



I/O VIVAT

VOLUME 32
NO 2

Europe's energy policy
Europe's vision for energy in 2020

Power Systems Security

Protecting the Grid

The magic of Elon Musk

Musk's second master plan

Energy Timeline

Energy development through time

And more...

Puzzle
Company visits
Columns

Green Team Twente



Inter-Actief



Think Inhouse Day, act Keylane.

11 mei 2017

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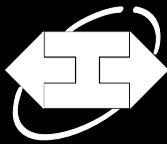
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I/O VIVAT

//Editorial

Dear reader,

Welcome to this first English written I/O Vivat! In September 2016, 36 international freshmen became a member of Inter-Actief, with their roots in Bulgaria, Luxembourg and Romania to name a few. Beside this development, we also have a new editor-in-chief. You may know me as puzzlemaker and editor of the I/O Vivat. Kyra, thank you for all your efforts, I will proudly take over the job.

In this issue, we try to give you more insights in IT & Energy. Nowadays we are all dependent on the electricity grid for travelling, lights, health care and of course charging our extensive collection of devices. Amsterdam was blacked out due to a power failure in January 2017 causing a great disruption to residents, commuters and workers. It seems obvious that security of the power grid is of extreme importance. Herman ends his writing career at I/O Vivat with a smasher of an article about the security of power systems.

While we are more and more dependent of the power grid, we try to reduce the CO₂ emissions. Finally, sustainability and renewable energy are buzzwords. It is about time! Dennis dives in the policies on and developments in energy in Europe. What is the vision for 2020? Furthermore, Marlène gives a nice overview of the developments of energy over time, highlighting the most revolutionary inventions in a beautiful design made by Mart.

And while governments are squabbling, the innovative and durable solutions by companies take place in rapid succession. Marlène gives you an insight in the adventures of Elon Musk. Furthermore, Yannis, our new editor from Greece, writes about fusion power and other future perspectives.

Besides that, you can make my new puzzle to train your brain. It's an old-fashioned puzzle page with a twist. It may look easy, but something like a rebus can be much harder when it is not in your native language!

Meike Nauta
Editor-in-chief I/O Vivat

Answer puzzle 32.1

The solution of the puzzle from issue 32.1 is: [Houthalen](#).

The winner of the cinema voucher is Martijn Atema. Congratulations!

We received lots of answers on our last puzzle and two alumni even gave a solution to create this puzzle more efficiently. Stefan de Bruijn wrote a nice anecdote and stated that the creation of this puzzle is a bounded knapsack problem. Steven van der Wal used backtracking to generate words for this type of puzzle: 'Handelscorrespondent' and 'Aardrijkskundeleraar' were his nice findings.

//Content 32.2



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Power Systems Security



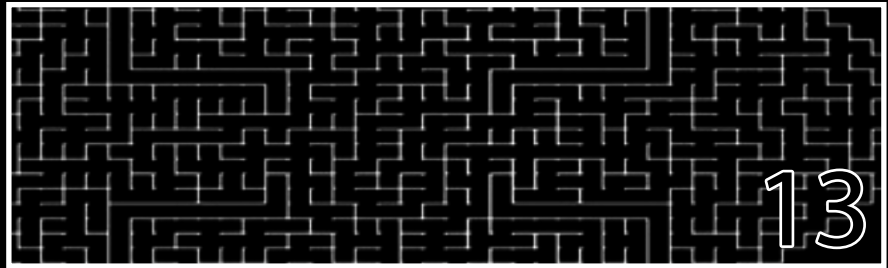
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Energy: Future Perspectives



Power Systems Security

Protecting the Grid



By: Herman Slatman
Editor I/O Vivat

In December 2015, just before Christmas, thousands of Ukrainian citizens experienced a large black out. Several power distribution facilities experienced unscheduled power outages caused by a coordinated cyber attack. In addition to gaining access to central control rooms through VPN connections, the attackers also performed Denial-of-Service attacks on the facilities' call centers to keep legitimate customers from successfully establishing phone calls to ask for information, increasing the amount of disorder.

Attacks on critical infrastructure have been performed since infrastructure exists. In the (far) past adversaries mainly targeted (military) supply lines and storages, but this practice changed considerably over time. Because of the extensive dependence on energy in our industrialized world, energy generation, transmission and distribution are now considered critical infrastructure. The attack on Ukraine's energy sector illustrates that cyber attacks on critical infrastructure are already having an impact on people, increasing the need for adequate protection to be in place. This article will describe the elements of an industrial network, discuss the history of attacks on the energy sector and how critical infrastructure can be protected.

Industrial networks in the energy context

Industrial facilities are heavily dependent on computer systems to control processes. These computer systems are increasingly interconnected with each other and may be connected to company networks and the Internet to increase production efficiency and control. These heterogeneous networks comprise several different types of systems, including field, control and supervisory systems.

Field systems are typically remote systems. In the context of the energy infrastructure they are part of the distribution network and are exemplified by substations and distribution boxes. They may contain several Remote Terminal Units (RTUs), Programmable Logic Controllers (PLCs) and/or Intelligent Electronic Devices (IEDs) to acquire data from electrical equipment, perform data processing, control equipment (e.g. for protection functions) and transfer data.

The control system comprises several types of technology to aggregate the data from remote distribution locations, substations and energy production facilities, and can also control these. Master Terminal Units (MTUs) are at the heart of the control system, initiating the bidirectional communication with RTUs. The communication is largely automated based on predefined logic, but can be manually overridden. MTUs

can communicate the data and processes they control via Human-Machine Interfaces (HMIs), which are usually running on typical PCs running Windows. HMIs provide human operators with the ability to monitor and control the power system, including generation, transmission and distribution facilities.

Supervisory Control and Data Acquisition (SCADA) systems oversee all of the processes, systems and data acquisition. In many cases these processes and systems are geographically distributed and thus need to be centrally monitored and controlled. The data that is reported by the subsystems is saved in databases which can then be queried for report creation and usage accounting. Historical data can be saved in a so-called Data Historian which can be queried for long-term analyses and to perform historical and real-time trending analysis. The increased insights into historical and current performance can be used to increase the efficiency in the future. HMIs and SCADA are also responsible for communicating alarming situations to the human operators who can then take appropriate action.

In addition to all of the connections between systems part of the field, control and supervisory systems, these are also increasingly being connected to business networks. This allows direct interaction with low level systems typically found exerting direct control over these systems and getting insights about current operation more easily.

Moving field systems, such as IEDs and micro-energy sources, closer to the consumers of energy is another recent development. Smart meters are being installed in buildings to get more fine-grained data with respect to energy usage patterns. These also allow the actual consumer of energy to get insights about their usage. Aggregating the usage patterns of consumers and information about the grid and combining these with flexible, distributed generation and home energy management can result in increased distributed control and reliability: the smart grid.

As described shortly before, many systems in industrial networks are connected and interacting with each other. They may be transmitting data or sending commands, just like computer systems on a typical network, but there exist some differences between the two. First, there is the need for low latency in industrial networks, because control systems need to be operated in real-time. SCADA may also depend on specific data communication techniques, such as master-slave or peer-to-peer communication and may make use of distinctive network topologies, such as bus, star or a ring topology. Communication is performed using numerous different protocols, including Modbus, IEC 60870-5, S7, ICCP and the Distributed Network Protocol 3 (DNP3).

Attacks on power systems

The energy sector is under constant attack nowadays, but in most cases you don't notice any of the consequences resulting from these attacks. This is because in most cases the critical processes are not affected by the attack. Still, there have been a number of attacks where adversaries had control over critical processes and controls.

The first example I would like to highlight is an attack on the largest gas extraction company in Russia. Attackers had successfully gained access to the control board for pipelines through a Trojan horse. Through controlling these pipelines they could've disrupted the

it was infected by the Slammer worm. Although no critical systems were affected by the worm, the incident did raise concerns with respect to safety and security.

The Aurora Generator Test was one of the first events during which a destructive attack was performed on the physical components of an electrical grid. It was an experiment performed by the Idaho National Laboratory to demonstrate how a digital attack could affect operations in the grid. The Aurora Vulnerability, the vulnerability exposed during the experiment, involved a computer program that opened and closed the breakers of protective relays out-of-sync, introducing a lot of stress on the

mechanical parts of the relay, resulting in a partial breakdown of the generator. A single failing generator does not necessarily have to result in a catastrophe,

perhaps due to built-in resilience measures such as fail-overs, but surely can be the harbinger of a serious blackout.

Attackers do not only target the power generation, transmission and distribution companies: they also target upstream organizations. A prime example is the Stuxnet virus. It targeted a very specific set of PLCs that were configured to control a cascade of high frequency gas turbines to enrich uranium that can be used for energy production or other purposes. This specific configuration was likely to be found only in an enrichment facility in Iran, thereby limiting collateral damage of this targeted attack. Due to the additional functionality of spoofing the monitoring systems the virus was not detected for a long period of time.

Another example is the Shamoon (Distrack) malware that was used against several organizations in the Middle East. After a single manual infection it managed to infect several thousands of workstations at Saudi Aramco, the largest producer of oil on earth. The malware was able to replicate itself via network shares and could be used for stealing information. Its main payload was a destructive attack, however, consisting of a timed attack that destroyed

“..increased distributed control and reliability..”

gas supply but fortunately this didn't happen. Another non-disruptive attack happened in California during 2001, which involved a power distribution center. The adversaries had gained access through compromising two web servers and pivoted from there, but were stopped in their tracks before they managed to attack critical systems. In 2003 the safety monitoring system of a nuclear plant in Ohio went offline after

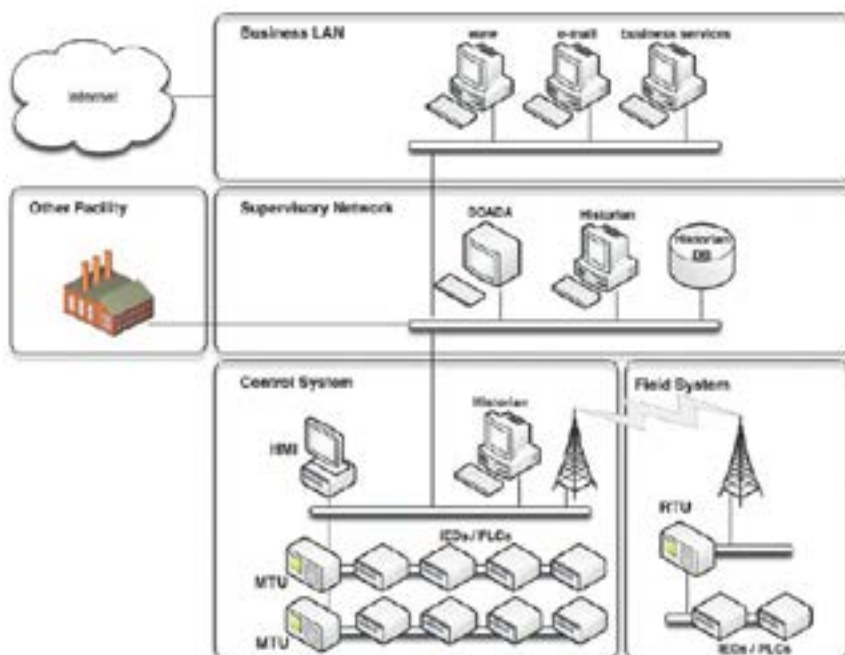


Figure 1: An example ICS and SCADA network indirectly connected to the Internet

files and sabotaged the master boot record of the computer, thereby necessitating a reinstallation of the affected systems. Through proper network segregation the production of oil was never affected, only requiring the restoration of the workstations, but the attack proved that you don't have to be sophisticated to pull an attack like this.

for example, and that they can only access the functionality they need to operate these, instead of having full control. Physical security is also critical to consider in the smart grid. People should not be able to easily tamper with devices that are part of the smart grid. Furthermore, physical access by unauthorized people to energy production, transmission and distribution facilities should be minimized, because having physical ac-

also monitor the current security status of the system as a whole to decrease the risks of service disruption. Having a well-established baseline of the network forms the basis for detecting anomalous behavior in operational as well as security monitoring.

Conclusion

The usage of industrial control systems introduces many improvements with regard to efficiency and the amount of real-time control that can be exerted on industrial systems such as energy production, transmission and distribution. Increasing the connectivity between operational systems, control systems, company networks and the Internet does not only create opportunities, as several attacks with differing consequences against the energy sector have been observed in the past couple of years. These attacks practically attack all and any part of the energy sector as a whole, including energy production, transmission and distribution facilities, but also organizations further up the chain. This is why an extensive approach to maintaining security is necessary, taking into account all of the interconnected systems and possible avenues of entrance.

"...protecting the systems as a whole is a complex task to accomplish."

Protecting the grid

Due to the variety of systems interconnected in a (smart) grid, protecting the systems as a whole is a complex task to accomplish. Appropriate security controls should be in place for all systems and should be implemented using a layered approach. When an adversary then gets access to the company network for example, he does not necessarily have access to the control systems, because there may be a firewall and network segregation in place. Some protocols used in industrial settings do not provide security features themselves, demanding alternative solutions such as setting up virtual private networks (VPNs).

Access control is another important area to focus on for protecting power systems. Care should be taken that only authorized personnel can access HMI's,

access to systems running in a substation can escalate incidents tremendously.

The network forming the connections between all of the components of the grid also needs to be adequately protected. Eavesdropping, traffic analysis and modification of telemetry are some examples that the smart grid needs to be protected from. The communication between smart meters and substations, for example, needs to be authenticated and encrypted to prevent an adversary from learning about the contents of the communication. The grid should also be able to withstand resource exhaustion and other denial-of-service attacks to prevent energy transmission and distribution from experiencing service outage.

In addition to monitoring the operational status of the grid, operators should



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From the ENIAC board

Koers houden en toch een eigen weg!

By: **Sandra Drenthen**
Chairwoman ENIAC 2016



Ik mag met trots vertellen dat ik samen met Evenynke, Ralph, Jarmo en Nils op 13 augustus gechargeerd ben als het nieuwe ENIAC-bestuur! We zijn zowaar met vijf mensen dit keer; wat mij betreft een erg goed teken dat we met zoveel geïnteresseerd zijn om via de alumnivereniging de onderlinge band tussen alumni (en studenten) dicht bij elkaar te brengen en te houden.

Koers houden

Voor ons voelt dit als een nieuw tijdperk, met natuurlijk wat nieuwe ideeën voor de komende tijd, maar niet zonder ook de huidige koers aan te houden. Zo hebben we in september een tweede editie van de afstudeerspeeddate georganiseerd waar tussen de tien bedrijven en zestien studenten vele leuke matches zijn ontstaan die (hopelijk) tot een afstudeeropdracht zijn gekomen. Verder vond het afstudeerdersevenement met de uitreiking van de scriptieprijs plaats op 11 januari in de MBasement (een van de borrelruimtes in de Zilverling). De jaarlijkse ALV inclusief een aansluitende activiteit zal op 18 maart plaatsvinden. De uitnodiging, stukken en meer informatie over de bijbehorende activiteit zullen t.z.t. volgen. Tot slot zijn de regioborrels voor 2017 weer gepland: 3 maart in Den Haag, 19 mei in Apeldoorn, 18 augustus in Utrecht, 13 oktober in Enschede en 8 december in Leiden. Alle borrels zullen om 20:00 starten en ook hiervan zal de exacte locatie t.z.t. bekend worden gemaakt.

Eigen weg

Natuurlijk hebben we als nieuw bestuur ook weer nieuwe ideeën die we graag een invulling geven. Zo willen we werken aan een betere ledenadministratie, maar zijn we bijvoorbeeld ook van mening dat de huidige huisstijl en het logo van ENIAC aan een opfrisbeurt toe is! Daarnaast lijkt het ons erg gaaf om in het najaar 2017 een mini-symposium op te zetten, als een gaaf inhoudelijk event, waar we hopelijk alumni uit alle jaargangen mee aan zullen spreken. Mocht je geïnteresseerd zijn om de huisstijl en het logo aan te pakken of vind je het leuk om bijvoorbeeld een lezing, training of workshop te geven tijdens ons mini-symposium of heb je interesse in een van onze commissies of heb je een ander leuk idee? Neem dan vrijblijvend contact op met het bestuur (bestuur@eni.ac.utwente.nl) en dan zullen we kijken wat we voor elkaar kunnen betekenen!

Blijf op de hoogte

Er zijn nu heel wat data genoemd, maar van de meeste events volgt de verdere informatie nog! Wij sturen alle ENIAC-leden mails met agenda-aankondigingen en extra informatie op zijn of haar alumni-adres. Wist je dat je via de alumniportal van de Universiteit Twente je alumni-mail kunt doorsturen naar een ander mail adres? Dan ben je verzekerd dat je geen updates mist.

Ook hebben we een eigen Facebook-groep waar ook alle activiteiten aangeemaakt worden. Mocht je daar nog niet in zitten en dat wel willen, dan kun je zoeken naar 'Alumnivereniging ENIAC' en vragen om toegevoegd te worden.

Sandra Drenthen is voorzitter van ENIAC: de ENSchedese Informatica Alumni Club. ENIAC is de alumnivereniging voor de bachelor- en masteropleidingen Technische Informatica, Telematica en Bedrijfsinformatietechnologie aan de Universiteit Twente.

Voor slechts €5,- ben je al lid van ENIAC. Je ontvangt dan vier keer per jaar het populair-wetenschappelijk magazine I/O Vivat, bent uitgenodigd voor alle activiteiten, en houd op deze manier contact met je oud-studiegenoten. Ook afgestudeerde Bachelor-studenten worden van harte uitgenodigd om lid te worden. Aanmelden kan via de website.

ENIAC heeft als missie de contacten tussen alumni onderling en met de faculteit EWI te stimuleren. Daarom wordt jaarlijks de ENIAC Scriptieprijs uitgereikt voor de beste scriptie van het afgelopen collegejaar, en wordt ook het ENIAC Scholarship toegekend aan een student als ondersteuning van een buitenlandse stage of afstudeerscriptie.

ENIAC heeft met Inter-Actief de afspraak gemaakt dat activiteiten van beide vereniging toegankelijk zijn voor leden van beide verenigingen. Als lid van Inter-Actief ben je dus van harte welkom bij de activiteiten van ENIAC, en als alumnus kun je ook de activiteiten van Inter-Actief bezoeken.

Communicatie van de belangrijkste activiteiten vindt plaats via de Inter-Actief weekmail en ENIAC Buzz.

Moneybird

Interview with Oliver Jundt and Jorieke Levink



By: Dennis Aanstoot
Redacteur

For this edition of the I/O Vivat the editors visited Moneybird, an IT company based in Enschede that deals with administrative software. We spoke to Oliver Jundt and Jorieke Levink at the Moneybird office.

Could you tell us something about Moneybird?

The company Moneybird was founded by Joost, Edwin and Berend in 2008. Edwin and Joost are still the owners of the company, Berend has since moved to new pastures. Joost and Edwin both studied at the UT. As entrepreneurs, they found out that financial administration is a lot of work. As they wanted to spend as little time as possible doing it, something had to be done to make it easier. Therefore, they built a tool to do bookkeeping for their own companies. This tool has become what is today a full-fledged accounting application, with currently 20 people working on the product. Our goal is that our users will be able to give as much time as possible to their passions and to growing their business, letting the software take care of time-consuming financial administration. Moneybird started out as a program for invoicing, but nowadays it has grown to an all-around accounting application. For example, you can see your balance and your profit at a glance and you can file your tax returns with ease. Additionally, your accountant can help check everything you do. It is a SAAS product, which means the software can

be used anywhere where an internet connection is available.

Our company focuses on entrepreneurs and freelancers. We do not have custom-built versions for any of our customers. They all have access to the same features. If a customer needs functionality that is not yet available, they can use the open Moneybird API to implement it themselves or to connect Moneybird to other software. Moneybird is a fast-growing company, we recently published five new job offers. That means we can no longer stay in our current building, so we are moving the last week of March to a building that is almost three times bigger.

Oliver is a Software Engineer at Moneybird. Can you tell us something about yourself?

I started working here in April last year. I too studied at the University of Twente. I'm officially still a student as I still have to finish my thesis. I did my Master's degree in Computer Science with Information System Engineering as specialization. I focused mainly on data processing and I am particularly interested in automating things using machine learning.



What do you do at Moneybird?

At Moneybird we want to focus more on facilitating the reconciliation banking transactions. The point is that receipts or invoices can be linked to banking transactions, or receipts can be linked to invoices. But sometimes there are errors in invoices, which makes it difficult to link them correctly. To be able to make the links, we are thinking about solving the problem with machine learning. Our 150,000 customers have made many links manually in the past, and these can be good training data for machine learning. For example: a trader buys office supplies and saves the purchase invoices in Moneybird. Payment is made via bank transfer and the bank transaction data is sent to Moneybird. The system should now automatically suggest to the user that the purchase invoice and the bank transaction belong together. This makes the process of reconciliation much easier.

A second thing is that when you receive a bill, such as the costs of hosting a server, you will have to process this information, such as the kind of product you have purchased, and the amount of mo-

ney you have paid. You will also have to determine the category under which the invoice is supposed to be filed. Preferably, you want to process all of this automatically. We do have a system for that, but it can always be made even smarter.

Using our mobile phone app you can take pictures of invoices or receipts. Preferably the app would be able to instantly recognize what information is in the picture and save it to Moneybird immediately. Everything could in theory be recognized from the picture, like the amount of money and invoice number. Machine learning can be applied here in many ways.

What drew you to Moneybird?

I now work for Moneybird; first I worked at a startup, but that was not really a great fit for me. I love working with Ruby on Rails and Moneybird is a company where I can work with it most of the time. We are also encouraged to experiment a lot. When a colleague has created something that would be useful for everybody, he or she will give a demonstration for everyone on Friday.

We are a small and modern company and every day we learn something new.

A previous colleague actually pointed me to Moneybird. Furthermore, they have created and are managing a great product. The average age of employees is very low, around 27. That makes Moneybird a young and dynamic company, with a team that creates many fresh ideas. You get the freedom to come up with new ideas. There are no managers, you are just part of the team. It feels like Moneybird is YOUR business. Whatever you do has a big impact. The fact that you have an impact on 150,000 customers is amazing. When I started here I specialized in data analysis, but you also

work on other parts of the stack. For example, everyone helps the support team. That means you are scheduled to talk directly with customers and resolve customer problems. This ensures you will get to know every part of the software, rather than you are only dealing with your own part of the software. Besides, it ensures that each engineer is close to the customer. It is more fun to develop something to make a customer happy, than doing something just for the sake of it. We have flexible working hours. Working at home is a possibility too. In addition, we lunch together with everyone at the company every day. We do most of our work in silence, but when having drinks or lunch the company can be very lively as well.



Moneybird is a company located in Enschede. The company develops administrative software for entrepreneurs to send invoices and manage their finances. The software makes it possible for entrepreneurs to spend less time on administration, and instead spend time on their business.

Moneybird is looking for new colleagues. Doing an internship or a graduation project is possible too. Are you interested? Take a look at moneybird.nl.

“It feels like Moneybird is YOUR business.”



By: Iris Heerlien
Chairwoman board 38



Since this is my first contribution to the I/O Vivat as chairwoman, I will introduce myself a bit more extensively than I've done in my biography.

My name is Iris Heerlien and I am a first year master student Technical Computer Science. I have completed my bachelor nominally in the last three years after which I decided I would like to do a board year.

I was born in Eindhoven 21 years ago and have grown up there with a lot of fun together with my little sister and parents. After finishing my primary school I went to a bilingual atheneum where I have had a nice time. In fourth class I decided I wanted to study Technical Computer Science whereafter I attended 'student for a day' days in Eindhoven, Twente and Delft. I liked the University of Twente the most and so I chose to move to Enschede after my 6 years of secondary school. I still live in the dormitory where I moved to when I started my study. In my free time I'm training for the Batavierenrace together with Dennis Cai and Pieter Bos to make sure we will run a good relay. Besides training I like to meet up with friends, housemates and family.

I have done a lot of committees at *Inter-Actief*. This started right away in my first year in Enschede when I, together with all the first year girls, was invited for the Girls Committee meeting. When the previous members of the Girls Committee asked me whether I would like to join the Girls Committee I said "yes, of course", because I was very curious about how committees operate and I thought it would be very fun to be part of it.

I am in the Girls Committee for the fourth year now. In these four years I have fulfilled different functions, respectively promotion, vice chairwoman, advisory member & logistics and board representative. During my first year I also decided to fulfill the function of treasurer in the First Year's Committee. Halfway this year I became a member of the Education Committee as a general member. I became chairwoman of this committee in my third year. I decided to stop participating in this committee at the start of this academic year since I became a board member. At the end of my first year I decided to apply for the Symposium Committee in which I was responsible for the speakers. With this committee, we presented the successful symposium MoveIT. Last academic year I decided to join the Rally Committee where I became chairwoman. After being a member of these committees I made the choice to apply for the board of *Inter-Actief*, so that I can contribute even more. I thought it would be a nice year in between my bachelor and master to learn other skills than I would learn in my study programme.

We, as a board, started this year with a positive feeling and we still feel this way. With my fellow board members we form a real team. We are all very excited to support the members of our study association where possible and to make sure everyone feels at home in our association.

Biography:

Iris is a first year student of the master Technical Computer Science. She is 22 years old. She lived in Eindhoven for the first 18 years of her life where she completed her primary and secondary school. She moved to Enschede when she started her study. She completed the bachelor Technical Computer Science after which she decided she would like to do a board year at *Inter-Actief*. She was a member of several committees and is now the chairwoman of *Inter-Actief*. In her free time she likes to be around people and trains for the Batavierenrace.

Old-fashioned puzzle page

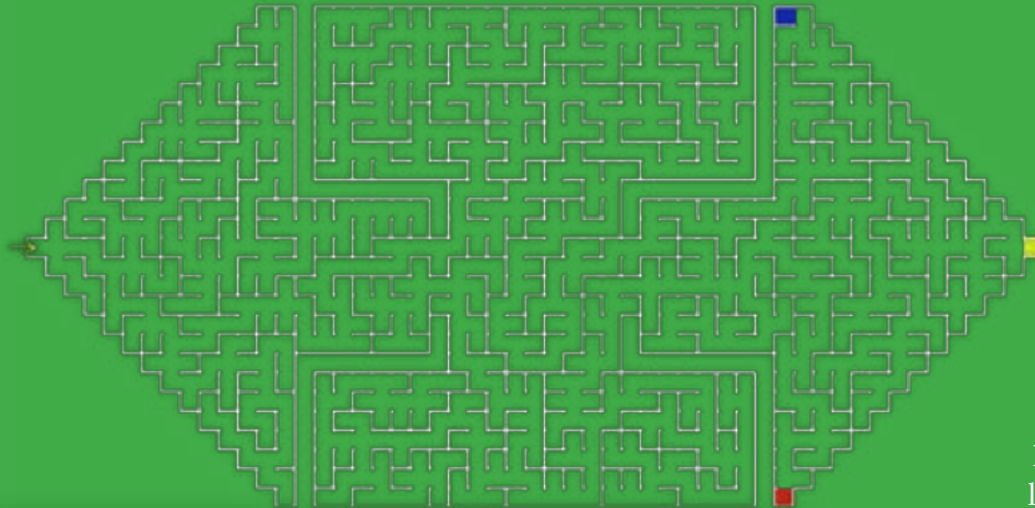
//Puzzle

Solve the puzzles and figure out the solution sentence



By: Meike Nauta
Editor-in-chief and puzzle maker

Solve the maze and end up at the correct color. This color is the first word of the sentence.

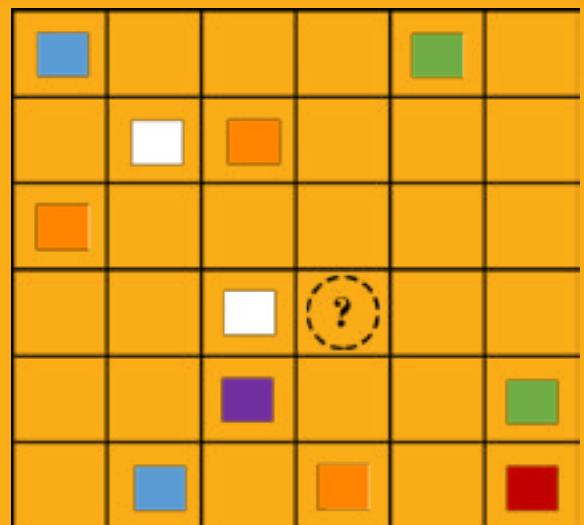


Find the missing letter in this star! This letter is the fourth word of the sentence.

The solution of this rebus gives the last word of the sentence.



Move 3 matches and leave four squares. The letters of the moved matches will form the the third word of the sentence.



Solve the color sudoku! The color in the circle gives the fifth word of the sentence.

- WORD 1:
MAZE
- WORD 2:
WORD SEARCH
- WORD 3:
MATCHES
- WORD 4:
STAR
- WORD 5:
SUDOKU
- WORD 6:
REBUS

Send your solution sentence before the 1st of May 2017 to puzzle@inter-actief.net and get a chance to win a €10,- IA-cinema voucher!

The answer of puzzle 32.1 can be found on the editorial page.

ASML: Be part of progress

ASML

Be part of progress

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Facts and figures

- Founded in 1984.
- More than 15,000 employees
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- Employees of 97 nationalities.
- Offices in 16 countries in Europe, North America and Asia.
- All of the world's top chip makers are our customers.

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Source: <https://www.asml.com>

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ENE —THROU



STEAM ENGINE

Newcomen developed the first commercial steam engine. In 1781 Watt improved the Newcomen's engine by introducing a vacuum. This doubled the power of Newcomen's original steam engine. Before the steam engine, people relied on nature and muscle for energy. With the arrival of the steam engine, lots of new possibilities arrived. Soon, steam engines were used as energy sources for factories, locomotives and much more. Therefore, it is often said that steam engines have been the moving force behind the Industrial Revolution.



GASOLIN

Otto and Langen succeeded in creating the first internal combustion engine for the automotive industry. Automobiles were introduced but were not fulfilling the needs and expectations of the time. The word gasoline, under the name gasoline, made it possible to use petroleum products as still one of the biggest energy sources. However, since the second half of the 20th century, the use of gasoline. The most known effect is the impact on the environment and particles when a gasoline engine is running. Our climate is changing due to the use of fossil fuels and water. Our climate is changing due to the use of fossil fuels and renewable energy is necessary.

400 BC

THE WORD ENERGY

Aristoteles first used the ancient Greek word *Energieia* from which the word energy is derived. The word originally meant activity or operation.



1712

ELECTRICAL ENERGY

Faraday first proved the feasibility of converting mechanical energy into electrical energy. Funny thing is that his basic method is still used nowadays: electricity is generated by the movement of a loop of wire between the poles of a magnet. With this invention, electrical energy became an important part of the daily life. In 1872, Thomas Edison invented the lightbulb. In 1882, the first commercial plant running on coal is established. The influence of this invention has even been that basis for the delivery of the energy nowadays.

1876



ENERGY

RIGHT TIME—



first internal combustion engine that made it possible to fuel increasing in numbers, but the energy sources before this. The fuel created by the combustion engine, later known to create more cars with better power. Nowadays, gasoline is

entury, society realizes more of the dangerous effects of the use of gasoline on the environment. The emitted gasses from the use of gasoline, which leads to global warming and pollution of the air.

RENEWABLE ENERGY

An oil crisis happened when the Organization of Arab Petroleum Exporting countries (OAPEC) proclaimed an oil embargo. The embargo, which started in October, did not end until March 1974. Although this had a very negative effect on the oil prices, it also had the positive effect that more attention was given to renewable energy. Attention was already given to renewable energy due to the fact that fossil fuels won't last forever and also because of the negative effect of fossil fuels to the environment, but this was not as much attention as during the oil embargo. After the oil crisis more renewable energy sources are used, like solar panels and wind energy. Funny thing is that these resources were already used before the invention of petroleum and the steam engine.

1945

NUCLEAR POWER

Nuclear power unleashed and many nuclear power plants were planned to produce energy. Fossil fuels still dominate the energy market. However, more scientists and politicians start to acknowledge that renewable energy is necessary because the fossil fuels will not last long enough. Because of this change in mindset, other renewable energy sources start to grow.

1974



ENERGY

— these days —

SMART METERS

One recent development in which IT has an important role, is the increasing number of smart meters. Smart meters are electronic devices which make it possible to read out the energy consumption at home but also from a distance. European guidelines dictate that in 2020 80% of the households should have smart meters. This has mainly to do with the positive effect for the energy consumers. Since the smart meters frequently send out the energy consumption to the central service, people can easily get an extensive overview of their energy consumption, which leads to more awareness, which finally leads to cost savings. Of course, this will not be possible without information technology. The signals between the meter and the central service, the smart meter itself and the (web) applications the energy suppliers developed are all in the core IT projects.



HOW GREEN IS THE NETHERLANDS?

One recent development in which IT has an important role, is the increasing number of smart meters. Smart meters are electronic devices which make it possible to read out the energy consumption at home but also from a distance. European guidelines dictate that in 2020 80% of the households should have smart meters. This has mainly to do with the positive effect for the energy consumers. Since the smart meters frequently send out the energy consumption to the central service, people can easily get an extensive overview of their energy consumption, which leads to more awareness, which finally leads to cost savings. Of course, this will not be possible without information technology. The signals between the meter and the central service, the smart meter itself and the (web) applications the energy suppliers developed are all in the core IT projects.

TOON

More extensive versions of smart meters are smart thermostats. Probably the most known example in the Netherlands is Toon, developed by Eneco. About five years ago, Toon was launched on the Dutch market. Toon has the functionality of always knowing how much energy and gas you are using, but smart meters already had this functionality. However, Toon extended this functionality by making it possible to set your thermostat from a distance with a app for smartphones and tablets. Besides the role information technology plays in the development of smart meters, smart thermostats like Toon involve even more IT since it generates more options and needs to be even more user friendly.

However, with the introduction of Toon and smart thermostats in general, there was also a lot of resistance due to the privacy and security risks involved. For example, many people were concerned that the data of Toon revealed when people were not home. When this data was retrieved by the wrong people, this leads to a higher probability of burglary.

Concerns like this led to many discussions about privacy (what information are they saving) and security (how is that data protected). These issues are real important for companies like Eneco, and many IT specialist are used to ensure that these concerns are handled as carefully as possible. Therefore, right now there is no reason to assume this is not safe. If you should use Toon, that is a decision you should make yourself, but a little bit trust in the company is often a good choice.

GASOIL

As mentioned before oil is still the most important energy source, even though green energy is emerging. One of the most known oil companies worldwide and pride of the Netherlands is Shell. However, who still thinks that oil companies are not that related to information technology is wrong. Shell is one of the biggest IT employers of the Netherlands and according to a research done by intermediair also the second most popular employer of 2015 und highly educated people. This once again proves that IT employers are involved in every sector, and nonetheless in companies related to energy.

User-Centric Energy Management in (Semi)Public Spaces - Challenges



By: Nirvana Meratnia
Pervasive Systems

The worldwide energy consumption for buildings is expected to “grow by 45% from 2002 to 2025” [1]. While buildings are responsible for at least 40% of the energy demand and 36% of CO₂ emissions in the EU [2], 33% of such demand has its share in the non-residential sector and 67% in residential sector [1].

The current initiatives in energy management in non-residential buildings have put their focus mainly on either civil engineering techniques to ensure isolation and presentation of energy waste or on the use of renewable and green energy alternatives. These techniques have shown to be effective and should be used wherever economically feasible. However, these techniques are in general meant for static optimizations, which do not take into account the dynamic use, dynamicity of users of these spaces and their comfort. The implication is that short and long term changes in the use of the buildings and spaces and satisfaction of the users are not effectively reflected in the potential energy savings.

In response to the growing energy demand in the residential sector, the Demand Side Management (DSM) Programs have been setup, which aim to actively engage consumers in planning their energy usage [3]. These programs consist of various energy management strategies focusing either on load shif-

ting to better schedule energy consuming activities during peak hours or stopping these activities all together. According to the McKinsey research, the following six factors, all of which targeting consumers, are incorporated in successful DSM programs: adaptive pricing, incentives and consumer engagement, availability of real-time and up-to-date energy usage information, direct load control to change and adapt the energy consumption, education and marketing, and feedback from consumers [3]. These programs considered IT solutions primarily for monitoring and usage scheduling and target home users who have direct benefits (in terms of lower cost) from lower energy consumption. To this end, a number of achievements have been made in recent years with respect to hardware development of accurate energy consumption measuring devices, software development of intelligent device scheduling mechanisms to reduce overall energy consumption, as well as designing suitable incentive mechanisms to encourage users to follow systems recommendations.

To accommodate various dynamic aspects in energy management strategies, a missing ingredient is an integrated user-centric sensing, communication, sensor data analytics and optimization approach. To this end, heterogeneous and opportunistic embedded sensing and communication technologies, combined with advanced pattern recognition and learning techniques are needed to provide micro and macro level

situation awareness about both energy usage and users collectively. This is the very approach we utilize in the recently started project COPAS. By considering occupancy, mobility, and behavioural patterns of visitors of large (semi)public buildings, such as hotels, hospitals and educational institutions, we design smart energy management and utilization strategies and optimize/adapt them in order to maintain users' satisfaction and comfort on the one hand and energy saving on the other.

The COPAS project goes beyond the current initiatives by addressing situations in which large groups of diverse unknown users exhibit unpredictable behavioural patterns and requirements and have no direct benefit in reducing the energy demands. Targeting this sector and user group introduces a number of challenges including scalability, heterogeneity, privacy, dynamicity, user behavior's unpredictability, and sensor data analytics in presence of unreliability and uncertainty.

Sources

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Toenemend belang van informatie in de energiesector

Energie Data Services Nederland (EDSN)



By: Arwin Scholten
Manager Informatie Management EDSN & UT alumnu

De Nederlandse energiesector heeft het afgelopen decennium een grote transformatie ondergaan naar een succesvol geliberaliseerde markt en is voor andere (West-) Europese landen een voorbeeld geworden van een goed-functionerende vrije energiemarkt.

In de jaren negentig hebben overheden van de Europese Unie besloten de energieproductie en -verkoop te liberaliseren. Dat heeft ertoe geleid dat consumenten en bedrijven in verschillende lidstaten van de Europese Unie zelf hun energieleverancier kunnen kiezen.

In een aantal West-Europese landen zijn de traditionele energiebedrijven bij de liberalisering gesplitst in een netwerkbedrijf (netbeheerder) en een energieleveringsbedrijf (leverancier). Daarbij zijn de leveranciers geprivatiseerd en is de markt opengesteld voor nieuwe energiebedrijven uit binnen- en buitenland.

Om deze transitie naar een vrije energiemarkt tot een succes te maken, is een betrouwbare informatie-uitwisseling tussen alle partijen in de energiesector van groot belang. Netbeheerders hebben vanuit de overheid de taak gekregen de markt hierin te faciliteren en hebben Energie Data Services Nederland (EDSN) opgericht om hier invulling aan te geven. EDSN heeft de IT-voorzieningen ingericht voor een betrouwbare

communicatie tussen alle marktpartijen en beheert centrale sectorale registers als 'single point of truth' en hoeksteen van de informatievoorziening in de energiesector.

Mede door een goed functionerende informatievoorziening in de sector, stappen consumenten in Nederland probleemloos over van energieleverancier. Het percentage Nederlandse consumenten dat in 2015 van energieleverancier wisselde, was al 14% (ten opzichte van een gemiddelde van 6% in de rest van Europa). Bij het ter perse gaan van dit artikel, lijkt het Nederlandse overstappercentage over 2016 op 17% uit te komen. Dit is een goede indicatie van het succes van een geliberaliseerde markt.

De Nederlandse energiemarkt is mede door een gestandaardiseerde informatievoorziening, goed toegankelijk voor nieuwe (internationale) energieleveran-

ciers. Tal van nieuwe bedrijven hebben een plaats in de markt veroverd. Dankzij het brede aanbod aan leveranciers, heeft de Nederlandse consument ruime keuze.

De actuele ontwikkelingen

De overgang naar een vrije energiemarkt in Nederland mag een succes genoemd worden, en de volgende transitie is reeds ingezet: de transitie naar duurzame energie, decentrale opwek en verdere internationalisering van de energiemarkt.

Technologische innovaties, het maatschappelijk belang en de ambities en politieke afspraken voor een duurzame samenleving, maken de energiesector één van de meest dynamische sectoren. Elektrisch vervoer, warmtepompen, windenergie, zonnepanelen, 'Smart Metering', 'Smart Grids', 'Smart Buildings' etc. zijn technologische ontwikkelingen



Figuur 1: Overstappercentage per jaar voor elektriciteit en gas tot januari 2016 (bron: Energie-Nederland)

die reeds volop aan de gang zijn. Daarnaast zullen ontwikkelingen van bedrijven zoals onder andere Tesla en Google, de komende jaren steeds nadrukkelijker een stempel op de energiesector en onze maatschappij drukken.

Consumenten zullen de komende jaren meer veranderingen en keuzes ervaren, zoals wellicht ook de keuze voor meerdere leveranciers tegelijkertijd op één aansluiting en energieprijzen die variëren op basis van de vraag en het aanbod in de markt op dat moment.

De uitdagingen

De politieke ambities voor een betaalbare, betrouwbare en duurzame energievoorziening in combinatie met de snelle technologische ontwikkelingen dagen de bestaande markt uit en vragen om een snelle aanpassing.

In deze markt ontstaan omvangrijke datastromen die tal van nieuwe mogelijkheden bieden. Slimme meters en op internet aangesloten apparaten in het net genereren enorme datastromen. Op basis van deze data kunnen bijvoorbeeld consumenten bewuster met energie omgaan, kan (lokaal) vraag en aanbod op elkaar worden afgestemd of kunnen apparaten op gunstige momenten worden ingeschakeld.

Innovatieve IT-oplossingen zijn nodig om op een veilige wijze met de grote hoeveelheden data om te gaan. Daarbij zullen IT-innovaties zoals Big-Data, IoT, API-Management, Microservices etc. in een hoog tempo toegepast worden.

De grote rol van data in de energietransitie, maakt ook dat data privacy en security een uitdagend vraagstuk is. Consumenten moeten kunnen vertrouwen op een veilige verwerking en doelmatig gebruik van de data. EDSN wil op dat gebied dan ook voorop lopen.

De dynamische omgeving van EDSN

Het is aan EDSN om ook de energiemarkt van de nabije toekomst (met bijbehorende grote complexe datastromen) te ondersteunen met een passende informatievoorziening en zo via een goed functionerende vrije energiemarkt bij te dragen aan een versnelling van de energietransitie.

De afgelopen jaren heeft EDSN zich in de geliberaliseerde energiemarkt ontwikkeld tot een 'trusted' organisatie. Netbeheerders brengen steeds meer kernsystemen onder bij EDSN om zo de markt op een kostenefficiënte en uniforme wijze te faciliteren. Dit zijn complexe programma's waarin nauw samengewerkt wordt met alle netbeheerders en andere marktpartijen.

EDSN is een organisatie die de realisatie en het beheer van de oplossingen uitbesteedt aan haar IT-partners. Voor de medewerkers van EDSN betekent het dat ze enerzijds voortdurend bezig zijn met de politieke-, markt- en technologische ontwikkelingen in de energiesector en anderzijds dat ze samen met de IT-partners bezig zijn om slimme innovatieve IT-oplossingen te realiseren.

De uitdaging voor EDSN om de snel veranderende energiemarkt te blijven voorzien van een goede informatievoorziening, is groot. EDSN werkt daarom met Business- en IT portfoliofunnels waarin zowel Business- als IT-ontwikkelingen vanaf een vroeg stadium worden gevolgd om tijdig te kunnen inspelen op de ontwikkelingen.

Om in de nabije toekomst nog wendbaarder te zijn, transformeert de EDSN organisatie van een 'Plan', 'Build', 'Run' organisatie naar een 'Broker', 'Integrate', 'Orchestrate' organisatie. Daarin worden behoeftes in de sector vroegtijdig geprojecteerd op innovatieve oplossingen van IT-Partners. EDSN treedt hierin op als 'makelaar' met zeer grondige kennis van de sectorontwikkelingen en van beschikbare innovatieve IT-oplossingen. Vervolgens biedt EDSN een integratieplatform waarop de innovatieve IT-oplossingen snel, efficiënt en op een veilige wijze ontsloten kunnen worden voor de hele energiesector.

In alle dienstverlening waarborgt EDSN nauwgezet de privacy en security. Daarvoor is er een Data Privacy en Security Office dat nauw samenwerkt met alle partners in de keten. Als 'trusted' organisatie is het belangrijk dat EDSN te allen tijde aan alle relevante compliance richtlijnen voldoet en hier volledige 'assurance' over af kan geven.

Een mooie duurzame toekomst

Onze samenleving heeft een betaalbare, betrouwbare en duurzame energievoorziening nodig.

Om dit te realiseren is een succesvolle energietransitie nodig. Deze transitie kan alleen succesvol zijn wanneer er een betrouwbare informatievoorziening in de hele sector en voor de consumenten is. Innovatieve IT-oplossingen zullen een belangrijke rol spelen in het succesvol realiseren van deze informatievoorziening. EDSN zal het komende decennium nauw samenwerken met de politiek en met de sector- en IT-specialisten om deze duurzame toekomst te verwezenlijken.



Over EDSN

Energie Data Services Nederland (EDSN) werkt samen met de regionale netbeheerders, TenneT en GTS aan de centrale marktfacilitering voor de energiesector. EDSN ontwikkelt met deze partijen een betrouwbare en innovatieve ICT-infrastructuur voor de energiemarkt van de toekomst en geeft zo de energietransitie en daarmee ook de verduurzaming van Nederland ruim baan.

EDSN groeit. Wij zijn dan ook met regelmaat op zoek naar nieuwe collega's. Meer weten over EDSN? Volg EDSN op LinkedIn of kijk op:

<http://www.edsn.nl/werkenbijedsn>

Over Arwin

Arwin Scholten studeerde van 1996 tot 2000 Bedrijfsinformatietechnologie aan de Universiteit Twente. Hij begon zijn carrière als consultant in de IT-Architectuur & IT-Strategie en maakte in 2012 de overstap naar EDSN. Bij EDSN is hij als manager verantwoordelijk voor Business Innovatie en Enterprise Architectuur.

Fortes Solutions

“We enable change”



Door: Marlène Hol en Mart Oude Weernink
Redactie I/O Vivat

In het nieuwe pand van Fortes Solutions aan het Capitool te Enschede worden we welkom geheten om kennis te maken met het bedrijf en haar medewerkers. Fortes Solutions staat aan de vooravond van het lanceren van hun nieuwe multi app platform Fortes Connect. Hun nu al uitgebreide applicatieportfolio op het gebied van change management en het identificeren en ondersteunen van mogelijkheden wordt hier uitgebreid met ondersteuning voor agile processen. Om meer te ontdekken over hun applicaties en de open bedrijfscultuur, gaan we in gesprek met Sander Nijenhuis, Chiel Hakkenberg, Mark Reestman en Ismay Bax.

Fortes Solutions is in 1997 opgericht door Sander Nijenhuis. Al snel kwam Mark Reestman bij het team en werd de eerste applicatie gemaakt. Fortes maakte toen al de innovatieve stap om een webapplicatie te bouwen in plaats van een traditionele client-server architectuur. Waar toentertijd de basic HTML gegenereerd werd met een Java-applicatie op de server, worden de nieuwe applicaties van Fortes inmiddels helemaal gebouwd in JavaScript met een NodeJS backend. Door de jaren heen is er een duidelijke scheiding gekomen tussen de client applicatie en de server. Momenteel is Fortes druk bezig een service-based architecture in te voeren om een duidelijke scheiding tussen de applicaties te realiseren, waardoor er makkelijk parallel gewerkt kan worden.

Change Management

Met de Principal Toolbox ondersteunt Fortes bedrijven in change management. Hierbij vormt de software-oplossing de kern van wat Fortes aanbiedt aan zijn klanten. Daarnaast bieden ze hierbij ondersteuning aan grote bedrijven hoe ze de veranderingen in hun organisatie kunnen embedden.

Iets wat meteen opvalt als je het kantoor van Fortes binnenloopt is de informele en open sfeer. Dit werd ook sterk benadrukt door onze gesprekspartners. “Er heerst een heel open sfeer bij ons, je kan altijd bij iedereen aankloppen als je vragen of ideeën hebt”, vertelt Chiel ons. Ambitie en leergierigheid staan centraal bij Fortes. Het gaat er niet om dat je de meeste kennis of de beste skills hebt; zolang je wilt leren, groeien medewerkers

“Agile is het helemaal, maar daar kunnen bedrijven in doorschieten.”

Een van de voorbeelden die Sander Nijenhuis tijdens ons gesprek aanhaalt is het gebruik van technieken als Agile en Scrum in grote organisaties. “Agile is het helemaal, maar daar kunnen bedrijven ook wel een beetje in doorschieten. Wat ik daarmee bedoel is dat als je een huis bouwt, je dat liever niet op een Agile manier wil doen.”

Fortes helpt zijn klanten begrijpen waar Agile zinvol is en waar niet en hoe je die twee werelden aan elkaar kunt koppelen.

zowel op persoonlijk als technisch vlak. Chiel heeft zelf elektrotechniek gestudeerd, maar een sterke interesse in IT gehad. Door de mogelijkheden van Fortes heeft hij nu toch de kans gekregen hier wat mee te doen, ook al sluit zijn studie hier niet helemaal op aan.

Wat je merkt bij Fortes zijn de vele studenten die bij de projecten betrokken zijn. “Studenten komen vaak met nieuwe ideeën en inzichten, dit is een leuke toevoeging aan het team”, aldus Mark. Ook Chiel is begonnen als student bij Fortes. Oorspronkelijk deed hij

“Het voelt bijna nooit als werk”



zijn opdracht om de studiereis te financieren, maar heeft daarna nog een stage en bijbaan gehad als tester en DevOps engineer. Afgelopen zomer is hij afgestudeerd en inmiddels is hij voltijd in dienst. Nu is hij voornamelijk bezig met de hosting en de toekomstgerichtheid van de applicaties en de hosting.

Kleine betrokken teams

Na de verhuizing naar het nieuwe pand rondom de jaarwisseling, zijn de ongeveer 30 werknemers verdeeld over drie nieuwe teams. Tijdens de teambuilding-activiteiten kregen de teams ook de mogelijkheid om een eigen teamnaam te bedenken. Dit heeft geleid tot de drie teams: /dev/null, Barbapapa en Cosmo Citty. Team /dev/null houdt zich bezig met het onderhoud van de oorspronkelijke applicatie, Principle Toolbox, en nieuwe functionaliteit. Team Barbapapa houdt zich bezig met het nieuwe platform en de integratie met de Principle

Toolbox. Het laatste team, Cosmo Citty, houdt zich bezig met de ontwikkelingen op SaaS-gebied, waaronder hosting, de backend en de toekomstgerichtheid. Elke dag beginnen de teams met een daily, waarbij er wordt besproken wat er de dag ervoor is gedaan en waar ze vandaag aan gaan werken. “Elke dag een daily houdt je scherp” zegt Mark. Chiel voegt hier nog aan toe dat het ook erg nuttig is voor nieuwe suggesties.

Typisch Fortes

Aan het eind van het interview vroegen we aan Chiel, Mark en Ismay wat nou zo typerend was aan het werken voor Fortes. Ismay gaf hierbij drie dingen aan: de mogelijkheden, de sfeer en de collega's. “Deze combinatie draagt veel bij aan het werk, het zorgt ervoor dat je met plezier naar je werk toe gaat”, aldus Ismay. Chiel en Mark stemmen hiermee in. “Het is heel divers werk, waardoor het nooit saai is”, vult Mark nog aan. We

hebben in het interview geleerd dat dit inderdaad typerend is voor een baan bij Fortes. Je kan veel verschillende functies uitoefenen binnen het bedrijf in een relatief korte tijd. Hierdoor leer je veel en heb je de mogelijkheid om uit te zoeken wat je graag wilt doen. “Het voelt bijna nooit als werk” sluit Chiel het interview af.

Dit past goed in het beeld van Fortes Solutions dat wij hebben gekregen. Het is een bedrijf met een open cultuur, waarbinnen er veel ruimte is voor innovatie en ontwikkeling. Mogelijkheden om nieuwe ideeën in te brengen zijn er genoeg. De combinatie van constante ontwikkeling van applicaties en technologische verbeteringen maakt Fortes een divers bedrijf met een innovatieve cultuur.

Fortes Solutions laat organisaties al ruim 15 jaar meer rendement halen uit hun projecten, programma's en portfolio's dankzij de softwareoplossing Principal Toolbox.

Om hun klanten optimaal te bedienen en hun groei verder te realiseren zijn zij altijd op zoek naar nieuw talent.

Wil je meer weten over werken bij Fortes? Neem dan gerust contact op met Ismay Bax via i.bax@fortes.nl / tel. 053 431 7450



Europe's Energy Policy

Europe 2020



By: Dennis Aanstoot
Editor I/O Vivat

The Europe 2020 [1] is a ten year plan of the European Commission that contains policy aims where the European Union should be heading to obtain a smart, sustainable and inclusive growth.

One of the objectives of the document is to reduce the amount of greenhouse gasses the EU produces by 2020. This has been included because the climate change is at an all time high, and should be decreased to secure a livable future. To achieve this, the European Commission has set targets to reduce greenhouse gas emissions by 20% (30% if the conditions are right) to increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency. This strategy has been proposed in 2010, so ideally we should be halfway there. But how far are we from reaching our goals?

Every member of the European Union has set its own goals to reach for the Europe 2020 project to be a success. The reason it has been organized this way is because some countries may have a growing industry, and a reduction is not a feasible goal. The EU has written some guidelines to reach these targets, for both the public sector and the private sector, which the member states have to implement in their own policy.

Europe is doing great overall when it comes to the reduction of greenhouse gasses. In 2012, Europe already reached 82% of the level set in 1990[3], getting

very close to the ultimate goal. Europe still is on the right track to get to 20% by 2020. The figure shows that the Netherlands is making progress to its own target to reduce the emissions, but it is not expected that we will reach it.

The European commission also wants to invest in renewable resources to generate our energy from. The majority of the energy consumed today is produced from fossil fuels like oil, gas and coal. By investing in resources like solar panels and wind turbines the electricity can be produced cleanly. While other countries have been busy to get to this goal, the Netherlands have not come close. The amount of renewable energy was in 2012 under a half of what it should be in 2020. It is countries like Sweden, Estonia and Austria that achieved the greatest transition to renewable energy over the last 7 years.

The last goal for the climate change and energy sustainability part of Europe 2020 is increasing the energy efficiency by 20%. This is measured by the decrease of total primary energy consumption. A lot of countries are on par to reach this goal. But this is also due to the decrease in energy consumption, because of to the economic recession of 2006, so the consumption of energy is expected to increase when the economy grows.

On April 22nd 2016, 195 nations came together in Paris to sign a treaty at the United Nations Climate Change Conference, the so called Paris Agreement. This treaty is supported by more nations than the EU has. It also gives guidelines, on how the nations should reduce the impact on the climate, and it has some overlapping subjects with the Europe 2020 agreement. The treaty is of most importance to the United States and

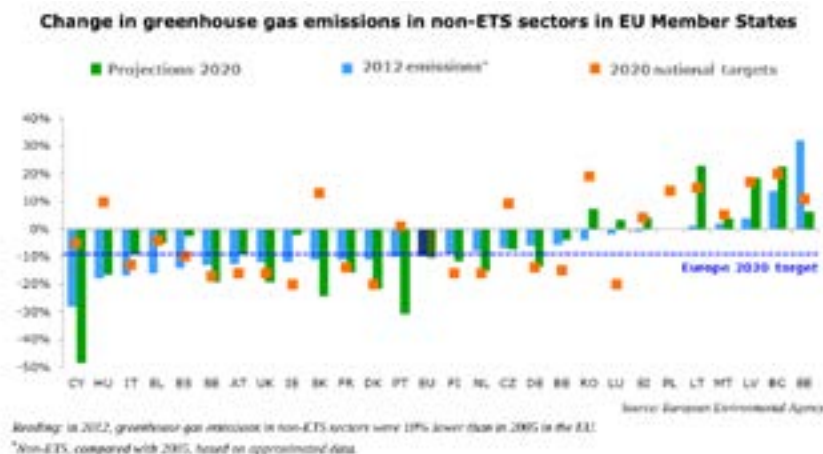


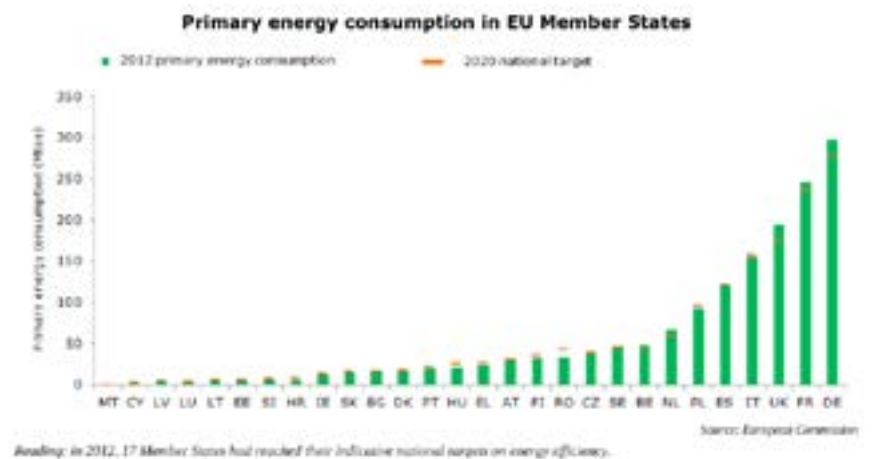
Figure 1: Change in greenhouse gas emissions

China. These are the two countries that produce the most greenhouse gases. China is already supporting the treaty, and the US did for a long time. But now that Donald Trump will be president of the States, it is entirely possible that he will make sure the US will pull out of the agreement. The treaty says that the nations will work together to not let the global average temperature rise with more than 2 degrees. Also, the energy policy of each country will be evaluated every 5 years. With Europe 2020, the EU can tell they are prepared in the fight against climate change.

But why does this all matter? Of course we have to think about the future of Europe's people with climate change in our minds. Fortunately, some positive findings have been reported about Europe where humanity can be proud of. Germany for example, at some point paid consumers to consume electricity: the price was set below zero. The reason for this was that the amount renewable energy that was generated exceeded the amount of energy consumed. Also, at some time Denmark found itself producing 140% of the demanded electricity, and exported the excess power to Germany and Norway, where energy can be stored for later use. These are examples of the power demand falling low and production being high, mostly happening at night. In Portugal the government has put a lot of effort into modernizing its energy infrastructure. This

resulted in renewable energy sources producing sufficient energy to power the entire country for four days straight during sunny and windy days.

“The majority of the energy consumed today is produced from fossil fuels”



Following the events and the result of the past years, we can be confident that our union of countries will reach its goals set for 2020, and will sustain that line.

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Figure 2: EU share of renewables in energy consumption

De ervaringen van Dirk-Maarten



By: Dirk-Maarten
IT-specialist OVSoftware

OVSoftware ontwerpt en ontwikkelt al ruim 40 jaar software voor het bedrijfsleven en de overheid. Ruim 120 software developers en consultants ondersteunen onze klanten bij het oplossen van automatiseringsvraagstukken. Ons familiebedrijf wordt geleid door drie directieleden waarvan 2 vrouwelijke, een unieke situatie in de ICT-wereld. We zijn een financieel onafhankelijke organisatie die landelijk actief is met vestigingen in het oosten, midden en westen van het land, maar ook in Duitsland. Doordat OVSoftware in de breedte actief is, en voor een breed scala aan klanten projecten uitvoert, is het werken erg afwisselend. Zo ook voor Dirk-Maarten:

In 2011 heb ik twee bachelor opleidingen afgerond aan de Saxion Hogeschool in Enschede: Informatica en Technische Bedrijfskunde. Na mijn opleidingen ben ik, na gesprekken bij verschillende bedrijven in de regio, begonnen als software ontwikkelaar bij OVSoftware. Ik hou van een uitgebreide community rondom een programmeertaal en werk graag met Open Source producten, een start als Java developer lag dan ook voor de hand. Buiten mijn werk om hou ik er van om bestaande code uit computergames uit te pluizen.

Veel leuke en afwisselende projecten

In de jaren die ik nu bij OVSoftware werk, heb ik veel leuke en uitdagende projecten mogen doen. Vanuit ons hoofdkantoor in Oldenzaal heb ik ge-

werkt aan projecten voor Rijkswaterstaat en betalingsverkeerprovider CCV. Bij CCV heb ik gewerkt aan de transitie naar het SEPA-systeem voor betalingsystemen bij tankstations. Ook heb ik inmiddels ervaring opgedaan bij klanten op locatie. In 2012 ben ik gedetacheerd geweest bij TRIMM, hier heb ik voor NXP, de voormalige chipdivisie van Philips, gewerkt. Binnen dit project heb ik een zogeheten parametric search module gemaakt, te vinden op www.nxp.com/parametrics. Hiermee kan de eindgebruiker zoeken op allerlei parameters zoals voltage of het aantal aansluitingen. Sinds mei 2013 werk ik als Java developer bij Thales. Veel diversiteit dus!

Hecht bedrijf met fijne sfeer

OVSoftware kwam op mij al snel over als een klein en hecht bedrijf met een fijne sfeer. Het feit dat OVSoftware een familiebedrijf is draagt hier ook zeker aan bij. Nu ik er alweer een paar jaar werkzaam ben, is OVSoftware voor mij nog steeds een prettige werkgever waarbij zeker aan mijn verwachtingen wordt voldaan. Bij Thales hebben er in mijn periode ook nog een aantal OVSoftware-collega's meer gewerkt. Daarnaast worden er in Oldenzaal pizza-sessies en overige sessies om kennis te delen georganiseerd en ook tijdens de maandmeeting en overige bedrijfsuitjes heb ik veel contact met mijn collega's.



Spannende apparatuur

Een tijd geleden heb ik binnen Thales Nederland de overstap gemaakt van de afdeling Core, die werkt aan het Thales' Combat Management System Tacticsos, naar de afdeling Interface Products (IP). Bij IP maken we koppelingen tussen Tacticsos en diverse hardware. Thales levert aan veel marines over de hele wereld radars en geavanceerde wapensystemen, spannende apparatuur om koppelingen mee te realiseren dus. De koppeling die mijn afdeling maakt kan je zien als een driver voor bijvoorbeeld een printer. Ons doel is het om zoveel mogelijk verschillende hardware vloeiend te laten werken op het besturingsstelsel Tacticsos.

de klant, een interne medewerker, aanlevert. Omdat juridisch gezien eindgebruikers zelden tot nooit om hun user experience gevraagd mag worden, is het gebruikelijk om gepensioneerde experts, meestal oud-officieren van de marine, in te huren voor vakspecifieke kennis.

Op een slimme manier de hardware en bijbehorende code nabootsen

Naast de gebruikelijke bezigheden van een software engineer, zoals het optimaliseren van software en het toevoegen van functionaliteit, is mijn taak breder bij dit project. Zo houd ik me bezig met het maken van automatische regressie-tests en het inrichten van de teststraat. Eén van de punten waar ik het meest

als Java en Groovy. Het Java messaging system dat we gebruiken is gebaseerd op Hazelcast en we schrijven in onze IntelliJ IDEA. Uitdagend aan de code bij Thales is dat software erg lang mee moet kunnen gaan, sommige stukken code zijn wel 20 jaar oud. Het is hier dan ook van belang dat wat je schrijft ook op de lange termijn nog bruikbaar is. Wat me persoonlijk aanspreekt is dat het werk dat je levert als Java developer het verschil kan maken in vredesmissies over de hele wereld!

Heeft het verhaal van Dirk-Maarten je enthousiast gemaakt en ben je benieuwd naar wat OVSoftware voor jou als IT-specialist kan betekenen? Bekijk dan onze vacatures of neem contact op met Martijn via 06-81777175 of martijn.klein.haarhuis@ovsoftware.com. Volg OVSoftware op Twitter, LinkedIn of Facebook!



“Ik hou van een uitgebreide community rondom een programmeertaal”

Agile organisatie met scrum teams

Bij Thales wordt gewerkt vanuit een agile organisatie met scrumteams, met onder andere dagelijks een stand-up overleg en backlogs met user stories. Elke twee weken is er een oplevermoment met daaraan gekoppeld een demo, gevolgd door een evaluatie en een planningssessie voor de volgende sprint. Mijn eigen team bestaat uit een Scrum master, vier developers en een fulltime tester, die continue bezig is het systeem te testen. Dit is voor Thales ontzettend belangrijk, want ieder foutje in deze industrie kan levens kosten! Verder is er een product owner die user stories van

trots op ben is dat het ons team is gelukt om delen van Tacticsos lokaal op je workstation te kunnen testen. Eerder moest dit altijd getest worden op de bijbehorende hardware, wat niet erg praktisch was. Dit hebben we opgelost door op een slimme manier de hardware en bijbehorende code na te bootsen, zoals virtuele DVD-drives dat bijvoorbeeld doen.

Java framework en duurzaamheid op lange termijn

Qua techniek wordt er hier gewerkt binnen het Java-framework van OSGi, waarbij we op Linux werken met talen

OVSoftware is opgericht door de familie Oude Velthuis in 1972. OVSoftware is één van de eerste softwarebedrijven in Oost Nederland. Door zich steeds innovatief op te stellen en zich voortdurend te vernieuwen heeft OVSoftware alle stormen van de snelle hardwareontwikkelingen met de systemsoftwareupdates en de ups en downs van de economie altijd overleefd.

Allereerst de organisatieprocessen met de informatiestromen analyseren en uit het niets daar maatwerk software van te ontwikkelen voor klanten in diverse marktsegmenten. Door de langetermijnrelaties met hun klanten kennen ze niet alleen de ICT-omgeving maar ook de business van de klant. OVSoftware is een familiebedrijf waar de tweede generatie Oude Velthuis (de zussen Hanneke en Mathilde) nu samen met Leo Stelloo de directie van de OVSoftware Groep vormen.

OVSoftware heeft vestigingen in Amersfoort, Apeldoorn, Den Haag, Oldenzaal en Münster (D) en focust op Java en .NET-technologie.



Internationalisation

'Nobody said it was easy..'



By: Luís Ferreira Pires
Programme director Business & IT

Starting from September 2016, the Bachelor 'Business & IT' programme became international. I think this is something we should celebrate, but together with the perspective of attracting students from other parts of the world and other cultures comes the challenges of creating a real intercultural learning environment. 'Going international' is not a synonym for 'giving lectures in English', although lectures in English are the enabling factor for internationalisation. Another essential factor is awareness of cultural differences and how we can cope with them.

I followed a workshop about internationalisation that brought a lot of insight to the participants. The workshop was given by a lady who has a lot of experience with intercultural relations. She started with a nice metaphor for operating in another culture, namely writing with your 'left hand' ('right hand' when you are 'left handed'). You feel a bit uncomfortable, the results are readable but sub-optimal, and it takes much longer to write. This is how people coming to our university from other cultures will probably feel (actually some of the Dutch students feel like this when they start at the UT).

After that we started discussing what is 'culture'. She gave the following definition: 'learned and shared patterns of behaviour, beliefs and values, held by a group of interacting people', and told us that cultures can be organised in different ways, according to geographical locations (countries), religion, ethnic groups, but also disciplines (CS and BIT sub-cultures at the UT, for example). Since the definition of cultures mention

beliefs and values, we also discussed whether some beliefs are universal (everybody has this belief), cultural (only some cultures have this belief) or personal (some individuals have this belief). A nice example is 'Eating with utensils', which we find normal, while in some cultures it is pretty normal to grab food with your hands. From these beliefs we can define then the cultural differences, and by acknowledging these differences we can create a so called 'intercultural classroom'.

We discussed many cultural aspects that differentiate cultures, and at the end we discussed the classic problem of 'plagiarism'. 'We' have a general conception that 'copying a piece of work from someone and not mentioning the source' constitutes plagiarism, and we can approach people ('cultures') who do not share this belief in many different ways, varying from denial ('everybody shares this belief') to integration ('I get your point and we will integrate your beliefs in our intercultural environment').

Of course I am not advocating that we should allow students to commit what we consider to be plagiarism, but rather try to understand why in some cultures this is acceptable. A plausible explanation seems to be that it is a pity to spend time rewriting stuff written by other people, and it is better to concentrate on the creation of new knowledge from this available knowledge. Any way, we can only get further and avoid conflicts by trying to understand the differences, their background and talking about them to find common grounds to form an intercultural environment. Indeed, it is not easy but we have to take up this challenge because we are not alone in this world.

Luís Ferreira Pires was born on 7 April 1961 in São Paulo (Brazil). In 1983, he received his engineering degree from 'Instituto Tecnológico de Aeronáutica' (ITA) (São José dos Campos, Brazil) and obtained his MSc degree in 1989 at 'Escola Politécnica da Universidade de São Paulo' (São Paulo, Brazil). In 1988, Luís moved to the Netherlands to start a PhD project at the University of Twente, and he obtained his PhD degree in 1994. He is currently an Associate Professor at the University of Twente, in the 'Services, Cyber-security and Safety' (SCS) group. In August 2013, Luís also became Programme Director of the Bachelor 'Business & IT' and the Master 'Business Information Technology'.

Luís lives in Hengelo with his wife and three kids: Elena, Melinda and Caio. In his spare time, Luís likes to watch and practise sports. He is mainly a fanatic supporter of São Paulo FC, but you can also find him sometimes in the Grolsch Veste, and at BWO in Hengelo, to watch the football games of Melinda and Caio. Luís plays tennis at TV Haselo (Hengelo).

The magic of Elon Musk



By: Marlène Hol
Editor I/O Vivat

Over the past few months, there has been a lot of criticism on Elon Musk. This all started with the deadly accident with a Tesla driving, reportedly, in autopilot mode. There has been a lot of discussion about the safety of self-driving modes and also the autopilot mode of the Tesla. There is even discussion whether the technology should be forbidden at all. Besides the negative publicity, there are also troubles within the company. Shareholders were not too happy about Musk's idea to let Tesla buy SolarCity, another company of Musk. Right now, both companies have high debts, so it does not seem like a lucrative action. But as always, Musk has an answer ready. First, he twitters that he has been working on a masterplan and a week later, on July 22th 2016, he presented this masterplan. What does the future hold with Elon Musk?

Musk's second masterplan (his first masterplan was presented ten years ago) basically consists of two parts. First, Tesla is also going to produce trucks and buses, whereas now Tesla only produces cars. Secondly, he would like to integrate solar panels in the car's roofs, which is the foundation for the deal with SolarCity. With this technology, the cars can be directly charged and any excess energy will be saved in batteries. This approach fits Musk's idea behind Tesla: create a complete durable energy supply. The idea behind the buses and trucks fits his idea that electric cars should be available for everyone.

Even though these ideas seem very promising, this does not take away all the criticism of Elon Musk. First of all,

many people believe the second masterplan was a way to satisfy the media and the shareholders. If they believe he had a plan all along, moves may not seem so sudden or unsatisfying. Besides that, Elon Musk once again presented his plans without many details. A timeline or any kind of financial plan is not present. Tesla is still not profitable and there is no assurance these ideas will fix this. The fact that the details are once again not available, only seems to worry the shareholders and critics more.

This leads to the question: why do people still believe in Elon Musk? Even though I can't speak for everyone, in my opinion it is because he addresses the topics we are all rooting for. Believing we can go into space (the SpaceX project of Musk is about this) and we can make sustainable cars without the need for gasoline, does not only feed the idealistic thoughts of many people, it also makes us believe that solutions can be realized. It makes us believe a better world is possible and even within reach.

I think most people can agree on the fact that Musk is a visionary. Not only does he fund most of the projects with his own money, he also create the ideas and directs the execution of these ideas. Not because it makes him richer, but because he actually believes in a better world. Don't we all wish for a leader that actually seems to make the world a better place?

So, does the second master plan contain lucrative business ideas? Maybe not. But I, and with me many other people, choose to believe that Musk has an achievable vision, a vision that could actually improve this world and our way of living. Doesn't that sound like magic?

Elon Musk was born on 28 June 1971 in Pretoria, South-Africa. Just before his 18th birthday he moved to Canada, the home country of his mother. At the age of 19 he was accepted at Queen's University in Kingston, Ontario. After two years he transferred to the University of Pennsylvania. At the age of 24 he received a Bachelor of Science Degree in physics from its College of Arts and Sciences, and a Bachelor of Science in economics from Wharton School of Business. In 1995 he moved to California to begin a PhD in applied physics and materials science at Stanford University, but he left the program because of his entrepreneurial aspirations. In 2002, he became a U.S. Citizen.

Elon Musk is known for a lot of his projects. Currently he is founder, CEO, and CTO of SpaceX; co-founder, CEO, and product architect of Tesla Motors; co-founder and chairman of SolarCity; co-chairman of OpenAI; co-founder of Zip2; and founder of X.com. In December 2016, Musk was ranked 21st on Forbes list of The World's Most Powerful People. As of June 2016, he has an estimated net worth of US\$11.5 billion, which makes him the 83rd wealthiest person in the world. The theme of most projects is related to sustainable energy and reducing the risk of human extinction.

Green Team's H2.Zero

Using the hidden powers of hydrogen

By: Green Team Twente

There are many sources on which cars can drive. The most common way is to drive on fossil fuels, like gasoline, diesel or natural gas. The last couple of years the electric car is been up and coming, some people believe that this is the alternative for fossil fuels. But there are more possibilities and one of them is hydrogen. The Green Team Twente believes in a future where there will be many cars driving on hydrogen.

But how does it work, driving on hydrogen? A car which drives on hydrogen gets his energy from hydrogen gas. This gas goes into the fuel cell of the car. In the fuel cell the hydrogen splits into two electrons and two protons, due to the catalyst present. The protons can go through the membrane in the fuel cell but the electrons cannot. So the electrons have to pass through another circuit and this creates electricity. At the other side of the membrane the protons, electrons and air, which is pumped into the fuel cell, come together. Here the protons, electrons and the oxygen from the air react to water.

The electricity which comes from the fuel cell is used to power the rest of the car. There are already modern cars driving on hydrogen. An example is the Toyota Mirai, a hydrogen-driven car already on the market.

The biggest different between the cars which are on the market and the car the Green Team Twente is building is the

efficiency. One of the main goals of the Green Team Twente is to use the energy we get from our fuel cell as efficient as possible and in that way build a car that is really efficient. With this car, H2.Zero, the team competes in eco marathons. The first race was in France and here the Green Team become second! Our second race is in London, this takes place at the end of June. The biggest difference between this year's track and last year's track are the hills, because of this we had to adjust our design.

For instance, the buffer is one of the components of which the design has been adjusted. Before the energy is used to run the electric system, it flows through a buffer. The buffer is used to accumulate energy so the fuel cell can run at an almost constant, energy efficient level. Also when we use the brakes,

we create energy. This is called regenerative braking. The buffer also supplies storage for the energy generated by regenerative braking.

The buffer is made out of a number of super capacitors placed in series. Supercapacitors are in essence similar to batteries with the advantage that you can pull energy from and charge them very quickly. Since the supercapacitors are placed in series, it will be possible to balance the individual capacitors to make sure the voltage over the individual capacitors will not exceed their absolute maximum voltage. For the London track, we need the buffer in order to get up the steep hills. The fuel cell alone is not capable to supply enough current in an efficient way. When we have too much energy, it will be stored in the buffer. There it will be taken

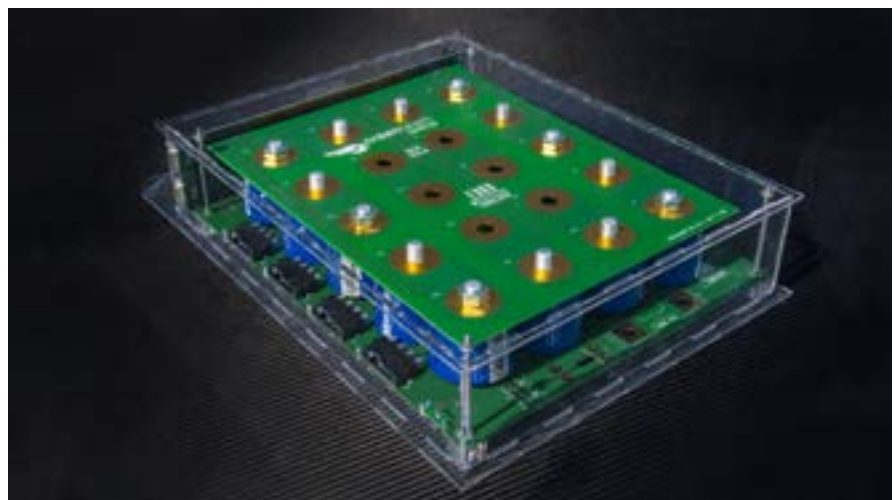


Figure 1: The super capacity buffer used in the H₂.Zero

out of when we lack energy. When the emergency switch is triggered, the output of the buffer is disconnected from the rest of the electrical system. This safety measure makes sure that the energy left in the buffer does not go into the electrical system and thus reassures that all the systems really stop.

The buffer is an electrical part

of the car, but our car also consists mechanical parts. Our gearbox is a component in the car which is new this year. At the race in France we also got an award for this innovative part! The task of the gearbox is simple: slowing down the high rotational speed of the motors to the required rotational speed of the wheels. The challenge lies in the motors having the highest efficiency at their highest rotational speed. At this speed, the motor makes more than 100 rotations per second. If the motor turns slower, for example during acceleration from standstill, it is less efficient. To tackle this problem, we choose to use two different gear ratios. For one set of gears, the gear reduction is high. This means the motor has to make many revolutions before the wheel makes one turn. This is ideal for low speeds, because even at these low speeds, the motors rotate fast, increasing efficiency.

However, when the car is moving at higher speeds, the motors have to turn faster than what they are capable of. Therefore, another set of gears is implemented. These have a lower reduction,

which means that the motors have to make less revolutions for each revolution of the wheels. This set of gears is used when driving at higher speeds. At these higher speeds, the motors are operating in its most efficient range.

This solution brings in another problem: how do we change between those set of gears. A regular car uses a complicated system of levers and clutches. Building this into the H2.Zero would result in a very complicated and heavy system. Because of this, we have chosen for a very simple solution. Instead of having one motor with two different sets of gears, each set of gears has its own motors. We declutch the motors we do not need with one-way clutch. If the motors are used, this bearing couples the motors with the drive shaft. When the motors are not used, the bearing decouples the motors so that they don't turn when they are not needed, making the car more efficient.

Besides of this, we use a mechanical clutch to completely decouple the gearbox from the wheels. This makes it possible to let the car roll out, without having the gears running. To reduce the weight, we combined the two sets of gears in one gearbox. The gearbox is connected to one rear wheel via a drive shaft. Both the gearbox and the drive shaft are made out of aluminium. The

weight of the gearbox and drive shaft combined is less than two kilos. The gearbox is also very compact, with a size comparable of the size of a small shoe box.

With these innovative solutions we built a very efficient hydrogen car. It would be great if these techniques could be used in the automotive industry one day.

We hope that there will be a future with a lot of cars which use hydrogen as their energy source.

“We believe in a future where many cars drive on hydrogen.”

Green Team Twente

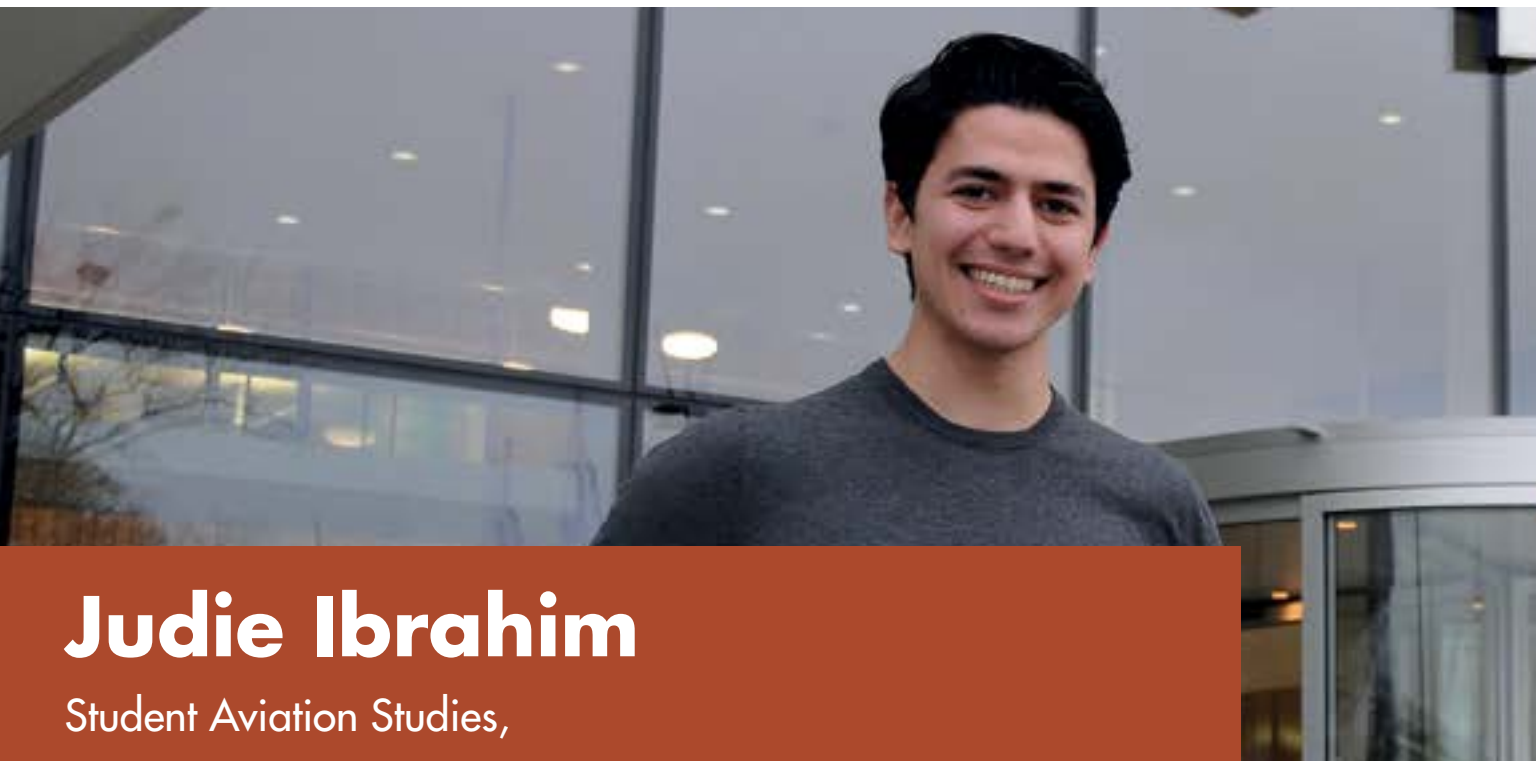
The Green Team Twente is a student initiative that begun at the University of Twente whose goal is to build an ultra efficient car that runs on hydrogen. We believe that hydrogen is the future of sustainable transportation, and future cars will run on this zero emission fuel. The team encompasses disciplines spanning the educational system at the University of Twente. The end goal is the Shell Eco Marathon, a unique race where the winners are determined by efficiency rather than speed or time. Over 200 teams from Europe and Africa join the European edition of this race. All the meanwhile promoting sustainable technologies to a large audience and creating a car that epitomizes the future city car.

More cars on hydrogen, that is the philosophy of the team. The Green Team Twente is building a hydrogen car of the future. It is therefore built to be more accessible to the general public. Not only with the technological advances but also its appearance and general usability. The entire car has been rebuilt on the knowledge learned from its predecessor, the H2.Zero. The new car is called the H2.Zero. It is based on the same design but redesigned to be more efficient and reliable.

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Figure 2: The H2.Zero at the car presentation



Judie Ibrahim

Student Aviation Studies,
Hogeschool van Amsterdam, 23 jaar

“Toen ik op zoek was naar een stage heb ik veel bedrijven aangeschreven, van drie bedrijven kreeg ik een aanbieding. Ik koos voor Thales omdat het een internationaal georiënteerd bedrijf is met meer dan 85% export. Tijdens mijn opdracht bij Thales hield ik mij bezig met het analyseren van het kostprijscalculatie proces en onderzocht ik waar dat mogelijk te verbeteren. Aangezien ik bij Aviation Studies mij vooral bezig houd met techniek zocht ik juist een stage waar ik mij bezig kon houden met bedrijfskundige processen. Het onderwerp van de opdracht bij Thales was mij onbekend, maar juist daarom wilde ik ermee aan de slag en zag ik het als een uitdaging.

Ik ben van mening dat je met een oprechte interesse theorie wel eigen kunt maken. Toen ik bij Thales aan de slag ging was ik verrast over de open cultuur. Je kunt iedereen aanspreken en er wordt tijd voor je vrijgemaakt om je verder te helpen. Als je zelf initiatief neemt dan liggen er veel kansen. Na mijn advies te hebben geïmplementeerd ben ik van plan om in september te beginnen met een de Master Business Administration aan de UvA in Amsterdam.

Ik denk dat dat de combinatie van een technische Bachelor met een Bedrijfskundige master je helpt om met twee verschillende brillen naar oplossingen te zoeken. Ik onderhoud contact met mijn stagebegeleider en hoop dat ik na mijn master bij Thales aan de slag kan.”

“Als student is je grootste angst dat je afstudeeronderzoek in een lade verdwijnt. Bij Thales word je echt serieus genomen en is er vertrouwen in je. Zo wordt mijn advies omtrent een nieuwe methode van kostencalculatie zelfs in 2016 geïmplementeerd.”

**Op zoek naar een stage, af
Start jouw carrière bij Thales. K**

“Tijdens mijn studie was ik mij al aan het oriënteren op de arbeidsmarkt. Ik was op zoek naar een technisch bedrijf met een interessant product waar ik mijn natuurkunde achtergrond zou kunnen inzetten. Op de BètaBedrijvenBeurs in Nijmegen kwam ik in gesprek met een recruiter van Thales. Zij nodigde me uit op het hoofdkantoor om samen de mogelijkheden bij Thales te bespreken. Eén van de vacatures sprong er voor mij meteen uit, namelijk die voor de functie van Trial Conductor. Hiernaar heb ik gesolliciteerd en na een paar gesprekken werd ik aangenomen. Inmiddels werk ik al een paar maanden met veel plezier bij Thales.

Als Trial Conductor bouw ik voort op de tijdens mijn studie opgedane kennis. Regelmatig zal ik met een team naar het buitenland gaan om onze radarsystemen op marineschepen te testen. Daar laten we op zee aan de klant zien dat het systeem inderdaad zo goed is als beloofd in het contract. Dit doen we door middel van allerlei scenario's. Zo laten we bijvoorbeeld een F-16 invliegen om te zien wanneer de radar deze voor het eerst detecteert.

Tijdens mijn sollicitatie kreeg ik ook een aanbod van een ander technisch bedrijf, maar de goede sfeer bij Thales was voor mij doorslaggevend. De mensen hier zijn erg behulpzaam en nemen de tijd om je iets uit te leggen. Thales voldoet zeker aan het beeld dat ik ervan had: een high tech bedrijf met een fijne werksfeer.”

“Als Trial Conductor bouw ik voort op de tijdens mijn studie opgedane kennis. Regelmatig zal ik met een team naar het buitenland gaan om onze radarsystemen op marineschepen te testen.”



Annelot Schuring

Afgestudeerd in Natuurkunde,

Radboud Universiteit Nijmegen, 24 jaar

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Energy: Future Perspectives

Where does the way lead us?



By: Yannis Linardos
Editor I/O Vivat

In physics, energy is usually defined as “the ability of systems to perform work”. This definition makes it immediately obvious why energy is of so much importance in human societies. As a matter of fact, most of the technical breakthroughs before the information age were somehow related to the exploitation and the transformation of various forms of energy. From ships that use wind energy to generate kinetic energy, to catapults using stored dynamic energy; the basic principle remains the same.

In 1964, the Russian astrophysicist Nikolai Kardashev proposed a scale to measure the technological advancement of a civilization by taking into account the amount of energy that they can control. “Type I” civilizations are those who can harness all the energy that falls on their planet from their parent star, “Type II” civilizations are those who can exploit all the energy radiated by their star and civilizations of “Type III” are those in possession of energy on the scale of their galaxy. Nowadays, the global human energy consumption amounts at about 70% of the energy that arrives at our planet from the Sun. According to some scientists, we will reach “Type I” in 2100. However, what the Kardashev scale fails to take into account is sustainability.

Currently, almost $\frac{3}{4}$ of the global energy is produced with the use of fossil fuels, like oil, coal and natural gas. Fossil fuels

are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms, containing energy originating in ancient photosynthesis. It is actually the energy that the Sun radiated to Earth millions of years ago. Humanity, though, depletes earth’s natural resources at a much faster rate than they can be replenished. In 2008, Gilbert Masters, Stanford Professor of Civil and Environmental Engineering, estimated that the current oil supplies in all nations combined would last the world for only about 40 years more. In contrast, current advancements in drilling technology unlocked new oil reserves leading to a historic low in crude oil prices. However, that discovery does not solve the problem of the depleting fossil fuels resources. It only postpones the discussion. Set aside the environmental issues

that arise, which need a separate article to be thoroughly presented. Ultimately, we need to find a new form of energy that is truly sustainable on the long run.

Fortunately, there are many options for humanity. Our planet is constantly bombarded with energy by the Sun while we stand on a planet whose core consists of melting metal. We float on a river of energy and we are dying of thirst because we do not have a glass to drink. Or do we?

First of all, there are the “traditional” renewable energy resources: hydroelectric, solar, wind and geothermal. Our current technology allows a decent exploitation of those resources. There are already numerous dams that convert hydroelectric power to electricity while

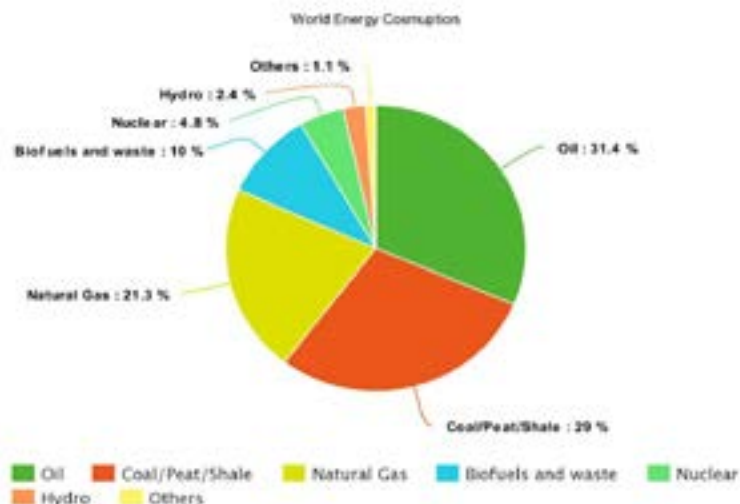


Figure 1: World Energy Consumption

more and more wind turbines and solar panels appear. There are also some truly remarkable initiatives. In Denmark, they have succeeded in covering 140% of their energy demand with wind turbines, most of them offshore. Moreover, the “notorious” entrepreneur Elon Musk has computed that we need about 496,805 square kilometers of solar panels to power the world (if we only use solar power). This is roughly the area covered by Spain.

It may sound like a lot but if we split it by country, it is actually a really small number. Finally, there are even some other renewable energy resources “waiting” for the technology to exploit them to be developed, like tidal power. Ultimately though, almost all energy sources on Earth can trace their ancestry back to the Sun. But where does the Sun get its energy from?

Sun is a giant ball of hydrogen and helium. At its center, the conditions are suitable for nuclear fusion to take place. Nuclei of hydrogen merge into nuclei of helium producing large amounts of energy in the process. It is the exact opposite process from what happens inside traditional fission nuclear reactors, where heavy elements, such as uranium, are split into lighter elements.

Traditional fission nuclear reactors, though, suffer from similar problems with fossil fuels. Uranium is a scarce

element and its reserves on Earth are doomed to be depleted in the following decades while there are some serious objections regarding the environmental dangers from nuclear waste. In contrast, fusion works with plain hydrogen, the most common element in the universe,

is that it will deliver a sustainable fusion reactor at 2025. The leading scientists and engineers of the project are positive that during the second half of the 21st century, fusion reactor technology will have been industrialized. Maybe the projection that we will have reached “Type I” civilization by 2100 is not that far-fetched after all.

“Almost all energy sources on Earth can trace their ancestry back to Sun”

and its nuclear waste is primarily helium, a noble gas which poses no health or environmental hazards whatsoever. It sounds like a very good deal, doesn't it? Why don't we bring the power of the Sun down to Earth then?

It turns out that it is quite difficult to reproduce and maintain the necessary conditions for nuclear fusion to start. There are numerous fusion reactors around the world. However, in order to maintain the necessary conditions and keep the reaction under control, more energy needs to be consumed than produced. That is the reason that the most advanced and powerful nations in the world (EU, USA, Russia, China, Japan, India and S. Korea) collaborate in what has been called the largest engineering project in the human history, the Iter project (which means “the way” in Latin), which is being constructed in Provence, France. It begun in 1985, it is estimated to cost €18 billion and the plan

In conclusion, the importance of energy in human development is self-evident while our reliance on non-renewable and environmentally hazardous energy resources poses the greatest threat to our collective existence. Fortunately, there is a way. It seems that even with our current technology we can cover most of our needs from renewable and environmentally friendly energy resources while some “exotic” engineering projects may reveal the secret to solve humanity's ever growing energy hunger for good. Lev Artsimovich, the head of the Soviet fusion power programme for more than two decades, once said: “Fusion power will arrive when mankind needs it – maybe a short time before that”. Let us all hope that his prediction will be proved right.

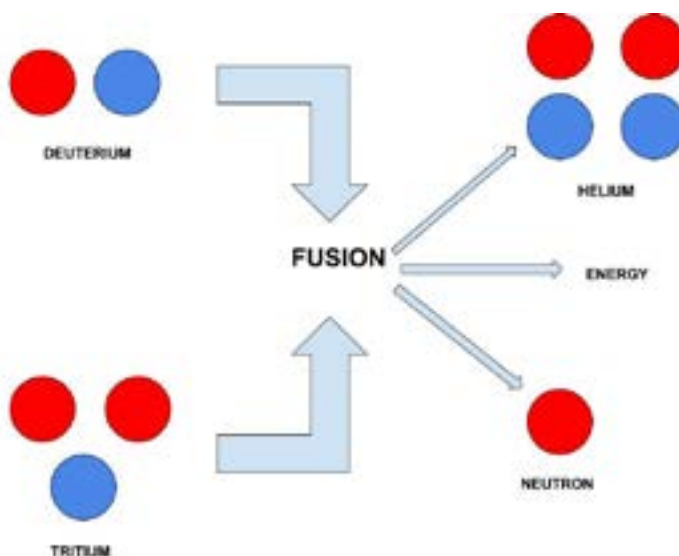


Figure 2: Nuclear Fusion

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