitimacy and optimized research funding allocation (SpringerLink, 2023).

The Faculty of Transportation Sciences (FTS) takes the lead in initiating stakeholder engagement. Recognizing that the success of the project hinges on the active participation and buy-in of various stakeholders, the FTS

organizes a series of workshops, focus group discussions, and one-on-one interviews. These engagements target a diverse group, including local residents, community leaders, urban planners, transport agencies, and representatives from the municipalities that are potential beneficiaries of the project.

These interactions serve a dual purpose. Firstly, they provide an opportunity for the consortium to communicate the project's objectives, scope, and potential benefits to the stakeholders. This transparency fosters trust and ensures that the stakeholders feel valued and involved. Secondly, these engagements are instrumental in gathering insights, feedback, and suggestions from the stakeholders. Their lived experiences, challenges, and aspirations provide invaluable data that can shape the project's direction.

Parallel to these engagements, the FTS, in collaboration with other academic partners, embarks on a rigorous needs assessment. This involves a combination of quantitative and qualitative research methods. Surveys are disseminated to gather data on current urban mobility patterns, infrastructure challenges, and residents' perceptions of safety and sustainability. Field visits are conducted to observe and document the existing urban mobility infrastructure, identify bottlenecks, and understand the dynamics of traffic flow. Additionally, in-depth interviews with experts in urban planning and mobility provide a nuanced understanding of the challenges and potential solutions.

The needs assessment also pays special attention to vulnerable groups such as women, children, the elderly, and people with disabilities. Their

unique challenges and requirements are often overlooked in urban planning, and the project aims to address this gap.

By the end of this phase, the consortium will have a comprehensive understanding of the current urban mobility landscape, the challenges faced by residents, and the gaps in existing infrastructure and policies. This rich repository of data and insights forms the bedrock on which the subsequent phases of the project are built. It ensures that the project's interventions are not just innovative but also deeply rooted in the real-world needs of the communities it aims to serve.

5.3.3. Information Gathering and Preliminary Research (Months 5-6)

Upon successfully engaging stakeholders and conducting a comprehensive needs assessment, the project moves into its next pivotal phase: Information Gathering and Preliminary Research. Spanning the fifth and sixth months, this phase is dedicated to deepening the consortium's understanding of the urban mobility landscape, both in terms of existing solutions and emerging innovations.

The Faculty of Transportation Sciences (FTS) spearheads this phase, leveraging its academic prowess and research capabilities. Recognizing the importance of a holistic understanding, the FTS adopts a multi-pronged approach to information gathering.

Firstly, a thorough literature review is conducted. Academic journals, industry reports, white papers, and case studies related to urban mobility, sustainable transportation, and smart city initiatives are meticulously analysed. This review not only provides insights into the latest research findings and best practices but also helps identify gaps in the current body of knowledge. It

offers a global perspective, highlighting successful urban mobility initiatives from around the world, which can serve as inspiration for the project.

Simultaneously, the FTS collaborates with tech startups, innovation hubs, and industry experts to stay abreast of the latest technological advancements in the realm of urban mobility. Workshops and seminars are organized, where these entities showcase their innovations, ranging from smart traffic management systems to sustainable transportation solutions. These interactions provide a glimpse into the future of urban mobility and offer potential technological solutions that the project can adopt or adapt.

In addition to technological insights, the FTS also focuses on gathering socio-economic data pertinent to the municipalities targeted by the project. This includes data on population density, economic activities, public transportation usage, and more. Such data aids in understanding the unique challenges and opportunities each municipality presents and ensures that the project's interventions are tailored to the specific needs of each community.

Furthermore, the consortium also engages in preliminary field research. Small pilot studies or experiments might be conducted to test certain hypotheses or validate the feasibility of potential solutions. For instance, a short-term experiment might be launched to gauge public response to a new type of sustainable transportation mode or to test the efficiency of a new traffic management system.

By the conclusion of this phase, the consortium is armed with a wealth of information, encompassing both theoretical knowledge and practical insights. This robust foundation ensures that the project's subsequent phases,

especially the proposal development, are informed, innovative, and in tune with the latest advancements in the field of urban mobility.

6.3.3. Proposal Drafting and Refinement (Months 7-8)

As the consortium moves into the seventh and eighth months of its preparatory journey, the focus shifts to the crucial stage of drafting and refining the project proposal. This phase is the culmination of all prior efforts, where ideas, research findings, and stakeholder inputs coalesce into a structured and compelling document.

To begin with, the Faculty of Transportation Sciences takes the lead in drafting the initial proposal. Drawing from the extensive preliminary research and the needs assessment, the faculty outlines the project's objectives, methodologies, expected outcomes, and potential impact. This draft serves as the foundation upon which the entire proposal is built.

Parallelly, specialized working groups are formed within the consortium, each focusing on specific sections of the proposal. These groups, often led by experts from partner entities, delve deep into their assigned sections, ensuring that every detail aligns with the call's requirements and objectives. For instance, a working group might focus on the technical aspects, detailing the innovative urban mobility solutions proposed, while another group might concentrate on the project's expected societal impact.

As the draft takes shape, regular review meetings are organized. These meetings, often facilitated by the Faculty of Transportation Sciences, allow consortium members to provide feedback, suggest improvements, and ensure that the proposal remains cohesive and aligned with the call's objectives. External experts, such as those from academic institutions or industry

specialists, might be invited to these meetings to provide an external perspective, ensuring that the proposal is both innovative and feasible.

Stakeholder engagement doesn't cease during this phase. On the contrary, continuous communication with municipalities, civic associations, and other stakeholders is maintained. Their feedback is invaluable, ensuring that the proposal remains grounded in real-world needs and challenges.

Towards the end of this phase, a series of refinement sessions are held. These sessions are intensive, focusing on polishing the proposal, ensuring clarity, and eliminating any ambiguities. Every aspect, from the technical methodologies to the budgetary allocations, undergoes meticulous scrutiny. The goal is to ensure that the proposal not only meets the call's requirements but also stands out for its innovation, feasibility, and potential impact.

In conclusion, the "Proposal Drafting and Refinement" phase is a collaborative and iterative process. It requires the concerted efforts of all consortium members, a deep understanding of the call's objectives, and a clear vision of the project's potential impact. With the combined expertise of the consortium and continuous stakeholder engagement, the proposal is refined to its final form, ready for submission.

6.3.4. Proposal Submission (Month 9)

The ninth month marks a pivotal moment in the consortium's journey: the submission of the meticulously crafted proposal. This phase, while seemingly straightforward, is laden with critical tasks that demand precision, coordination, and a keen eye for detail.

The Faculty of Transportation Sciences, having played a central role in the proposal's development, assumes the responsibility of coordinating the

submission process. This involves ensuring that all required documents, attachments, and supplementary materials are collated and formatted according to the stipulations of the Horizon Europe programme.

Before the actual submission, a comprehensive review of the entire proposal package is undertaken. This is not merely a cursory glance but an in-depth examination to ensure that every section of the proposal, from the technical descriptions to the budgetary allocations, aligns perfectly with the guidelines provided. Any discrepancies, no matter how minor, are addressed promptly to ensure that the submission is flawless.

Parallel to this, there's a verification of all administrative details. This includes checking the accuracy of partner details, ensuring that letters of commitment from stakeholders are duly signed and attached, and verifying that any required permissions or ethical clearances are in place. Given the diverse nature of the consortium, with partners spanning academia, municipalities, NGOs, and beyond, this administrative check is crucial to prevent any last-minute hitches.

As the submission deadline approaches, the consortium maintains open lines of communication. Regular updates are shared, ensuring that all partners are apprised of the submission's status. This transparency not only keeps everyone informed but also fosters a sense of collective ownership and anticipation.

The actual submission process, often conducted through a dedicated online portal, is approached with meticulous care. Every step is double-checked, every document uploaded is verified for accuracy, and every section of the online form is filled with precision. Given the importance of this

submission, multiple backups of the proposal are maintained, and high-speed, reliable internet connectivity is ensured to prevent any technical glitches.

Once the proposal is successfully submitted, a confirmation receipt is obtained. This receipt, often bearing a unique submission ID, serves as proof of the consortium's timely and successful submission. It's shared with all consortium members, marking the culmination of months of collaborative effort.

In conclusion, the "Proposal Submission" phase, while brief, is characterized by a blend of precision, coordination, and meticulous attention to detail. It's the moment where the consortium's collective efforts are presented to the Horizon Europe programme, with the hope of embarking on a transformative journey towards designing inclusive, safe, affordable, and sustainable urban mobility.

Certainly! Here's a detailed description of the "Contingency: If the Proposal is Not Approved" phase:

6.4. Contingency: If the Proposal is Not Approved

In the realm of research and innovation, not every proposal receives the green light for implementation. While the non-approval of a proposal can be disheartening, it's essential to view it as an opportunity for reflection, learning, and growth. The journey of proposal development is filled with insights, collaborations, and a wealth of knowledge that can be harnessed even if the proposal doesn't secure the desired funding or approval.

Feedback Analysis:

The first step after receiving the news of non-approval is to seek detailed feedback from the funding body or organization. Understanding the reasons

for rejection is crucial. The Faculty of Transportation Sciences, along with its consortium partners, should meticulously analyse this feedback to identify areas of improvement, gaps in the proposal, or any other concerns that might have led to the decision.

Internal Review and Reflection:

Post the feedback analysis, an internal review meeting should be convened. This meeting aims to discuss the feedback, share individual perspectives, and collectively reflect on the proposal's strengths and weaknesses. It's a platform for open dialogue, where every consortium member can voice their opinions, concerns, and suggestions.

Refinement and Repositioning:

Armed with feedback and insights from the internal review, the next step is to refine the proposal. This could mean restructuring certain sections, adding more data, revising the objectives, or even repositioning the entire proposal to align better with funding priorities. The essence is to address the identified gaps and enhance the proposal's overall quality and relevance.

Exploring Alternative Funding Sources:

While the initial proposal might have been tailored for a specific call or funding body, it's worth exploring alternative sources of funding. This could include other European grants, national funding bodies, private sector partnerships, or even crowdfunding. The refined proposal can be tweaked to align with the requirements and priorities of these alternative sources.

Leveraging the Consortium's Strength:

The consortium, formed for the proposal, is a powerful network of expertise, resources, and capabilities. Even if the proposal isn't approved, this network

can be leveraged for other collaborative initiatives, research projects, or even smaller pilot projects that can be self-funded or require minimal resources. The idea is to capitalize on the collective strength and not disband the consortium merely because of a setback.

Knowledge Dissemination:

The research, insights, and data gathered during the proposal development phase are valuable. These can be compiled, documented, and disseminated through academic journals, workshops, seminars, or even online platforms. Sharing this knowledge not only positions the Faculty of Transportation Sciences and its partners as thought leaders but also contributes to the broader academic and industry discourse.

Preparing for Future Opportunities:

The world of research and innovation is dynamic, with new funding opportunities, calls for proposals, and challenges emerging regularly. The consortium should remain vigilant and proactive, keeping an eye out for future opportunities that align with their expertise and the proposal's objectives. Being prepared and having a refined proposal at hand can provide a competitive edge when such opportunities arise.

In conclusion, while the non-approval of a proposal can be a setback, it's by no means the end of the journey. With a proactive, reflective, and collaborative approach, the Faculty of Transportation Sciences and its partners can navigate this challenge, harnessing it as a steppingstone for future successes.

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Chapter 7: Roadmap for cooperation between European universities and external stakeholders

Assoc. Prof. Anders Riel Müller, Dr. Utku Ali Riza Alpaydin

Mission-oriented research is research that contributes towards solving a societal challenge. The 100 Climate Neutral and Smart Cities mission is a complex societal challenge that does not only require technical solutions, but also political, social, economic, and cultural innovation. Such a mission requires many partial and parallel solutions (European Commission. Directorate General for Research and Innovation., 2018). Thus, there is a need for a broad range of disciplinary and transdisciplinary research activities that address different needs of the mission. Furthermore mission-oriented research needs to be aligned with the knowledge needs and requirements of the public, private and civic sectors. This means there needs to be both a mobilization internally among researchers as well externally with other sectors. This is by no means a simple task.

This chapter outlines a possible roadmap for how this could be achieved, from the perspective of a university institution, based on a synthesis of various previous experiences with trans-disciplinary research and inter-sectoral collaboration to address societal challenges. It is by no means a blueprint to follow without critical reflection, but rather a set of suggestions for things to consider if one wants to get engaged in EU missions. Because the recommendations come from a focus on the EU mission for 100 climate neutral and smart cities by 2030, these recommendations have a specific regional local focus. What we are concerned about is how to address local and regional challenges for collaboration across sectors to address the challenges

we need to overcome to achieve the mission goals. Thus, some of our recommendations may not be relevant for all mission-oriented research.

What characterizes the climate neutral cities mission is its complexity. Not only does a city need to become climate neutral by 2030 but they must achieve this in a context of almost endless layers of complexity that need a multiplicity of local governments departments, industries and citizens all with different values and interests to align themselves with each other and collaborate. The EU climate 100 neutral and smart cities mission does not only require the cities to become to climate neutral by 2030. They also require cities to cooperate with citizens, industry, and finance to achieve the mission target. Thus, the climate neutral cities mission is much more than a merely technical exercise of reducing CO_2 emissions.

7.1. Challenges

One of the challenges in mobilizing cooperation between universities and external stakeholders relates to the mismatch of the expectations. In many cases, what the external stakeholders want and what the researchers prefer to explore do not match each other, which creates a tension and non-alignment of expectations from the cooperation even before they are formed. Public and private sector are mainly interested in the solutions that can be applied in the short run, while academia seeks to explore interesting topics that carry scientific potential. Thus, it becomes problematic to reach an agreement on the topics that will be worked on together. This problem is exacerbated by the different working principles, routines and timescales of the engaging partners. The academics strongly favor the scientific rigor, methodical approach and explore the perfect solution. On the contrary, for the other spheres of the

quadruple helix, a solution that provides a workable result might be necessary and adequate. However, these problems are of a reconcilable nature and can be mitigated through effective and continuous communication. The building of trust between the partners involved through repeated collaboration eases the process of coordination in an interactive activity.

Second, the cooperation between universities and external stakeholders remains at the individual level and not institutionalized. This results in the loss of contact in the case of job changes of the people involved in the collaboration. Since many of the collaborations are not registered or implemented under the radar, when a researcher moves to another university, his/her links with the regional stakeholders also fly with him/her. It may present also an obstacle even if such tracking and recording practices are in place. Ensuring the flow of knowledge from the gatekeepers to the entire ecosystem is a daunting task. The people who represent their institutions in joint collaborative activities may not forward the information they gather from the ecosystem to their colleagues, which produces a bottleneck and impediment against cross-sectoral idea exchange. Thus, institutionalization of external stakeholder management, creating multiple points of contact within the universities on specific topics and ensuring the flow of information from the meetings to all relevant researchers is critical.

Last, universities are often assumed to undertake many roles in an ecosystem than they can manage, which may lead to a “mission overload”. In an ideal quadruple helix formation, universities represent just one of the helices with its constituent elements of management, researchers, students, and non-academic staff. Even though universities are seen as neutral mediators in

such a constellation, it becomes important for any university not to promise too much and not to assume too many responsibilities with regards to the collaboration between other spheres of the quadruple helix. In this regard, universities can and should identify the “intersection zone” that they can contribute and not take the responsibility to lead every collaborative initiative among the members of the quadruple helix. This role should focus on the “research gaps” that can be taken up by the academics. In other words, the universities should be involved in the matters and activities that carry a research potential. If they promise more than what they can deliver and assume the leadership and management of the quadruple helix, they can risk turning into a “consulting business”.

7.2. Organisation

Mission activities at the regional/city level require first and foremost a proper organisational setup that ensures coordination, anchoring, and commitment from relevant stakeholders and different levels. In this section we will outline a possible way to manage and coordinate mission activities drawing on experiences from Stavanger and EU (Mazzucato, 2018), not only in organizing the local mission on Climate Neutral and Smart Cities, but also from other large societal challenges.

The illustration below (Figure 6.1) shows a regional organisation in which multiple missions and societal challenges are decided upon and coordinated. What missions/challenges is thus a regional collective decision that involves politicians, industry organisations, civil society organisations and the university.

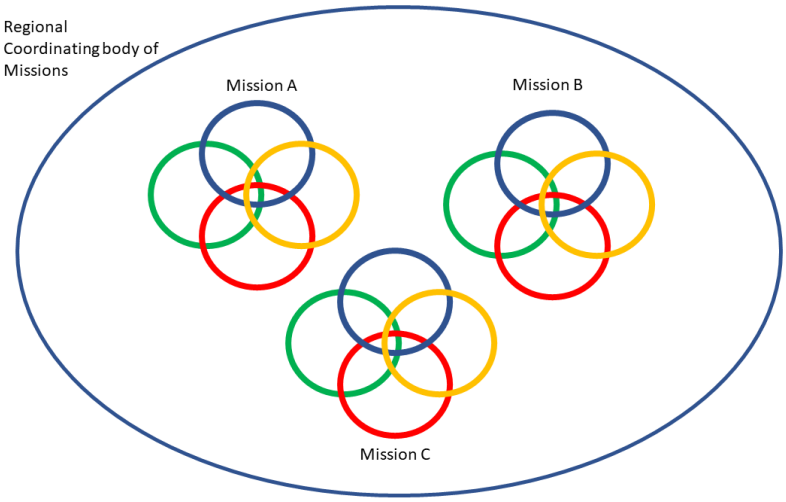

Figure 6.1. Schematic representation of a regional organisation coordinating multiple missions and societal challenges involving politicians, industry organisations, civil society organisations, and the university. Author's own illustration.

This Coordinating body should ideally consist of top representatives from the government, industry, civil society and academia that has the power to make decisions for the region as a whole. Whether this body should be hosted by one of the participating institutions or operate as an independent entity would have to be based on the specific context.

For each mission, relevant representatives from the four sectors of society should be represented on a mission board (see Figure 6.2). By relevance, we mean managers and decision makers that are key to the mission. For the mission on Climate Neutral and Smart Cities, this could include municipal politicians and top administrators, industry managers from either important companies or industry clusters, civil society leaders and lead researchers or department heads from the university. The mission board should set overall targets, priorities and coordinate the various programmes.

Underneath the mission board, a set of mission programmes should be set up. Each programme should represent different areas of the mission that

need to be addressed. For the Climate Neutral and Smart Cities mission this could include programmes on mobility and transport, energy, land use, etc. The programme committee is tasked with identifying, prioritising and coordinating the different projects that will contribute to the completion of the mission programme as well as report to the mission board on the progress of the programme. Experts with decision-making powers and most importantly expertise in the particular programme area should sit on the programme committee. This could include managers from specific municipal departments, business divisions, research group leaders and so forth.

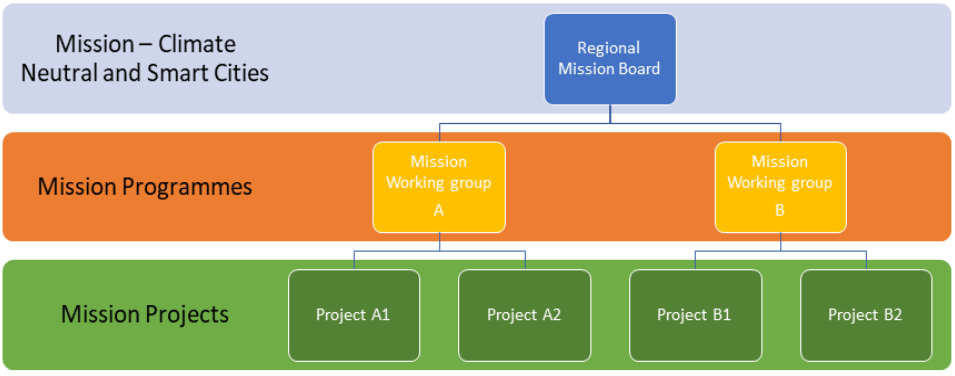

Figure 6.3. Organizational structure of a mission board, illustrating the representation from the four societal sectors and the subsequent mission programmes addressing specific areas of the mission, with their respective committees and experts. Author's own illustration.

For each mission programme project, a project team needs to be set up with the right participants from relevant stakeholders. It is important to note here that not all sectors need to be represented in each project. A project can easily only have participants from two or three sectors. For the university, participants in a mission project could include both university faculty members and students. The project is thus the executing part of the regional mission organisation proposed here. This is where specific challenges are addressed, and solutions proposed and implemented.

The suggested organisation could indicate a very top-down approach in which the mission board dictates what each programme should do. This is not the intention with this suggested organisation. Rather, the mission board and the mission programme committee should develop the framework for mission projects. Thus, individual projects could be suggested from below, but the mission programme committee must ensure alignment with programme targets and priorities, and in extension, the overall mission. How each mission programme goes about initiating projects can vary. They can come from the programme itself or it can come from the ground up. In most cases a mixture of top-down and bottom-up projects will be likely.

7.3. Implementation

Implementation of the organisational structure is of course not enough. Implementation of missions at the regional level is not as complex as at the European level but complexity is still high and requires navigating a multitude of sectors, actors, and interests. There is also a risk of too strong top-down control in which innovative ideas do not get the space to develop. Furthermore, continuous engagement across sectors, institutions and individuals must be encouraged and enabled.

While the organisational proposal above seeks to develop the enabling framework, most of the work will take place at the project level. The mission programme committees should agree on challenges that projects should address. Projects must take their departure in these challenges, but project proposals can come from all sectors involving a few or several partners spanning a single or multiple sectors. One lesson learned from regional collaboration in Stavanger is that collaboration must be concrete: concrete

challenges leading to concrete knowledge and solutions. Thus, the mission programme should facilitate meeting spaces for the different sectors to come together and discuss possible projects that can address the challenges identified.

Different sectors operate according to different logics, operate in different ways, and they also have expectations and preconceptions about other sectors. The meeting spaces are not only important to discuss challenges and projects, but also align expectations and getting to know each other. As mentioned earlier in Chapter 3, research activities sometimes operate on a different temporal scale than, for example, a business scale. Research activities are not well-suited for immediate action. Research mainly offers to fill knowledge gaps for others to then act upon.

Figure 6.4 seeks to illustrate how collaboration should occur in the intersecting overlaps. From a university perspective, not all projects require research-based knowledge. Thus, it is important to identify what challenges and projects that require research activities. Similarly, not all research projects necessarily need partners from other sectors. This identification of research needs is difficult to achieve. It also requires researchers to get familiar with the needs, logics, and perspectives of other sectors. In order to showcase the capabilities of the universities in such an organizational setup for missions, university researchers should be more visible and contribute to public debates as much as possible. Attending events organized by external stakeholders and presenting their research ideas, results, insights will be helpful to create awareness in the public about what the university can deliver in terms of the needs of the relevant stakeholders. Just as there can be impatience with slow

research, researchers can also, from experience, show impatience with long meetings in which the other sectors are deliberating on their needs. When researchers meet with external stakeholders, it is equally important to listen to the demands of the other parties and find a better way to explore the issues at hand. In this way, the risk of the expectation mismatch can be minimized, if not totally eliminated. It can also ensure the ownership of the mission projects by the external stakeholders involved.

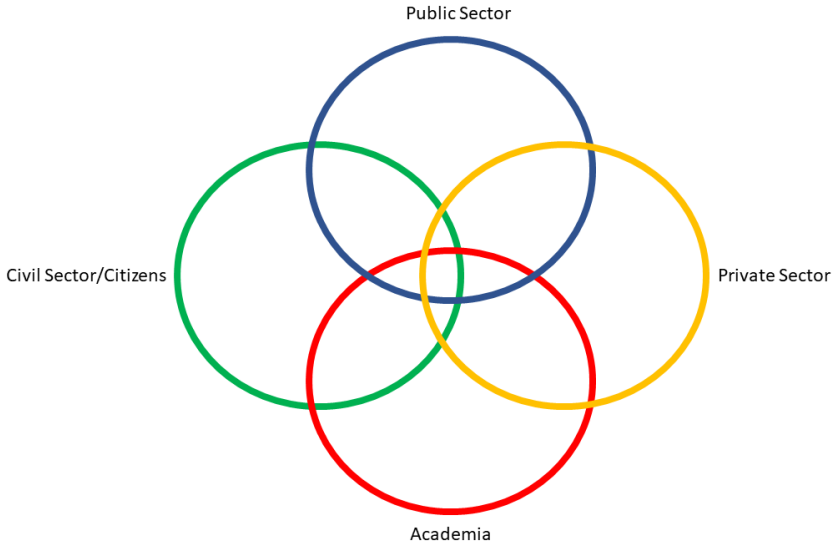

Figure 6.4. Illustration of collaborative intersections among various sectors, emphasizing the identification of research needs and the importance of mutual understanding and communication between university researchers and external stakeholders.

In an ongoing Horizon 2020 project, 12 European Universities have developed a set of guidelines for public engagement, i.e. how research institutions can facilitate and individual researchers can approach collaboration with other sectors (Müller and Neset, 2022). These guidelines focus on how universities can support researchers in public engagement as well as how the individual researchers could approach public engagement.

Recommendations for Institutional level initiatives to enhance public engagement

1. ***Recognize*** Public engagement in line with other scientific activities such as research publications. Public engagement involves increased interaction, dialogue and communication with external stakeholders – time that may be otherwise spent on producing more recognized forms of scientific outputs.
2. Create ***incentives***. Incentives can take different forms from seed funding to specific allocated time for public engagement in work portfolios – most often a combination of different incentives should be explored. Other incentives can also include more symbolic recognition such as awards to researchers who have made special efforts in public engagement.
3. Provide ***training programs*** in different forms of public engagement. There are many forms of public engagement, each with their own benefits and caveats and many different stakeholders one could potentially engage with. Such training programs can be designed as formal programs offered centrally or developed by supporting bottom-up learning communities initiated by researchers themselves.
4. Provide ***organizational support*** for public engagement. This can include assisting researchers facilitating as point of contact to stakeholders and existing regional meeting spaces, organizational support for managing projects with complex public engagement activities and provide training programs in public engagement methods to researchers.
5. Make public engagement part of ***career development*** objectives. Early career researchers often struggle to balance teaching and research activities and have little time for anything else. However, it may be important to encourage researchers to engage with external stakeholder early on their career through training and network building, which means allocating dedicated time for such activities as part of professional development and career advancement. Assessing and recognizing public engagement will in many cases involve the development of indicators by which public engagement can be assessed (Neresini & Bucchi, 2011). Public engagement is not easily quantifiable or easily measured in terms of number of collaborative activities, patents issued or commercialization. Public engagement may require a rethinking of performance indicators that takes on a broader understanding of societal value and the role of science, scientists and scientific knowledge production in relation to society (Thorpe & Gregory, 2010).

Guidelines for Individual Researchers

1. Be ***pro-active***. seek out regional meeting spaces and establish relations with regional stakeholders.
2. Develop **interpersonal skills and competences** that are key to building relations and trust with stakeholders.
3. ***Enhance*** you research communication skills. Good research communication is important to building relations.
4. ***Invest*** time to develop long-term relationships with relevant sectors.
5. ***Commit*** to stakeholder engagement at every stage of the research process.
6. ***Rethink*** the role of the researcher from expert to also think of the researcher as facilitator.

The guidelines above indicate the need for a re-calibration or re-orientation both of institutional and individual values and practices.

7.4. Engage students

For small-scale mission projects, universities can also draw on the huge potential of students. They can be mobilized and activated for concrete, short-term projects that do not require too much involvement from the researchers. It can be achieved either using the challenge-based education approach (for instance, InGenious programme at University of Stavanger) or some other extra-curricular activities such as hackathons mentioned in the other parts of this sourcebook. In this way, the human capital of the universities can be opened up for the service of the mission stakeholders. These small-scale student projects can also serve the basis for bigger research projects, such as PhD research or an externally funded research project that will involve more researchers from the university.

7.5. Conclusion

In this chapter, we have outlined the challenges faced when facing complex societal missions. The different logics and practices that govern various sectors provide a challenge to inter-sectoral collaboration that needs to be overcome. There is also a need to be clear on the roles and tasks that different sectors and institutions are able to perform. Based on these challenges, the chapter outlines a proposal for how to organize and coordinate mission activities at the regional level and suggestions for how to re-orient values and practices in order to enabling the implementation of a mission-oriented approach. Of course, this is easier said than done but there is no doubt that mission-oriented research challenges business as usual logics and practices.

Chapter 8: Synthesis and Pathways Forward: Empowering Academia in Shaping Sustainable, Smart Urban Futures

Dr. Ticiano Costa Jordão, Assoc. Prof. Miroslav Svitek

As this sourcebook, "EU Climate and Smart City Missions: Universities Bridging Research & Education," draws to a close, it is imperative to reflect on the multifaceted discussions, insights, and scholarly contributions that have punctuated its chapters. The convergence of climate imperatives with the transformative potential of smart cities presents a unique and urgent challenge for academic institutions worldwide. This final chapter aims to synthesize the key themes explored throughout the book, offering a cohesive narrative that underscores the critical role of universities in driving forward the agenda of sustainable, smart urban development. Furthermore, it seeks to chart a course for future action, delineating clear, actionable recommendations for academics, researchers, and institutional leaders.

Synthesis of Key Themes

Interdisciplinary Approaches to Climate and Smart City Challenges:

- The sourcebook has consistently highlighted the necessity of an interdisciplinary approach in addressing the complex, interwoven challenges of climate change and urban development. Universities are uniquely positioned to foster cross-disciplinary research and education, breaking down traditional silos to encourage a holistic understanding of the socio-economic, technological, and environmental dimensions of these global issues.

Innovative Pedagogy and Curriculum Development:

- The imperative for curriculum innovation has been a recurring theme, emphasizing the need for educational programs that not only impart knowledge but also instill the critical thinking, problem-solving, and collaborative skills essential for climate action and smart city development. Challenge-based learning, experiential learning, and digital pedagogies have been identified as key strategies to enhance the relevance and impact of higher education in these fields.

University-Industry Collaboration:

- The sourcebook has underscored the value of strong partnerships between academic institutions and industry stakeholders. Such collaborations can provide practical insights, drive innovation, and ensure that research and education are aligned with real-world needs and opportunities, particularly in the fast-evolving sectors of climate technology and smart urban infrastructure.

Community Engagement and Social Inclusion:

- Recognizing the social dimension of climate action and smart city initiatives, the contributions within this sourcebook have advocated for community-engaged research and participatory approaches in urban planning and policy-making. Universities have a critical role to play in facilitating dialogue, fostering civic engagement, and ensuring that the transition to smart, sustainable cities is inclusive and equitable.

Recommendations for Academia

Foster Interdisciplinary Research and Learning Hubs:

- Universities should establish dedicated centers or hubs that promote interdisciplinary research and learning on climate action and smart cities. These hubs can serve as platforms for collaboration, innovation, and knowledge exchange, bringing together experts from diverse fields, industry partners, and community stakeholders.

Revitalize Curricula to Address Contemporary Challenges:

- Academic institutions must continually update and adapt their curricula to reflect the latest scientific understandings, technological advancements, and societal needs related to climate change and urban development. This involves not only the integration of new content but also the adoption of pedagogical approaches that encourage active learning, critical thinking, and problem-solving.

Strengthen Industry and Community Partnerships:

- To enhance the practical relevance and impact of their programs, universities should actively seek and nurture partnerships with industry, government, and community organizations. These partnerships can provide valuable opportunities for internships, collaborative research projects, and community-engaged learning, ensuring that students and researchers are well-prepared to contribute to sustainable, smart urban futures.

Champion Policy Advocacy and Public Engagement:

- Universities have a responsibility to not only generate knowledge but also to actively participate in public discourse and policy advocacy on climate and urban issues. By leveraging their expertise and authority, academic institutions can play a pivotal role in shaping public opinion, informing policy decisions, and driving societal change towards sustainability and resilience.

In conclusion, as we stand at the crossroads of climate imperatives and urban transformation, the role of universities has never been more critical. Through

innovative research, transformative education, and active civic engagement, academic institutions have the power to lead the way in forging sustainable, smart, and inclusive urban futures. The path forward demands courage, creativity, and collaboration; it is a path that the academic community must navigate with foresight, dedication, and a deep commitment to the betterment of society and the planet.