A dot on the horizon

This spring will mark ten years since the Port of Rotterdam Authority and TU Delft started collaborating in what is known as the Port Research Centre Rotterdam-Delft. A look back and a selection of some of the current research projects.

Jos Wassink

The view from the 17th floor of the World Port Center is breathtaking. Off in the distance, the Noordereiland connects to the shore by means of an old railway bridge, while to the north high-rise buildings stretch all the way from the city centre to the river. Just below lies the Erasmus Bridge, under which speedy ferryboats and sluggish river barges pass each other in a dance that seemingly never ends. To the west, far beyond the old harbour district, the international Port of Rotterdam stretches all the way to the horizon.

This office on the Wilhelminakade is the workplace of company strategist Henk de Bruijn and senior advisor Teun Tuigtel, men whose broad views have allowed them to command such lofty positions. “We are about to face new challenges,” says Tuijtel, who from the start has been involved in the collaboration with TU Delft. “The current recession is an incentive for forward thinking.” Long-term planning, vision, and strategy – Henk de Bruijn likes to test his ideas in a dialogue with TU Delft: “Just hold up a mirror to us, whether we ask for it or not.”

“When we started, we considered TU Delft rather tunnel-visioned,” says Tuijtel, who, together with Professor Han Ligteringen, a hydraulic engineer at the Faculty of Civil Engineering and Geosciences, is the co-chairman of the Port Research Centre (Prc) programme council. “Collaboration between different faculties was awkward, but that has improved a lot. For the first two years we were simply testing the water, but after that the collaboration became professionalised – on both sides.”

This professional approach is reflected in the work plan, in which research projects are arranged according to theme, listing the responsibilities of TU Delft and the Port Authority. The research themes are Space, Access, Energy, and Miscellaneous. Every quarter a progress report is published in which a column lists the various projects, with smiley or sad faces indicating the progress of each project. Additional explanations include: ‘Project leader has left TU Delft’ and ‘Concept still to be finalised’, which the programme council must then decide about.

“We decided to use a project-wise method,” Tuijtel explains. Each research proposal must include a strategy plan, and must be approved by the programme council. Tuijtel: “It’s not quite as rigid a way of doing things as we’re used to in Rotterdam, but you need to be able to set deadlines and make..."
Highs and lows

Captain Leeuwenstein had already struck bottom three times that morning on an old bicycle, a piece of wood and various debris posed serious threats to his boat’s propeller. It was August 2003, and the low water level had forced river barges to reduce their speed and take detours. Whenever ships passed each other in the narrow, summertime channels, they would suck the water from around their decks of ships. Admittedly, the summer of 2003 was extremely dry, but still, climate scenarios predict that future summer droughts in Europe will become more frequent and last longer, and that water levels will sink even lower. Seventeen times over the past 14 years the amount of water flowing into the Netherlands via the Rhine fell below 1,000 cubic metres per second. According to the medium climate scenario for 2050, this figure will rise to 25 times, while the dry scenario predicts 60 times, which would render the dramatic scenes of 2003 yearly events. Little wonder then that the Port of Rotterdam Authority commissioned a strategic study of the effects climate change will have on inland shipping, an industry that accounts for 35 percent of the tonnage transported throughout the Netherlands’ provinces. The study resulted in a graduation project thesis, ‘Climate change and inland shipping’ by Carolien Boschieter (2005). She found that trends such as larger vessels and river levelling will exacerbate the effects of climate change. Boschieter’s graduation project supervisor, hydraulics engineer Professor Han Ligteringen (Civil Engineering and Geosciences), explains how a research programme, ‘Space for the River’, has been launched in an effort to reconcile the conflicting demands of safety and navigability. The outer (winter) dikes must be moved back to provide more room for the river, while the summer bed must also be maintained. The aim is to establish a narrow, deep channel as a climate-proof navigation route, flanked by open space on each side to accommodate extremely high water levels. ‘A tight summer bed and a spacious winter profile,’ is how Ligteringen describes it. There is however a risk that the narrow summer river will start meandering all over the wide winter bed. Meandering can be prevented by building groynes, or low dams that project into the river at right angles to the shore. ‘The challenge is to get the dimensions just right, so they will prevent the river from cutting into its edges, while still allowing it to carry off as much surface water as possible. We’re thinking of using underwater groynes. We’re developing the idea in collaboration with Deltateam,’ Ligteringen adds. Another development is the design of future river barges, which will have to be wider and lighter than the current vessels. Aluminium and plastics could be used to reduce the ships’ weight. During the summer, water levels are low because there is less drainage from meltwater, while during the winter, the Rhine’s flow increases as the amount of rain and snow in the catchment area increases. Add to this the rising sea levels, and the threat to Rotterdam from having water on both sides becomes alarmingly clear. ‘You want to keep the Rijnmond area open,’ says Tiedo Vellinga, director of environmental monitoring for the Tweede Maasvlakte land extension to the coast outside Rotterdam, “but water levels are rising. You can increase dike levels where possible along the approaches, but in the city itself you soon reach a limit. You simply have to resort to a flood barrier.” Two of those already exist: the Maeslant Barrier in the Nieuwe Waterweg, and the Hartel Barrier in the Hartel Canal near Spijkenisse. Both protect the Rijnmond area from the sea, but with the danger of flooding in future also coming from the inland side, the construction of flood barriers in the rivers could also be considered. Tien Rijksen prepared a sketch for the Veerman Committee’s report (‘Working together with water’, 2008), in which the Rijnmond area is surrounded by a ring of seven flood barriers. In the recommended scenario, ‘Open and closed Rijnmond’, presented to the Veerman Committee, the water from the Lek river will drain through an artificial ‘New Lek’ east of the area and be carried south in the Haringvliet, which will act as a water buffer. ‘It’s in the port’s interest to have the barriers closed as little as possible,’ Vellinga emphasises. ‘We’d rather have high dikes and a barrier that would seldom close. But there is bound to be lots of discussion about this issue over the course of the next few years.’ One of the consequences will be to restrict building activities outside the dikes, and greater scrutiny and discussion will be given to the status of all the various structures that have spread across the dikes over the years. Every report concludes with a list of recommendations, and ‘Climate change and inland shipping’ is no exception. Boschieter recommends that rivers be made suitable for both high water levels in winter and low water levels in summer. In the short term, problems with inland shipping could best be handled by means of information management. Low water levels can easily be predicted a few days in advance, leaving enough time to book alternative transport by rail or road. In the long run, the new ships constructed to expand or replace the existing fleets should be designed for use in shallower waters. Vellinga summarises matters even more concisely: ‘Climate change means lots of work.’ More information: Professor Han Ligteringen h.ligteringen@tudelft.nl phone: +31 (0)15 27 84285

‘For the next decade, Space and Access will remain the main themes’

As the collaboration progressed, mutual understanding grew. The Port Authority started to see that researchers – obtrusive though they can be – sometimes said things that made sense, and vice versa, with the university community developing a better appreciation of applied research. “We grew closer,” De Brujin summarises. Last year, the renewed collaboration agreement between TU Delft and the Port Authority included the funding of three professorial chairs at the faculties of Civil Engineering and Geosciences, Technology, Policy, and Management, and Mechanical, Maritime and Materials Engineering. An additional partial-time chair at the Faculty of Civil Engineering and Geosciences may follow later this year.

The Port Authority is willing to fund research, but also has certain expectations, such as clarity about the organisation, and especially about the results. De Brujin: “Will we agree to get the right results, or should we be happy whatever the results? Tuijtel joins in: “There has to be something in it for us. We don’t conduct research for its own sake; it has to have added value.”

mutual arrangements. We simply tightened the reins a bit.”

Henk de Brujin, the current director of corporate strategy for the Port of Rotterdam Authority, will soon take over Tuijtel’s position as co-chairman of the programme council. In De Brujin’s view, the collaboration with TU Delft is mainly explanatory: “We place a dot on the horizon, and then retrace our steps to see what we can do about it today. The projects are more intended for setting the agenda than being realised.” De Brujin says that collaborating with the university is especially useful during the early project stages, when both parties working together to narrow down the questions to a point where consultants and engineering companies can get to work on the construction stages. Tuijtel: “That’s the right way of doing things. You need to clearly define the boundaries together.” While De Brujin adds “If you ask a professor or a teaching assistant a question, you get an answer, but above all you get lots of answers you didn’t ask for.”
For the next decade, Space and Access will remain the main themes. In addition, both parties want more attention given to Energy and Sustainability. “We’re trying to get Energy accepted as a discussion point,” says TU Delft’s Stikkelman. “Think of CO2 extraction and storage, or coal gasification. Both are of major importance to the Rotterdam petrochemical industry.”

De Bruijn would like to establish a high-sustainability container terminal on the new port expansion area, with docked ocean vessels no longer generating their own power from polluting heavy oil, but rather using shore-based power instead. “The port as test bed,” as he likes to call it. The challenge for TU Delft and the Port Authority will be to inspire the major industries in the area, such as APM Terminals (APMT) and European Container Terminals (ECT), to become more innovative.

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Beyond traffic jams

The daily gridlock on the A15, the main traffic artery leading to the Port of Rotterdam, is more or less a fact of life. Every morning, trucks destined for Europort, as well as employees of the various local businesses, queue up in one seeming endless line of vehicles. And every evening they do the same in the other direction. According to Professor Henk van Zuylen, of the transport and planning section of the Faculty of Civil Engineering and Geosciences, this a typical example of diffuse traffic demand, which is, characterised by a wide dispersion of destinations, low demand per area, and a transport demand that is distributed across the entire day, even outside rush hours. Moreover, this is a situation in which buses, trains, trams and metros offer no solution to the traffic problem, so everyone simply travels by car and gets in line. Could passenger traffic be handled differently, in order to give heavy goods vehicles more room to move?

Just imagine, at the edge of a large car park, you enter your destination at a terminal, and within two minutes an electric shuttle arrives for you to board. The vehicle seats four and drives itself, following special tracks and passing over and through viaducts and tunnels. En route, this vehicle maintains a favourable speed of 40 kilometres per hour, which is not only faster than travelling by bike or bus, but also beats the average speed of a car. Since each destination has its own branch off the track, the other traffic can pass unhindered. Vehicles join the traffic flow automatically, maintaining a minimum distance of 60 metres (which corresponds to six seconds). No searching, no fuss, safe, fast and always available: the Personal Rapid Transit (PRT) system. The city of Cardiff, in Wales, has PRT running on a test track, and this autumn a PRT system built by the Ultra company will enter service at London’s Heathrow Airport.

Van Zuylen, who believes a similar system could solve many traffic problems, including pollution, traffic distress and time loss due to delays, has asked various researchers to conduct a feasibility study. The researchers will use a questionnaire to present the system to people working in the port area, asking them whether they would want to switch to PRT and how much they would be prepared to pay for the service. The survey’s results will be used to estimate the required system capacity and calculate the costs and returns. The final report is expected by the end of 2009.

The system also offers environmental benefits. Weighing only 700 kilos, each vehicle will have an average power of 2 kilowatts. Even at a low occupancy rate of 1.4 passengers, and 40 percent passenger capacity rate, this would mean an energy saving of 75 percent compared with a private car. Even better would be to fit the system with solar panels and the occasional windmill, which would generate 60 to 80 percent of the required power.

Subject to the outcome of the report, Van Zuylen believes a limited PRT system would be ideal for the expanded port area, which includes plans for a hotel. How would guests reach their destinations from there at various times of the day? That is a diffuse transport problem, as we now know.

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The Northeast Passage is an old dream. In 1596, seafarer and explorer Willem Barentsz undertook his third attempt to sail east, past the northern coast of Scandinavia. His expedition however got caught in the ice at Nova Zembla, forcing the captain and crew to bunk down for the winter. The return voyage couldn’t be undertaken until June of the following year, and just two weeks into that return trip, Barentsz died, on 20 June 1597.

Until today, that is. Leon Lammers recently completed his graduation thesis project on the feasibility of shipping containers along the Northern Sea Route (NSR), as the route through the Arctic Sea is known today. Lammers completed the interfaculty Master’s course of Transport, Infrastructure and Logistics (TIL), offered by the faculties of Technology, Policy, and Management; Civil Engineering and Geosciences; and Mechanical, Maritime and Materials Engineering. His graduation project was supervised by Professor Bert van Wee (Technology, Policy and Management).

Satellite images reveal that the ice covering the arctic region is retreating at a rate of about three percent per decade. The average ice cover at the end of the artic summer - around October - is now 20 percent less than it was 30 years ago, a trend that is expected to continue at an increasing rate. In 2006, for the first time, the ice pack had retreated far enough for a ship to sail from Norway all the way to the North Pole, which certainly won’t please the polar bears, but does offer the perspective of a shipping route to Asia that is 40 percent shorter than the route passing through the Suez Canal. Given the present state of affairs, the Port of Rotterdam Authority wondered under what conditions a shipping route to the Far East would be viable around the years 2030 to 2040.

Lammers based his climate prediction for 2030 on international climate panel (IPCC) reports, while also envisioning a world in which extensive trade and order prevailed. He then explored the effects that such a route would have on the shipping industry in general, and on Rotterdam in particular. Lammers also studied the kind of actions that would be needed to facilitate the scenario of economic progress. This method is known as backcasting – instead of making predictions, one looks back on the present from the future and tries to find out how to arrive at that specific future scenario for the world, rather than some other. According to Van Wee, backcasting is a popular method for studies with a high ‘what if’ aspect: “If you want to know the possible relevance of the access to a route, you take access to that route as a given.”

Although this may come as a disappointment to many people, in his graduation thesis, entitled ‘The possibilities of container transit shipping via the Northern Sea Route’, Lammers concludes that any effect on the Port of Rotterdam would be minimal. First of all, ships would need to be smaller and stronger, and adapted to arctic conditions. Lammers: “Suppose a shipping company were to start a weekly shipping service. They would need six ships of 100 million euros each. An investment of 600 million euros is quite something. On the other hand, the volumes involved, given three to six months of ice-free passage, would be about one half to one percent of what currently passes through the Suez Canal. It would take great effort to corner just a tiny section of the market.”

What does offer financially viable prospects, according to Lammers, is the export of oil and gas from the polar region. His advice would be to monitor the developments on the ice cover front, as well as those in the northern oil and gas industry. Companies based in the Port of Rotterdam should try to get involved in this development.

In the longer term, while it’s conceivable that the Northern Sea Route could someday trace a straight line across an iceless Arctic Ocean, the resulting two to six metre rise in sea levels would be very bad news for Rotterdam. Van Wee: “In such an event, there would be other things to worry about. There would be major implications.”

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Better than Barentsz