

# Home of Innovation

Stories about knowledge transfer by Valorisation Centre

**Stephan van Dijk**  
**about Roboat:**

‘In a few years time,  
Roboats will be  
collecting waste  
in Amsterdam’

**Arjan van  
Timmeren:**

‘The traditional  
models no  
longer work’

**Udo Kock**

‘AMS Institute  
delivers concrete  
solutions for the city’



  
**TU Delft**

 **Special**

  
AMSTERDAM INSTITUTE FOR  
ADVANCED METROPOLITAN SOLUTIONS



# Home of Innovation

Stories about knowledge transfer by Valorisation Centre

# Colophon

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## Print

Edauw en Johannissen

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With courtesy of AMS Institute  
for their collaboration  
on this magazine.



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This edition of Home of Innovation is entirely devoted to the Amsterdam Institute for Advanced Metropolitan Solutions (AMS Institute). Together with Wageningen University & Research and the Massachusetts Institute of Technology, Delft University of Technology forms the scientific heart of this unique institute, in which various parties work closely together with the City of Amsterdam to find solutions to the major challenges facing the metropolitan region.

What is Delft University of Technology doing in Amsterdam? The answer is simple: some of the biggest urban challenges in the Netherlands are found here. In the areas of mobility, energy, sustainability, climate and food supply. Amsterdam is a metropolis, with the complex problems typically associated with such large cities.

Consider, for example, the 500 kilometres of quay walls in Amsterdam. Over the coming years, reconstructing these walls, which are so characteristic for the city, will have a huge impact on the city and requires billions of funding. Thanks to the Roboat project, autonomous vessels may soon be able to carry out the inspections, thus making more targeted maintenance possible. Even a one percent saving achieved through such innovations would represent many millions cost reductions. The good thing is that these innovations can also be used in other cities. Not only in the Netherlands, but also in the rest of the world. For example, a city like Venice could benefit greatly from a Roboat. This innovation can also be used for many more interesting applications – more details can be found in this edition.

The strength of the AMS Institute lies in several areas: its close collaboration with the City of Amsterdam, the innovative educational methods, the role of data in all our activities. But the living labs approach remains pivotal, because through them we can actively involve residents and other parties in our research. It leads to better solutions, and accelerates innovation.

You can read all about it in this magazine in our interviews with Amsterdam alderman Udo Kock, MSc MADE student/entrepreneur Laurens van der Wal and data scientist Alessandro Bozzon.

Delft University of Technology's mission is based on the motto: 'impact for a better society'. In 2050, seventy percent of people will live in urban areas. Participating within the AMS Institute means that the university can create a social impact as well as achieve something real and concrete for all those people living in cities. We can directly influence their lives in a positive way by improving their living environment. Direct impact. It's for a reason that *solutions* is part of our name.

**Kenneth Heijns**  
Managing Director, AMS Institute

# ‘The traditional models no longer work’

The increasing complexity of the world around us means that scientific research is also in a state of flux. It has now become necessary for researchers working on metropolitan challenges - traffic, climate, energy, sustainability - to start testing their ideas at a much earlier stage than before at the place where the bottlenecks actually occur. In other words, in the big city. AMS Institute proves that this is the right approach, says Scientific Director Arjan van Timmeren.

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By Jurjen Slump

“**T**he models used by scientists earlier to simulate reality no longer work at all times”, says Van Timmeren. Thanks to the internet, people have become less predictable than before, because they are exposed to many more influences and direct feedback. “Think of traffic jams, for example. Nowadays drivers will look up alternative routes on their phone. The models in general are not yet designed to cope with this.”

## Double complexity

This is what Van Timmeren refers to as the ‘double complexity’: on the one hand, we have urban (technical) systems becoming increasingly complex and, on the other hand, there is real life in cities, with residents not always following the rules of logic. To ensure proper research despite this complexity, it has become necessary to take the laboratory to the city.

It is possible to approach the complexity of urban life in a ‘living lab’ if you involve the city residents and other relevant stakeholders such as the city council, water and energy providers, business community, etc. in the research. An additional advantage is that you can test potential

applications much faster and refine them in real-life and real-time conditions. This means that you will have a completed product sooner, which can then be launched by either public authorities or for commercial purposes, by a company.

## International interest

Acceleration is the buzzword here. The AMS Institute’s approach accelerates innovation (see box on page 8). And this is absolutely essential. “The relevance of the work we are doing turns out to be even greater than expected”, says Van Timmeren. The institute can barely handle all the incoming requests for meetings, lectures and guided tours coming from both national and international delegations. “Cities are desperately looking for approaches and solutions to their problems.” Besides, other universities increasingly also want to know how the institute itself operates. Originally set up around three general themes, AMS Institute’s activities are now focused on six, more specific topics (see infographic on page 10 and 11). “In recent years, we have identified the areas in which we have been able to develop excellence”, says the Scientific Director. “Those are the areas in which we can truly add value.” In addition, in



Professor Van Timmeren (Photo: Job Jansweijer)

close consultation with the city council, we explore where the most important challenges for the city lie, and connect these to newly validated research projects.

### Important role of SMEs

The AMS Institute works closely together with companies. Van Timmeren is surprised by the role played by SMEs, which is much more significant than expected. “They have to distinguish themselves primarily through innovation”, he explains. “That’s why they are more likely to take risks, while large companies focus more on consolidation.” The institute itself also generates entrepreneurial activities in the form of start-ups. “The tools we have been working on in recent years are now mature enough to be put on the market.” The institute currently runs almost 100 projects, with different consortia, which already include a total of more than 150 companies.

Entrepreneurship also plays an important role in the institute’s educational offering. This consequently attracts enterprising students. “An above-average number of students registering for our MSc MADE already own a company, or set up their own businesses while studying”.

### Innovative education

The educational programme is organised by Wageningen University & Research and Delft University of Technology. This collaboration has also resulted in highly innovative education, says Van Timmeren, himself a professor in Delft. “It is interesting to experience how multiple universities, with different educational cultures, enrich one another.”

Delft University of Technology also benefits from the positive effects of these collaborations, because it connects colleagues from different faculties more easily. “Urban development used to be a rather conservative discipline, but with the emergence of new technologies, the pace of innovation is also picking up here. As a result, within Delft University of Technology, we now have collaborations between my own faculty (Architecture and the Built Environment) and various others: Computer Science, Civil Engineering, Mechanical Engineering, Industrial Design Engineering, Technology, Policy and Management and the Applied Science faculty.

“It adds so much value! Together you will be able to address an unprecedented level of complexity. And the solutions are all the more effective because everyone keeps doing what they’re good at. Here, one and one really add up to three.”

### Fundamental research

Although the working method followed by the AMS Institute is very much in line with applied research, it also offers added value for fundamental research. Through more targeted innovations, you will increase the chances of success and, therefore, of follow-up research. This means that you can set up long-term research projects based on the same themes, making them relevant for fundamental research, which often also has a longer time span. This way of working has also been recognized by the NWO, the Netherlands Organisation for Scientific Research and European research councils. >>

## Breeding ground

Innovative education, enterprising students, the development of a campus in the heart of the city: Van Timmeren calls it a breeding ground. "As it will be developed the coming years as an innovation district, where 'urban professionals' will be able to attend courses. These professionals often find it difficult to keep up with the rapid pace of developments in the areas of IT and big data," says the professor. "This refers to professionals in both public and private sectors."

The Marineterrein area, where the institute has relocated, used to be government property for many years. It has a rich history. The beauty of it, says Van Timmeren, is that the area is now being returned to the city. "Until recently, this area was blurred out on Google Maps. Now it will become a test area, an innovation campus where we will develop applications that will ultimately benefit the whole of Amsterdam as well as the rest of the Netherlands." <<



## AMS Institute Living Labs

# Hop, step and jump

### *Living labs key to AMS Institute's working method*

Living labs form a crucial link in how AMS Institute ensures that innovative research benefits society earlier. The institute refers to this innovative research method as the 'hop, step and jump' approach:

#### **Hop**

"Together with our most important stakeholders and partners, we draw up a problem analysis of a specific challenge the metropolitan area is facing. At this stage, the scientific research takes place in the laboratories of Wageningen University & Research, MIT and Delft University of Technology."

#### **Step**

"This is followed by the innovative part of the research process: the results of the first part of the research are tested and validated in a real, 'living' environment within the Amsterdam metropolitan area. All parties concerned, including residents, are also involved at this stage. This unique intermediate step forms the basis of the AMS Institute: ensuring that our solutions are aligned more closely with real life in urban environments."

#### **Jump**

"This enables us to take a bigger leap forward: faster implementation of our solutions in society, as a result of which they will have a bigger impact. This creates sustainable and resilient cities that know how to deal with major societal challenges."



Tamara Streefland discusses the role of the industry within AMS Institute

# 'I always wanted to work on the city of the future'

As a sustainability consultant at Metabolic, Tamara Streefland is closely involved in several projects of AMS Institute. She believes that the involvement of the industry is important to ensure that innovations can have a real impact in society.

By Jurjen Slump

Tamara Streefland



“I actually always wanted to work on the city of the future and find out how to make it sustainable”, tells Streefland. She studied earth sciences and urban design in New York, but returned to Amsterdam because Metabolic’s wide-ranging strategy appealed to her.

## Circular area development

Metabolic is a consulting and venture building company that advises government bodies and companies on the transition of the economy towards a ‘fundamentally sustainable, circular state’. This focusses partly on circular area development, which, for example, explores how a

residential neighbourhood can be made completely sustainable: ranging from recycled construction materials to extracting raw materials from waste water.

## REPAiR

The AMS Institute is also conducting a lot of research in this field. For example, the REPAiR project is developing a model in collaboration with Metabolic that provides insight into how all the waste flows pass through the city. These data can then be used to determine the best place in the chain to remove materials from the waste for recycling. Metabolic brings technological and practical knowledge to the table, acquired in previous projects and research. “We have a great deal of expertise on the circular economy, systems theory and the creation of data visualisations”, says Streefland.

## Office boats

She considers De Ceuveld to be an excellent example, a living lab based on a former shipyard in Amsterdam-Noord. It is Amsterdam’s first ever ‘circular business park’ and is made up of old house boats placed onto the site and connected together by jetties.

Plants are being used to slowly clean up the polluted soil on the site. Metabolic has been involved in developing the area. “The project has been running for around five years

*‘The residents even have their own crypto-currency to pay for it’*

and we are testing all kinds of things there”, says Streefland. “The waste from the restaurant boat is converted into biogas.” The houseboats can generate energy using solar panels and the electricity is shared using a smart grid. “The residents even have their own crypto-currency to pay for it.”

## Catalyst for collaboration

Streefland believes that the industry involvement in the AMS Institute is important to ensure that technological knowledge actually reaches society. The strength of the AMS Institute lies in the living labs approach and the different parties involved, such as industry, government and the citizens of Amsterdam. “This works as a highly effective catalyst for collaboration and provides a network and an environment where you can test and then implement innovations.” <<

# AMS Institute: designing solutions for urban challenges

AMS Institute takes on the challenges posed by our rapidly urbanising world. The institute wants to develop a deep understanding of the city – sense the city – to design solutions for its challenges, and integrate these into the city of Amsterdam.

## The institute's three core pillars

Research &  
Urban Data

Education  
Programme

Valorisation

## Focus on six urban challenges

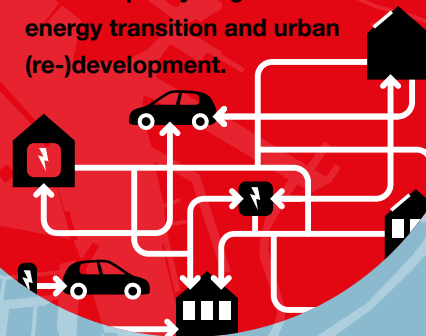
### Smart Urban Mobility

Ensure an accessible and liveable city by developing smart, sustainable and seamless mobility solutions that can be integrated into the urban fabric.



### Urban Energy

Design integrated innovations that help establish sustainable and resilient energy systems, for example synergies between energy transition and urban (re-)development.



Kattenburgerstraat 7  
Marineterrein Amsterdam

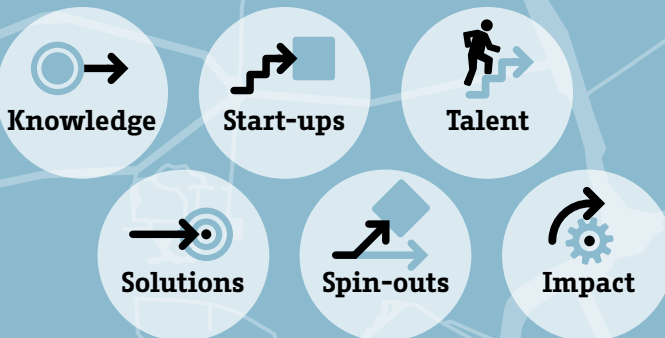


### Collaboration

AMS Institute is an ambitious institute at the forefront of innovation, and works closely with industry, government, academia and the citizens of Amsterdam.

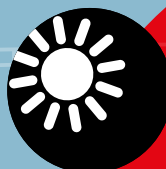


Our activities result in:



### Climate Resilient Cities

Making cities resilient and prepared for the impact of climate change, focussing on environmental, health related and societal challenges.





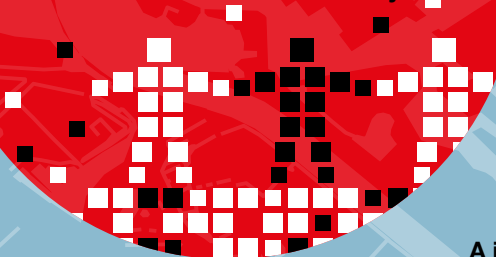
## Metropolitan Food Systems

Create inspiring scenarios to make food systems more sustainable and future-proof, by focusing on core elements such as: economic development, health, mobility and regional attractiveness.



## Urban Data & Intelligence

Develop new analytical tools to better use urban (big) data and improve city life, while strengthening and safeguarding the democratic values of citizens and society.



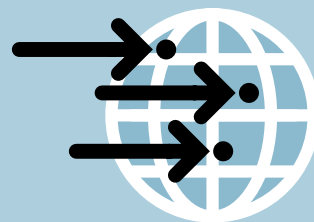
## Circularity in Urban Regions

Re-design resource flows that drive urban activities, whilst establishing integral sustainable urban ecosystems, supported by a new, resilient economic model.



## Amsterdam as a Living Lab

What makes AMS Institute unique is that we valorise our research through practice, using the city of Amsterdam as a living lab: a valuable context for experiments that helps develop and test advanced solutions for challenges in urbanised metropolitan areas around the globe.



The solutions we develop can be used by cities worldwide

## MSc MADE

A joint master's programme offered by Delft University of Technology and Wageningen University & Research, using the city of Amsterdam as a case study and living lab in close collaboration with AMS Institute.

Design

Analysis

Engineering

57

students

# Addressing metropolitan challenges: 'typical engineering work'

Together with Wageningen University & Research and the Massachusetts Institute of Technology Delft University of Technology forms the scientific heart of AMS Institute. Participating in the institute is important to Delft University of Technology, says Rob Mudde, Vice-Rector Magnificus and Vice-President for Education on the Executive Board. AMS Institute is part of his portfolio. "To solve urban problems, we need to be in the city ourselves."

By Jurjen Slump

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## Urbanisation

"By 2050, 70 percent of people will live in cities. If we consider where in society most of the problems arise and where living conditions of people might be improved, we will mostly look at urban environments. The extent of urbanisation will only increase, as well as its associated challenges. Take, for example, the food supply

system: 30 percent of goods transport

in Amsterdam are food-related. That is an incredible amount of transport movements within the city. We need to do something about this; it can be done in a smarter way. We want to be able to supply the shops without the city becoming gridlocked. Offering a solution to this means we will make an immediate contribution. Scientists find these challenges immensely interesting. Many people at Delft University of Technology are fascinated by it."

## In Amsterdam, but typically Delft

"The way we work within AMS Institute is representative of the Delft approach: it's typical engineering work. Because we think in terms of solutions. In a big city, there are certain preconditions to be taken into account. Traffic and residents need to be able to move around at all times. We cannot simply close off a bridge or a road. Engineers are used to this way of working and that's also the reason why we have to be physically present in Amsterdam. One cannot recreate this complexity in a lab - we have to let ourselves be inspired by the city, listen to the city governance, to its civil servants, and its citizens. That's why we find it perfectly logical to leave the campus in Delft and come to Amsterdam: the city is a living laboratory."

## Complexity

"For the same reason, it is also essential to get the scientists out of the TU Delft Campus labs. It's often about practical applications, so we need to seek out actual social complexities. We cannot simply strip it down to the core problem and try to solve it in 'splendid isolation' inside a laboratory, because then we will lose sight of some of its complexity. That's why we collaborate in the AMS Institute."



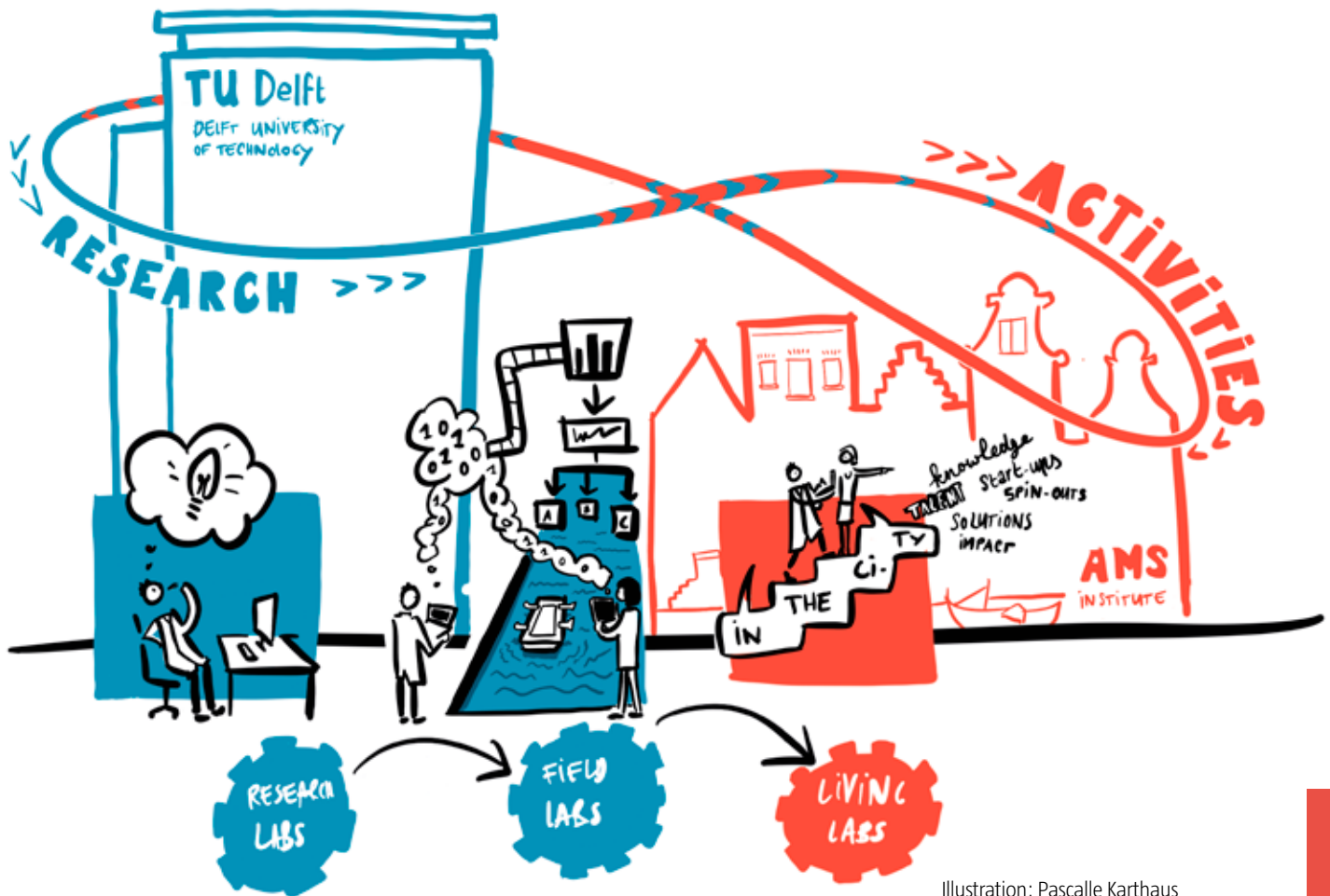


Illustration: Pascalle Karthaus

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### Chain: taking the campus to the city

“The research carried out by the AMS Institute in living labs and the activities performed within Delft University of Technology perfectly complement each other. It is a chain that runs from the laboratories, via field labs at the campus to living labs in the city. It is a new method of working thanks to which innovations can be brought to market faster, because we know in advance what works and what doesn’t.”

### Knowledge valorisation as a core task

“This new way of doing research is a recent phenomenon. It has come about because the pace of development is faster than before and the role of universities has become broader: knowledge valorisation is currently a core task. In addition, many of the issues we study are characterised by a high level of complexity and interconnection. Many isolated topics have been more or less dealt with by now. Another relevant factor is that we need to move towards a sustainable economy. Fifty years ago, we could not have realised, for example, that plastic in rivers would become such a huge problem. To find a solution for such major urban issue, we need an institution like the AMS Institute.”

### Roboat

“A project that I personally find very interesting is Roboat. It’s scalable, offers a range of possible applications, and also

looks great. Scientists like that, it inspires and excites them. I also find it fascinating to contemplate the possibilities of a circular city and all its consequences. Take, for example, the circular kitchen: you no longer buy a kitchen, you lease it. This, in turn, forces manufacturers to recycle old kitchens. What does this signify in terms of design and production methods?

### Inspiration

“Besides research results, participation in the AMS Institute provides us with another very important thing: inspiration. Inspired by the questions that matter and their complexity: that is what energises us as engineers, scientists and researchers. It also inspires young people. This is reflected in the master Metropolitan Analysis, Design and Engineering, a joint programme offered by Delft University of Technology and Wageningen University & Research, using the city of Amsterdam as a case study and a living lab via the collaboration with the AMS Institute. In this way, we prove that we not just train young engineers, but also address societal problems. This is an example of how education can be meaningful to students and the city alike. The excitement of the students is also a great reward. Bursting with energy, they contribute their powerful thinking as well as a tremendous drive. All this comes together wonderfully within the AMS Institute.” <<



Artist's impression of a Roboat collecting waste. (Image: MIT/AMS Institute)

# **‘In a few years time, Roboats will be collecting waste in Amsterdam’**

When you think of Amsterdam, you think of canals. So it's only logical to include the city's waterways for solutions to challenges faced by the metropolis. One of AMS Institute's most eye-catching projects is Roboat. In the future, these autonomous boats will be used for numerous applications: from waste collection to inspecting quay walls.

“Roboat is more than a self-driving boat”, says Stephan van Dijk, head of Research and Valorisation at AMS Institute. Van Dijk sees the Roboat as a platform that can be used for all kinds of things. Obviously, you can use it for carrying goods and people. “But you could also line up the boats to build a temporary footbridge. Or use them as a floating stage on the water.” By linking them together, Roboats could also be used to build all kinds of structures.

### Floating supermarket

City planners are excited about the idea, because it adds flexibility to the urban infrastructure. “Today, things still have a fixed place, but in a few decades’ time you may well stumble across a floating market or temporary supermarket on the water.” Inspection of quay walls and bridges is another task for which the autonomous boats could be used. There are more than 200 kilometres of waterways in Amsterdam, and they will require a lot of maintenance in the coming years. At present, there is simply not enough manpower available to inspect all the city’s waterways. But with Roboats, this will happen automatically. During its journey, the boat automatically records its surroundings - bridges, quays, houseboats, obstacles on the water - with LIDAR and stereo-cameras, which can be analysed afterwards by image analysis software.

### Water quality

Or how about measuring water quality? That’s also something that can be easily combined with the other tasks performed by Roboats. They will soon be plying the city’s waterways, enabling the city to accurately monitor surface water quality. This will be done in close collaboration with Waternet. Although many of the applications are still a thing of the future, the project team is actively working on developing use cases where Roboats can be used to collect household waste in the Amsterdam city centre. At present, this is a major problem. “There is hardly any room on the narrow streets of the canals, and we have 17 different waste

collection services driving through the city with large trucks, causing traffic jams”, summarises Van Dijk. Moreover, it is very difficult to construct underground containers, because in many cases the quay walls are fragile and unsuitable for this purpose.

### Floating waste bins

A fleet of Roboats could manage those tasks. This works as follows: floating waste bins are moored alongside the quay. Using a smart system, people can throw their waste from the street into the bins, just as they are used to doing now. The waste bin is fitted with a sensor which transmits a signal when the bin is full, and along comes a

*‘This gives us true insight into the issues at hand. As a result, our innovations have a greater chance of succeeding in the market. Because there is a demand for them’*

Roboat which disconnects the waste bin from the quay and takes it to the waste disposal plant. In the meantime, another Roboat arrives with an empty waste bin to replace the full bin. All of this is done at night, because the Roboats are fitted with electric motors and are therefore very silent. “With around forty of these floating waste bins and a few self-driving Roboats, you can dispose of the same waste volumes that we handle today, servicing 1100 households”, says Van Dijk. The Roboats themselves determine the ‘smartest’ route and can have multiple waste bins in tow at a time.

### Pilot project in 2021

This may also sound somewhat futuristic, but the plan is to actually launch a pilot project in 2021. “We have now developed everything on a



Stephan van Dijk

small scale and are working on the autonomy and algorithms of the boats”, explains Van Dijk. Research is also being carried out on the transport system: what exactly should the waste bins look like and how will the system work. “By next summer, we will have the first two prototypes of a waste bin and a tug boat, which we want to test in practice in the Amsterdam canals.” If the 2021 pilot is successful, this will mean the technology is sufficiently developed to be implemented by a commercial party. “It could be a spin-off from AMS Institute or another party.” Van Dijk notices a growing interest in the Roboat from the maritime sector as well as from large Japanese and German electronics manufacturers. The latter includes suppliers of sensors and batteries. This growing interest from the business community is no coincidence. In the field of autonomy, the Roboat is already leading the way, says Van Dijk. “In our case, it involves a two-by-four-metre boat that needs to be very flexible. Since our perspective is completely different from that, for example, of the car industry, we can develop autonomous systems more easily and quickly.”

### Driving force for applied technology

When it comes to integrating solutions in the city, the AMS Institute is a driving force. This is entirely thanks to the close collaboration with the City of Amsterdam. >>





(Image: MIT/AMS Institute)

Roboat is a five-year project of the AMS Institute and the Massachusetts Institute of Technology (MIT). The second year of research was recently completed with the presentation of the first prototypes. From the research perspective, the project is primarily driven by MIT, but researchers from Wageningen University & Research and TU Delft are also involved. For example, Javier Alonso and Michal Cap of the TU Delft Robotics Institute have developed methods that enable Roboats to safely navigate the busy canals.

“As a result of this partnership, we have a very good understanding of the problems faced by this metropolitan region and the practical solutions required for solving these problems”, says Van Dijk. In addition, the researchers have access to all the relevant aldermen and policy makers. “From day one, you’ll be sitting together with the right people.” “This gives us true insight into the issues at hand. As a result, our innovations have a greater chance of succeeding in the market. Because there is a demand for them.” These are important considerations for companies to work with the AMS Institute. It all comes together wonderfully in the Roboat. “This is a project after my own heart. It involves science that you can immediately translate into a practical application.” <<



The canals through the ‘eyes’ of a Roboat. (Image: MIT/AMS Institute)



It is a site steeped in history: where, back in the 17th century, ships were built for the Dutch East India Company, Roboat prototypes are now plying the waters. The site plays host to the staff of the institute, students of the MADE (Metropolitan Analysis, Design and Engineering) master’s degree programme, researchers, start-ups and other partners of the AMS Institute. “Our relocation to Marineterrein is a very important move”, says managing director Kenneth Heijns. “This is becoming an ecosystem for everyone, where you can meet researchers, students, public administrators, and industry experts right in the heart of the city. From here, we will be setting up our living labs.”

The place is set to become a very lively part of Amsterdam (see illustration on page 17). Students will be taught on site, there will be





Marineterrein Amsterdam  
transforms into a test bed  
for urban innovation

# AMS Institute Campus

Practise what you preach. That's certainly what AMS Institute does. The institute recently relocated to Marineterrein Amsterdam, in the heart of Amsterdam. The location is being transformed into a vibrant hub where students and researchers are working with businesses and residents to develop new solutions for Amsterdam.

Aerial view of Marineterrein Amsterdam. (Photo: Siebe Swart)

a collaboration space for industry, government and science to work together on innovation, and the institute's partners are welcomed to work on the new location to further increase collaboration. There is even room for a makerspace. "When

experimenting in the open air or on water, as with the Roboat, one still needs a good place to work on it." Heijns would not be too surprised if a student team from Delft University of Technology or Wageningen University & Research also showed up

to work on special projects. Scientific Director Arjan van Timmeren calls Marineterrein 'the ideal place for developing solutions, designing and testing, as a breeding ground for Amsterdam as well as for cities worldwide.' <<

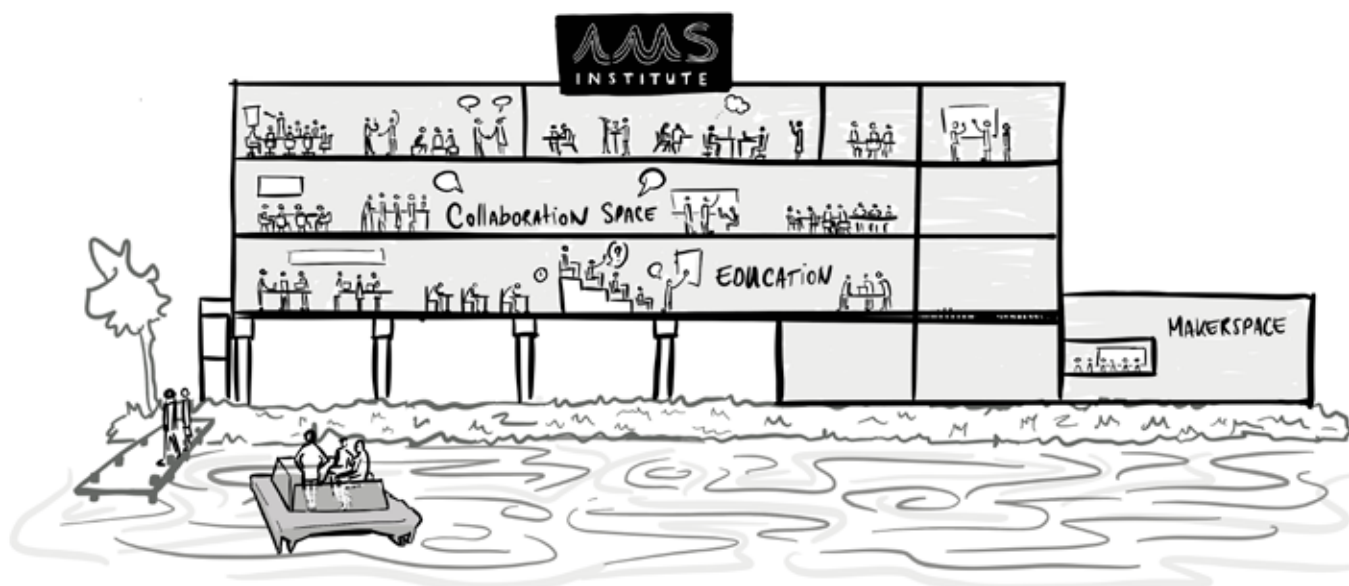


Illustration: Pascal Karthaus

Living labs play a central role in master's degree programme

# Education: Master programme Metropolitan Analysis, Design and Engineering

Students can obtain a master's degree in Metropolitan Analysis, Design and Engineering (MSc MADE). They are taught right in the heart of the city, and living labs have an important role to play here.

**“W**e educate urban engineers who, in the complex and confusing world of major cities, are capable of contributing to changes, have the courage to make decisions and are aware these often have unexpected consequences”, explains Arjen Zegwaard from Wageningen University & Research (WUR). Together with Maurice Harteveld, his counterpart from Delft University of Technology, he leads the MADE education programme. “All of the students share the same drive: a commitment to improve the city and make it more sustainable.”

## Living lab

The master's programme is an alliance between WUR and Delft University of

Technology and focuses on the topics of the AMS Institute. Students attend courses on metropolitan challenges and metropolitan solutions. The living lab plays a central role. “Whereas an internship is compulsory on many degree programmes, we rather like to focus on living labs”, says Zegwaard. “It enables us to get to a feasible solution more quickly”, says Harteveld. Students work with all stakeholders on a problem with lots of unanswered questions. The keyword here is ‘co-creation’: collaboration is key at all stages of learning. “No single actor can make metropolises move in a specific direction”, Harteveld explains. “Metropolitan solutions require cooperation between knowledge experts, as well as between city, citizens and civil society.”

This approach does justice to the

interconnected nature and complexity of today's problems, Zegwaard states. “It is 21st-century engineering at its best.”

## Generalist specialists

Students who have completed the master's programme are ‘generalist specialists’ and are able to pursue a wide range of careers. From advising municipalities, to running a business in the field of sustainable applications for metropolitan regions, explains Zegwaard. Harteveld calls them ‘metropolitan innovators’: experts able to build bridges between different stakeholders.

## Synergy

The alliance between WUR and Delft University of Technology results in ‘amazing synergy’, say both Zegwaard and Harteveld. The lecturers who teach the programme courses come from different backgrounds, which results in a very creative and innovative style of teaching. Zegwaard: “They clearly enjoy what they are doing and that rubs off on the students.”

## MOOCs, Summer Schools, and more

In addition to the MSc MADE, Delft University of Technology and WUR also develop MOOCs and Summer Schools for AMS Institute, while courses for business community and government professionals are also in the pipeline. <<





Student Laurens van der Wal on the MADE master's degree programme

# 'I really enjoy being at the vanguard, where all the innovation is happening'

As a bachelor student of Architecture and the Built Environment at Delft University of Technology, Laurens van der Wal and his sister Lena founded the design agency Walden Studio, which develops sustainable design on all levels from the urban scale, to 'tiny houses'. For his master, he opted for the MSc MADE. Van der Wal is now in his second year, and he is enjoying the programme. "If you really want to create sustainable products, you first need to understand what the underlying problem is."

For Van der Wal, MADE combines the best of both worlds: it is not only strongly application-driven and targets the real problems faced by major cities, but also offers a theoretical scientific basis with a focus on sustainability. This 'deeper knowledge' is needed in order to have a genuine impact. "At Walden Studio, we realised that the architect is often involved too late in the creation process of truly sustainable projects", says Van der Wal. "You need to be the party that takes the first initiative. In order to do that, you have to fully understand the problems involved."

## Reusing waste materials

The Master's degree programme that takes place at the AMS Institute offers Van der Wal the knowledge and skills he needs. Consider, for example, the waste disposal system in Amsterdam, which fascinates Van der Wal. "In the MADE courses, you start by looking at how the system fits together at the meta-level - how to recycle more in the city - before going on to see how it works in Amsterdam. You identify all the actors involved and try to link together all the different interests that are at play", he explains.

## Living lab

Van der Wal is currently conducting research in a living lab on the subject of waste. It is part of the AMS Institute's WASCOM project, which is investigating how toilet paper, for example, that ends up in the sewer can be reused as a raw material. Cellulose can actually be extracted from toilet paper, which can then be reused in bio-composites and other construction materials, such as façade panels. Some of the other involved parties are biocomposite producer NPSP, Waternet and ChainCraft.

## Vanguard

The 27-year-old student is among the first cohort of MADE students. This means that some things are new for everyone, but this is certainly not holding him back. "I actually enjoy

*'You need to be the party that takes the first initiative. In order to do that, you have to fully understand the problems involved'*

being at the vanguard, where all the innovation is happening." Van der Wal is still unsure what he plans to do next. But it is quite likely that Walden Studio will ultimately become a 'sustainable project developer', enabling his sustainable housing solutions to become part of a completely sustainable environment. <<



Laurens van der Wal

# 'AMS Institute delivers concrete solutions for the city'

AMS Institute was established at the initiative of the City of Amsterdam. Udo Kock, the alderman responsible (Economic Affairs, D66), has therefore been carefully monitoring the institute's numerous research projects. In an interview with Home of Innovation, he explains how impressed he is with what the institute has achieved so far.

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By Jurjen Slump

**T**he Roboat. Even Kock is fascinated by the wealth of possibilities offered by the autonomous boat. "Making a robot boat that can navigate through the canals is not actually that complicated in itself", he explains. "But it does become interesting when you consider the potential applications: collecting domestic waste, carrying construction materials and solving other transport and mobility problems".

It is even possible that, in ten years' time, when the Roboat will have been developed into a commercial product that navigates the local waters, Amsterdam's canals could again be used intensively for goods transport. "Just like three centuries ago", says Kock.

## Smart city

It was the City Council that, in 2012, called for the establishment of a technological Institute in Amsterdam to focus on the metropolitan challenges faced by the city, explains Kock. "How can you ensure that the city can continue to grow in a responsible way, without compromising on quality of life? How do you develop new forms of mobility? How do you implement the smart city concept? All of this is so complex that we cannot develop solutions in city hall alone." It was clear from the outset that education and research on metropolitan issues needed to come together within the institute.

It called for an interdisciplinary approach, centred around practical problems, with the aim of stimulating business through start-ups working on solutions. The City of Amsterdam invested € 50 million in the institute for a 10 year period.

Six years on, the first prototypes of the Roboat are now sailing through the canals. As the person with ultimate responsibility, Kock receives regular updates on the

*'It attracts students from across the world. One of the most recent summer schools involved some 70 students from 29 different countries'*

usable and interesting solutions that are emerging from the research. "I use what I learn in my discussions with colleagues on these issues. So many great and interesting things are happening!"

## Real-time crowd control

The Roboat may be a prototype, but SocialGlass, another innovation from the AMS Institute, has already proved its worth. It is a real-time crowd control system (see article on



page 22). “We put it to use during SAIL Amsterdam in 2015. Thanks to the system, we were able to point people in a particular direction using real-time information signs.” This involved hundreds of thousands of people. “You can see that it works. The system is now also being deployed in the red-light district and during other large-scale events, such as King’s Day.”

### Export product

Other major cities could benefit from these innovations. “Barcelona, Brussels, Paris. They are facing similar problems with mobility, traffic and pedestrian flows.” The City has appointed a chief technology officer, who also liaises with other cities. Through him, Amsterdam’s innovations are shared with other global cities.

“What makes the AMS Institute special, and therefore relevant for major cities, is that the problems being researched actually come from the real world of practice”, says Kock. You can only achieve that if you are also based in the city.” Intensive collaboration with the City of Amsterdam is also important to ensure that the right research is conducted. “We meet every two weeks to discuss progress in projects and explore how we can use the research results.”

### Education

Kock also has plenty of praise for the educational programme set up by the AMS Institute, with its Master’s

*‘What makes AMS Institute special, and therefore relevant for major cities, is that the problems being researched actually come from the real world of practice’*

degree programme MADE and various summer schools. “It attracts students from across the world. One of the most recent summer schools involved some 70 students from 29 different countries.” Extremely international. “It is also a very effective way of putting Amsterdam on the map as an interesting place for international students.”

### Concrete solutions

The AMS Institute is an academic success and is also attracting many international students to the city. But ultimately, it is all about the results, emphasises Kock. “It is delivering concrete solutions for problems that Amsterdam would like to see addressed as quickly as possible.” The process of knowledge valorisation is never easy, but the AMS Institute is certainly on the right track, concludes Kock. “This is a model that works.” <<



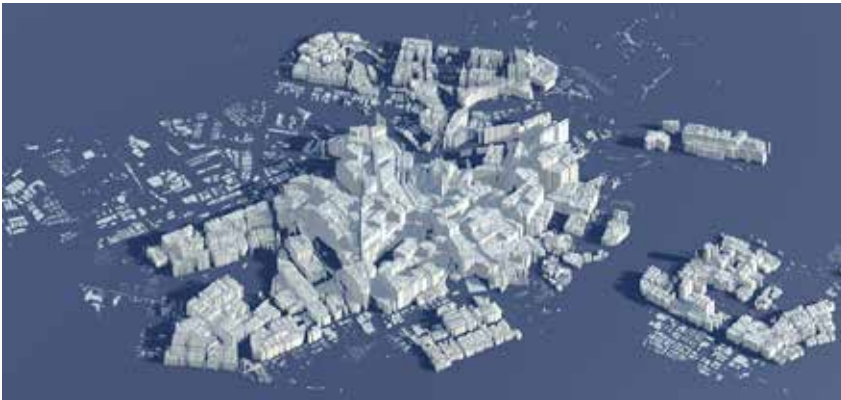
Udo Kock (Photo: Horus Fotografie)

# 'The role of data will only become more important'

Chatbots that provide the public with real-time information on gridlocks in the city. A bridge, connected to the Internet of Things (IoT), that records the number of people crossing it. A database containing the precise location of all the urban objects in the city. Data play a big role in cities - and will only become more important. Obviously, data also play a significant role within AMS Institute's projects.

By Jurjen Slump

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(Image: Erik Broertjes/AMS Institute)

"Ultimately, it's all about good decision-making", says data scientist Alessandro Bozzon. He heads AMS Institute's Urban Data Science Team. "You want to know what's going on in the city, what kind of policy needs to be pursued. And for this you need a lot of information." The goal is to use data to improve the quality of life. "Our job is to enable citizens, administrators, and scientists to extract actionable knowledge from data."

## SocialGlass

Bozzon and his team are involved in all projects involving data. They

ensure that the data are collected in an optimal manner, so that they can be properly integrated within various applications. In addition, the Urban Data Science Team develops ground-breaking innovations. A well-known project called 'SocialGlass' provides a readily available technical infrastructure to integrate in real time streams of urban data, for instance from social media applications such as

Twitter and Instagram.

On their smartphones, visitors and residents generate gigabytes of information each day about their activities in the city, and about their (social) environment. SocialGlass is a tool that enables policy makers to analyse this information in real time. Technologies such as machine learning and spatial data mining are used for this. As a result, it is possible for traffic engineers to work towards the prediction of the course of visitor flows in the city. SocialGlass was successfully used for instance, to monitor visitor crowds during the SAIL Amsterdam event in 2015, in a collaboration with the ALLEGRO team led by professor Serge Hoogendoorn. ALLEGRO is another project of the AMS Institute, aimed at establishing a comprehensive theory of active mode behaviour, considering the different behavioural levels for pedestrians and cyclists in cities.



Alessandro Bozzon



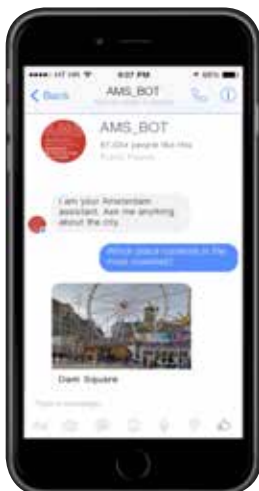
## Chatbots

One of the components of SocialGlass is a chatbot that answers visitors' questions about, for example, how busy a particular location in the city is. The new feature of the chatbot is that it can ask users questions in return. This also provides valuable information for the city and other users. All these data are combined and analysed in the City Simulation Lab where, for example, tourist flows can be simulated and predicted with high accuracy.

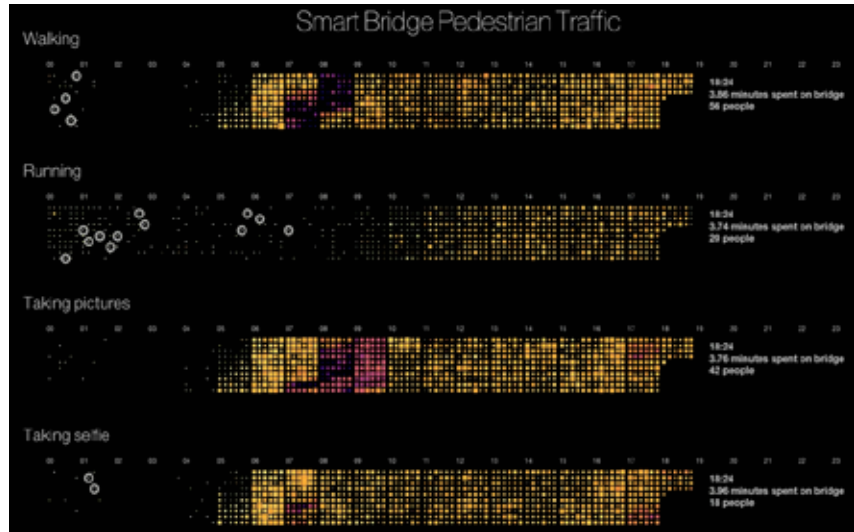
## Privacy

Of course, collecting all these data will have privacy implications, but this aspect has been given careful consideration. Bozzon emphasises

that everything is in accordance with the new European privacy regulations. What's more, the data are processed in a privacy-by-design manner, so that it cannot be



traced back to individuals. Bozzon's team includes about 10 people. Also, he is an associate professor affiliated to the faculty of Electrical Engineering, Mathematics and Computer Science at Delft University of Technology. At the university, another 10 people are working indirectly on topics related to AMS Institute's projects. This includes



The smart bridge provides real time information about pedestrian traffic. (Image: MX3D)

research on crowd computing and human-centred artificial intelligence, i.e. intelligent systems working together with people.

## Catalyst

The partnership within AMS Institute is an amazing catalyst for collaboration, both with other knowledge partners and companies and within Delft University of Technology. "We work together with the Civil Engineering, Industrial Design and Engineering, and Architecture and Built Environment faculties", he elaborates. "Since we are all working on issues with tangible impact on the life of people, all the usual collaboration barriers disappear."

## The future

Bozzon expects data to become ever more important in the next few years. "We are still in the early stages

*'Our job is to enable citizens, administrators, and scientists to extract actionable knowledge from data'*

in terms of the role that data are going to fulfil in the decision-making process." The Internet of Things

is also expected to take a big leap forward, with increasingly intelligent devices generating valuable data. Consider, for example, self-driving cars that supply data for mobility issues. Or the previously mentioned MX3D Bridge, where IoT sensing infrastructure developed by the team of professor Gerd Kortuem will provide information about the bridge's status and usage, in real time. Artificial intelligence will also claim a bigger role, so there will have to be a strong focus on ethical issues. "You need to make sure that people don't feel excluded."

## Education

In short: there's enough to keep Bozzon and his colleagues busy in the coming years. In addition, it is important that the field of education focuses sufficient attention on data and how to handle them. "At Delft University of Technology and within AMS Institute, we're training the next generation of engineers and professionals. Data are the alpha and omega within this field. It is therefore important for students to understand how to handle these data in a correct and responsible manner. This is just as important as knowing how to program software – maybe even more so." <<

# Facts & Figures

## Research Projects



### AMS Institute has 6 main themes

The distribution in % per urban challenge of the  
total project portfolio, per Q3 2018

METROPOLITAN  
FOOD  
SYSTEMS

10,2%

CIRCULARITY  
IN URBAN  
REGIONS

20,4%

SMART  
URBAN  
MOBILITY

16,3%

CLIMATE  
RESILIENT  
CITIES

13,3%

URBAN  
DATA &  
INTELLIGENCE

19,4%

URBAN  
ENERGY

20,4%



**101**  
projects

of which **69** running  
projects in cooperation with

**200**

researchers and

**150** partners

**21**  
projects

granted  
in 2018

€

**16 M**

Total portfolio value

**€ 56 M**

Annual portfolio turnover

**€ 14 M**



# Education

AMS  
MOOCs  
**43.000**  
enrolments  
worldwide

Number of  
organised  
**Summer  
Schools**  
since 2014:  
**9**

**2 AMS MOOCs**  
developed:

- Sustainable Urban Development
- Co-creating Sustainable Cities

3 AMS MOOCs in development



Summer School

**Making  
the Metropolis**

was well  
attended:

**70 participants**  
from  
**29 countries**

**MSc  
MADE**

**57** MSc MADE  
students  
**39** 1<sup>st</sup> year  
students  
**18** 2<sup>nd</sup> year  
students

enrollment capacity  
200 students  
(1st & 2nd year)

25

# PR & Media

The **Roboat** project (September 2016) received a lot of national and international media coverage, among others via the **BBC** and the **World Economic Forum**

Total media value:

**12,5 M**

**Social  
media**

**f** **t** **in**  
**2.254 3.220 1.644**

