DISPUUT TRANSPORTKUNDE PANDORA

NetwerkNieuws.

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Solar Boat

PHD research
Marc Fransen

From the Staff
Hans Veeke

Operations Manager
Operations Clerk
IN BOX
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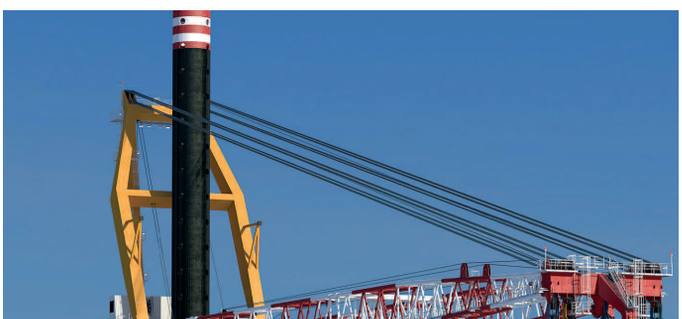

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Colofon

Dispuut Transportkunde
Mekelweg 2, 2628 CD, Delft
E: info@transportkunde.nl
T: +31(0)15-2786566
W: www.transportkunde.nl

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FROM THE STAFF

By: Hans Veeke

Als je geboren bent in het jaar waarin Elisabeth II tot koningin werd gekroond, weet je dat er een eind aan je werkzame leven gaat komen. Ja, jongens en meisjes (èn iedereen die zich hierdoor niet aangesproken voelt), ik heb de moord op John F. Kennedy nog bewust meegemaakt……

En zo kun je nog een paar uur doorgaan, maar dat heeft geen zin. Met gezonde tegenzin ga ik met pensioen, en ik mag me gelukkig prijzen dat ik dat in redelijke gezondheid heb bereikt. Niet in de laatste plaats door de prettig uitdagende samenwerking met studenten en collega's. Steeds weer werd ik gestimuleerd het onderste uit de kan te halen, en heel soms wisten jullie ook het bloed onder mijn nagels vandaan te halen. Afstudeerders die beginnen met het genereren van oplossingen, voordat het probleem duidelijk is onderbouwd: ik kan er nog steeds niet goed tegen. Misschien omdat ik prof. Jan in 't Veld nog heb meegemaakt (en erdoor gedrild ben). Hij had een volledige masterstudie alleen gewijd aan het juist formuleren van een vaag omschreven probleem. Dat was de sectie Industriële Organisatie, die bij het pensioen van prof. Henk Bikker in 2003 werd opgeheven. Dat was al een duidelijk signaal van een klimaatverandering: er moest gepubliceerd, gepromoveerd en onderzocht worden; DAT werd de prioriteit van deze universiteit. Daar legden in 't Veld en Bikker nou juist niet de nadruk op; zij stoomden ingenieurs klaar voor die "weerbarstige" praktijk en beschouwden de industrie als hun laboratorium, en niet als iets dat per definitie tien jaar achterliep op de nieuwe methoden en ideeën die op de TU werden ontwikkeld. Ik was in 1995 nota beide bene op basis van mijn praktijkervaring toch weer zonder probleem heringetreden bij die sectie.

In 2003 volgde voor de stafleden van Industriële Organisatie een kerst vol onzekerheid. Gelukkig kon ik samen met Frans Sopers het werk voortzetten bij prof. Gabriel Lodewijks, die het belang van een systematische benadering voor probleem- en oplossing formulering voor het industriële veld herkende. Het gedachtegoed van Industriële Organisatie was voorlopig gered en werd ondergebracht in de master Production Engineering and Logistics (PEL), naast de transport-master Transport Engineering and Logistics (TEL). We probeerden het onderzoek in PEL te ontwikkelen d.m.v. de toepassing van nieuwe technieken op nieuwe gebieden(RFID en robots bijv.) of bij sectoren als gezondheidszorg en groente- en fruitteelt, waar logistiek gezien nog veel te winnen is. Het was een moeizaam proces, dat vooral door de onderwijsinspanningen achterbleef bij de verwachtingen, maar de waardering voor het denken

De ontwerpers van het DSA erfgoed

in systemen en processen bleef onverminderd hoog. PEL heeft 10 jaar min of meer zelfstandig bestaan en bijna 150 ingenieurs afgeleverd, die allemaal zonder probleem in de industrie of advieswereld terechtgekomen zijn. Samen met Frans Sopers en Albert Valkenberg kijken we met veel voldoening op de PEL-periode terug.

Kern van het PEL-programma was uiteraard The Delft Systems Approach. Naast de colleges Systeembenadering en Discrete Simulatie, volgden de studenten gedurende drie kwartalen de masterclass, waarin cases uit de praktijk werden behandeld. De meest succesvolle case is altijd de LIRA-case geweest, het optuigen van een productielijn geïllustreerd met LEGO-autootjes. Een foto hiervan met Wiggert Kalis is zelfs jarenlang te zien geweest op een wervingsfolder voor TEL/PEL! Ook werd het onderwijs aanschouwelijk gemaakt met excursies en een groepsopdracht in de praktijk. Ik herinner me nog een zeer succesvolle case bij Broekman Car terminal over het invoeren van RFID bij het vinden van auto's op een gigantisch groot terrein.

Als ik terugkijk op 40 jaar werken (waarvan dertig min of meer bij de TU) dan komen er herinneringen aan heel veel dierbare collega's en studenten boven drijven. Teveel om allemaal op te noemen, want dan zou ik er zeker enkele vergeten. Ik beperk me daarom tot enkele collega's die veel voor me hebben betekend (en niet ook al zijn genoemd in mijn proefschrift uit 2003).

In de eerste plaats zijn daar Rob Sierenberg en Onno de Gans, die samen de benadering van discrete simulatie hebben ontwikkeld zoals nu toegepast wordt in Tomas en Salabim. Rob ontwikkelde de visie van de benadering en kon complexe zaken in slechts enkele eenvoudige processen weergeven en Onno was in staat om alles te realiseren. Een ijzersterk duo waarvan ik veel geleerd heb. Generaties studenten zijn opgeleid met hun taal PROSIM, en ik ben blij betrokken te zijn geweest bij de ontwikkeling ervan.

Bij Industriële Organisatie was Sjaak Vos degene, die me duidelijk maakte dat de ingenieurslogica moet functioneren in een menselijke wereld. Dat was de sleutel om hersenspinsels en praktijk met elkaar in verbinding te brengen (een belangrijke case van hem was "De kunst van het kijken"). Begin te denken vanuit de omgeving waarin het moet functioneren, en ontwikkel het samen met die omgeving; als ingenieur heb je slechts een beperkt en gekleurd beeld van het te ontwerpen object. Software ontwerpers zouden daar nu veel van kunnen leren.

Het is raar, maar bij elk team waarvan je onderdeel uitmaakt zijn er altijd een paar waar je meer mee hebt dan de rest. Bij TEL was dat -naast Jaap Ottjes- vooral Karel Drenth. Wij hadden gedrieën ons "overleg" altijd 's ochtends vroeg en hebben vele malen de wereldproblemen opgelost. Karel was een echte ingenieur, had veel lol in het bedenken van de ontwerpwedstrijden en rekende bijvoorbeeld in enkele seconden uit hoeveel kolencentrales extra we nodig hebben wanneer alle auto's volledig elektrisch worden aangedreven. Dat zijn er nogal wat, dus begin dan niet allemaal te rekenen aan het aantal laadpalen wat je nodig hebt. Karel maakte me duidelijk dat een berekening op de achterkant van een sigarendoos uitstekend geschikt is om gevoel voor een probleem te krijgen. Karel overleed helaas in 2010, vlak voordat hij met pensioen zou gaan.

Vervolgens ging Jaap met pensioen in 2012 (Frans Sopers was al in 2009 vertrokken), en volgde vorig jaar het onverwachte vertrek van Gabri Lodewijks naar Sydney. Ik voelde me langzaamaan een

'De leiding van te veel bedrijven is uitsluitend in handen van economen geraakt en het ontbreken van technische kennis binnen het topniveau begint zich nu te wreken', prof.ir. Jan in 't Veld

(Foto's: Benelux Press, Den Haag)

vreemde in de eigen sectie (hoewel ik met Wouter Beelaerts van Blokland heerlijk kon bomen over het vakgebied en de toestand in de wereld in het algemeen en over voetbal in het bijzonder). Je merkt wel dat het klimaat op de TU is veranderd, maar zolang er vertrouwde gezichten om je heen zijn, is daar prima mee te leven.

Ik kreeg van een van mijn laatste afstudeerders het boekje: “Haalt de universiteit 2040?”. Ik stel me die vraag ook wel eens; laatst nog toen een van mijn collega’s reageerde op mijn opmerking “ik geloof er niet” met de opmerking “ja, maar het hoeft ook niet te werken!”. Een betere illustratie van de klimaatverandering is niet mogelijk. Ik vind iets pas een wetenschappelijke ingenieursuitdaging wanneer het eindresultaat daadwerkelijk moet functioneren. Wetenschap wordt anders een gesloten systeem, dat zichzelf in stand houdt. Daar ligt voor mij het fundamentele verschil tussen een “Universiteit” en een “Technische Universiteit”. Techniek is geen wetenschap zonder realiteit. Een architect (bouwkundig ingenieur) wordt niet beroemd door de gebouwen die hij heeft getekend, maar door de gebouwen die daadwerkelijk zijn neergezet.

Wij (als TEL) zitten nu midden in de discussie over autonomie van transportmiddelen. Pas als het spoor volledig onbemand en autonoom kan rijden, vind ik het een uitdaging om dat door te trekken naar het vrije auto- en scheepvaartverkeer, en tenslotte pas het 3-dimensionale vliegverkeer (ik las vorige week nog in de krant dat er de komende twintig jaar wereldwijd 790.000 piloten nodig zijn).

Uitdagingen genoeg, maar laten wij als sectie TEL nooit vergeten, dat we ingenieurs opleiden om de omgeving op een veilige goeddoordachte (systematische) manier verder te ontwikkelen.

Tot slot: iedereen bedankt voor zoveel geweldige jaren. Het gaat jullie allemaal goed!

Did you know:

The most popular car color is white.

FROM THE BOARD

By: Frans de Groot

At the beginning of our study year, when we were selected to be the new board of Dispuut Transportkunde Pandora, we set a couple of goals we wanted to reach. One of these was creating a strong bond among the TEL students. This may not seem as a significant goal, but I disagree. Not only did we find help from each other during difficult assignments or preparing for exams, there were also a lot of moments next to our study that we got together. A WhatsApp group was created for students from TEL that like to play beach volleyball or another sport from time to time. TEL students met with each other to play videogames and have some drinks in the evening. During each company excursion and TEL activity students got know each other more and more. Until at some point we were not only fellow students anymore, we have become friends. Enjoying your study is nice, but it only lasts for two years (in some cases a little longer), while friendships are forever. I dare to say that our goal is reached.

I want to thank everyone from TEL, students and teachers, for the wonderful year. Thank you fellow board members, this year would not have been successful without you. Thank you. Frans out, Jurian in.

Did you know:

Rotterdam port handled 467.4 million tons of goods.
In total 8.2 million containers, 13.7 million TEU. That is provided by 29.6 thousand sea ships!

SMOELENBOEK

Boelhouwers, Jules

Bogerd, Gerrit van den

Bouwens, Daisy

Brink Carvalho, Eva

Bui Duc, Franco

Cappon, Paul

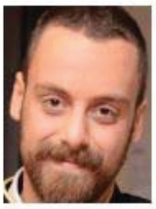
Crombag, Pim

Dijk, Jurian van

Hepworth, Matt

Hoogendoorn, Gerben

Leeuwen, Anouk van

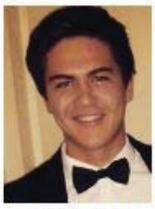

Logothetis, Dimitris

Overes, Frank

Pauwels, Alex

Rasch, Tycho

Schoorl, Daan

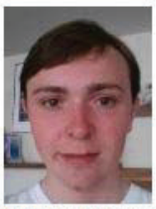

Smit, Neil

Sprokkereef, Jasper

Sridhar, Shreyas

Stuijt, Lin

Theodoridis, Nander


Tholen, Max van der

Verbeij, Marco

Wassenaer, Friso van

Wijnands, Patrick

Wijsman, Bram

Zeijl, Jelmer van

Did you know:

66% of the world's 130 million bicycles made are in China.

Bigger and bigger wind turbine installation cranes: what next?

For a long time we at PES have been saying that components in the wind industry are getting bigger and bigger and obviously this includes the tools of the trade. How much more increase can there be in size and how does this affect the weight?

HUISMAN EQUIPMENT B.V.

By: Huisman Equipment

Huisman from the beginning

Before looking at the developments in the wind industry, let's take a closer look at Huisman, one of the manufacturers of offshore wind tools and cranes, and start at the beginning. Huisman, founded in 1929 and was originally a construction company for steel structures and derricks.

In 1987 Huisman joined forces with engineering company ITREC to develop steel construction projects entirely under its own management. In 1983, during the early ITREC days, the mast crane concept was developed: a compact and innovative crane design for heavy offshore lifts: the Heavy Lift Mast Crane. Another important development from the early days is Active Heave compensation. Currently, this system is also delivered in an electric version, with frequency controlled motors. Unlike in the second half of the eighties, when everyone considered 300m water depth to be extremely deep, indeed nowadays, we consider this to be shallow water. With innovation being at the heart of the company, Huisman kept on developing crane designs towards the foreseen future applications, in deeper water. Good examples are the newly designed Hybrid Boom Crane, which won the OSJ innovation of the Year Award in 2015 and the set of two 10,000mt cranes which are currently under construction for Heerema's Sleipnir, the world's largest to date.

Building on the successful operation of the existing Huisman cranes, for the installation of offshore wind turbines, such as the crane on board the Rambiz, the company introduced a range of cranes and tools tailored toward wind turbine installation and maintenance. These cranes and tools are a result of many years of research, design and operational experience, based on the company's determination to design and deliver new solutions, which add value to the market's existing technologies.

In addition to cranes, Huisman entered the market for Pipelay systems in 1996, with a Rigid-lay system for the Acergy Falcon. This was the take-off for an impressive number of Flex-lay, S-lay, J-lay and Reel-lay systems and combinations of these: Multi-lay systems.

Huisman has delivered many different pipelay systems over the years, with the most complicated of these being in 2012, a Multi-lay tower combining an 800mt Reel-lay, including 3,000mt portable reels and a 2,000mt J-lay System. The offshore drilling market followed in 1998.

Today, the company is known for its advanced and pioneering pipelay solutions and its ground-breaking Multi-Purpose Tower (MPT). In 2012 the Huisman MPT received the Dutch Maritime Innovation Award. The design of the MPT has been further developed, resulting in the full scale, 90m high, 1,630mt rated load, full robotics, test tower located at the quayside of Huisman Schiedam and capable of handling 180ft stands and 150ft risers. Any and all newly developed drilling technology is thoroughly tested on this test tower, also known as the Huisman Innovation Tower (HIT).

Since the turn of the century Huisman has grown into a major provider of pace changing technical solutions to the world's leading companies in the oil & gas, renewables, leisure and civil industries. With innovation, product development, quality, reliability, safety and sustainable growth as key company values, the company continuously searches for technical solutions to improve efficiency, safety and to also diminish any negative impact on the environment.

The present and looking forwards

Recently, Huisman delivered the world's largest Leg Encircling Crane to one of its clients. With the installation of the crane on this vessel it now has the strongest crane on a jack-up vessel ever built. The crane is capable of lifting 1600ton and was ordered to keep up with the increasing dimensions of offshore wind turbines.

Huisman's design philosophy is to minimise the crane's impact on a jack-up vessel. One of the most important issues with a jack-up vessel is the jacking capacity and the maximum allowable load on the legs. In order to get the maximum deck load available, attention is given to some severe weight reduction. This ensured that the existing 900mt crane could be taken off and replaced by a lightweight Huisman 1600t crane, with only a minor weight increase to the vessel.

Cees van Veluw, Huisman's Product Manager Cranes: 'In our engineering process, we pay a lot of attention to weight control. All steel and components we put into the crane must be as lightweight as possible. As the total weight is important, we sometimes need to actually spend money to reduce the crane's weight. Like Colin Chapman from Lotus says, we add some 'lightness' to the crane.'

Being in the renewables sector, a lot of attention is paid to the energy consumption of the crane as well. These cranes are always equipped with full electric drive systems. This type of drive system uses variable frequency drives, thus enabling much better energy efficiency for the total crane.

During lifting operations, the crane is on stand-by for a long period and the actual time that the crane is fully functional is relatively short. A crane, with a traditional electro-hydraulic drive system, typically consumes quite a substantial amount of power just to keep the crane on stand-by. This stand-by power consumption is brought back to a minimum level by using a full electric variable frequency drive system.

Additionally, the full electric drive system ensures a very high accuracy during operations. As these full electric drive systems have direct control on the winch motor, instead of on some non-direct valves that come with hydraulic systems, the control of the hook is much more direct, which is very useful when positioning the objects that need to be installed with the wind turbine.

The slew bearing of the crane was produced in-house. The Huisman segmented slew bearing design, developed in 2007, means the issue of the vessel's flexibility to the loads in the slew bearing has been resolved. This leads to a much longer lifetime

of the slew bearing, compared to traditional designs. While this crane has a slew bearing diameter of 14 meters, this segmented set up can be produced in other diameters as well. The largest one produced so far is the 30metre diameter slew bearing for Heerema's Sleipnir 10,000mt cranes.

While the crane is today's biggest Leg Encircling Crane with its 1600ton SWL, even larger crane designs are on the drawing board. With some trends looking into 15MW to 20MW turbines, suitable cranes for these sizes are available. Not only will the SWL increase, also other features may become available in this segment. With a drive for long booms for the turbines themselves, the SWL increase is mainly driven by the foundation work, which may not require such a long boom.

With this in mind, the Huisman Foldable Offshore Crane is also available as a Leg Encircling Crane. This is suitable for foundation installations, with a relatively short configuration, whilst having a long configuration option available for turbine installation. However, it does not require any telescoping mechanism and thus adds to the reliability and lightness of the crane.

More and more attention is being paid to digitisation. Digital assistance, with the upending of components, is just one example of what is seen as the near future trends and is expected to be one of the improvements that will further contribute to the reduction in installation time. This a constant drive in the wind turbine installation industry and Huisman is ready to take up any future challenges.

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INTRODUCTION DAYS

By: Frans de Groot & Pieter Bouwstra

This year Dispute Transportkunde Pandora organized the introduction days for the new TEL-students on the 4th and 5th of September. Goal of the introduction days was to familiarize the students with some topics and companies that the TEL-industry has to offer. However, the most important reason for new TEL-students to attend the introduction days is to get to know your fellow-students and have a great time together!

The first challenge of the program was faced by the students at approximately 06.00 a.m. Tuesday morning: their wake-up alarms. Probably most students didn't enjoy coming out of bed this early, however, this was required for the first activity of the introduction days: a visit to Royal Floraholland. At 08:00 a.m. we arrived at Royal Floraholland in Aalsmeer, which is the largest flower auction in the world and processes more than 34 million flowers a day on average. Our visit started with a tour through the facilities. It was impressive to see all buzzing logistics process on the warehouse floor. The building of Royal floraholland is the largest of Europe when it comes to the area it covers. During the tour we got an explanation about the auctioning process from one of the auctioneers and took a look at the auctioning room with its auction clocks. After the tour the students were put to work to think about the company of Royal Floraholland themselves. We studied a case that focussed on the future challenges and reasons of existence for Royal Floraholland as more and more flowers are sold through direct sales and not through auctioning anymore.

After the case at Royal Floraholland the bus took us back to the TU Delft where the students received a lunch before the pubquiz organised by Nemag took off. Manual and Wilbert from Nemag prepared an exciting and interactive pub quiz centered around the bulk transportation sector. Through a sequence of typical TEL question the winner of the desirable nemag price was determined. Surprisingly, there was one team far ahead of all the others and that team can now proudly call itself the Nemag Pubquiz winners of 2018!

After brief TEL-introduction presentations by Mr. Duinkerken en Mr. Pang we traveled to the "Kubus-woningen" in Rotterdam and had a drink at the old harbor right next to our stay-okay hostel. This was also a moment for everyone to relax and recover a bit from the intensive program of that day and the early rise.

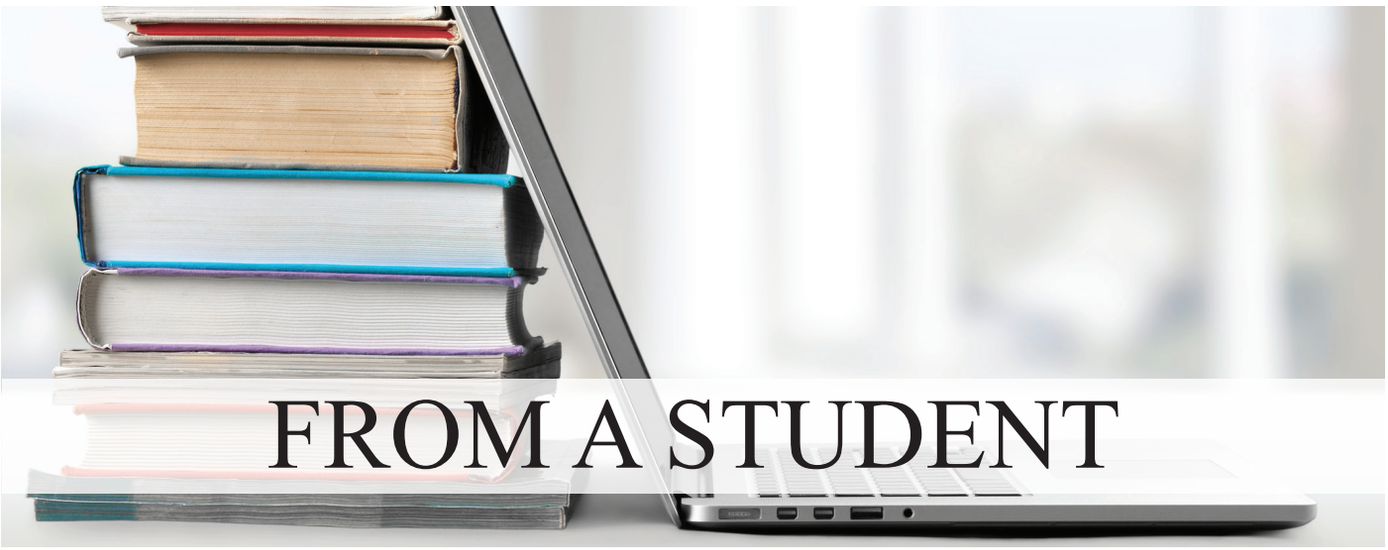
After dinner a boat-tour through the harbour of Rotterdam was arranged. On the boat Mr. van den Bos organized a lively TEL-quiz. This scenery of Mr. van den Bos managing a pub quiz on a boat in the harbor is probably the most TELish experience anyone can get. The boat tour finished around 22.30 and most of us found it far to early to go to bed. Most of the group transported themselves to the Witte de Withstraat. This street is filled with restaurants and nice bars. We all had some more drinks here and casually talked with each other about the quiz and what was more to come. Some were brave enough to visit the Apres Ski bar, but most went back to the hostel for a good night rest.

The next morning it was obvious that some were not present for breakfast, I guess they forgot to set an alarm. Around 11.00 we all hopped in the bus and went to the Air Force base in Woensdrecht. We were welcomed by C-981 SQN, Dienst PLV and the commander of the Air Force base, Richard Laurijssen. It was very unusual for commander Laurijssen to be present at an event like this. He found it important to give a short presentation about the activities and the importance of the Air Force. It was an impressive and convincing speech. After the speech of the commander, we had a presentation about the history of Air Force Woensdrecht, what they all do there and what will be the future of the Air Force base. Next, we had a restricted tour through the base. Multiple companies are stationed at the base, for instance Fokker and Aviolanda. These companies do not want everyone to see what they are doing and how they do it. It is interesting to see how public-private relations have formed over the years. Why would there be such a relation? An example of the advantage of the public-private partnership is that the Air Force base supplies space and the companies provide people. It was easy to distinguish who was working for the companies and who worked for the Air Force. Company employees wore company outfits, while the people from the Air Force wore their uniform. One of the things that stood out most during the tour were the massive (jet) engines. Sadly, we were not able to see F16's, apache helicopters or chinooks, but at least we got to see the engines up close! During the tour they showed us the workstations at which parts were repaired or replaced. We were asked to watch carefully how it goes, since there would be a short case at the end about the maintenance logistics. The case was mainly about the transportation of the components from one station to another. Every station has its own specialty and most parts require more than one treatment. Not every station works equally fast which created intermediary storages. Also, how does one component get to the next storage? A push or pull system? These were all part of the case and we gave our opinion about the current situation and improvements. After a successful day, we all went back to Delft by bus.

Arriving in Delft, we went to the Italian restaurant Ciao Ciao. Teacher Mark Duinkerken joined us during dinner and had a conversation with a couple of the students. Hopefully Mark did not scare the students too much about the coming courses. The introduction days were officially at an end after dinner. A couple of us went to a bar to meet some of the second year TEL students, but most went home to prepare for the coming week. It would be there first week as a TEL masters student.

Did you know:

The world's fastest train is the Maglev – in Shanghai – which can cover 30.5km in eight minutes. It runs with maglev technology, 'magnetic levitation', meaning there is no friction so the vehicle makes virtually no sound when travelling.



FROM A STUDENT

By: Pim Crombag

Hi everyone,

You may recognize my face from the TEL group. I am Pim Crombag and I started last February with my master's degree Transport Engineering and Logistics. I started in February because I first needed to finish my bridging programme.

During my bachelor Civil Engineering I wanted to do more with logistics and transport systems. I followed a minor in the Transport Infrastructure and Logistics. The programme was very interesting but I missed some aspect of making logistic systems, machines or companies smarter. Automation already plays a big role in our lifes, but I think we can let it play a much bigger role. We, people of TEL, can make large differences using automation.

Last year I participated some business courses with Pandora at lots of different companies. I liked to see how pleased every company was to welcome us. Most of the time we get the chance to solve problems for companies we visited. It was very interesting and working together with my fellow TEL students made it even nicer.

As this is my start, I hope to speak you all in the following two years (or later).

Regards,

Pim Crombag

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M: +31 629065861
E: johan.pruisken@rhdhv.com

royalhaskoningdhv.com

SOLAR BOAT

By: Redmer Aarnink

Did you know that the largest 16 ships sailing the world produce as much sulphate as all cars in the world combined? And there are a lot more than 16 ships sailing the world right now.

We are the TU Delft Solar Boat Team and we are a Dreamteam that designs and develops hydrofoil boats powered purely and solely by solar energy. The hydrofoils lift the hull out of the water, decreasing water resistance drastically. As a result the boats can reach astounding speeds using the same amount of power as two mere water boilers.

The team

The TU Delft Solar Boat Team is completely run by students, of which the composition changes every year. This year, the 2019 team will design and build a completely new boat. The current team consists of 25 students from ten different faculties from the TU Delft. Most of these students have put their degree on hold for a year to work full time on the solar boat.

Our vision and goals

Since 2006 the TU Delft Solar Boat Team has inspired the maritime sector to work towards more sustainable shipping. We did this by showing what a student team can do on inland waters through the innovative use of solar power. In which we have succeeded by having a lot of interaction with the industry. But this year we go big, this year we will step up our game. We will participate in the

challenge the maritime sector is actually about: The Offshore Challenge. We will be representing The Netherlands as the only Dutch student team in this competition. And we will design and build a Solar Boat from scratch. This boat will have to handle the rough conditions of the open oceans with a boat that carries three people. The Netherlands has always been one of the leaders when it comes to innovations in the maritime sector. And the time has come for the next generation of shipping: the sustainable era. The maritime sector is extremely polluting and conservative. It is our job to find innovation with the

industry, to create new possibilities, we will be the pioneers of sustainable shipping. We will work for one year to build a SolarBoat with which we can win the Independent Offshore Class in Monaco and set a world record on crossing The Channel on Solar Energy.

About our year: The design phase

At this moment we are just done with our 'Top Level Concept' phase. This means that we have made the first decisions about what our boat will roughly look like. What its dimensions are, how many hulls it will have and what size the solar deck will have. Through the coming months we will become more and more specific in what our boat is going to look like. We have just started with the 'Sub Level Concept' phase. In this phase we will look at specific parts of the boat like the driveline, engine, struts, hull(s) and much more. At the end of this phase we will know how all the smaller systems in our boat will work and how they will connect to each other. The last design phase will be the 'Detailed Design' phase which starts around mid-October. In this phase we will make drawings of every single part of our boat. Our boat should be completely finished(on paper) before Christmas!

About our year: The production phase

When we are finished with the design we will first spend two weeks making a production plan. In these two weeks we will look at what is necessary for us to produce every part in our boat. We will then spend two months producing and one month assembling the entire boat. And in April the boat should be able to sail. With three months of testing in the spring of 2019 our boat will be completely ready for the Independent Offshore Class in Monaco in July 2019.

About our year: A race and a world record

After a year of blood, sweat and tears we will reach the month in which it all comes down. In July 2019 we will win the Monaco Independent Offshore Class and set a world record in crossing The Channel on solar power!

Follow us!

If you are interested in following our progress of designing, producing, testing and racing with an offshore Solar Boat, please follow us on social media! We post informative and fun content on Facebook, Instagram, Twitter, LinkedIn and YouTube.

About the author:

Redmer Aarnink is the Exposure Manager of the 2019 TU Delft Solar Boat Team. He is 21 years old and has a Bachelor in Applied Physics.

Did you know:

There are 3.410bn annual riders of the Beijing subway system. Following them in popularity of annual riders is Tokyo, Seoul, Shanghai, Moscow, Guangzhou, New York City, Mexico City, Hong Kong and Paris which finishes the top ten.

APPLICATION OF METAMODELING IN DESIGN STRATEGIES FOR BULK HANDLING EQUIPMENT.

By: Marc Fransen

In this article I will give an introduction of my PhD project, plans, and work in progress. The topic of the project is "Application of metamodeling in design strategies for bulk handling equipment" and evolves around the development of computationally efficient models that inherit a high fidelity representation of bulk equipment behaviour which can be used in design optimization. The goal of the project is to develop a robust design strategy for bulk handling equipment which utilizes the information from DEM and FEM models efficiently through metamodels.

Before describing my project in more detail I would like to introduce myself. My name is Marc Fransen and I have obtained both my BSc and MSc in Mechanical Engineering at TU Delft. My master track was solid and fluid mechanics in which I focussed on optimization and computational mechanics. During my graduation project I worked on a computational method to reconstruct stress fields caused by selective laser melting. After my graduation I wanted to continue in research but combine it with a closer link to practical aspects of mechanical engineering. After I graduated Dingena Schott and Yusong Pang initiated this project which included mechanical design and modelling of equipment behaviour. I was enthusiastic right away and after presenting my ideas I started in April 2017.

In current design strategies for bulk handling equipment we heavily rely on the knowledge and experience of engineers. To aid the engineer in the design process several numerical techniques have been developed over the last couple of decades. Well known tools are the finite element method for structural analysis and the discrete element method for modelling of granular and bulk behaviour. It enables us to gain more insight on the behaviour of bulk equipment and the material that is handled. Although the use increases the time required to carry out these simulations is way too long for efficient use in practice. A lot of research is focussed on improving the speed of these simulations but as speed is improved also more complexities are added to the models. One of the issues with these long computations is that a limited amount of simulations is permitted. The consequence is that only a select area of the design space can be explored for design solutions. To utilize the full potential of computational tools such as DEM a technique called metamodeling can be used to create a model that captures the characteristic behaviour extracted from simulation data. In general, metamodels are able to capture the characteristics of a system with a high fidelity and can give predictions of system behaviour in a computational efficient manner. Based on the research done thus far I formulated the following research question: "How can metamodels be used to improve the design strategies for equipment handling bulk, granular, and powder material?"

During my PhD project I will work on a proof of concept for a robust design strategy including metamodels. The aspects that will be considered are shown in Fig. 1. As a part of the proof of concept I will extract the characteristic behaviour of a discharging silo

from the experimental setup shown in Fig. 2. The experimental setup is adjustable in hopper angle, size of the discharge opening, and the depth of the silo. The goal is to extract discharge rates and flow types within the silo related to the design parameters of the silo. The data will be extracted according to a design of experiments (DoE) which will cover the majority of the design space.

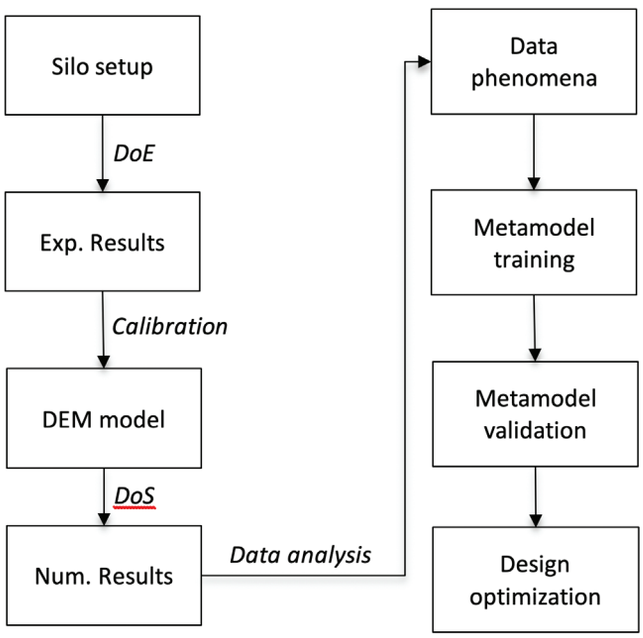

Figure 1: Schematic

Because of the expenses involved with experiments we are modelling the silo in a DEM program to gather more information at a lower expense. The experimental results will be used to calibrate the DEM model of the silo which means that the behaviour of the model is matched to the experimentally observed behaviour. After calibration the numerical model is used to create additional data for the silo system. The gathered data is analysed to extract the discharge rates and phenomena such as avalanching and funnel flow.

When sufficient and accurate data is obtained from the simulation data we can start with building a metamodel. In metamodeling there are a wide variety of techniques available such as response surface methodologies and kriging. To get a good feeling of the proper metamodels I will train several of them and compare their performance. Based on the performance of these models we can state whether a method is suitable for modelling of a bulk handling phenomenon such as avalanching, mass flow, or segregation. This will be formatted into guidelines that can be used by engineers to pick a metamodeling technique for the equipment they are modelling.

Figure 2 Picture of the silo setup

After training of the metamodel it is necessary to assess the validity of the model by comparison with new experimental or simulation data. When the validation is finished the metamodel can be incorporated in a design optimization strategy where the entire design space can be used. With the metamodel of the silo setup I will test several optimization techniques and compare the results to the corresponding experimental and numerical results for the optimal design parameters.

As part of the experimental work with the silo a group of bachelor students did their final bachelor project on the measurement of flow patterns for the silo setup. They used a high speed camera to record the discharge of the silo. The images they recorded with the camera were analysed using a method called particle image velocimetry (PIV). With the PIV method the velocity patterns of the silo discharge

are extracted by cross-correlation of subsequent images. An example of the obtained flow patterns is shown in Fig. 3 where funnel flow in combination with avalanching on the slopes is clearly visible. The group methodically investigated which settings lead to the most reliable results. While investigating the different options it became clear that the particle size in pixels and the frame rate are very important in obtaining reliable results.

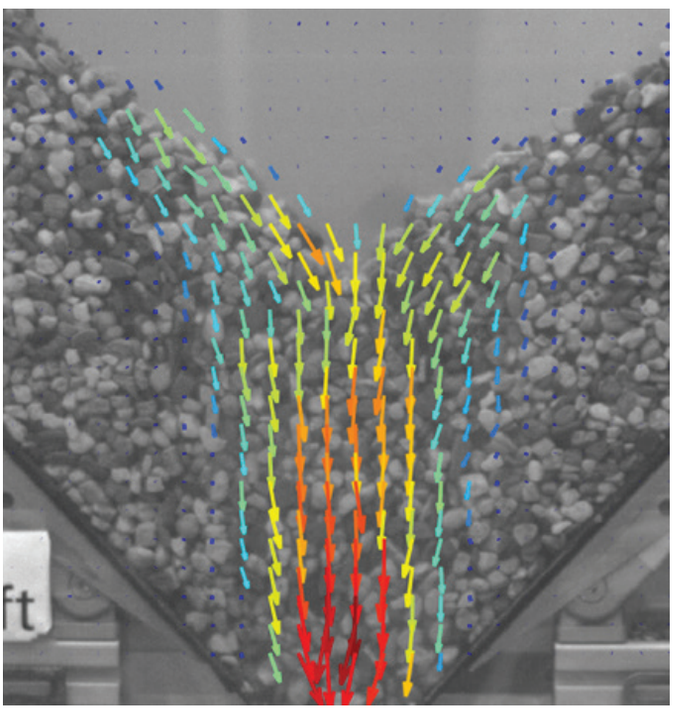

Figure 3: Picture of the flow patterns obtained with PIV

With the results from the bachelor project the next step can be taken which is analysis of the flow patterns in the silo. In the recorded data specific phenomena such as avalanching on the slopes and pipe flow in the core were clearly visible. Although they are visible our goal is to analyse the data and see whether it is possible to extract numerical patterns for these phenomena from the data and use this as input for metamodels that can predict the flow behaviour in silos.

In September I will attend the conference on handling of particulate solids (CHoPS) in Londen where I shall give a presentation about the response surface model that I developed to relate the discharge performance of a DEM model of the silo to the design parameters of the silo. Additionally I will discuss the possibilities of metamodeling in design of bulk and powder handling equipment. The preliminary results showed that we were able to find relations between the discharge performance of the numerical model of the silo setup and the hopper angle and size of the discharge opening.

If you would like to know more about metamodeling or see possibilities to get involved in some way don't hesitate to get in touch. For students that are enthusiastic about metamodeling, DEM, and experimental work and want to do a literature, research, or graduation assignment, please contact me or Dingena Schott.

Did you know:

Domestic transport largest goods flow

More than 630 million tons are transported within the Netherlands: nearly 82 percent by road and almost 18 percent by inland waterways. Only 2 percent of the total goods transport goes by rail and less than 1 percent by air. The inland waterways are mainly used for bulk goods and containers, and for destinations accessible along these waterways. Containers are becoming more and more used because the transshipment of containers from seagoing vessels on trucks, inland vessels and trains is relatively simple.

BUSINESS TOUR

By: Thyco van Engelshoven

Getting 15 people from the TU Delft to Shanghai and Beijing was not as simple as booking flight tickets and hoping for the best. This journey started, for at least 4 of us, months before we departed from Schiphol. Looking at possible locations to travel to, our attention was pulled towards China due to the large cultural difference compared to the Netherlands and its prevalent production industry which products reach World-wide. From this curiosity about China, a theme arose which we could explore in Shanghai and Beijing, namely; "Innovation in scaling automation to meet national goals and worldwide demand". From this theme, we tried to explore this at different locations in the country.

To make this business tour possible, a location and theme would only give the barebones to build upon. To make this trip possible, we would need participants! Within days we had 15 enthusiastic students ready, willing and excited to travel to China. With a group students and a committee ready to work, we found many partners who were willing to help us make this trip possible.

With plans, participants, and partners, the tour was after months of planning becoming a reality, and we left together from Schiphol on the 18th of July arriving in Shanghai the 19th of July. The group of students were proactive, flexible, and understanding from the start of the tour, which made the tour even more enjoyable. Within the committe, people played to their strengths, from some of making sure that company visits and cultural activities can happen as planned, while the others led us through the night, so there was never a boring minute throughout the day for anyone. Next to the committe, this trip would also not have been as great as it was without the help of Dr. Ir. Xiaoli Jiang, from helping to organize company and university visits to joining us for some nights. The fantastic group that helped and participated in the business tour made it an experience to remember.

Looking back on the trip, this trip has left lasting impressions on everyone. Providing different insights to how the Chinese culture functions within companies and Universities and how that is so different than the Dutch culture. Next to cultural impressions, everyone has also been able to get a new insight on scale, from the small dutch country to China with its extremely large endeavors. Considering many companies and universities from the Netherlands and China made this possible, made everyone on the trip very thankful for their contribution. This contribution has changed or expanded everyone's ambition for their future endeavours and makes them dream further for what is possible. As the Business Tour Committee this was our goal, which means for our success we have to thank our partners who made this possible and Dr. Ir. Xiaoli Jiang, who went out of her way to make this trip exceptional. Thank you one last time to everyone to make this a tour to remember!

ACTIVITIES

By: The Board

Excursions

Inhouseday Accenture

On the 28th of March dispute Transportkunde Pandora organised an inhouse-day together with Accenture and in close collaboration with Dr. Beelaerts van Blokland from the TU Delft.

After the bus arrived at the ITO tower we went up all the way to the 17th floor were we were welcomed by Rogier Toetenel and started the day with a cup of coffee and a short company introduction presentation.

After the day's program was explained we went on a site tour during which we explored the floors of the ITO tower that are occupied by Accenture. Our guides briefly explained about the working environment at Accenture and how the office works.

Next, we started on the main activity of the day: the case. Every year Accenture organises a case that perfectly goes together with Beelaert's class "Advanced Operation" and gives an insight in the process optimalisation techniques Accenture applies at its clients. Within three rounds of optimalisation alternated with some elaboration on the theory of process optimalisation we were able to increase performance of a fictional company significantly. It was so much fun to experience the effects of process optimalisation ourselves, and to compete against one another in two teams both representing a company.

The was rounded of with a drink in the cantine. Unfortunately the weather didn't allow us to enjoy the roof terrace and its view. At the end of this very exciting day at Accenture the students got a good idea of what Accenture does and what it would be like to work at the company.

Nemag

Wednesday on the 23th of May Dispuut transportkunde Pandora organized an excursion to Nemag. The Day started to drive with busses to Zierikzee where Nemag is located. The day started with a coffee and a welcome by Micheal Corbeau.

After the welcome Micheal give a presentation about Nemag and it position in the global market.

The second presentation was about the turnaround that happened at Nemag and the will to standardize the grappler manufacturing while still be able to compel with the desires of a customer.

Afterwards we had presentation about the nemaX the new grappler that is developed at Nemag.

Shortly after we had tour around the factory to see how the grapplers are made. During the tour, it was also very visible too see the improvements they made at Nemag. To be more efficient and better equipped for the modern market. After the tour, we had a nice lunch at a local restaurant.

In the midday, a business case was presented to us: Develop a new way to unload ships many designs where shown. It was a hard and interesting challenge. The main challenge was too find a solution wat can still use the Quay cranes as a base.

In the end of the midday a we had a small drink with everybody of Nemag who helped during the day. It was a interesting day with a new look on Nemag as a company

Mieloo & Alexander

On Thursday the 26th of April dispute Transportkunde Pandora organised an excursion in collaboration with the company Mieloo & Alexander. The day started at the TU Delft with a cup of coffee and an interesting presentation about the many different projects Mieloo & Alexander are working on, which gave the students a good idea of the company's activities.

After the presentation we left the university and travelled to C.Ro in Rotterdam. While enjoying a nice lunch, a presentation was given by C.Ro to explain more about their company. This was followed by a presentation by Mieloo & Alexander to explain in more detail what project they had executed there. The tour provided by C.Ro around the site was very interesting as the size and the amount of cars they handled was impressive.

In the end of the afternoon we drove back to Delft to enjoy a nice drink and dinner in Café de Wijnhaven to have a chat with each other in a relaxed setting. All in all it was a really nice day, which all students enjoyed a lot. We thank Mieloo & Alexander for the great day!

Did you know:

The shortest flight for sale is the one which arrives at the Scottish Isle of Westray and lands in Papa Westray – it lasts for a grand total of just two minutes.

Lunch Lectures

Krohne

In collaboration with Wouter Beelaerts we organized a guest lecture given by Pim Stam about the continuous improvement within Krohne Altometer. Pim is part of the Krohne Lean steering committee. It consists of 2 people working full time on improving the performance of the company.

During the presentation Pim told us about the different techniques that the committee uses to, for instance, reduce waste. To put it simple, waste can be seen as any step in the process that does not add value to the product. Examples of waste are waiting, transportation, over-production, etc.

Krohne did not implement these lean techniques overnight. They first started a few years back with Kaizen (first used by the Toyota Production System). The cycle of the Kaizen Activity can be defined as: "Plan -> Do -> Check -> Act". The purpose of Kaizen is to humanize the workplace, eliminate overly hard work and teach people how to spot and eliminate waste in business process. The introduction of Kaizen had a positive effect and the board was convinced that lean techniques were of value. In time also Lean Six Sigma (introduced by Motorola in 1986 to compete with the Japanese Kaizen) and TPM (Total Productive Maintenance) were introduced.

Next to these techniques, also Smart Industry or Industry 4.0 was shortly discussed. This new kind of industry involves around the automation and data exchange in manufacturing technologies.

What is interesting to mention is that these techniques only work when everyone in the company is involved. Everybody has to be like-minded to make these changes work. This seems like something trivial, but is often the reason why implementations of new techniques fail. Pim solves this problem by communicating with the people on the work floor to find some of the biggest issues, he also has to convince the board that these changes will have a positive effect. Only after a “green light” given by the board, the committee can start to implement the changes.

A couple of us have visited Krohne Altometer during the Germany trip, there we have seen in practice how it works. This guest lecture was the perfect opportunity for the ones that did not visit the company to see how these techniques are used in the industry.

Mieloo & Alexander

On Thursday March 29th Mieloo & Alexander held a lunch lecture in association with Dispuut Transportkunde Pandora. The guest speaker was no other than Joseph Owusu, one of the founders of Mieloo & Alexander. Mieloo & Alexander is specialized in designing, planning and implementing technology solutions and aiming to transform companies to achieve operational excellence.

During this very informative session, Mister Owusu showed the wide range of projects his company is involved in around Europe. He also showed the wide range of impressive companies Mieloo & Alexander is doing business with.

Many of the projects involved AutoID, such as RFID technology, which could be used by clients to gain useful insights about their products. Using passive RFID chips Mieloo & Alexander were able to help Sony set up a system in warehouses in Germany with which prove of shipment for their products could be given, thus eliminating false claims of non-delivery.

Another project involved active RFID technology with which the position of cars could be monitored at all times in a car storage area for import. So when a specific car needed to be moved to a customer, the position of this vehicle could be narrowly pinpointed from a huge car parking area.

All in all it was a very informative and inspiring lunch lecture, which also functioned as an introduction to the company for the upcoming excursion with Mieloo & Alexander. For this excursion there was a maximum appliance of 15 persons. This limit was reached within 2 hours.

TBA

On Monday 5th of march 2018 Zack and Kaj from TBA visited the Faculty of 3me at TU Delft. To give a presentation on TBA and what projects they both work on during their time at the company.

At first, they started talking about TBA in general and giving examples on what type of project they work on. TBA is mostly working on simulations to solve problems and find them before a Container terminal is build. It was very impressive to see how they find problems and the way it was solved. Also, the structure of the project was interested to see. From the start of a simple simulation to a full working terminal was a good example of TBA.

After the lecture it was mentioned that if you are looking for a graduation project with an interest on simulations? Send an email to TBA because there are still looking for students

Did you know:

In 2015 the word’s first hydrogen-powered, zero-emissions street trolley tram opened in Dubai. The hop-on, hop-off transit system connects tourist attractions, malls and hotels to make exploring the city more convenient and sustainable.

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- Leverage our alliances with the world's leading technology providers and explore emerging technologies

OPERATIONS **OPERATES**

- You bring together muliple stakeholders and new technologies to create innovation that shapes customer and employee experiences
- Automate business processes to drive efficiency and productivity

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SHAWCOR VERHOOGT EFFICIËNTIE EN KWALITEIT MET IOT OPLOSSINGEN

By: S. Merkx

Shawcor opereert wereldwijd in de olie- en gassector als coater voor stalen buizen. Met een breed scala aan producten en services en zo'n 100 sites in 20 verschillende landen, realiseren zij een omzet van +/- 2 miljard dollar.

Een van de belangrijkste pijlers van Shawcor is the Pipe Performance Products divisie. Deze divisie is gespecialiseerd in het coaten, o.a. anti-corrosie, thermische of betoncoatings, van stalen buizen die voor olie- en gaspijplijnen worden gebruikt.

Binnen deze divisie is het van belang dat Shawcor, tezamen met de andere schakels in de keten, een volledig rapport kan overhandigen aan de operator, waarin alle stappen van het productieproces, kwaliteitskeuringen en de logistieke bewegingen staan opgenomen.

Tot op heden wordt dit gehele process manueel bijgehouden. Dit brengt echter, door de grootte en het gewicht van de buizen, de nodige veiligheidsrisico's met zich mee.

De buizen worden op locatie gemiddeld 8 keer verplaatst en niet alle barcodes of handschreven serie nummers kenmerken zijn overal goed leesbaar. Naast gevaarlijk is het dan ook een zeer intensief, inefficiënt en foutgevoelig process.

Als een van de eerste bedrijven in deze sector implementeert Shawcor IoT systemen om de traceerbaarheid van de buizen te verbeteren en kwaliteit issues op te sporen.

Voor de stap naar IoT heeft Shawcor, via haar Nederlandse dochterbedrijf Dhatec, contact gezocht met Mieloo & Alexander, een system integrator die is gespecialiseerd in IoT en RFID oplossingen voor industrie, logistiek en retail.

In nauwe samenwerking met Shawcor's engineering en IT team, ontwikkelde Mieloo & Alexander verschillende industriële IoT oplossingen op basis van UHF RFID en D-GPS waarmee alle logistieke beweging van de buizen.

Met de UHF RFID tags worden de buizen automatisch geïdentificeerd en dan gekoppeld aan GPS-coördinaten om de locaties en bewegingen van de buizen vast te leggen.

Bij de productie van buizen voor een nieuwe pijplijn

in Noord-Europa is het systeem voor het eerst in gebruik genomen. Op beide endcaps, die dienen om vocht en vuil uit de buizen te houden, worden RFID-tags aangebracht.

De spreaderbars van de zware hefmachines werden uitgerust met een complete box met daarin een RFID-reader, Differential GPS-modem en 4G/wifi, modem.

Zo zijn de machines in staat om de tags van de buizen uit te lezen op het moment dat een buis wordt verplaatst. Dit had als bijkomend voordeel dat er on-site geen operators meer nodig waren om de data van de buizen te noteren.

De test tijdens de productie voor de pijplijn in Noord-Europa gaven positieve resultaten waarop er meteen gekeken is op welke vlakken RFID nog meer ingezet kan worden.

Een van deze mogelijkheden is om te gaan werken met RFID-portals. Hiermee wordt het mogelijk om een gedetailleerd overzicht bij te houden voor de klant welke buizen wanneer de locatie hebben verlaten.

Uiteindelijk zal alle data samen moeten komen in het IoT-Cloud platform gerealiseerd door Mieloo & Alexander.

Dit platform geeft Shawcor inzicht in de bewegingen die er gemaakt worden en waar de buis zich op dat moment bevindt en de mogelijkheid om hier rapporten uit te halen voor de klant.

De stap naar digitalisatie geeft Shawcor een grote voorsprong op de concurrentie, die nog vaak vasthouden aan de traditionele werkwijze, en biedt zowel Shawcor als haar partners en klanten een betrouwbaardere en veiligere keten. Door de centralisatie van de data geeft dit tevens de mogelijkheden om in de toekomst efficiënter te werken en betere beslissingen te kunnen nemen.

Did you know:

"Metros" Get Their Names From Paris' Subway System
One of the original companies to build and operate the Paris metro system around the turn of the 20th century was the Compagnie du Chemin de Fer Métropolitain de Paris. The transit system was often referred to by a shortened version of the
became the common way to refer to underground rapid transit systems all around the world. Just another trend set by Parisians.

FROM THE ALUMNI

By: Peter Marijnen

De Reünie

U kijkt net als wij natuurlijk al uit naar de volgende reünie. Dit jaar moest u hem missen, want helaas wordt de reünie één keer in de twee jaar georganiseerd en na de succesvolle reünie bij ORTEC van vorig jaar is de volgende reünie weer in Q3-2019.

De organisatie van deze nieuwe reünie begint begin volgend jaar, hoewel we natuurlijk ook nu al openstaan voor bedrijven, die zich zouden willen aanmelden om onze alumni en de studenten te ontvangen. Een unieke gelegenheid om uw bedrijf te presenteren en voor ons een unieke kans om uw bedrijf beter te leren kennen.

Reunie 2015

Huisman

Reunie 2017

ORTEC

Reünie Q3 - 2019

?

Het Alumnibestuur

In het studiejaar 2012/2013 zijn de secties PEL en TEL geïntegreerd. Kort daarna zijn ook de disputen samengegaan onder de naam Dispuut Transportkunde Pandora. Vervolgens zijn ook de alumni-organisaties samengebracht onder de naam Alumni Transportkunde Pandora.

Het huidige bestuur van Alumni Transportkunde Pandora bestaat uit:

Lilan Lie (PEL-2010)

Jos Beckers (TEL-2004)

Peter Marijnen (PEL/IO-1983)

De voornaamste activiteit van het Alumnibestuur is het tweejaarlijks samen met het dispuutsbestuur organiseren van de reünie. Daarnaast is de Alumni-organisatie een contactpunt voor het dispuut voor het organiseren van excursies en het vinden van stageplaatsen. Op dit moment wordt ook gekeken naar een betere samenwerking met het bestuur van de KIVI-afdeling Transport en Logistiek, die ook lezingen, excursies e.d. organiseren.

Het Alumni Bestuur is op zoek naar uitbreiding/verbreding en daarbij gaat onze lichte voorkeur uit naar iemand met een TEL-achtergrond, zodat er balans PEL/TEL ontstaat.

Dus mocht u interesse hebben dan horen we dat graag!

Jaarcommissarissen

Het huidige Alumnibestuur heeft het initiatief genomen om per jaarring een jaarcommissaris te zoeken, die bereid is de contactpersoon te zijn tussen het Alumnibestuur en zijn eigen jaarring. Voor het studiejaar 2012/2013 hebben TEL en PEL een eigen jaarcommissaris, vanaf dat studiejaar is er een jaarcommissaris PEL/TEL.

Voornaamste taak van de jaar- commissaris is het enthousiasmeren van de eigen jaarring deel te nemen aan de reünie of aan andere georganiseerde activiteiten. Het heeft zich ook bewezen datals een alumnus weet dat er meerdere alumni uit de eigen jaarring naar bijv. de reünie komendat dit erg helpt om ook zelf te gaan.

Op dit moment hebben wij de volgende alumni bereid gevonden om jaarcommissaris te zijn. Enerzijds hebben we al veel alumni bereid gevonden jaarcommissaris te zijn, anderzijds missen we nog heel wat jaarringen.

Jaarring	Jaarcommissaris	IO/PEL	TEL	PEL/TEL
1953-1974				
1975	Herman Klein Entink			
1976	Hessel Visser			
1978	Jeroen Meier			
1980	Maarten Peters			
1983	Peter Marijnen			
1984	Lex Reiff			
1986	Thomas Rubbens			
1990	Robert van der Holst			
1993	Luc Kremers			
1996	Lars Wiggersma			
2001	Norbert Tio			
2004	Jos Beckers			
2005	Krijn van Aken			
2006	Selma Schwab			
2007	Wim Vlaar			
2008	Wichert Kalis | Robin Voorend			
2009	Lilan Lie | Martin Kruiver			
2011	Navied Tavakolly | Richard Karssen			
2012	Jan Osterholt			
2013	Daan Duppen			
2014	Marnix van der Heide			
2015	Kelly de Vos			
2016	Marcel Ceelen			
2017	Frans de Groot			
2018				

Vandaar bij deze een oproep aan alumni, die jaarcommissaris zouden willen worden om zich op te geven. We zouden het zeer op prijs stellen!

Algemene Verordening Gegevensbescherming (AVG)

In mei van dit jaar is de nieuwe privacy-wetgeving in werking getreden. Het alumnibestuur beheert het bestand met alumni-gegevens. U zult binnenkort gevraagd worden uw toestemming voor het opslaan van uw gegevens in dit alumnibestand te herbevestigen. Verder verzoeken wij iedereen om de eigen gegevens in dit bestand nog eens te checken. Het is vooral belangrijk dat de jaarcommissarissen en wij beschikken over de juiste e-mail adressen, zodat we u op de hoogte kunnen houden van de evenementen. U kunt uw gegevens terugvinden op www.transportkunde.nl onder Alumni/ Alumnidatabase. Mocht u uw inloggegevens kwijt zijn dan kunt u hulp vragen bij het Pandora dispuut, secretaris@transportkunde.nl

Uw eventuele reactie naar ons kunt u sturen naar p.marijnen@marijnen-im.nl.

Did you know:

Swindon's Magic Roundabout has to be one of the UK's most terrifying roundabouts to drive through. You have to see this to believe it. Made up of 1 central and five satellite mini roundabouts, each connecting to the next, the Magic Roundabout is on the map as one of the UK's most terrifying roads. It's hard enough navigating one roundabout, let alone navigating up to five in one succession.

Sudoku

					9	6	1	
		5	6	3	7		8	
6				1	8		5	
		9		2		8		
	7		1				9	5
		6	9	5			3	7
9		2					7	8
	5		8		2	3	4	
				7				1

Word search

U	C	E	C	U	U	H	W	V	X	E	T	S	O	E	T	K	P
E	G	K	E	V	Y	Y	G	V	W	C	N	T	A	R	M	S	K
J	L	Q	X	I	J	R	O	M	E	S	O	A	A	E	O	I	D
I	T	P	P	F	W	A	U	C	T	O	V	N	R	F	L	O	I
V	B	R	O	C	X	R	Q	U	Y	M	S	Y	L	C	Q	Q	S
J	H	R	N	P	V	C	D	E	H	P	P	F	L	E	J	B	P
G	I	M	R	C	L	E	S	B	O	T	R	O	S	F	F	Q	U
I	U	T	M	J	N	I	U	R	E	E	M	3	R	H	V	F	U
Y	H	I	U	T	G	D	T	E	V	F	O	B	R	X	L	D	T
Q	I	D	U	M	H	K	X	P	T	Y	P	C	B	B	B	U	U
O	S	X	A	E	U	E	G	N	A	E	L	M	J	P	K	E	U
F	A	I	N	N	E	T	P	N	E	N	D	X	S	P	Q	C	B
S	R	S	D	K	Q	M	A	E	T	M	A	E	R	D	R	N	E
S	O	E	Q	B	P	R	Q	M	D	D	T	H	O	D	R	E	N
M	D	N	F	D	X	E	T	A	C	S	I	N	M	E	L	I	M
R	N	M	A	T	E	R	I	A	L	S	W	E	C	Q	I	C	S
H	A	C	H	Y	S	U	O	M	O	N	O	T	U	A	E	S	O
D	P	Z	W	M	S	S	C	I	T	S	I	G	O	L	A	X	Y

- 3ME
- DISPUUT
- LEMNISCATE
- PANDORA
- SIX
- TRANSPORTKUNDE
- AUTONOMOUS
- DREAMTEAM
- LOGISTICS
- SCIENCE
- STUDENT
- CRANE
- LEAN
- MATERIALS
- SIGMA
- TEU

Sudoku solution

2	8	7	5	4	9	6	1	3
1	9	5	6	3	7	4	8	2
6	3	4	2	1	8	7	5	9
5	1	9	7	2	3	8	6	4
4	7	3	1	8	6	2	9	5
8	2	6	9	5	4	1	3	7
9	4	2	3	6	1	5	7	8
7	5	1	8	9	2	3	4	6
3	6	8	4	7	5	9	2	1

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