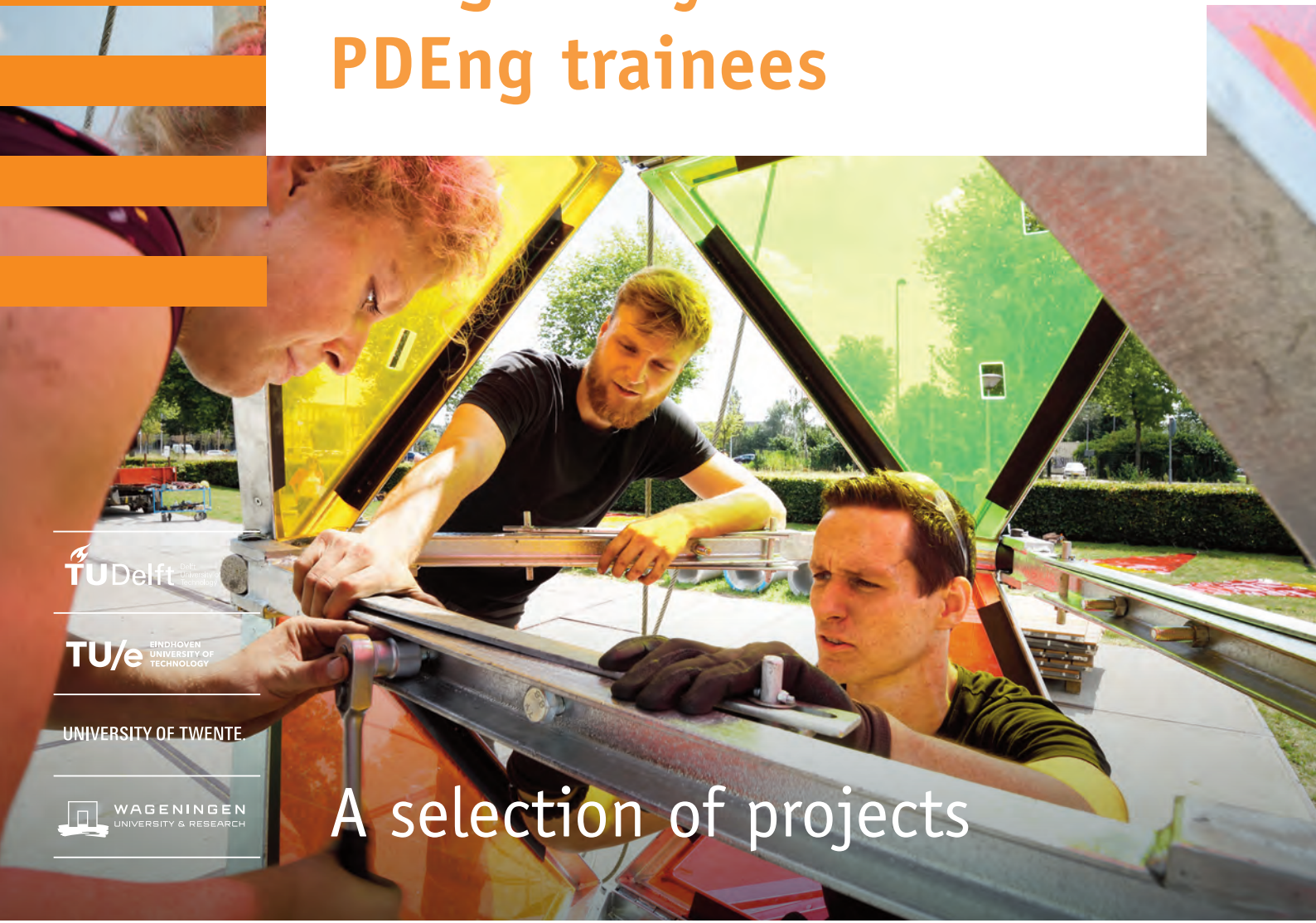
2021

Innovative solutions designed by PDEng trainees



4TU. School for Technological Design STAN ACKERMANS INSTITUTE

The GEM-tower is a green energy solution for festivals to replace fossil fuels and will help festivals to be more sustainable.

Table of contents

What do a sustainable energy solution for festivals and better distribution of visitors flow have in common? They were all designed for organisations by PDEng trainees of 4TU.School for Technological Design, Stan Ackermans Institute, a collaboration of the 4 Dutch universities of technology.

Their projects are quite often not open for public. However, we can give a short impression of the value oft their projects. We have made a selection and combined them in this publication. We are very proud on all of our PDEngs and happy with their supervisors. I look forward to the next lustrum with confidence!

Paul Koenraad,
Director Stan Ackermans Institute

Introduction

One of our goals as 4TU (Federation of 4 Dutch universities of technology) – is to educate and deliver excellent engineers and technological designers for the needs of society.
With our PDEng programmes, joined in the Stan Ackermans Institute, we have been succeeding in delivering technological designers for a long time. This year, 2021, the PDEng programmes and the Stan Ackermans Institute are celebrating their respective 35th and 15th anniversary. We are very proud of these milestones and of our cooperation and look forward to further increase the importance of delivering excellent technological designers. We are especially proud that the University of Wageningen will join us with its own dedicated PDEng program.

PDEng trainees

PDEng trainees are selected from highly qualified MSc graduates and are doing a full-time, two-year traineeship to become technological designers, ready to face the tough challenges in industry or public organisations. After completing the programme they obtain the Professional Doctorate in Engineering (PDEng) degree, an academic degree on a similar level as the PhD.

Putting theory into practice

PDEng trainees receive one year of training according to a well-designed curriculum, which involves courses, interactive workshops, and group and practical assignments. They often work in close collaboration with industrial, public and healthcare partners and carry out a one-year in-company design assignment. University experts act as their supervisors, providing access to state-of-the-art technology, advising on the structure and execution of the project, and watching over the project's goals. During the design project, our trainees demonstrate their skills in turning their knowledge into innovative business solutions for the high-tech industry or public or healthcare sector.

After their degree

Our graduates immediately start working for outstanding companies but also for public organisations, hospitals or other health institutes. This proofs our relevance for industry and society.

More information

For more information about our PDEng programmes, please visit www.4tu.nl/sai.

With best regards,
Prof.dr.ir. Tim van der Hagen,
Rector Magnificus, Delft University of Technology
Prof.dr.ir. Frank Baaijens,
Rector Magnificus, Eindhoven University of Technology
Prof.dr.ir. Tom Veldkamp,
Rector Magnificus, University Twente
Prof.dr.ir. Arthur Mol,
Rector Magnificus, Wageningen University

Company: Eindhoven Medical Robotics
Project: Design & development of an experimental hand-held system for ROP laser treatment
PDEng trainee: Arash Arjmandi Basmenj PDEng MSc, TU/e

Automotive Systems Design

ROP is a disease associated with the vision loss of premature babies and a major cause of childhood blindness around the world. This disease is uniquely characterised by the retinal detachment due to abnormal growth of retinal blood vessels and leads to an irreversible visual deficiency in premature babies. Approximately 15 million babies per year are born premature, out of which thousands develop severe ROP and become blind. The existing solutions to screen and treat ROP are not able to address the high demand in developing countries. These solutions have considerable drawbacks that lead to less accurate and efficient diagnosis/treatment procedures and result in high fatigue on the ophthalmologists as well as exposing the patients to the numerous risks.

To this end, Eindhoven Medical Robotics (EMR) has initialized in 2017 a project in for developing a new laser delivery surgical system to diagnose and cure ROP. This new system is primarily intended to be more efficient, accurate and autonomous.
The ultimate goal of this project was to design and implement the first prototype of this surgical system including all the essential functions. This goal was realized by designing and implementing a system including optics and automated laser delivery control system. In order to verify different design and implementation aspects, multiple integration and system tests have been performed and presented.

"Arash has developed an opto-mechatronic laser delivery system that can potentially be used to cure childhood blindness. He successfully collaborated with surgeons from India and The Netherlands to not only gather requirements but also fundamentally understand the ROP problem. Later, he was able to blend this knowledge into a system architectural frame work and hence create a robust plan to develop the laser delivery system. He took up the challenge to create a knowledge base for opto-mechatronic system design and successfully implemented the design in his project. Furthermore, he conducted several experiments to validate the system and made a road map for future developments. He is now a valuable asset for Eindhoven Medical Robotics and we share a common vision of, eradicating childhood blindness". - ***Siddarth Khalate, Eindhoven Medical Robotics***

Company: Janssen Vaccines & Prevention B.V.
Project: Development of a Reduced Scale Model (RSM) for a mixing unit operation in vaccines manufacturing
PDEng trainee: Daniel Puerta Jiménez MSc, PDEng, TU Delft

Bioprocess Engineering

Infectious diseases account for 15% of all deaths worldwide each year. Vaccines, also known as Drug Products (DPs), play an indispensable role to prevent them. Janssen Vaccines & Prevention B.V. is committed to delivering high-quality and innovative vaccines in a promptly and accurate manner to all its patients and customers. To achieve these high standards, it is of utmost importance to robustly characterize the DP manufacturing process. The three main stages of this process are upstream processing (goal: cultivating of the virus), down-streamprocessing (goal: purification of the culture) and Fill & Finish processing (goal: manufacturing of the drug product).

Current Fill & Finish process characterization strategies are often associated with high costs, limited flexibility, and resource intensiveness. The main goal of this project was to develop a computational and an experimental Reduced Scale Model (RSM) for characterizing a large-scale mixing step from this process. This goal was accomplished as follows:

1. Scale-down of critical process parameters based on engineering principles and the geometric similarity between the scales.
2. Development of computational models for the large- and small-scale mixing steps using a Computational Fluid Dynamics (CFD) software.
3. Validation assessment of the RSMs at small-scale through blending time measurements.

4. Assessment of the mixing behavior similarity between the small- and large-scale processes based on DP critical quality attributes (CQAs).

From experimental and computational comparisons, it was concluded that both RSMs yield a representative behavior of the large-scale process in terms of homogeneity, mixing regime, shear rate, and impact on the DP CQAs.

"Daniel had the honor to kick-off the first big and important modelling project within our department. He handled the tight timelines and pressure on the project flawlessly, resulting in a huge amount of data regarding mixing times, shear rates and ability to scale-up without impact on our Drug Product. These models will save precious time and money and furthermore, with this excellent experience, our department is embracing modelling in future developments." - ***Wouter den Dekker, supervisor***

Company: Kadaster
Project: Designing Kadaster's data platform of the future
PDEng trainee: Alexandra Rowland, PDEng MSc, University of Twente

Business and IT

Kadaster, the Dutch Cadastre, Land Registry and Mapping Agency, is statutorily tasked with the registration of administrative and spatial data relating to property and the rights associated with these. The organisation also manages the facilities of other organisations, called National Facilities (Dutch: Landelijke Voorzieningen), including the Base Register for Addresses and Buildings (BAG). As part of its Multi-Year Policy Plan, the organisation has outlined a number of goals including integral object registration and the provision of geoinformation for everyone. These goals serve as key starting points for the design of Kadaster's future data platform.

Alexandra's project aims to support Kadaster in achieving these goals by making use of linked data and graph technologies as central elements of my design. The use of these technologies allow for previously siloed datasets to be integrated and placed into a single knowledge graph from which users from a wide range of user groups can query, analyse and visualise geoinformation registered and maintained by Kadaster. This knowledge graph, in applying the FAIR principles to its design, can also support Kadaster in the maintenance and delivery of quality metadata for datasets. By applying the conceptual lens of self-service GIS, the project aims to ensure that any data platform design supports the building of applications and interfaces which support the end user, particularly the non-professional user, with easily and reliably combining geospatial information to answer questions in a manner which best suits their required output.

"The PDEng project gives us the opportunity to ensure that, while we are caught up in finding solutions for the here and now, that we are also working towards integrating the solutions of tomorrow in our organisation. Lexi, in her role at Kadaster, builds a very valuable bridge between our current, practical situation and the state-of-the-art scientific solutions; the latter of which generally still need to prove themselves in industry and it is here that we happily play a role." - ***Dr.ir. Erwin Folmer, Kadaster***

Company: B12 Institute
Project: Design of an extended treatment protocol of B12 deficiency
PDEng trainee: Gabriela Hadiwinoto MPhil PDEng, TU Delft

Chemical Product Design

Vitamin B12 is the most complex vitamin, which is essential as a co-enzyme in the central cellular methylation process. A severe lack of B12 manifests in the nerves system damage and a broad range of symptoms, from neurological complaints to personality changes, amongst others.
The standard diagnostic criteria of B12 deficiency is the persistence of anaemia and the low level of serum B12, while the current treatment protocol is periodic injections of hydroxocobalamin in high doses. However, the normalization of serum B12 after the treatment fails to explain the persistence of symptoms. The current practice of B12 deficiency diagnosis also lacks in monitoring tools to assess the activity of cellular B12. As B12 is the co-enzyme of the one-carbon cycle, the dysfunction of the vitamin will lead to other deficiencies and bottlenecks. The aim of this project is to expand the knowledge of B12 deficiency by exploring overlooked root causes and impacts of B12 deficiency, and to design an extended treatment protocol of B12 deficiency.
Using chemical engineering logic to analyze the issues, several hypotheses on the B12 metabolism bottlenecks were produced and depicted in a simplified of vicious cycle. The current knowledge on the mechanisms explaining a lower B12 enzyme activity may still be insufficient to explain the whole condition and issues related to B12 cellular inactivity. Nevertheless, with the obtained knowledge, new biomarkers and corrective actions were proposed as an extended protocol to support the treatment of B12 deficient patients.

The main results of this conceptual design project are expected to open a new direction for the research study and the clinical practice of B12 deficiency treatment. As the treatment and recovery of the patients require a significant amount of time, we expect to see the outcome of the study to be reported by the B12 Institute in the coming future. This design study was co-funded by the Interreg VL/NL HELIS Academy project.

"B12 deficiency can lead to serious health problems. The lack of consensus in the diagnosis and treatment of this chronic disease is a challenge, in addition to the fact that there is a lack of clinical trials to finally test the current protocols in practice. The metabolism where the conversion of cobalamin takes place is a complicated matter. While clinical chemistry was not part of Gabriela's direct field of knowledge, she quickly mastered it. In addition to the fact that she has drawn up her report thoroughly and completely, this has also ensured that we have been further tracked of new markers that could possibly bring about an improvement in the treatment and diagnosis and thus can improve the health condition of the patient with a B12 deficiency."
- Clara Plattel, B12 Institute

Company: Rijkswaterstaat
Project: A decision support system for sustainable pavement management
PDEng trainee: Andrea Vargas, University of Twente

Civil Engineering

Transportation agencies worldwide are steering towards more sustainable road pavement management approaches given that the construction, maintenance, and rehabilitation of road pavements generate significant environmental impacts throughout their entire life cycle. This PDEng project is set in the context of the main Dutch road network and aims to support a transition from traditional to more sustainable pavement management approaches, working in close collaboration with the Dutch Ministry of Infrastructure: Rijkswaterstaat (RWS). To do so, the design object of this PDEng project corresponds to a decision support system (DSS) that will provide an assessment of the environmental performance of different road pavement maintenance and rehabilitation alternatives that are developed by the RWS using life-cycle assessment (LCA). LCA is an approach has been increasingly adopted by transportation agencies worldwide to account for the environmental impacts of road pavements during their complete life cycle. Following important insights retrieved during the problem investigation phase, it was decided that the architecture of the DSS will be composed by three main sub-systems, one of which already exists, and two are to be designed during the duration of this project. The design of the DSS comprises the design of the sub-systems and their related interfaces. The resultant design will contribute to an enhanced environmentally conscious decision-making process in the RWS that can support the transition towards more sustainable pavement management practices.

RWS has set ambitious goals to become more sustainable by 2030 and 2050. This project is part of the steps that are being taken in the road infrastructure sector to meet such goals and tackle the challenge of how to develop and implement approaches that facilitate a transition towards more sustainable pavement management. - ***Thijs Bennis, Rijkswaterstaat***

Company: Jeroen Bosch Ziekenhuis
Project: Preparing medical data for AI development
PDEng trainee: Tijs Samson PDEng MSc, TU/e

Clinical Informatics

The use of Artifical Intelligence within healthcare is seen as one of the potential answers to the rising demand of high-quality care. Radiology is a frontrunner when it comes to the use of AI and many examples can be found of AI algorithms which show similar performance or even outperform radiologists in specific tasks.

For the development and improvement of such algorithms in the field of radiology, many medical images amongst other clinical information are required. Different types of data are stored in hospitals within different applications (PACS, EMR) from multiple vendors. Collection of the desired data and making it suitable for AI development is therefore not obvious. With the developed design, it is now possible in Jeroen Bosch Hospital to collect large datasets of high-quality consisting of medical images combined with other clinical information, ready to be used for AI development. An important aspect of the design is the de-identification of personal data to comply to the applicable laws and regulations.

Since the design is based on global information standards and open source software components, this solution can easily be adopted by other hospitals.

"Our hospital has the ambition to improve healthcare by searching for patterns in the large amount of medical data that we hold. Tijs completely understood the challenges we face in making these image and non-image data available for machine learning. The infrastructure that he has designed, enables us to now realize our ambition." - ***Chris Peters, Medical Physicist, Jeroen Bosch Ziekenhuis, 's Hertogenbosch***

Company: De Efteling
Project: A personalized recommendation system for Efteling using crowdedness and guest behavior
PDEng trainee: Abouzar Abbaspourghomi PDEng MSc, TU/e

Data Science

The Efteling is the largest theme park in The Netherlands and hosting over 5 million people yearly. The Efteling is woven into the hearts and minds of so many adults and kids in The Netherlands. It represents a world of magic, creativity, and wonder. When people visit a place like the Efteling, it all comes down to one word; experience.

The experience of the visitors is likely affected by the waiting times at the attractions, crowdedness in the park, possibility to visit their favorite attractions, quality of the food, and other parameters. In order to enhance the experience, we aimed to design an intelligent system to inform visitors about the best place that they can visit next in the park. First step to achieve that, was to quantify the crowdedness in different areas of the park, we created prediction models for waiting time of the attractions and number of transactions taking place in the restaurants. Using the output of the prediction models, we then created a special function that could forecast the crowdedness of each area in the park at specific time.

We collected the movement data of the visitors and their preference throughout their visit in the park. Using the output from the prediction models and the preference and movement

data, we developed a neural network model to predict their best next move and gave it as a recommendation to visitors. The recommendation engine is presented via an app that is called “Efteling Lab App”. Thanks to this app, Efteling will be able to better distribute its visitor flow throughout the park.

Recommendations from the app allows visitors to get the most out of their day. Efteling is the first theme park worldwide to use this functionality.

Company: ASML
Project: Process INtegrated HEat Pump Drying - PINcHED
Accelerating the implementation of high-temperature heat pumps
PDEng trainee: Loes van Rijswijk PDEng MSc, TU/e

Design of Electrical Engineering Systems

We can’t ignore it. We all are surrounded by smart and connected devices. And all these devices contain chips. New devices need to be faster and better and that means that the chips inside also needs to improve.

This has resulted in a new type of memory chip (3D-NAND/ V-NAND) that looks completely different from previous ones (2D-NAND). These next generation chips are different in the sense that they contain many layers of materials and the memory cells are stacked vertically. Instead of just a few layers, 3D-NANDs have hundreds of layers. To get a clear interpretation: the previous type of chips are like building a house, while the new type of chips are like building a New-York type skyscraper, but then all at nanometer scale.

ASML is a company that develops machines which produce chips. The new types of chip require that ASML innovates its techniques such that the new chip type is properly fabricated and, at least, as fast and accurately as other types of chips. Loes van Rijswijk worked on a simulation method that ASML uses to monitor its manufacturing process for 3D-NAND chips. She improved an algorithm within this method such that it can now be used for 3D-NAND chips by making it a lot faster and more efficient.

”Loes has made an important contribution to the electromagnetic-modeling capabilities at ASML, and in broader perspective to the global IC industry.” - ***Dr Frank Buijnsters (supervisor) en Dr Henk-Jan Smilde (head Algorithm and Physical Modeling group).***

Company: Trivium Packaging
Project: Zero porosity of lacquer on (tin)plate for food packaging
PDEng trainee: Mieke van den Berg, University of Twente

Energy and Process Technology

Trivium Packaging is a large supplier of metal food packaging, among which tin cans. These cans are coated on the in- and outside to protect the metal from the foodstuff and the other way around. When the coating is damaged, the metal can start to corrode, consequently consumers might waste the contents. The coating is damaged in production at the factory in Deventer. At the start of the PDEng project, the cause of the damage was unknown. It also seemed to only happen for one specific coating. There is currently no suitable method to predict how the material will perform during production. Furthermore, the process comes with quite some variables which need to be included in a predictive test.

The project touches on a lot of topics in order to find the root cause, which brings a lot of new information and established knowledge to the surface. Based on this and the obtained knowledge, an improvement can be implemented and a clear plan of action will be available for comparable issues.

Furthermore, process adjustments are designed as a result. In doing this, not only consumer and customer complaints can be resolved, the quality of the produced material can be guaranteed, and food and material waste can be decreased.

"Through help and support of a PDEng in this study we have been able to dive much deeper in the subject than we usually do. The unbiassed view of the PDEng and the support of the University is an enrichment of the standard R&D department of a production company. Together we discover new test methods that are possible to recognize and solve the problem." - ***Hein van Jaarsveld, Trivium***

Company: DEAC - Dutch Electric Aviation Centre
Project: Design for maintenance in all-electric/hybrid aircraft system
PDEng trainee: Ashrith Jain MSc, University of Twente

Maintenance

"We are the first generation to feel the sting of climate change, and we are the last generation that can do something about it."
– Jay Inslee

There are several reasons for the interest in the design and certification of electrically powered aircraft in recent years. Electric propulsion systems offer better efficiency and have zero-emission locally. To realize the vision of electric aviation, there are several challenges to overcome, such as economic and operational feasibility, community acceptance, certifications, and safety. Currently, a lot of attention is paid to the technical feasibility of a wide variety of aircraft design concepts and operational modes. However, there is a gap in the knowledge of future maintenance issues associated with electric aircraft. This PDEng design project is carried out at the Dutch Electric Aviation Center (DEAC), where Cessna Skymaster 337F aircraft is being used as a testbed. Modifying existing aircraft to support electric propulsion systems encompasses a complete rethinking and re-design to facilitate safe and efficient interaction with aircraft system components and the airport ecosystems, storage facility, and maintenance organization. As maintenance operations deeply affect both the operability and the financial side of an asset during all the lifetime, a Design for Maintenance (DfM) approach should be considered from an early stage in parallel to the development of the system itself.

"The research on the Hybrid/Electric Aviation System at DEAC mainly focus on understanding how the system should be designed in order to facilitate the maintenance operations. Results will have a high impact on the long-term sustainability of electric aviation." - ***Menno van Luijn and Remco de Wit, company representatives from DEAC***

Company: Conceptual Design of a PAT-Based Control System for Savory Manufacturing via Basket Granulation
Project: Unilever Foods Innovation Center
PDEng trainee: Amin A. Zadeh MSc, PDEng, TU Delft

Process and Equipment Design

Unilever's savory granules have a considerable market growth in Asia. Nevertheless, the production process of granules in the current sourcing units is not very robust. It is found out that equipment failure, throughput fluctuations, and lack of effective quality control are, among all, issues to be addressed. The latter can be of great importance in the food industry due to variations in raw material quality. This highlights the importance of increasing the granulation operational efficiency. One way of achieving this is to control quality of the granules and the granulation process itself. The objective of this project is to improve the granule quality control on size and hardness as well as a better process control on the granulation process, such as throughput and rotors' torque in the basket granulator. It is often difficult to automate and control food processes, partly due to the high variability of raw materials and issues with the real-time measuring and monitoring of important food process parameters and food quality characteristics. Moreover, food processes are mostly nonlinear and show different process dynamics with various recipes and different processing conditions. Process Analytical Technology, PAT, has become increasingly important for the food industry since the last decades due to its capability of improving food safety, food quality control as well as increasing yield, and minimizing production cost.

To this end, a PAT approach is followed which includes activities such as Degree of Freedom (DoF) analysis, economic

study, implementing in-line and off-line measurement techniques, pilot plant trials, process modelling, and control system design.

A DoF analysis is performed to identify the potential process input variables and control system output variables. An economic model is developed which prioritizes the control objectives.

Pilot plant trials are set up based on Design of (Dynamic) Experiments, Do(D)E, methodology. Further analysis of trial results are performed by JMP Statistical Software and MATLAB System Identification tools for static and dynamic experiments, respectively.

The PDEng project with Amin has lifted the project to a high technical level. It was therefore well worth the investment to have a smart and experienced student work on this for a year. The systematic approach with DoEs, conceptual design of a PAT-Based Control System, the discussions with Dr. ir. P.J. (Peter) Daudey and Dr. ir. J.T. (Johan) Padding have been invaluable. - ***Ing. M. (Mark) van Dijk MSc, Unilever***

Company: Consortium project with Institute for Sustainable Process Technology (ISPT), Huhtamaki, Cosun, Andritz, Avebe and TNO
Project: Process INtegrated HEat Pump Drying - PINcHED / Accelerating the implementation of high-temperature heat pump
PDEng trainee: Sanduni Pathiraja PDEng MSc, TU/e

Process and Product Design

Energy use in the industrial sector is dominated by the use of heat from non-renewable fuel sources. A low carbon economy requires transition to more sustainable sources. Heat pumps allow for the recycling of waste heat from industrial processes by upgrading the temperature level of this waste heat to supply process heat. Drying is one of the most common and significant unit operations in the chemical and food process industries, which represents a highly energy intensive, high temperature process that is estimated to account for 12-25% of the total industrial energy consumption. In this context, the PINcHED consortium project focused on heat pump solutions for high temperature applications.

Consequently, the utilization of waste exhaust heat from two different industrial thermal drying processes, namely, contact-drying in food processing, and convective drying in paper industrial sector was considered in both a brownfield and a greenfield approach.

Heat pump technologies named, subcritical, transcritical, mechanical vapour recompression (MVR) and stirling cycles were evaluated with refrigerant choices having low global warming potential (GWP) and ozone depletion potential (ODP). Results showed that retrofitting a heat pump onto existing installations

in brownfield give rise to more inefficiencies. While, process optimizations to existing dryers and new dryer concepts resulted in technically promising solutions, the feasibility of realizing them remains to be evaluated.
These initial results have been translated into a step-by-step plan that serves as an aid in the future developments needed to create the business case.

"Sanduni Pathiraja has shown in an excellent way what a PDEng should be capable of: to master a subject in a short time, apply it in different situations, be a worthy discussion partner with experts in the field, and deliver a solid process design." - ***Martin van Sint Annaland, coordinator PPD***

Company: Flexotels
Project: Green Energy Mill: A sustainable energy solution for festivals
PDEng trainee: Floor van Schie PDEng MSc, TU/e

Smart Buildings & Cities

Increased awareness for climate change in combination with new regulations such as the 'Paris agreement' requires emission reduction from every sector, including the festival industry. Currently, most festivals focus on the reduction of CO^2 emissions of audience transport and on-site waste disposal. Power provision is a topic that has been focused on by festivals very briefly, despite the large amount of CO^2 emissions.

The majority of the festivals is not able to obtain power through the national grid. Festivals need to create their own off-grid energy system. Energy for this system is most of the time provided by under-utilised and oversized diesel generators, which results in a large amount of CO2 emission.

This PDEng-project focussed on the development of a sustainable alternative for diesel generators: the Green Energy Mill (GEM). The GEM-Tower uses a combination of different renewable energy sources, solar power and wind power. These sources are combined with a battery system to provide sustainable energy with any weather type. The function of the tower is not only the production of sustainable energy, but it also creates awareness among the festival visitors and festival organisers. The GEM-Tower was built in 2019 and tested at several festivals and locations through Europe.

"From the start of the project – GEM Tower – Floor was the designer, builder and manager. She took the leading role and her contribution to the success of the project was enormous. She has grown from the PDEng trainee to a young professional." - ***Faas Moonen, supervisor TU/e***

Company: Philips
Project: The Philips Remote AI Streaming (PRAIS) platform
PDEng trainee: Robin Mennens PDEng MSc, TU/e

Software Technology

Artificial Intelligence (AI) has the potential to improve many aspects of people's lives, and thereby coincides perfectly with the Philips ambition to improve the lives of three billion people per year by 2030. Relatively new AI data sources include audio/video/data streams that deliver data in real time and enable many new AI use cases. For example:

- Real-time analysis of Intensive Care Unit video and vital sign data can provide faster and more accurate detection of anomalies, such as apnea in neonates.
- Speech to text transcription enables automatic transcription of a doctors consult and real-time sentiment analysis.

While the combination of AI and streaming has significant potential, the harmonized platform services at Philips do not yet provide out-of-the-box streaming functionality.
In this project, we developed the Philips Remote AI Streaming (PRAIS) platform, which enables the remote execution of AI algorithms that take an audio/video/data stream as input and/or output.

We designed and implemented PRAIS based on multiple use cases and have been able to validate twice during two collaborations. Firstly, a group of bachelor computer science students used PRAIS to develop demonstrators. By abstracting away the complexities of realtime streaming, PRAIS enabled the students to build complex streaming applications in just six weeks. Secondly, in collaboration with Maxima Medisch Centrum, we explored how PRAIS can be used to record Neonatal Intensive Care Unit baby footage. Such recordings are used for AI research purposes.

"Robin turned a preliminary proof of concept into a real 'Access to AI' platform to stream audio and video data sources (e.g. from camera, screen share, or communication apps) from wherever in the world, to an AI algorithm wherever in the world (e.g. Microsoft, Google, and Amazon clouds, as well as dedicated Philips Healthcare AI solution components). This impacts people… This impacts resources … This impacts speed of innovation." - ***Ir. Marcel Quist***

Company: Voortman Steel Machinery
Project: Design and validate knowledge models for automation of the design of steel connections
PDEng trainee: Pardis Narenjkar MSc, University of Twente

Robotics

In steel structure construction, automatic welding is one of the cutting-edge topics. Voortman Steel Machinery (VSM) has developed one of the few state-of-the-art automatic welding robots. Steel structures such as beams are connected through steel connections/joints. The structural engineer can choose connections/joints among different categories based on applicable standards, available welding capacity, and structural consideration. The selected connection type impacts the required plates, beam fabrication time, required qualification, assembling time on site, and ultimately the structure cost. Robotic welding has less flexibility than manual welding; thus, there are some limitations for performing and welding all the joints in robotic welding. This has a significant effect on the connection types and beamline logistics which must be considered. Also, the process of design and selecting connections is the most time-consuming part of the steel structure and making a practical and comprehensive digital database of the connections to automate the process is very valuable. The PDEng project of Pardis aims to design and validate knowledge models for automation of determination and design of steel connections as well as cost and time estimation and planning for steel structures. In this regard, a digitalized database of connections will be designed. Also, new software architecture is planned to be developed and implemented in the VSM company to make automated connections between inputs from clients, steel structure, connection database, welding trajectory, and robotic welding.

"Voortman Steel Machinery has been designing and developing CNC-controlled machines and solutions for the steel fabrication and manufacturing industry for 50 years. With automation as one of the company's technology pillars, VSM is becoming more and more a supplier of turnkey solutions rather than only machinery. VSM's goal is to supply customers with software and tools to optimize the complete factory, including logistics, planning, cost optimization, etc. The automatic generation of structural connections, based on cost, buildability with robotic welding, certifications, is one of the first steps of this development." - ***supervisor Voortman***

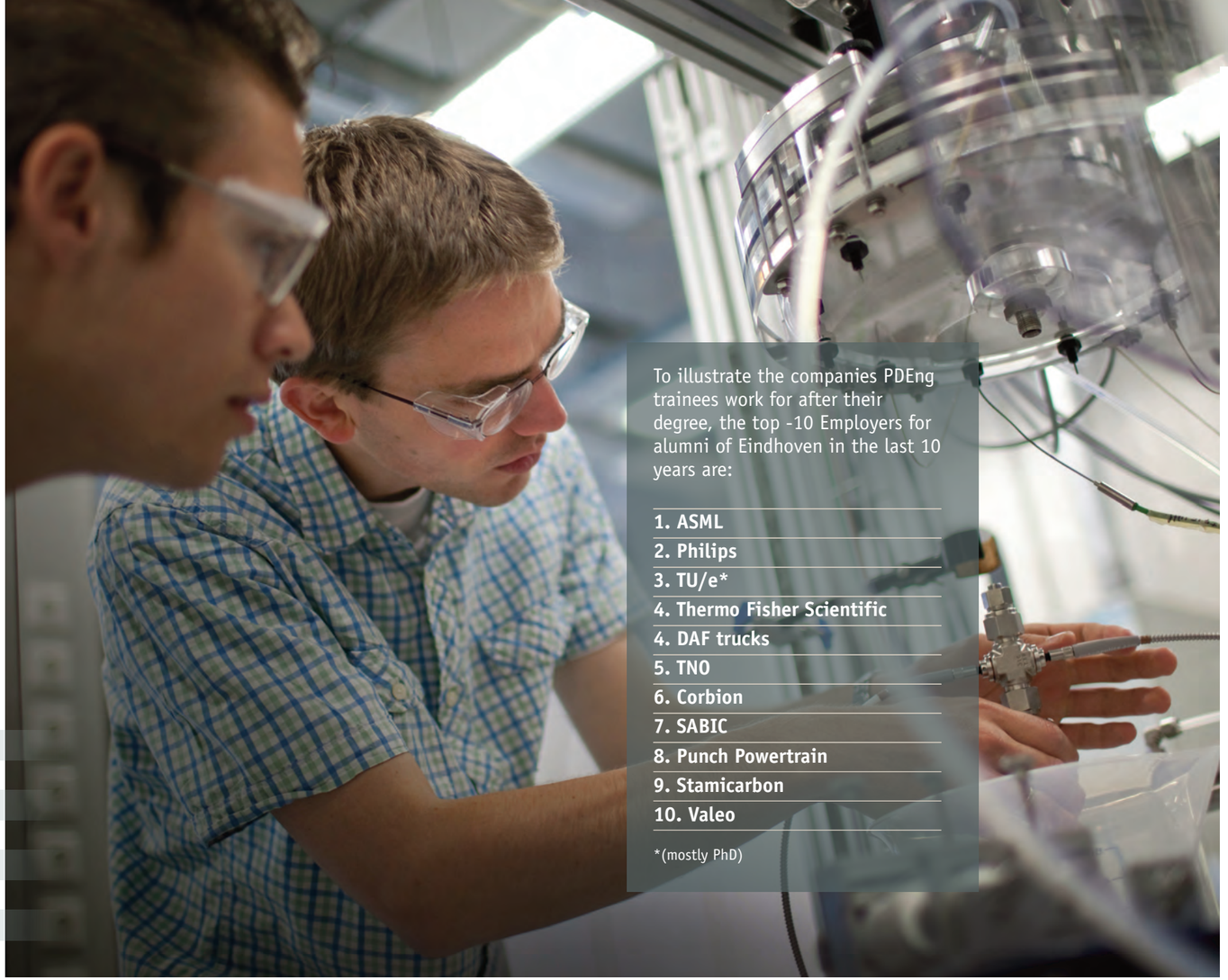
Company: Catharina Hospital Eindhoven LifeTec Group B.V.
Project: AngioSupport: a novel and quantitative tool allowing clinical decision making for cardiac teams to plan coronary interventions
PDEng trainee: Tim van den Boom PDEng MSc, Bettine van Willigen PDEng MSc, TU/e

Qualified Medical Engineer

When the vessels surrounding the heart become narrowed, the reduction in oxygen supply can result in serious heart problems. Treatment of this narrowing of the vessel can be done either by medical therapy or reopening of the vessel.
The two main techniques to reopen a vessel are performing a bypass surgery or placement of a stent. Clinical outcomes after these treatments depend on many characteristics, such as patient current condition and medical history. Therefore, the decision between a stent or bypass is complex.
To support clinicians with this decision, we successfully developed a patient-specific model-based interactive tool, AngioSupport. This decision support tool combines numerical models that have been developed at the Technical University of Eindhoven with patient-specific data. With the help of an interface, doctors now have access to a simulation-platform to predict the outcome of a stent or bypass. This allows clinicians to use AngioSupport for support in deciding what would be the best treatment for each patient. With a prototype of AngioSupport, we received NWO take-off phase 1 subsidy to investigate the commercial feasibility of AngioSupport. Currently, the development of AngioSupport continues to create a high accuracy to, ultimately, roll it out in the market as a medical device.

The work of Tim *concentrated on the data and software flow: the models had to be adapted to the actual data available in a typical clinical setting, and in addition results should be available in real time (so that clinicians can evaluate easily different options). The work of Tim resulted in a working prototype, which is ready for the final round of making it fully robust in real life. During the project Tim has also shown to be able to run the project in a structured, professional way.*

The work of Bettine *concentrated more on the user interaction of the prototype: which data are necessary to make proper decisions, how will they be presented to clinicians and how can different cases be easily (and visually) compared etc. Evaluations on different versions were done with several clinicians, in several hospitals. This all lead to a version which was highly valued. . During the project Bettine has also shown to be able to run the project in a structured, professional way. The work of Bettine and Tim had many interactions: they always had to strike the balance between what is ideal for clinicians versus what can AngioSupport actually deliver, and what is computationally possible. - Lukas Dekkers, Catharina Ziekenhuis"*



To illustrate the companies PDEng trainees work for after their degree, the top -10 Employers for alumni of Eindhoven in the last 10 years are:

1. ASML
2. Philips
3. TU/e*
4. Thermo Fisher Scientific
4. DAF trucks
5. TNO
6. Corbion
7. SABIC
8. Punch Powertrain
9. Stamicarbon
10. Valeo

*(mostly PhD)

The Professional Doctorate in Engineering (PDEng) programmes in brief

Programme	Founded	Graduates 1988-2020	Location
Design of Electrical Engineering Systems (Track Information & Communication Technology, Track Healthcare Systems Design)	1988	280	TU/e
Process and Product Design	1989	503	TU/e
Software Technology	1990	488	TU/e
Design and Technology of Instrumentation*	1991	180	TU/e
Process and Equipment Design	1991	225	TUD
Bioprocess Engineering	1994	159	TUD
User System Interaction	1998	333	TU/e
Automotive Systems Design	2011	90	TU/e
Smart Buildings & Cities**	2011	60	TU/e
Energy & Process Technology	2011	32	UT
Robotics	2011	17	UT
Civil Engineering	2011	28	UT
Clinical Informatics	2012	87	TU/e
Chemical Product Design	2012	35	TUD
Maintenance	2014	14	UT
Qualified Medical Engineer	2014	29	TU/e
Data Science	2016	44	TU/e
Civil and Environmental Engineering	2017	2	TUD
Business & IT	2019	0	UT

** This program is being built down. The current trainees will be supported during their finalisation of the programme in order to receive the PDEng degree. / ** Before Smart Energy Buildings & Cities*

The 4TU.School for Technological Design, Stan Ackermans Institute offers two-year post-master technological designer programmes.

The institute is a joint initiative of the four universities of technology in the Netherlands: Delft University of Technology, Eindhoven University of Technology, University of Twente and Wageningen University.

sai@4tu.nl

www.4tu.nl/sai

Photography: Bart van Overbeeke