

# **Development goals and measures (UMV) 2018-21**

**DTU Civil Engineering**

April 2017

## Table of contents

1.	Academic profile and expected performance goals of the department.....	3
2.	Education and teaching .....	4
3.	Research .....	7
4.	Scientific advice .....	9
5.	Innovation .....	10
6.	Partnerships .....	11
7.	Human resources .....	12
8.	Material resources .....	14
9.	Communication.....	17
10.	Process and employee involvement .....	17

## 1. Academic profile and expected performance goals of the department

*The mission of DTU CIVIL ENGINEERING is, through research, education, innovation and research-based consultancy in the area of civil engineering, proactively to develop decision basis and technology in support of sustainable developments - for the benefit of society.* It is our vision to be positioned among the world's 10 highest ranked civil engineering departments, to be excellent in research in a selected range of civil engineering disciplines, to be among the most attractive departments for students and a preferred provider of graduates, to be the favoured research based consulting partner to industry and public authorities nationally and internationally, and finally to develop innovative new solutions and processes for the construction industry and building users.

The activities at DTU Civil Engineering are organised in sections:

- Section for Building Design, addressing: building technology, building materials, renovation, building information modelling and fire safety.
- Section for Building Energy, addressing: building-energy technology, building services, and solar energy.
- Section for Structural Engineering, addressing: design in steel, concrete, glass and other construction materials, computational modelling, integral structural and material modelling, load processes and structural dynamics, monitoring and probabilistic methods.
- Section for Geotechnics and Geology, addressing: rock mechanics, rock physics, geotechnics, geology and pavement engineering.
- Section for Indoor Climate and Building Physics, addressing: comfort and health in buildings, impact of indoor climate on productivity, efficient indoor air distribution, air cleaning, user/occupant behaviour and the future sustainable approaches to heating, ventilation and cooling of buildings, as well as hygrothermal building physics.
- Section for Arctic Technology and Sustainable Solutions, addressing: infrastructure construction and Arctic conditions, buildings and energy systems, Arctic environmental technology and planning, sustainability and infrastructure systems.

Furthermore, the department is the platform for three centres:

- ARTEK, Arctic Technology Centre, is a DTU centre initiated and operated in collaboration with the Greenland Self-Government with the main objective to provide professional Bachelor of Engineering educations in Greenland, and to provide the platform for developing a University Centre for Arctic Technology.
- ICIEE, the International Centre for Indoor Environment and Energy, aims to identify and provide solutions to ensure healthy, comfortable and productive indoor environments with minimal energy consumption.
- Villum Centre for Advanced Structural and Material Testing (CASMaT) is a cross-departmental collaboration at DTU bringing infrastructural lab facilities for multi scale structural experiments to an international top level.

Finally, the department has defined three development areas that approach major societal challenges with interdisciplinarity and collaboration across the sections and centres in the department.

In order to maintain and develop the position of DTU Civil Engineering as one of Europe's leading civil engineering institutions, a strategic process has been launched to clarify the development until 2025, including analysis of issues like:

- The need to increase external funding by seeking out new partners and thereby be more relevant for stakeholders and society.
- Transformation of activities by intensified use of information technology and presence on a growing number of platforms.
- Develop and expand laboratory and research facilities to support frontier research and utilize possibilities as an experimentally based university unit
- The need to prioritize research areas in order to be excellent in a selected range of civil engineering research disciplines

In the UMV-period 2018-2021, the department is expected to increase the intake of students to meet societal needs, and to increase the number of scientific personnel to ensure a creative scientific environment as basis for research of excellent quality.

The department will front DTU's activities in Civil Engineering towards the society and the construction industry.

## **2. Education and teaching**

### **2.1 Education and teaching (BEng, BSc and MSc programmes)**

DTU Civil Engineering educates engineers for the building sector in both Denmark and Greenland and strives to improve both the quality and the number of graduates, as the demand by large numbers exceeds the numbers produced.

Several new initiatives will be launched and tested at DTU Civil Engineering to enhance excellence and efficiency of teaching activities, and increase the number graduates with a focus on these four areas:

1. Educate smarter
2. Functional bilingualism
3. E-learning
4. New teaching activities

#### **2.1.1. Educate smarter**

The education and teaching development aim at creating an inspiring educational environment, where both the students and the department can work smarter and achieve better results, while using less resources. Specifically, the department will:

- Share educational activities with other universities, e.g. with Nordic Five Tech as in the Nordic Master in Cold Climate Engineering.
- Organize project families to train peer-review, peer-instruction, peer presentations, the ability to collaborate and communicate, and increase the R&D impact of the projects through industry involvement during the project period
- Ensure that the department's educational effort is efficient by performing an analysis of the economy and resources underlying the educational activities
- Establish an overview of the distribution of supervision on projects and courses to ensure a more uniform distribution of the supervisions load and incorporating non-Danish speaking staff in basic courses.
- Reduce and rationalise the number of courses at DTU Byg with 10 % without reducing the students' possibilities for a deeper specialisation, while at the same time increase the number of faculty by 15 %.

- Establish a more rational use of the laboratories to increase the students experimental activities in courses and projects through use of Project Families, E-learning materials, and by increasing laboratory capacity to handle experimental activities in courses with 90+ students. Use of laboratories outside normal working hours will be investigated in order to increase the experimental capacities.
- Develop teaching and learning concepts to facilitate a more flexible use of lecture halls, group rooms and laboratories, thus increasing the effective number of students in these areas. A best practice manual will be developed to support these options.

### **2.1.2 Functional bilingualism**

The functional bilingualism (Danish and English) will be secured for the BEng and BSc students by introducing teaching activities in basic courses taught by English speaking personnel, and by establishing study plans, which incorporate courses taught in English.

The functional bilingualism will be supported by new Danish-English (both ways) dictionaries of civil engineering glossary, which are to be developed at the department.

### **2.1.3 E-learning**

The department will innovate the teaching and learning activities, by incorporating E-learning in relevant areas in cooperation with LearningLab, to achieve the goals outlined in DTU's E-learning policy. After DTU has established a common E-learning platform, cooperation with other departments will be increased to facilitate effective learning through the use of E-learning. These activities will facilitate the learning process, enable a deeper learning, and create a more efficient use of the resources. Thus, transforming the educational environment by increased use of:

- Blended E-learning techniques in more courses, preferably in combination with the flipped classroom, or in combination with distance teaching (e.g. Arctic courses, educations shared with other universities, Massive Open Online Courses (MOOC), continued education).
- E-quizzes for self-testing at the beginning of a course in combination with "patches" or "brush-up video lectures", and exercises to increase the level, while the weaker students have an efficient way to catch up.
- E-quizzes, E-peer-review and E-grading activities to facilitate the work for improvement of the student's feedback. This will be combined with the traditional, individual exam to secure the individual testing, but this exam and the grading will use the digital possibilities to a larger extend.
- Experimental possibilities for the students through instruction videos, which are either prepared by the staff or the students. This will both improve the learning and increase the capacity of the lab, which will result in improved access for the students.
- Involvement of students in the development of E-learning materials (e.g. The Open and Intelligent Laboratory).
- Establish an annual seminar for best practise in teaching. Presenting experiences and documentations of the most effective means for teaching and learning, which also improve the quality of the learning.
- Develop a strategy and handbook for the use of E-learning possibilities as well as E-learning supports.

These activities will be used as a part of the branding of DTU Civil Engineering, especially of the department's international and continued teaching activities. The E-learning facilities will form a strong and efficient support for project based activities, especially in cross-disciplinary problems. The E-learning facilities will also contribute to the reduction of the time it takes students to complete their studies, as they efficiently support the students chances to catch up with delays and succeed at reexaminations.

#### **2.1.4 New teaching activities**

The department aims at establishing or expanding several new teaching activities:

- Increase the capacity for the BSc Civil Engineering students to facilitate 90 in annual uptake, including an increase of laboratory capacities to accommodate 90+ students at the same time.
- Increase the experimental activities for students in courses and in projects based on new laboratory facilities in B128, B129 and B130.
- Maintain and improve the contribution to the Innovation Pilot in the BEng Building and Infrastructure. Develop a support for BEng thesis activities through use of project families.
- Upgrade and profile the teaching and learning in Building Structures in different educations through dialogue with students, Study Board and Heads of Studies
- Support the different aims of BEng and BSc educations with separate courses, while at the same time providing the students maximal support for specialisations within the educations rules.
- Further development of the Danish Building Academy as a CDIO based, innovative learning activity in order to provide both an improved learning platform and a living lab.
- Participate in the development and implementation of a new BSc/Diploma education in Fishing Technology headed by DTU Aqua and a new MSc education in Mineral Ressource Management in collaboration with Luleå University; both educations are to be based in Greenland within the framework of ARTEK.
- Outline detailed plans for the realization of educations at an Arctic Technical University Center in Sisimiut under the auspices of ARTEK along the lines of Vision 125.
- Introduce E-tools for following the performance of courses and teacher over time and initiate dialogues with teachers and sections for changes to optimize feedback and evaluations.

#### **2.2 PhD programme**

The PhD School of DTU Civil Engineering wants to offer a unique academic platform for PhD students, to graduate excellent PhD students and to be recognized as one of the best among peers.

The PhD School management will continue its focus on promoting stays abroad and facilitate an improved academic identity. Furthermore, it will facilitate incitements for PhD students to value and produce high quality research publications, such as the DTU Civil Engineering PhD School Best Paper Award and mutual peer reviews of drafts for research publications among PhD students.

DTU Civil Engineering aims at increasing the number of PhD students and the ratio of industrial PhD students in cooperation with not only the industry, but also regions, cities, suppliers and ministries. This will also enhance the innovation activities for PhD students.

The PhD development will be improved through cooperation with DTU's alliance partners.

#### **2.3 Continuing education**

In order to support engineering competencies among practitioners in the construction industry, DTU Civil Engineering will strive to increase the activities in the field of continuing education in cooperation with the industry and other educational institutions. Specifically, the department will:

- Review current activities and ensure the use of E-learning
- Develop new continued education in collaboration with various authorities nationally and abroad
- Seek possibilities to develop more continued education within the framework of Open Education as well as in collaboration with other departments at DTU
- Seek possibilities to develop continued education targeting Greenlandic/Arctic engineers.

### 3. Research

#### Research Areas

The research at DTU Civil Engineering is based on a deep understanding of underlying physical phenomena combined with forefront experimental investigations. The department is organised in six sections, three centres and three development areas, whereas the centres are interdisciplinary and draw on research resources from the sections. The research profile of DTU Civil Engineering is continuously adapted to ensure development of knowledge in the classic disciplines of civil engineering, identify novel means to provide innovative solutions to problems and to facilitate solutions to major societal challenges. Research activities may be identified in collaboration between researchers, external stakeholders and students.

The research activities within the department will include, but not be limited to:

- Building energy: (1) Transfer of surplus heat between rooms and flexibility in drawing energy from thermal and electrical grids; (2) Low temperature district heating systems for nearly zero energy buildings and existing buildings; (3) Solar energy systems in buildings including energy storage for the future energy systems; (4) Smart cities; (5) Composition of high performance building facades; (6) Development and operation of innovative, easy operable, maintainable and efficient building services for lighting, heating, cooling and ventilation; (7) Model predictive control and continuous commissioning for building services for optimized operation.
- Building design: (1) Interaction between construction management technologies and building design; (2) Building Information Modeling (BIM); (3) Use of semantic web technology and socio technical aspects in the design process; (4) Documentation and quality assurance in real life construction; (5) Establishment of design fire scenarios; (6) Characterization and durability of porous construction materials; e.g. concrete; (7) New construction materials based on new lab facilities; e.g. composites, fiber materials and bio-based materials; (8) Reuse of construction/demolition waste in new building materials supporting circular economy; (9) Ashes as cement substitute in concrete for optimal resource efficiency.
- Indoor climate and building physics: (1) Relationship between exposures in the indoor environment and human comfort, health and performance; (2) Physiological and chemical reactions for prediction of the impact of indoor environment on building occupants and its control in energy efficient buildings; (3) Thermodynamics in the building envelope; (4) Robust technical solutions for renovation of housing;
- Geotechnics and geology: (1) Characterization of shale and clay, with special emphasis on fracturing, elastic properties and permeability; (2) Development of pavement engineering, e.g. by use of recycled materials; (3) Geotechnical and geological aspects of geothermal energy extraction and heat storage; (4) Geotechnical centrifuge testing
- Structural engineering: (1) Construction methods and technologies of bridges, tunnels and harbours incl. new arch-sandwich bridges; (2) Systems for super-light building structures; (3) Monitoring, modelling and classifying capacity, durability and remaining service life of existing building structures and infrastructure systems for improved design and assets management; (4) Structural response and long-term behaviour to dynamic, stochastic, blast and impact loading; (5) Simulation/prediction of complex load processes

In addition hereto, a number of inter-disciplinary research projects are conducted across the different sections. Most of these research areas are dealt with in the department centres and will include, but not be confined to:

- ARTEK
  - Development of a research plan regarding Arctic technology as outlined in Vision 125.

- Development of technical solutions for foundations on permafrost.
- New Arctic Building Practice end evaluation of housing in an Arctic environment.
- ICIEE
  - Occupants' reactions to and control of indoor environment for prediction of the indoor environment and energy use in buildings.
  - Application of Big Data, sensors and smart controls for improving health, comfort and performance of building occupants, linking the “sensing” building to “sensing” society.
- CASMaT
  - Understanding fatigue through multi-scale testing and modelling
  - Large scale testing of structural elements and joints

Inter-disciplinary research in collaboration with other DTU departments on research areas outside the auspices of the centres will include, but not be confined to:

- Building systems as smart constituents within smart cities and intelligent energy systems.
- City climate including geographic information systems, wifi localisation and BIG data.
- Design Methodologies combining probabilistic based engineering and sustainability analysis

The department will revise and update its research strategy, and based on an international external research evaluation as well as the ongoing strategic process, selected research areas will be prioritized to ensure a strong future-oriented research profile of the department.

### **Research Collaboration**

The department will emphasise an expansion of external collaboration with stakeholders in the construction industry, e.g. consortia partners in *INNO-Byg* and strategical DTU partners, e.g. *Nordic Five Tech*. On the research area of Building Information Modelling (BIM), the department will complement its research by linking up with strong international partners.

The department will develop internal research collaboration among others with the following DTU departments and centres:

- CERE on geotechnic and geophysics.
- GDSI on decision support based on risk and sustainability analyses.
- Polar DTU on arctic technology.
- Center for Oil and Gas on structural dynamics in offshore environment as well as geology/rock mechanics
- DTU Electrical Eng. on building acoustics for super-light structures.
- DTU Compute on smart buildings
- DTU Management Eng. on construction management
- DTU Mechanical Eng. on fatigue and structural dynamics
- DTU Wind Energy on fatigue and wind load on structures
- Life science institutes on bio-based construction materials.

The department will continue to focus on research activities to ensure critical mass of all activities.

### **Research Funding**

The department will increase the external funding of research and innovation during the UMV period, and by including more VIP employees in externally funded research projects release resources for strategic research investments and strengthen core research areas. The aim is to both increase the number of



applications and strive to improve the quality of applications by peer-to-peer processes and departmental support to applicants. Thus increasing our success rate.

The senior researchers will increasingly be encouraged to take the lead in research programmes funded by the European Commission, whereas our young researchers are encouraged to link up to research projects led by other institutions.

The department will focus on funding through the following specific programmes and partners:

- Programmes under the auspices of EIT, including Horizon 2020, ERC and Climate KIC
- Marie-Curie Programme for PostDocs and PhD students
- Innovationsfonden
- INNObyg
- Private foundations

#### **4. Scientific advice**

The in-house competencies as well as developed techniques, methodologies and lab facilities of the department will be brought into play for the benefit of both private and public sector enterprises, nationally as well as internationally. This will happen not least through development of laboratory facilities on Campus Lyngby, where CASMaT will substantially enter its operational phase in the beginning of the UMV period, and the new Concrete and Material laboratory at the end of the UMV period.

The focus areas are closely linked to current major challenges for the built environment:

- New requirements on sustainability of the building sector with respect to environmental issues, resource consumption and re-use, economics, social and health issues.
- New requirements to the effectiveness and industrialization of the building sector.
- Upgrading and renovation of existing central elements in the aging built environment including the infrastructure.
- Utilization of possibilities for more efficient capacity building and operation of the Build Environment through use of embedded ICT (Internet of Things); e.g. sensing and active structures, intelligent materials and dynamic human-system interaction.

Furthermore, the following areas are expected to potentially be central in national and international research-based consultancy activities in the UMV period: mould in renovated buildings, indoor climate implications of a society with circular economy, condition assessment, maintenance scheduling and remaining service life prediction of the existing infrastructure, estimation of capacity of existing structures, foundations and constructions in permafrost areas, quality assurance and documentation of safety in buildings and finally performance specifications and quality assurance on scientific issues for future large infrastructure projects. All will be major challenges, not only for the society but also for owners, consultants and contractors.

In Greenland – as envisioned in Vision 125 – the establishment of a new university centre for research and education related to Arctic technology is foreseen in collaboration between DTU and the Greenlandic authorities to be fully developed in the next 10 years – provided that the necessary funding can be obtained – thus creating a stronghold for research based consultancy in Greenland.

Finally, the ongoing construction and renovation activities at DTU Lyngby Campus should be mentioned as a possibility to establish building and infrastructure (road) monitoring activities, which can strengthen the consultancy competences in the area of renovation, maintenance and facility management.

The department will:

- Prepare an analysis of a selected part of the construction sector activities including mapping of needs for scientific advice services among stakeholders; e.g. construction materials and/or Digitalisation 4.0.
- Expand consultancy relations with governmental institutions as scientific advice areas or tasks are put out to tender.
- Develop a business case for scientific advice services and strengthen administration by standard list prices for department staff and use of lab facilities.
- Ensure impartiality and independency as a strong basis for trustworthy advice.
- Develop scientific advice services for major building and infrastructure owners.
- Increase participation in national and international standardization.
- Seek long term service agreements with selected stakeholders, e.g. public or semi-public organisations.
- Develop scientific advice services based on lab testing facilities, optionally with university partners.

## **5. Innovation**

DTU Civil Engineering strives to integrate innovation in all its activities, including its core activities: education and research.

The department wishes to promote patenting and creation of start-ups with the department's research activities as a starting point. The department strongly encourages its researchers to engage in innovation activities, and thus make use of individual networks and expertise in innovation activities. The department has compiled the following three strategic goals for innovation in the UMV period:

- Improving the innovation environments
- Facilitating student innovation and entrepreneurship
- Strengthening and increasing innovation cooperation

### **Improving the innovation environments**

To obtain the goal of improving the innovation environment, the department will:

- Make use of the new facilities: CASMaT and the new laboratory buildings 128 and 129.
- Carry out planning and building of a new building 130 as a new innovation and research environment for civil engineering materials, e.g. biomaterials, ZeroWaste materials and concrete.
- Increase the capacity of student workshops in buildings 117 and 127 and the department's laboratories by combining "The open and intelligent laboratory"-concept (blended E-learning and access 24/7) with an upgrade and expansion of the concrete laboratory in building 119 provided necessary funding is obtained.
- Create and run a living lab by developing the Campus Village provided necessary funding is obtained. This leads to new innovation possibilities as the dormitory will be both a living lab made with a big data option as well as provide a platform for cross-disciplinary innovation and research in cooperation with the building industry.

### **Facilitating student innovation and entrepreneurship**

The department will strengthen the innovation activities of all bachelor educations, where the department contributes: BSc Civil Engineering, BSc Architectural Engineering, BEng Architectural Engineering, BEng Arctic Technology and BEng Building and Civil Engineering. The department will actively participate in these activities and use these as a starting point for further cooperation with external partners. To obtain this goal, the department will:

- Increase the number of student projects in collaboration with external partners, in order to encourage innovation and learning, e.g. by using Project Family concept.
- Make innovation and entrepreneurship part of the courses 11691 and 11996 "Project Work" for BSc students.
- Create innovation and entrepreneurship activities for BEng students as part of their mandatory semester in practice and later as a part of the Innovation Pilot course.
- Develop the concept of innovation immersion or research immersion in the summer period; among other things to be used for new concepts, project ideas or development of recruiting activities.
- Participate in Science Camps and Innovation Camps.

### **Strengthening and increase innovation cooperation**

The department wishes to strengthen the inter-disciplinary research, in order to increase the innovation cooperation with other DTU departments as well as the industry. To obtain this goal, the department will:

- Strengthen the cooperation on innovation through the interdisciplinary development areas, Danish Building Academy/Campus Village and selected project areas (e.g. SmartCities).
- Increase the cooperation with external partners (e.g. Krüger, Saint Gobain, Velux, Danish Industry member, The Capital Region of Denmark, Lyngby, Ballerup and Albertslund, Grundejernes Investeringsfond).
- Increase cooperation with other DTU departments and international universities.
- Refine the department's Innovation Day by inviting more external participants, selected persons from other DTU departments and representative students.

## **6. Partnerships**

DTU Civil Engineering's partnerships are fundamental platforms in order to reach the department's goals at both strategic and operational levels. Our identification and engagement with partners is based on a strategic consideration on how partnerships best support activities related to our core activities on research, education, innovation and research-based consultancy.

Important present partners include: Nordic Five Tech alliance universities, Harvard, Stanford, Aalto, BAM, the buildingSMART consortium, the INNObyg consortium, DONG A/S, COWI A/S, NIRAS A/S and the Greenland Self-Government.

Important future partners include: Climate KIC, Femern Belt, members of the Danish Building Academy, Raw Materials KIC, La Sapienza, LTH, KTH, TU Delft, TUM, Greenland Institute of Natural Resources, Universities/companies in BRIC-countries and other emerging economies.

In the UMV period, the department will strengthen partnerships with:

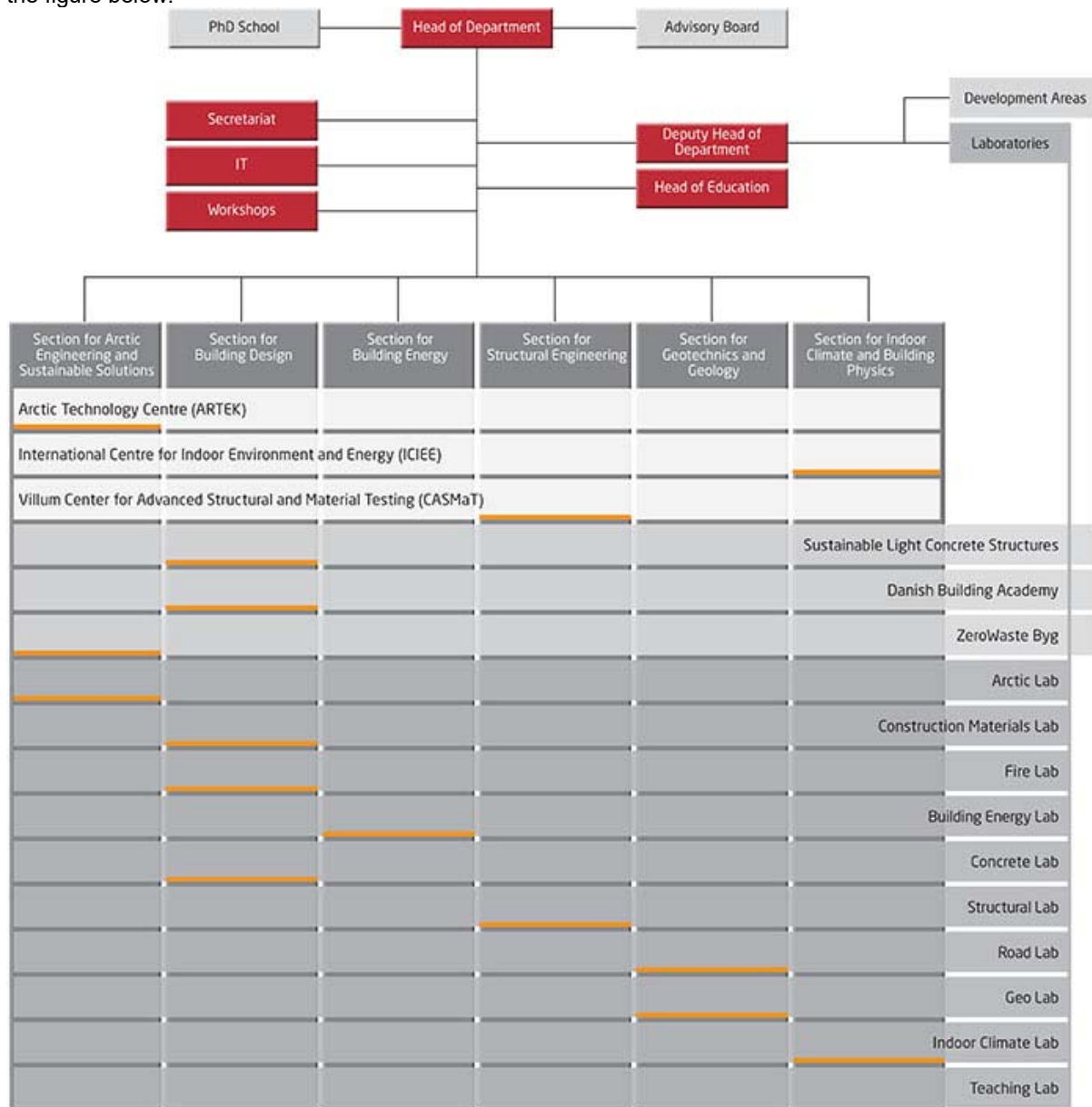
- Leading technical universities in Europe for mutual sharing of lab facilities and experiences on testing activities; e.g. within large scale structural testing.
- Leading construction material laboratories in preparation of the New Concrete and Material Lab in Building 130; e.g. study tour to selected labs.

- Technical universities in Arctic and Nordic countries for collaboration on research and combined educations, e.g. through UArctic and Nordic Five Tech.
- Leading organisations in the scandinavian construction industry.

## 7. Human resources

### 7.1 Organisation

DTU Civil Engineering is organized in six sections - three research centres and a central support unit comprising IT and a department secretariat including building services and laboratory services, as shown in the figure below.



DTU Civil Engineering wants to develop an agile organisation, which supports the key processes, which lead to successful delivery of our strategic goals. The overall aim of the administration is to support the scientists and research groups in the best possible way, thus ensuring that the department's scientists have the best terms and conditions to conduct excellent research.

As contribution to this, the department wants to strengthen the administrative resources, competencies and working culture enabling them to offer a wide range of specialized support across the department within the areas as project support, administrative support, laboratory support, management and communication. This support will supplement the services from the various DTU corporate units and in compliance with the new DTU systems. A high standard and precision within fundraising will be given special attention.

The actual organisation in sections and developmental areas will be reviewed and optimized to ensure a viable and quality oriented research environment. The cross-organisational operations for centres routed in the department will be developed; e.g. for ARTEK to address arctic partners on behalf of all DTU.

## **7.2 Leader and leadership development**

DTU Civil Engineering applies to the DTU Leadership Role and recognizes management development as an integral part of the activities at strategic and operational levels. The department aims for a clear understanding of individual roles and responsibilities in the overall functionality of the department.

All members of the management team are expected to participate actively in the strategic development of the department, in the day-to-day management activities and to develop as leaders; i.a.. through the DTU Leadership program. Seminars in the management group on leadership, strategy and awareness on culture will take place.

The management of ARTEK will be reviewed and developed, and it is envisioned that a separate UMV document for ARTEK will be developed in the beginning of this UMV period to ensure the financial and academic uniqueness between the activities undertaken within ARTEK and those undertaken elsewhere in the department.

## **7.3 Employee development**

Development of the employees at DTU Civil Engineering is a focus point in the daily operation but also at a strategic level. The process is rooted in the annual employee development interviews conducted between the individual employees and their immediate manager. The annual employee development interviews is a crucial leadership tool to show recognition, set up goals and be clear on expectations and development potentials. As stated in the DTU competence strategy, the aim is a clear link between the strategic goals at the department and the individual employee competence development, in order to develop the highest potential possible. Initiatives like implementing the Code of Conduct and the development of new laboratory facilities will need a strategic competence development plan, and an analysis of what kind of skills and competences is needed in order to fulfill the potentials in such initiatives.

New development areas are expected to be chosen based on job satisfaction survey to be undertaken in autumn 2017. The analysis and action plan will be developed in close collaboration with the local Collaboration Committee.

In order to further develop a productive work environment, the department will:

- Arrange an annual DTU Civil Engineering educational seminar, presenting best practice “from teachers to teachers”.
- Maintain a strong focus on continuous development of our lecturers – primarily via Learning Lab, e-learning and by integrating our young faculty members as PhD supervisors.
- Pay special and continuous attention to the administrative procedures towards obtaining an optimal organizational structure, enhanced efficiency in processes, clear collaboration structures, preparation of job and task descriptions and high quality knowledge sharing.
- Collaboration between the management and the Collaboration Committee enhancing the cohesion between strategic goals and competence development.

#### **7.4 Attracting and recruiting**

Developing and recruiting talent is crucial for increasing expertise within DTU Civil Engineering’s scientific fields. The department will continue its focus on the recruitment process and on recruiting the right people with the right talent and the right diversity for the right functions by making use of our strong profile and networks. All new positions will bring the department to an even higher level of expertise.

In order to further develop the potentials and talents of the department, we will look for possible professorships in relation to the strategic initiatives. In the UMV period, we will establish three professorships in strategic selected research areas, e.g. architectural engineering, fire safety, rehabilitation of buildings, building information modelling or civil engineering materials. Furthermore, we will improve start-up conditions and support in the beginning of employments, for post-docs to enter permanent employment, for industry experts to enter academia and for new international VIP. Finally, we will investigate national and international funding mechanisms that can support the department in attracting and developing talented researchers.

#### **7.5 HR key figures**

DTU Civil Engineering wants to obtain and maintain a sound scientific balance for the activities of each individual VIP; e.g. between education and research. In general, the educational part of VIP activities is high. At the same time, the department wants to maintain a critical mass in the research groups in order to ensure scientific quality and development.

In the UMV period, an 15 % increase in permanently employed research staff and an 50 % increase in PhD students is expected reflecting the expected growth in teaching activities, external funded projects as well as the research-based consultancy venture.

### **8. Material resources**

#### **8.1 IT**

The department wants to make a solid IT platform available for daily work as well as transition and digitalisation of professional activities, e.g. e-learning and knowledge sharing.

A virtual desktop infrastructure project in the B-databar is being carried out within the framework of the central computerlab committee. This will have a big impact for teachers as the use of IT in many different learning environments will be possible, use of multiple client platforms can be utilized and access at a VDI environment regardless of geographical location is made possible.

Computers are central components in all experimental activities, making the activities dependent on a both secure and flexible IT environment, where security threats (virus, ransomware, hackers etc.) should not result in compromised data and loss of valuable experimental knowledge. Data Management procedures will be reviewed to ensure a proper Code of Conduct. A more secure infrastructure in the lab environments will be planned, established and adjusted as a focus area of the departmental IT security committee.

The Internet at Campus Sisimiut will be updated to the highest possible standard, provided the necessary funding can be obtained.

Enhancement of knowledge sharing will be planned and implemented by means of common data structure, knowledge sharing systems and a 'sharing culture'.

## **8.2 Laboratory equipment/scientific infrastructure**

Experimental facilities of high quality are key components for a long range of the activities of the department. It is thus our strategy to maintain and further develop these to a high or the highest international level. The funding requirement for this is significant and should be reflected in both the base funding and external research funding.

At present, several laboratory units are undergoing a major transformation both in terms of the building infrastructure and the experimental facilities. Moreover, procedures are established to ensure professional operation and maintenance of the department's experimental infrastructure. These will be further expanded and developed in the UMV-period; including implementation in most laboratory units of an IT system to handle user search and booking of experimental equipment, user safety clearance, prising and maintenance of equipment, i.a. implementation in the three laboratory units in CASMaT, which also constitute an example of how the implementation can be done across departments.

CASMaT (Building 119A) forms a focal point in the coming years for the department, and constitute mechanical testing facilities at highest international standard, supporting research and forming the basis for international laboratory networking activities.

The DTU funding allocated for new laboratory buildings allows for establishment of a completely new lab infrastructure supporting geology and geotechnical engineering (Building 129) and ARTEK research (Building 128) - these laboratory facilities are expected to open officially in 2018.

Furthermore, the DTU funding allocated to a new concrete and construction material laboratory (Civil Engineering Materials) form the basis of a dedicated effort to rise external funding for equipment with new research possibilities; e.g. intelligent materials, composites, fiber-based materials or reuse of materials for a circular economy. These facilities will be included in the new Building 130 and rehabilitated areas in the basement of Building 119. Facilities for experimental pavement engineering for use in both education and research activities are highly needed as a consequence of the ongoing capacity building within geotechnical engineering. The equipment funding effort will be done in close collaboration with industrial partners, private foundations and possibly other DTU departments. This laboratory is expected to open officially in 2020.

The significant increase in experimental facilities and student uptake in the UMV-period which will inevitably require more supporting personnel in the workshop; e.g. measurement technicians and laboratory engineers, thus calling for more funding both from external sources and from DTU.

It is envisaged to establish a boundary-layer wind tunnel to perform studies on individual buildings and on the urban built environment at acceptable geometric scale. The available and future facilities at DTU MEK and DTU Wind are not suitable for this type of simulation, and the use of commercial wind tunnels comes with heavy time restrictions. The wind tunnel will be the main instrument for research in wind load on structures and dynamic response, verification of numerical simulation as well as for research on urban microclimate. In this connection, formation of a 'wind tunnel center' across DTU should be considered.

New research and technological challenges and possibilities dictates a new look at the indoor climate lab facilities. A major update is required and at the same time the current placement far from the main premises of DTU Civil Engineering is a barrier for a better integration of the Section for Indoor Environment and Building Physics in the department. Hence, the department will seek to attract funding for new research facilities to be located into the 1<sup>st</sup> quadrant. The funding comprises both external funding of lab facilities and DTU funding for a new building or alternatively reuse and rehabilitation of an existing building. In this connection formation of alliances across DTU or reaching outside DTU should be considered.

The activities envisioned in connection with the Danish Building Academy involves a continuous production of demonstration objects in the form of full scale building components, facades, or individual buildings. An outdoor space for testing and exhibition of these objects in a longer time span should be allocated.

With the help of a new financial laboratory structure, the need for allocation of funds for laboratory use, maintenance and upgrading will be clarified and made transparent. To further support the use and maintenance of the equipment in the various laboratory units a unique database system will be launched during the beginning of the UVM period.

During the UVM period, safety in lab units and workshops will be structured and enhanced in parallel with the increase in capacity and facilities supported by physical access control, user safety clearance and other actions.

### **8.3 Premises**

The renovation plan for DTU Civil Engineerings premises in the 1<sup>st</sup> quadrant consists of the following elements: Renovation of the building 119 and upgrade of workshop facilities (ongoing), renovation and upgrade of 117, extension of 118 with a building 128 (under construction) and a connection building between 118 and 119 with a building 129 (under construction), CASMaT in building 119A (in the final stages), renovation of building 116 (planning stage) and finally reshape of the out-door area and landscape between building 118/128/130 and building 116/127. This effort is expected to give the built environment in 1<sup>st</sup> quadrant a major upgrade both functionally, environmentally and visually. The plan is effectuated in close dialog between CAS and the department – a process which will be ongoing throughout the UVM period.

However, the plan does not foresee the envisioned relocation of Indoor Climate staff from building 402. Those issues will be addressed during the first years of the UVM period, including relocation of Indoor Climate staff to Building 118/119. The indoor climate laboratories are to be relocated to either a new DTU-funded building in 1st quadrant or refurbishment of an upgraded existing building (probably Building 117). In the latter case, current educational activities (student projects) moves to the west wing of Building 116.

Furthermore, the department will need an upgraded outdoor lab-environment ('terra lab', 4-5.000 sqm) north of Nordvej for outdoor experiments; e.g. durability test, test of solar systems, performance test of technical



solutions for the building envelope and infrastructure for experimental activities in Danish Building Academy, e.g. case houses (Solar Decathlon).

As predicted in ARTEK Vision 125, new campus facilities are needed in Sisimiut before the end of the Vision-period; year 2025. The department will, in collaboration with Greenlandic Self-Rule, seek funding for premises facilitating office work, educational activities, arctic laboratories, dormitories and accommodation for scientific personnel in Sisimiut. In 2017, an intermediate solution for ARTEK premises in Sisimiut is being settled in collaboration with Greenlandic Self-Rule and Municipality of Qeqqata as a good intermediate solution before reapplying for funding to revised campus premises later on in the UMV period. Support from central DTU administration is essential in these matters.

## **9. Communication**

The overall strategic external communication objective for DTU Civil Engineering is to:

- Disseminate knowledge of the activities within research, education and innovation.
- Be known by stakeholders and the general public for excellent research, education, innovation and research based consultancy services.
- Be known for pro-active and innovative approach to address future societal challenges.

In the beginning of the UMV period, DTU Civil Engineering will focus on implementing the communication strategy that has been developed during 2017 covering both internal and external communication. The communication strategy will support the overall strategic goals of the department's strategy towards 2025, and a better focus of the external communication activities is expected, both regarding subject and type of communication, e.g. web-communication, magazines, newspaper articles, workshops, etc.. This will in particular apply to potential users of DTU Civil Engineering's expanding laboratory facilities.

## **10. Process and employee involvement**

The UMV process was initiated in March 2017 in the management group of the department, followed by discussions within the individual organisational units and at staff meetings. All staff members have been given the opportunity to contribute to this UMV, however this has been on a voluntary basis as many of the department's employees are heavily engaged in the strategic process running in parallel with the writing of this UMV document. In the final phase, the UMV report has been reviewed within the department management group.