Fortify

PROTECT INNOVATIONS, IDEAS AND TRADEMARKS

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NLO
EUROPEAN PATENT AND TRADEMARK ATTORNEYS

WIM NAUDÉ
PROFESSOR AT MAASTRICHT SCHOOL OF MANAGEMENT, AND RWTH AACHEN UNIVERSITY

'The interaction between people and artificial intelligence is what makes it good or bad'

Interview with Oxycom
Using age-old techniques for industry transforming solutions

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The importance of balancing protection with reputation

Caroline Pallard
PARTNER NLO

'We are keeping our company firmly at the forefront of this emerging and pioneering field.'

It is my pleasure to present the latest issue of Fortify Magazine. As a partner, chairwoman of the Supervisory Board and Dutch and European patent attorney at NLO, I am witness to the broad spectrum of the firm's work. Looking back over the past 12 months, it has been a busy and rewarding period for NLO and NLO Shieldmark. Highlights have included the successful integration of Markenizer to the NLO Shieldmark family in November 2019, the building of an NLO Artificial Intelligence taskforce and the appointment of five new Associate Partners at the same time earlier this year - a unique event in the firm's history. This signals both our ongoing success, and our commitment to keeping the company firmly at the forefront of this emerging and pioneering field.

Along with the rest of the world, we've also had to adapt in the face of the challenges of the global COVID-19 crisis. As a company we have built a strong working culture and team spirit over the years, and this has stood us in good stead as we have found new flexible ways of working. The dedication and professionalism of our staff has enabled us to uphold our usual high standards of service for our clients.

This edition of Fortify is focused on the fascinating and rapidly developing world of Artificial Intelligence (AI) and Intellectual Property. In this issue Professor Wim Naudé talks about the pros and cons of AI; we explore the application of AI in life sciences; and we also hear from Belgium start-up DNAlytics who is applying the power of data science to deliver pioneering healthcare solutions. Within NLO, I lead the AI Taskforce - a team of patent attorneys from various technical disciplines further specialised in the application of AI in their own area of expertise. Together we are positioning ourselves as the go-to leading experts in the field.

I hope you enjoy our latest issue, and I wish you all a healthy, successful and innovative time ahead.

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Fortify is the free magazine for business relations published by NLO and NLO Shieldmark.

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'AI cannot do the research itself, but it can point researchers in promising new directions.'

Wim Naudé

INTERVIEW WITH WIM NAUDÉ

AI: the good, the bad, and the need for humans to take the reins

Artificial Intelligence can be awesome. It can be awful too. Beyond the hype surrounding AI, Professor Wim Naudé sees how it also stifles innovation, increases already woeful global inequalities and further concentrates power in the hands of a few haves. It requires drastic measures to reverse such developments. Above all, a governance system for AI is needed that ensures it does no harm and that facilitates the diffusion of AI. "The interaction between people and AI is what makes it good or bad. Getting people to be involved as much as possible with AI is, I think, the best way forward."

In your publications and popular writings[1] you describe a decline of entrepreneurship and innovation in the West. What have you observed that leads you to this conclusion?

"Almost every measure you use for entrepreneurship, innovation or business dynamics in general, tells the same story. The ratio of start-ups to total number of firms, research productivity or the share of entrepreneurs with higher education, are all declining significantly in almost all high-income countries. People generally believe that we live in a really fast-moving technological age, with all these great innovations that are disrupting everything all the time. But you know what? We don't. The last 40 years we have been at a relative standstill. The only real improvement we have had has been in ICT. I think it was entrepreneur Peter Thiel who said that if you could transport someone back from the 1970s to your city today, the world would be very recognisable to them, except for the mobile phones and the computers we use. Apart from that, the main technologies and innovations we use - trains, electricity, the combustion engine, shipping technology, aspirin and antibiotics as our most potent drugs - are all if not a century old, then approaching it."

'We need technology and innovation now more than ever, but instead we are smothering innovation.'

What causes this decline?

"There is no agreement yet. It can be seen as a matter of death by a thousand cuts. For example the extent of business regulations have continued to increase. While these are really cumbersome, they only play a small role in my opinion. The major reasons lie in a number of long-term trends that started in the 1970s and that represent a structural change in world economic history. For the first time in history, fertility rates in Western countries fell below the replacement rate. So populations get smaller and older. As a result, you have less risk-taking, less entrepreneurship, less innovation. Another major development that also started in the 1970s was a change in capitalist institutions in the West. We have seen the rise of monopolistic domination of the market by the rich that has led to the high levels of income and wealth inequality we have today."

How does that cause a decline in innovation?

"First, you have to realise how these inequalities were given a boost by the development of the digital economy. We thought that this was going to make it very easy for lots of small businesses to be created and to benefit from online opportunities. What actually happened is the rise of platform capitalism: there are a few digital platforms that dominate online business, because of their scalability and the winner-take-all effects from data network economies. Of the ten companies in the world with the highest market capitalisation, around eight are digital platform companies. Now to answer your question: these digital platforms are increasingly engaged in what we call defensive innovation. Many of their innovations aren't intended to bring significantly new and improved goods and services to the market, but are incremental, and designed to keep competitors out. And if smaller businesses become a threat, they can be bought out. That is, before potential competitors had the size to have enough data, to lure expensive PhD's in data science, to run AI algorithms, and so on. So, the area of competition policy needs to be revised, we haven't got that right now. We don't know how to properly regulate competition in the age of digital platforms. All of this really matters because we're confronted with a number of very serious self-inflicted problems and vulnerabilities in our societies. We have a big global population with older generations that are becoming more vulnerable, and younger ones that are increasingly on the move. We're facing climate change problems, we have put pressure on natural resources, we're very vulnerable to outbreaks of pandemics. We need technology and innovation now more than ever, but instead we are smothering innovation."

The perception that we're living in a fast-moving technological age is in large part due to advances in data science, and AI and machine learning in particular. How can such technologies help to create a new wave of innovations?

"Let's look at the current crisis we face. A lot of scientists have started to work on COVID-19. Hundreds of papers on the subject are published every day. Elsevier, the scientific publisher, has created a list of articles relevant to COVID-19. It currently contains tens of thousands of papers, which makes it really difficult for scientists to keep up. In general, we have too much information – which has been described as a "burden". This leads to decreasing returns to scale in scientific research; research teams have to get larger and

'As long as we don't understand the human brain, I don't think we will be making very good progress in developing real artificial general intelligence.'

larger because it gets more difficult to 'do' science. This is where AI can help to make research easier again for us. Algorithms are now reading and scanning these tens of thousands of papers, data-mining, identifying patterns and cross-references and looking for needles in haystacks. AI cannot do the research itself, but it can point researchers in promising new directions. I think this application of AI will have a very good impact on research and innovation."

This is an example of the use of AI as a research tool. A very powerful one perhaps, but still only a tool. There are also cases of AI being innovative in itself, for example by playing a truly creative move in Go[2], or by discovering a new antibiotic[3] after screening more than a 100 million chemical compounds. Given the overwhelming number of possibilities in both these cases, no human can reasonably be expected to have found that particular one. Do examples like these mean we're entering a new era where AI becomes more creative and innovative than humans?
"I fully agree that the volumes of data in these cases are really too much for humans to handle. But I don't see them as proof that we've entered a new world, I'm less optimistic. First of all, these discoveries were not made independently. AI is not an independent entity that comes up with something on its own. AI very much involves researchers who set it to do errands for them, who teach it what to do, who feed it the right data. Nowadays people are trying to let AI replicate innovations from the past. They throw certain data at it and then want to see if an algorithm will come up with the same kind of innovations or patents that people came up with. If you can do that, then you can feed it new data and it might come up with new innovations that humans might come up with if they could only see the bigger picture much more clearly. A number of patents that actually exist were predicted by this AI and that is quite a fascinating development. The second issue I have is that we still don't understand intelligence, let alone concepts like consciousness, common sense or creativity, well enough to be making these kinds of predictions. As long as we don't understand the human brain, I don't think we will be making very good progress in developing real artificial general intelligence. Google has programmed AI to compose music like Bach, others have programmed AI to paint like Rembrandt, but nobody is really convinced by it."

One of your research interests is the governance of AI: how should AI be governed to facilitate its wider diffusion for productive entrepreneurship, and how can we ensure that progress in the development of AI will benefit humanity and prevent bad outcomes? What steps do governments, companies, or individuals need to take for that?
"First, I don't think that AI poses an existential threat at the moment, as some people think it does. But sure, I do think there are some very negative aspects to developments in AI. Increasing surveillance of private lives and the development of lethal autonomous weapons, are examples that we need to avoid. But we need to also look very hard at a less nasty but more difficult issue. That is the question of who has access to AI and who gets to benefit from it? If you look at WIPO patenting data, roughly 30 companies, all located in three regions of the world, are responsible for 90% of patents on AI applications. This means that a handful of countries and companies utterly dominate the field of AI and hold all the patents, knowledge and information and the tools and techniques in their hands, while whole continents with billions of people have absolutely no role in the development of AI."

What would you personally advocate to create a better balance of power?
"In the past the unbundling and breaking-up of companies that became too big and powerful has happened quite a few times. The US provides some very good examples. The robber barons of the 19th century with their monopolies in railroads, shipping, finance and oil were forced to break-up their companies, and that proved to be very good for subsequent growth. Another measure might be to reinstate laws that prohibit companies from buying back their own shares. For a long time, in the US, companies were not allowed to do that, but under pressure from the business lobby that changed in the early 80's. These share buybacks are a very effective tool to pump up share prices, and thereby executives' bonuses. The result is that in the last ten years, big US firms have deviated an estimated 500 billion dollars away from investments in innovation and instead spent it on share buy-backs. That is another big reason for stifling innovation, leading to slow economic growth. Also, we need to be careful not to over-hype AI – there is an incentive to do this so as to attract finance. But this can create asset-price bubbles in share markets and distort investment decisions, and if the bubbles burst, we may end up with another AI-winter.

These are quite drastic measures, and the trend is in the opposite direction. Short of such drastic measures, what can be done to facilitate the wider diffusion of AI as a tool for more productive entrepreneurship and innovation?
"In addition to top-down measures it's good to also have a bottom-up approach. One thing to do is to put significantly more tools and resources into our university system, to make sure there are enough grassroots initiatives in AI. Currently

Wim Naudé (1968, South Africa) is a Full Professor in Development Economics and Entrepreneurship at the Maastricht School of Management, the Netherlands. He is also affiliated with the RWTH Aachen University and the IZA Institute for Labor Economics in Bonn, Germany, and is a Fellow at the Africa Study Centre, University of Leiden, the Netherlands.

Wim Naudé studied economics, development economics, econometrics, mathematics and statistics at the University of Warwick (UK) and North-West University (South Africa), and artificial intelligence at the University of Helsinki. The use of big data sets in addressing economic problems has been a constant in his career. For example he worked on modelling the economic impact of trade liberalization as part of South Africa's negotiations for entry into the GATT, and was part of initial workshops that established UN Global Pulse, the UN Secretary-General's innovation initiative on big data and AI for sustainable development, humanitarian action and global peace.

'AI is not an independent entity that comes up with something on its own. AI very much involves researchers who set it to do errands for them, who teach it what to do, who feed it the right data.'

the amount that European countries are investing in AI infrastructure and technology is relatively miniscule. Few universities have the number of servers or the computing power you need to develop, train and run serious cutting-edge AI models. More funding for fundamental science and physics, and better promotion of STEM skills, will also lead to further advances in AI. The number of calculations needed to be a leader in AI tasks like language comprehension, game playing, and common-sense reasoning has soared an estimated 300,000 times in the last six years. So, our computational abilities are reaching the end of the line, and quantum computing may be required that get past these computational constraints – but this is still quite far away in my view. Then there is the issue that governments tend to view AI as primarily a technical issue, not so much as an economic or business issue. It is a real shortcoming that involvement from these domains in governments' AI decisions is limited. Governments seem to think that you govern good AI by making sure computer scientists are writing good code and that the algorithms and datasets aren't biased. If that is the only way you are going to deal with AI governance, you are not going to be successful in getting the most out of AI. You may only end up with a few firms and organisations benefiting from "good AI" and most other firms and countries excluded – obviously in such a case even good AI can exacerbate inequality. We therefore need to think seriously about access to AI and its diffusion as well – and this is largely an economic and political challenge.

[1] https://www.wimnaude.com/blogs
[2] DeepMind, "AlphaGo - The Movie | Full Documentary", 13 Mar 2020, video, https://youtu.be/WXuK6gekU1Y
[3] Anne Trafton, "Artificial intelligence yields new antibiotic", MIT News Office, February 20, 2020, http://news.mit.edu/2020/artificial-intelligence-identifies-new-antibiotic-0220
[4] Wim Naudé, "Artificial Intelligence against COVID-19: An Early Review", Towards Data Science, April 1, 2020, https://towardsdatascience.com/artificial-intelligence-against-covid-19-an-early-review-92a8360edaba
[5] https://bluedot.global/
[6] The TWIML AI Podcast with Sam Charrington, "How AI Predicted the Coronavirus Outbreak with Kamran Khan - #350", February 20, 2020, video, https://youtu.be/V6BpKSGquRw
[7] Matissa Hollister, "AI can help with the COVID-19 crisis - but the right human input is key", World Economic Forum, March 30, 2020, https://www.weforum.org/agenda/2020/03/covid-19-crisis-artificial-intelligence-creativity/

AI VERSUS COVID-19, PART I

Wim Naudé published a widely quoted early review article on AI against COVID-19[4], with the following key takeaways: "I find that AI has not yet been impactful against COVID-19. Its use is hampered by a lack of data, and by too much noisy data and outliers. Overcoming these constraints will require a careful balance between data privacy and public health concerns, and more rigorous human-AI interaction. It is unlikely that these will be addressed in time to be of much help during the present pandemic."

As an illustrative example of both the power and the shortcomings of current AI models, Naudé describes the case of BlueDot[5], a relatively low-cost, Canadian-based AI model. BlueDot predicted the outbreak already on 31 December 2019, more than a week before the WHO did. It also generated a list of the top 20 destination cities where passengers from Wuhan would arrive, and it warned that these cities could be at the forefront of the global spread of the disease. Less well known is the fact that another AI-based model sounded an alarm even earlier than BlueDot, but this model attached a very low level of significance to the outbreak. Naudé concludes: "In essence, it required human interpretation and providing context to recognise the threat. Moreover, even in the case of BlueDot, humans remain central in evaluating its output, as Kamran Khan, Founder of BlueDot, explained in a podcast[6]. It is therefore rightly stressed that human input[7], and from various disciplines, is needed for the optimal application of AI."

TREND IN THE MARKET

NLO's IP Masterclass Podcasts

Looking for engaging expert discussions on patents and trademarks? Check out our podcast channel designed for curious minds. For our Dutch-speaking listeners we present our 'NLO IP Masterclass', exploring all aspects of the surprising and interesting world of intellectual property. Coming soon, we're also launching our 'NLO Patent Case Law' podcast, a new English language programme highlighting the most interesting European patent case law decisions. Find us on your favourite podcast platform or via: https://www.nlo.eu/en/nlos-podcast

NLO From Home

We took swift and decisive action early on in the COVID-19 crisis to ensure the safety of our staff. We quickly became fully operational from homes across Belgium and the Netherlands to provide our usual high standards of service to our clients. We're really proud of how our people rose to the challenge from the start, and once again as we are returning to a 'new normal'.

Delft Hyperloop team breaks speed record

In July, the Delft Hyperloop team smashed their 2019 SpaceX record with their Atlas04 pod reaching an incredible 360 km/h in under 300 metres at their test track in Hilversum. Now they've got their eyes firmly fixed on new horizons, hoping to break the 400 km/h mark in the race to revolutionise the future of high-speed travel. NLO is proud to be supporting the team on their journey with IP advice and a financial contribution as well as our enthusiastic applause at their progress.

New faces at NLO

We have welcomed many new faces to NLO over the last few months. Among others, new formalities officers and professional additions to our staff and operations departments have further strengthened our firm. We have also welcomed several new experienced attorneys and trainees within the patents and trademarks departments. Do you want to know more about our attorneys? A list of all our advisors and their areas of expertise is available on our website.

Ann-Sofie Hallbäck

European patent attorney

Elizabeth Hynes

Trainee patent attorney

Sharina Ibrahim

Trainee patent attorney

Teamin Kang

Trainee patent attorney

Ioannis Papapetridis

Trainee patent attorney

Xiaolei Shi

Trainee patent attorney

Lucas Tang

Trainee patent attorney

Hans Reinders (l) and Bart Reinders (r)

Oxycom applies an age-old technique to achieve cooling efficiencies that dwarf those of conventional air-conditioners. Yet it took many years before the company could finally enjoy a prolonged period of stable growth and success. Founder and former CEO Hans Reinders has remained steadfastly convinced all along that with his high-tech adiabatic cooling technology he had pure gold in his hands that would bring enormous environmental benefits. "What we have been doing for years is preaching a religion: that it is worthwhile to invest in comfortable and healthy working environments."

INTERVIEW WITH HANS REINDERS AND BART REINDERS

Air-conditioning done the natural way: cheaper, cleaner and healthier

"You know what the biggest mistake we made is?", asks Hans Reinders as he gives a tour around the Oxycom factory, "We hired a Polish woman as our production leader!" The pink-haired Polish woman nearby, kneeling on the floor with a big caulking gun in her hands, erupts in laughter. "Also, never hire a mechanic from Myanmar with two left hands to do assembly work", Reinders adds. The man standing within hearing distance joins the fun and the three of them briefly discuss the work at hand before Mr. Reinders continues his tour. "This is how I am. When I'm here, I never sit at a desk. I always walk around, I'm always talking to people, initiating things, asking questions, making jokes. I know everyone and everything that happens in this company. I've always known I'm better at working down in the trenches than sitting upstairs in the boardroom. I quit high school after three years, I preferred working at the local gas station to doing my homework."

"Tell me how I can be wrong"

Hans Reinders, age 67, is at the company he founded 18 years ago almost every day, even though he recently transferred the CEO role to his son Bart. It's his boundless passion and drive to see his dream fulfilled that keeps him going with so much energy. That, plus his rock-solid conviction that he has been right all along, and that it was always only a matter of time before the market would recognise that. "If you've got something that achieves so much with so little, tell me how can I be wrong." Mr. Reinders is referring to his high-tech incarnation of an age-old technique: adiabatic cooling or cooling by evaporation. Evaporation requires heat, and by making water evaporate you can extract heat from an object you want to cool. This is the principle at work where - since ancient times - wet towels have been hung in front of open windows to cool homes, and that also explains why humans start to sweat when they need to cool down.

Oxycom applies the same mechanism to manufacture industrial climate control installations, and claims that its coolers consume only 10 percent of the electricity, plus a negligible amount of water, to achieve the same amount of cooling as conventional air-conditioners. In addition, their technique is based on ventilation and thus provides a continuous flow of fresh and clean air to a room, whereas standard air-conditioners circulate the same air repeatedly. Finally, disadvantages often associated with adiabatic cooling - including that it can't cool to low temperatures in warm and humid outdoor environments, that it increases the humidity of the indoor air, or that it's a potential source of contamination with viruses and bacteria such as legionella - are all said to have been resolved.

The secret is turbulence

At the heart of Oxycom's products is an ultra-efficient heat exchanger. It consists of multiple, intricately-shaped aluminium plates, with numerous protruding fins covered in a fibrous coating, all arranged in parallel. In operation, air flows along these fins in separate channels: outgoing channels in which the water is evaporating, and adjacent ones in which the incoming fresh air provides the heat for this evaporation and is thereby cooled. The secret?

"Turbulence. If air is passing through in a nice laminar flow, not a lot of cooling will happen. Our design maximises turbulence and thereby heat transfer, and our heat exchanger contains numerous other smart features that increase its efficiency. Even if you took our design apart, analysed it and tried to replicate it, you would fall flat on your face several times before you could ever succeed. We have nonetheless patented our design worldwide, so no competitor should be able or allowed to copy it. So far we have not encountered anyone who has tried to copy us."

'We wanted to find the best way to cool air without using energy, and I think it is a blessing that we were not hindered by any technical knowledge.'

That may also be the case because Oxycom has been ahead of its time and the market for the majority of its existence. Now though, the feeling is that the market has reached a turning point and is now ready to embrace the Oxycom approach to cooling. "What we have been doing for years is preaching a religion: that it is necessary and worthwhile to invest in comfortable and healthy working environments. People get less tired, can concentrate better, make fewer mistakes and get sick less often, especially now with COVID-19 all around us. Cooling and ventilation are essential for this. We are clearly noticing that this awareness is growing. Once potential customers become aware of what we have to offer and we get a request for a proposal, we've been able to convert 9 out of 10 such requests into actual sales orders. In fact, our customer BMI, a machine manufacturer, claims that after they installed our equipment, their people are no longer in a hurry to go home on sunny days but prefer to stay in their comfortable working environment." The numbers back up this feeling. Oxycom doubled its revenue in each of the previous three years, and was on track to do so again this year before the COVID-19 crisis struck.

All-in for a final try

That growth has been a long time coming. "When I was 47 I sold my previous company and I never had to work a day in my life again. For the next three years indeed I did almost nothing, but I realised I was bored to death. In 2000, together with two former employees but without any specific knowledge about cooling, we started out literally in a shed. I was triggered by stuff that I had read and some people I had talked to. We wanted to find the best way to cool air without using energy, and I think it is a blessing that we were not hindered by any technical knowledge." Initial success for their innovative concept came quickly in 2004, with a 25 million euro order from German caravan manufacturer Hymer for 60 thousand cooling units. Success went out of the door just as quickly however, when a main supplier went bankrupt and Oxycom could no longer produce and deliver the units in the numbers they had agreed upon.

The story of Oxycom's first 15 years is full of other events that would make anyone less passionate, determined, proud and stubborn than Mr. Reinders give up for good: the debacle with Hymer that took years to resolve; a dispute with other shareholders that left him sidelined him for three years; the financial crisis that made it almost impossible to attract funding for a new production line and keep the company afloat; the decision to sell components to OEMs instead of complete products to end-users that proved a strategic dead-end. When he tells these stories, it still brings him to tears: "I've been to hell and back. When I was forced out of my company I had lost almost everything I believed in. Three years later I became convinced that I just had to give it another try. I sold my properties on Lake Como in Italy that were my old age provisions and went all-in. I've been so fortunate to have a family that was willing to once again go along with this fool, and that was able to stick together and endure everything. My son Bart decided to cancel his studies so he could join the company and help me, without asking for a salary. There have been days when there was literally no cash except the deposit money on bottles to put food on the table. No matter how much of a loudmouth you are, these things make you feel very, very small."

Data centres, dairy plants and shopping malls

After all the setbacks in the past, a number of factors and trends have now put the wind firmly back in Oxycom's sails. The Paris Agreement and the need to combat climate change is one. "Especially for the bigger companies who have committed themselves to the targets in the Paris Agreement, energy savings and the reduction of their ecological footprint are now a strategic imperative", explains Bart Reinders, the current CEO. Another factor is that rising temperatures and more frequent heat waves, as well as rising living standards are driving increasing demand for air-conditioning, indoor air quality and comfort. When everyone turns their airco on at full blast at the same time however, this will cause peaks in electricity consumption that power grids are barely able to handle. "We sell another solution that is placed in front of conventional air-conditioners that pre-cools the air these take in. This way we can reduce their energy consumption by 40 percent. Companies now demand that their installation companies install this technology from us in conjunction with existing air handling units, to avoid paying peak electricity tariffs." In Germany new legislation is being implemented that would mandate adiabatic cooling in certain HVAC (heating, ventilation, and air conditioning) applications, and the government is currently subsidising the technology. (Hans Reinders: "If only they had done this 15 years ago.") Developments such as these have already contributed to the fact that Oxycom products can be found on the rooftops of the Equinix data centre in Amsterdam, in distribution centres and stores of supermarket chains Jumbo and Albert Heijn, and in FrieslandCampina and soon in Danone dairy plants. Abroad, Oxycom equipment is used to cool a 60,000 square metre shopping mall in Saudi-Arabia and a Coca Cola bottling plant in Dubai.

"I really think we can be part of the solution"

Then there is COVID-19. "I've been saying for a long time, since well before the current pandemic, that a lack of ventilation in closed environments that contain many people is a hidden killer. As much as I hate to benefit from a crisis like the one we face now, I really think that we can be part of the solution and that our technology can help to prevent entire business sectors from going under." Mr. Reinders' reasoning is based on his conviction that aerosols - the miniscule droplets that everyone exhales all the time and that can travel large distances - are a carrier of the coronavirus and an important source of new infections. Adequate ventilation is therefore the key to his solution for nursing homes, cafes, restaurants, cinemas, theatres, offices, public transport, and so on. "We know from studies we did years ago with the aim to remove cigarette smoke from a bar, that when you blow in fresh air at the ground level and extract it via the ceiling, aerosols will move straight up. This means you can stand shoulder to shoulder in a bar without the risk of being infected by the people around you. And

take buses for example. We have a patented solution for buses, consisting of four compact boxes installed on the roof, that cool the air inside and refresh it 40 times every hour, at no energy cost. Dutch bus manufacturer VDL for example would set itself aside from its Chinese competitors if they would implement our technology. I'm really worried for the future of these businesses. I honestly hope we'll be able to help them find new ways to operate for as long as the coronavirus is around and beyond."

Feeling like Vincent van Gogh

If he still has so many new ideas and so much energy, why step down as CEO? "It was time for me, the past years have sometimes taken a very heavy toll. Together the shareholders, including myself, decided it would be good for the company to have new leadership and a fresh perspective on some issues. I had to swallow hard a few times and it took me some time to get used to the idea, but I fully agree. In the past two years we have invested significantly in the foundation for future growth by taking on board highly qualified people in marketing and sales, finance and technology. What the company needs now is a focus on the things we're doing already and the steady execution of the plans we made. Bart is much better suited to lead that than I am." The son agrees: "If we continue to follow the course we set out and focus on our two existing IntrCooll and PreCooll product lines, we will still grow at a tremendous rate and build a very healthy and valuable company. But my father is not interested in future profits and valuations. Most of all he wants to see his dreams fulfilled, sooner rather than later."

It is not easy for Hans Reinders to restrain himself though, and the current title on his business card - 'Founder & New Business Development' - allows him to continue to pursue his dream: mass production of Oxycom adiabatic coolers for the housing market. The built environment accounts for around 20 percent of global energy consumption, and half of that energy is used for cooling, heating and ventilation. With the 90 percent efficiency gains it promises, Oxycom technology could deliver massive energy and cost savings and contribute significantly to the achievement of climate goals. Hans Reinders shows the drawings he keeps on his phone and explains how his solution for a home installation would work and all the benefits that it would bring.
"I have this concept for home coolers fully worked out, but it has been lying waiting on the shelf for two years now. I feel like Vincent van Gogh sometimes, when he cut off his ear out of frustration because no one would buy his paintings. I know we have to focus and we have to be patient, but it can drive me mad sometimes. It's such a beautiful, logical and good concept. I am 67 already, I still want to see it becoming a reality."

5 NLO appoints five new Associate Partners

NLO appointed patent attorneys Marta Alvarez Guede, Aleidus van 't Hof, Willem Niesing and Willemijn Gommans and trademark and design attorney Peter Simonis as Associate Partners with effect from 1 January 2020. The appointment of five Associate Partners at the same time marks a unique event in the firm's more than 130-year history, reflecting the firm's successful growth in recent years and the ambition to remain at the vanguard of a fast-growing market.

Marta Alvarez Guede

European patent attorney

Willemijn Gommans

Dutch and European patent attorney

Aleidus van 't Hof

Dutch and European patent attorney

Willem Niesing

Dutch and European patent attorney

Peter Simonis

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Hugo Boss vs Boss Shot: The boundaries of protection of reputed trademarks

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Last May, the Board of Appeal of the European Union Intellectual Property Office (EUIPO) issued its decision in the case of *BOSS vs Boss Shot* (R 1221/2019-2). This case gives an interesting insight into the scope of protection of trademarks that enjoy a reputation. It shows that even the broader scope of protection that applies to trademarks with a reputation is not unlimited.

The case revolves around the EU trademark application for "Boss Shot", filed by the company Boss Shot Ltd. from Bolton, United Kingdom on August 7, 2017. The trademark application was filed for *food flavourings* in class 30 and *electronics cigarettes* in class 34. HUGO BOSS Trade Mark Management GmbH & Co. KG (hereafter: "HUGO BOSS TMM"), the company behind the famous fashion brand and the holder of over 400 trademark registrations valid in the EU that include the element "BOSS", wasn't too pleased with the trademark application. It therefore filed a notice of opposition against Boss Shot.

First instance

Before EUIPO's Opposition Division HUGO BOSS TMM argued that its trademarks had acquired considerable reputation in the EU and that the application for Boss Shot was infringing upon its EU trademark "BOSS", registered for, inter alia, *jewellery, clocks and watches* (class 14) and *clothing, headgear and shoes* (class 25). The Opposition Division did not follow HUGO BOSS TMM and concluded that the goods are so different that the public would not associate Boss Shot with (HUGO) BOSS, despite the fact that the trademarks themselves might be considered similar.

Arguments of the parties

HUGO BOSS TMM filed an appeal. First of all, it emphasised that the signs are inherently highly similar due to the complete inclusion of its trademark in the Boss Shot trademark application. Furthermore, according to HUGO TMM, the BOSS trademark enjoys a high degree of reputation in relation to the above mentioned goods in class 14 and class 25, and not merely 'a certain degree' as concluded by the Opposition Division. To substantiate this viewpoint, it submitted evidence which included market surveys on the recognition of the trademark BOSS among the public, advertisement expenses and articles in magazines indicating the strength of the BOSS and HUGO BOSS trademark.

Lastly - and this might be a little farfetched - it argued that there is also a degree of similarity between the goods, as it is not unlikely that shops that sell jewellery would also sell electric cigarettes, and that "the overlapping concepts of lifestyle and taste" would create a link in the mind of the public between BOSS and the contested sign.

In contrast, Boss Shot Ltd stated that the goods are not only dissimilar, but neither complementary or in competition with one another. The market for e-cigarettes should be considered far more niche than the overall fashion market. No association would be made by the consumers looking for e-cigarettes, when confronted with a reputed trademark for clothing and jewellery.

Board of Appeal

In its decision, the Board of Appeal firstly sets out the requirements of the extended protection of trademarks with a reputation following article 8(5) of the EU Trademark Regulation:

- The signs must be identical or similar;
- The older trademark must have a reputation in the territory concerned and for the goods or services on which the opposition is based;
- There must be a risk that the contested trademark will take unfair advantage of, or will be detrimental to the reputation or the distinctive character of the older trademark
- There is no due cause justifying the use of the trademark applied for.

What makes this extended protection so special, is that owners of reputed trademarks may invoke this provision, even if the goods or services of the contested trademark are not similar, contrary to the assessment of infringement regarding "regular" trademarks. However, an element which is not included in the wording of article 8(5), but is developed in case law, is the condition that the relevant public must establish a link between the two trademarks. This link does not necessarily have to lead to confusion, but in the mind of the public an association should be created between the trademarks.

When assessing whether the public will establish a link between the trademarks, one of the factors that should be looked at is the similarity of the goods and services, besides factors such as the level of reputation and the degree of similarity of the signs. The protection of article 8(5) depends on the interplay of these factors: the more the goods differ, the more similar the signs or the stronger the reputation will need to be in order for the public to establish a link between the trademarks. Therefore the question of similarity of the goods and services does in fact play a role for reputed trademarks.

Conclusion

The Board of Appeal stated that it is implausible that the public will think that the manufacturer of a clothing brand will expand to the business of e-cigarettes. It set out that the goods are not only dissimilar, but that the market sectors are not connected in any way and so far apart that the public will not believe that the trademarks are linked.

Based on this decision we may conclude that although the reputed trademarks deserve and enjoy enhanced protection, this protection is not without its limits.

Hugo Boss TMM is known for taking strong action against smaller firms that use the sign BOSS. Earlier this year, as a form of protest, the British comedian Joe Lycett officially changed his name to Hugo Boss, which obviously led to negative publicity for the German fashion brand. It shows us once more how careful one should be with one's reputation.

Patenting artificial intelligence in the life sciences: a practical guide

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Discussion about artificial intelligence (AI) is booming and examples of AI applications are being reported in all technical fields, including the life sciences. While there is much hype about the fourth industrial revolution and how companies in all fields will either reap benefits from AI or be threatened by it, there is a need for detailed advice on how to deal with AI innovations. This article attempts to give specific pointers on the application of AI in the life sciences field. In particular, the use of AI involves three different elements:

- A software product (an implementation of an AI algorithm or model) – the AI software may have some level of genericity, or have been specifically designed for the target application;
- Application of the AI software to solve a technical problem in the life sciences domain (the target application) – for example:
- To identify critical parameters and subsequently predict a given outcome – improvement of a life science method (e.g., diagnostic or treatment guidance); or
- To identify the best molecule candidate – improvement of a product used in life sciences (e.g., a drug); and
- The training data used to feed a machine learning algorithm – this data is usually secret (it tends to be expensive to collect and prepare and is subject to privacy considerations).

Strategy: keep the invention secret, patent it or just publish it?

This question should be familiar to innovative organisations: should we keep an invention secret, publish it or patent it? For inventions involving AI and life sciences, this strategic choice is even more difficult to make as there is uncertainty regarding what, if anything, can be patented.

Keeping part of an invention secret is an option if:

- Time is needed to generate more experimental data to ensure optimal scope of protection;
- The invention could not be described in a reproducible way without disclosing training data that should remain secret;
- Patent case law is not favourable in terms of patent eligibility;
- Infringement is hard to detect;
- The lifecycle of the invention is short; and
- The filing behaviour of the competition is not active.

Any decision to keep part of an invention secret should be re-evaluated periodically to ascertain whether the situation has changed.

If patient data is used in an AI invention, the data must generally remain secret for data privacy reasons. In many practical cases, the collection and preparation of data is such a costly process (both in terms of time and resources) that there is a strong incentive to keep the training data secret, even without a legal obligation of secrecy. The patent attorney must assess whether the invention could be considered reproducible without disclosing the training data used.

If the lifecycle of the invention is short and the filing behaviour of the competition is not active, it may be an option to simply keep the invention secret or to develop a national filing strategy in countries where patents are granted quickly. In addition, when specific restrictive patent considerations apply to this type of invention (e.g., reproducibility, adverse case law or low enforcement opportunities), companies may become even more reluctant to file a patent application. This is where the strategic advice of a patent attorney becomes necessary.

On a technical level, a distinction must be made between AI algorithms that are considered state of the art (e.g., the algorithms and underlying mathematical framework have been described in literature) and those that have some level of inventiveness. Most life sciences applications rely on known models which cannot be patented as such. Moreover, many jurisdictions exclude 'pure' AI algorithms (i.e., without a link to technical problem) from patentability, and qualify them as abstract methods (e.g., the United States and Europe).

If an AI technology has been further developed (in the sense of evolving the algorithmic framework) to allow its application in the life sciences, it may be worthwhile considering protecting the new algorithmic part of the technology as a specific solution to the technical problem to be solved. The patent attorney must assess the optimal level of disclosure for the invention.

The invention originating from the application of AI technology may be protected without actually mentioning any AI technology in the independent claims.

Patenting ai inventions

Question 1: Does the invention allow a technical problem to be solved?

Pure AI algorithms are not usually patentable because they are considered abstract or mathematical methods. In general, in order to be eligible for patentability in the life sciences field, the invention should involve a solution that would also be patentable in the absence of AI – for example, the optimisation of a diagnostic method by identifying a set of key parameters having a predictive value for a given situation is considered a patentable invention. If question 1 can be answered 'yes', then you can proceed to question 2.

Question 2: Is the invention in the AI technology itself?

Continuing with the example of the diagnostic method, such an optimisation method must be novel and inventive in view of the prior art. Just applying a state-of-the-art AI technology to a new application may not be considered inventive. For example, claiming the use of AI technology for providing a new parameter for diagnosing a disease may not be considered inventive, when:

- State-of-the-art AI technology is used; and
- A diagnostic method is already known for the disease.

In this case, the key inventive aspect may be the choice of training data. In this type of situation, further inventive step pointers should be looked for (e.g., a surprising result or prejudice against this approach). If these pointers cannot be found, patenting the use of AI for this particular problem is probably not a viable option.

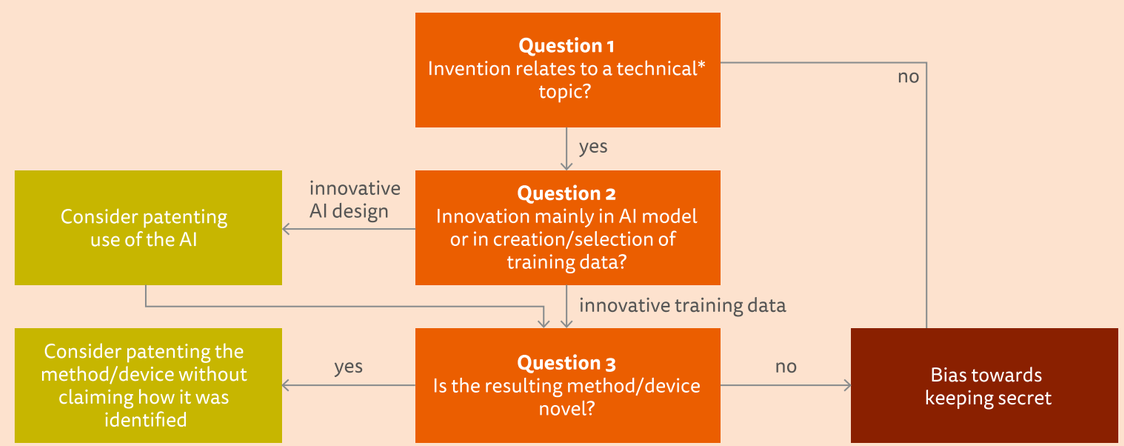
In opposition, if the answer to question 2 is 'yes', the AI technology itself may be patentable (if linked to the technical topic of question 1). Regardless of the answer, it is advisable to consider question 3.

Question 3: Did the AI technology result in a novel and inventive method or device or product?

If the answer to this question is 'yes', then regardless of the answer to question 2, the resulting method or device or product may be patentable. In many cases, the independent claims would not mention the AI technology at all.

When questions 2 and question 3 are answered 'yes', the inventive step should still be assessed in the standard way.

Figure 1: Questions and options for patenting AI inventions



** Key consideration for EPO. Other jurisdictions have similar considerations (eg, abstract method in the United States)*

A practical example: DNAlytics

DNAlytics is a start-up specialised in data-driven healthcare. In the framework of a partnership with an academic partner, it has developed a method for the assessment of upper gastrointestinal bleeding in decompensated cirrhotic children (*Pediatric Transplantation*, Bonnet N *et al* (2019) e13390).

While awaiting a transplant, children suffering from decompensated cirrhosis face the risk of upper gastrointestinal bleeding because of ruptured oesophageal or gastric varices – one of the most severe complications related to chronic liver disease. Such bleeding could become life-threatening and therefore the risk stratification of bleeding is important to identify those cases which may benefit from a prophylactic treatment with band ligation or sclerotherapy. In current clinical practice, there is no paediatric recommendation for primary prophylaxis with endoscopic ligation, sclerotherapy or non-specific beta-blockers in children.

In such a situation, state-of-the-art AI technology has been used to:

- Process retrospective data from clinical studies;
- Identify haemostatic factors with clinically relevant predictive power; and
- Elaborate a model fed with those factors that is able to predict gastrointestinal bleeding (this model is encapsulated in a web platform and openly accessible).

Assessing the risk of upper gastrointestinal bleeding in decompensated cirrhotic children is a patentable subject matter in most jurisdictions. The answer to question 1, therefore, is 'yes'.

The AI technology used by DNAlytics was state of the art. The innovation lay mostly in the selection of data with relevant predictive power and in identifying the AI approach (machine learning methods for feature selection and predictive modelling) most suitable to the problem and data dimensionality. As a result, the answer to question 2 should be 'no' – such use of AI in this optimisation problem will be considered an obvious approach to a skilled person.

The answer to question 3, however, would be 'yes', since such an assessment method was not known. In this case, a patent application could have been filed for protecting "an *in vitro* diagnostic method wherein the value of each of these three parameters would have been assessed in such children in order to predict whether an upper gastrointestinal bleeding is likely to happen". The main claim of such patent could read as follows:

CLAIM A

An *in vitro* diagnosis method of upper gastrointestinal bleeding in decompensated cirrhotic children comprising the steps of:

- assessing the level of three haemostatic factors: fibrinogen, the adenosine diphosphate and the thrombin-dependent platelet aggregation in such children,
- comparing these levels to corresponding levels in a control population, for each of these haemostatic factors and
- concluding as to the bleeding prediction of such children.

Such an *in vitro* diagnostic claim is eligible for patentability at the EPO following the Enlarged Board of Appeal Decision G01/04. Such a claim would need to be further adapted to the US practice as the USPTO applies more stringent criteria to the eligibility of diagnostic methods. One possibility is to add a treatment step in such a claim.

In summary, in this specific example, a technical problem (i.e., predicting bleeding in patients) was solved using AI technology. The solution of this technical problem (i.e., the diagnostic method with three predictive parameters as inputs) could have been a potentially patentable technical invention.

The AI method used, as such, was state of the art. However, a claim might have been drafted as follows:

CLAIM B1

Computer-implemented method to identify a predictive parameter for upper gastrointestinal bleeding in a decompensated cirrhotic child, the method comprising:

- providing computer-readable data comprising a plurality of parameters … and diagnostic outcomes … to a machine learning model
- identifying the predictive parameter among the plurality of parameters from the machine learning model.

CLAIM B2

Computer-implemented method to predict upper gastrointestinal bleeding of decompensated cirrhotic children, the method comprising:

- identifying a predictive parameter to predict the upper gastrointestinal bleeding of decompensated cirrhotic children from a machine learning model, by:
  - *providing computer-readable data comprising a plurality of parameters … and diagnostic outcomes … to the machine learning model*
  - *measuring the identified predictive parameter and computing the prediction.*

Claim B1 or B2 should be eligible for patentability at the EPO as a technical problem (i.e., identifying an event, preferably a parameter, to predict the bleeding) has been solved. The difference between B1 and B2 is that B2 further incorporates the step of carrying out the diagnostic method itself. There is case law to suggest that this is necessary to fulfil the requirements of patentability at the EPO, so the B2 variant should at least be included as a dependent claim.

Such a claim might be considered novel, as it can be assumed that nobody would have ever thought of using AI in this very specific context. However, the inventiveness of such a claim may be rather difficult to defend as, at first sight, it just seems a routine use of a state-of-the-art AI. The choice of the application "predict the upper gastrointestinal bleeding of decompensated cirrhotic children" seems to represent an arbitrary selection among the unlimited number of applications wherein AI technologies could be used. The invention seems to lie more in the overall workflow used to solve the technical problem, rather than in the choice of AI methodology used for feature selection or for computing the prediction. In the absence of any prejudice in the art to identify such parameters, it is anticipated that the inventiveness of such a claim will be difficult to defend.

Imagine that the AI technology used would have been improved (i.e., AI technology X) in order to allow it to solve similar technical problems and not only just the one of the invention. This new algorithm component, specific for the technical problem to be solved, could be protected when run on a computer for solving this problem:

CLAIM C1

Computer-implemented method to identify a parameter in a patient predictive of an event, the method comprising:

- providing computer-readable data comprising a plurality of parameters … and diagnostic outcomes … to a specific machine learning model
- identifying the predictive parameter among the plurality of parameters from the specific machine learning model.

CLAIM C2

Computer-implemented method to predict a parameter predictive of an event in a patient, the method comprising:

- identifying a predictive parameter to predict the event in said patient from a specific machine learning model, by:
  - *providing computer-readable data comprising a plurality of parameters … and diagnostic outcomes … to the specific machine learning model*
  - *measuring the identified predictive parameter and determining the prediction.*

However, the C-type of claim is only really useful if it can be applied to the identification of predictive parameters in different clinical situations with different training data. If the only actually relevant prediction method is the *in vitro* method of Claim A, then use of optimisation method Claim C1 and C2 will invariably result in a prediction method according Claim A. In that case, it may be more desirable to directly protect the method (Claim A) rather than the way of getting there (Claim C1 or C2).

Comment

To recap, the three questions that are key when assessing the patentability of AI inventions in the life sciences are as follows:

- Does the invention allow a technical problem to be solved?
- Is the invention in the AI technology itself?
- Did the AI technology result in a novel and inventive method or device?

If the answer to question 1 is 'no', then patenting is generally not possible, at least not in Europe or the United States. If the answer to question 2 is 'yes', the AI method may be protected. Regardless, a 'yes' to question 3 indicates that the obtained method or device is patentable, in which case the independent claims may not even refer to AI technology.

It may seem counterintuitive that a claim of an invention based on AI may not refer to any AI technology at all. However, there are certain advantages to such an 'AI-less' claim of an AI-based invention. It removes any doubt as to whether the training data should be disclosed. If the AI algorithm is not part of the claim, then clearly the invention can be worked without having access to the training data. It also removes the need to claim the AI algorithm in broad enough terms to make working around the claim impractical.

In case specific AI technologies can be applied successfully to a more broadly defined class of technical problems (Claims C1 and C2), then the use of AI can be claimed.

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Table 1: various options

		Q2: *AI technique new/inventive?*	
		No	Yes
Q3: *Resulting method new/inventive?*	No	*Not patentable*	*Consider patenting use of the AI*
	Yes	*Consider patenting the method/device wihtout claiming AI*	*AI approach applicable to broad range of problems? Patent the AI. Limited to specific problem? Patent the resulting method/device*

Patents with a view: patent landscaping and how to use it

AUTHOR: JORAN MICHIELS

Intellectual property rights are increasingly important assets in knowledge-driven, innovative economies. Patents in particular are one of the key drivers behind technological innovation. A granted patent confers on its owner the legal right to exclude others from commercially exploiting the patented invention. In exchange, an enabling disclosure of how to put the invention into practice must be made publicly available. For this reason, patent publications are arguably the best – and often the only – way to get insight into the research & development activities of innovative companies. Analysing this public patent information in order to gain technical or strategic insights is denoted as 'patent landscaping'. This article explains why patent databases are an invaluable source of technological and strategic information and how patent landscaping can help businesses to capitalise on this untapped potential.

Patents are a rich source of free information

In 2018, inventors in Europe and around the world filed 174,317 patent applications with the European Patent Office (EPO) – the highest number ever (EPO Annual Report 2018). In the same year, a record number of 252,684 international patent applications were filed under the Patent Cooperation Treaty (PCT) system, a unified procedure for seeking patent protection in a large number of countries in a simple and cost-effective way (WIPO IP Statistics Data Center). Still a much larger number of patent applications is filed through national offices; the total number of patent filings around the world exceeded 3.3 million in 2018 (WIPO, "World Intellectual Property Indicators 2019").

The ever-increasing trend in patenting activity across the world and across technological domains leads to exponentially increasing numbers of patent-related publications. Together, these documents constitute an immense source of valuable information which is, in many cases, not available from any other source. The majority of this information is contained in patents which are not (or no longer) in force, meaning that a vast number of inventions is effectively available for free. And even if a patent is still in force, the information it contains can be freely consulted, and – under certain conditions and limitations – used for research and development purposes.

Patent landscaping: generating insights from patent data

Patent landscaping is an umbrella term covering the different means for generating useful insights from patent-related data. The enormous size of the dataset, together with the complexity of patent procedures, makes patent analytics for landscaping challenging. Fortunately, all major patent offices strive to make the huge amount of patent documents conveniently accessible to the public. For example, the EPO as well as the World Intellectual Property Organization (WIPO) maintain excellent patent databases and provide advanced searching possibilities to explore the data. Moreover, they have developed powerful and free machine translation services providing automatic and reasonably high-quality translations of patent documents. This means that, for example, an innovative European company working on a new generation of more efficient solar cells can conveniently locate and access technical details of the latest solar cells developed by colleagues and competitors abroad, even if the colleague or competitor's inventions are only disclosed in a national patent application in a foreign language.

A freely available tool which is worth mentioning is The Lens, available at www.lens.org. The Lens is provided by Cambia, an independent non-profit organisation dedicated to democratising innovation. The software is user-friendly and provides several powerful analysis options, including a number of advanced tools for searching and analysing biological sequences disclosed in patents. For a comprehensive discussion on other useful tools, the WIPO manual on open source patent analytics is a good starting point

(available at https://wipo-analytics.github.io/).

Technological insights: steering R&D

A *technological patent landscape* creates a clear overview of the patents within a certain technology area, optionally filtered for certain jurisdictions, applicants, inventors or other parameters. It also provides a good view on the state-of-the-art within a certain technological domain. The technology area may be defined from very narrow (e.g., 'thin-film solar cells') to very broad (e.g., 'environmental technology'), depending on the type of questions you are trying to answer. While evaluating one's position within the technological landscape may seem a mere academic exercise at first, it may in fact help companies take important decisions such as how to spend their R&D budgets. Indeed, the EPO has once estimated that up to 30% of all R&D expenditure is wasted on redeveloping existing inventions (EPO, "Why researchers should care about patents", 2007). Take again the above example of a European innovator developing new solar cells. If a Chinese competitor is working on a similar technology and has already described a successful prototype solar cell in a patent application, it is crucial to become aware of this information in order to reconsider the research project, for example by using the Chinese prototype as a starting point for further innovation.

Considering the technological landscape may also help companies decide on new directions where R&D efforts should be headed. For example, landscaping may uncover opportunities for further innovation, also called "innovation gaps" or "white-space". The European solar cell innovator introduced above could, for example, stumble upon some patent applications describing a new and promising semiconductor material which has not yet been used in solar cells. Based on this information, the company could decide to start a project to investigate the potential of this new semiconductor material for use in solar cells. White-space analysis is especially useful in crowded markets, where fierce competition exists between several players developing similar products or services.

In conclusion, patent landscaping helps companies to uncover information which is essential for devising and pursuing a successful R&D strategy. Analysing the technological patent landscape will avoid money being wasted on duplicating R&D and will streamline and accelerate the innovation process.

Strategic insights: gathering business intelligence

Patent landscaping not only reveals your position in the technological landscape, it also enables comparing your position with that of your competitors. Information contained in patent documents is often not available elsewhere, meaning that it provides a unique view of the innovation strategies of competitors. Even though most companies are probably aware of their major competitors, new players will likely first appear in patent databases. Such a *competitive patent landscape* may benefit companies pursuing a proactive or aggressive IP strategy as well as more defensively-oriented ventures. For example, competitive landscapes may reveal third-party patents interfering with the planned launch of a potentially infringing new product. In such cases, follow-up actions are needed. Companies pursuing a proactive or aggressive IP strategy may for example consider taking legal action against these patents to restore their freedom to operate. Defensively-oriented ventures may rather choose to approach the right holder to discuss licensing opportunities.

Patent landscaping may also uncover new opportunities for business development. You may, at an early stage, uncover signals that your competitors are expanding to new geographic or product markets. Analysis of co-applicants can uncover collaborations between companies or between companies and research institutes. Landscaping may also reveal companies working on technologies which are dependent on your own patented technology – such companies are potential licensees or synergistic strategic partners.

Overall, we conclude that patent landscaping is not only important for a successful R&D strategy, but also contributes majorly to an overall successful corporate strategy.

Key insights from patent landscaping

- Mapping the state-of-the-art to identify starting points for further innovation
- Identifying new innovation opportunities by finding innovation gaps
- Developing a strategic and strong patent portfolio
- Gaining insight into your competitors' patenting strategies
- Uncovering new licensing opportunities
- Detecting new players in your field at the earliest possible stage

You can find the full article, including an interesting case study on CRISPR/CAS at:

https://publications.nlo.eu/article-patent-landscaping/cover/

'Patent landscaping not only reveals your position in the technological landscape, it also enables comparing your position with that of your competitors.'

Damien Bertrand (l) and Thibault Helleputte (r)

INTERVIEW WITH THIBAULT HELLEPUTTE AND DAMIEN BERTRAND

DNAlytics: building a bridge between data science and healthcare

DNAlytics, a start-up based in Louvain-la-Neuve, Belgium, applies its expertise in data science and Artificial Intelligence (AI) to improve public healthcare, medical and pharmaceutical R&D and biomanufacturing. Next to their service activity, their RheumaKit solution uses AI for the early diagnosis of arthritis. Yet the successful application of AI in these areas requires much more than mastery of sophisticated data analysis techniques. Regulatory, juridical and ethical obstacles must all be overcome before AI can be applied to its full potential. Co-founder and CEO Thibault Helleputte and business development manager Damien Bertrand talk about their approach to data-driven healthcare. "The medical and healthcare sectors have come to see that data science can create value for them."

How did the story of DNAlytics begin?

Thibault Helleputte: "When I started my engineering master thesis in 2004, new technologies were entering medical and biology labs: DNA sequencing, transcriptomics and proteomics, RNA analysis, and so on. What they all have in common is that they generate enormous amounts of data. That was quite new to doctors and medical researchers who previously used to do only relatively simple statistical tests, and for whom an excel sheet was enough to analyse the data they got. When they were suddenly flooded with data on thousands of variables, new approaches were needed. During my PhD we developed a number of machine learning methods for this. In 2012, together with Professor Pierre Dupont, I decided to create DNAlytics as a spin-off company."

'...this is a very powerful example of the value that advanced data science techniques can bring to medical research.'

What specific capabilities did you have at the time that were valuable and promising enough to build a new company on?

Thibault Helleputte: "We had three different things. First, we had developed a lot of know-how and a new culture: how can you make the bridge between data science engineering and healthcare. That combination wasn't very common at the time. Second, we had developed a set of reusable computer codes that serve as building blocks for the models: we still use those pieces of code today at DNAlytics. Third, which in fact came a bit later, but still early in the history of the company, we had a patent on a gene signature for diagnostic application in rheumatology. This gene sequence was identified with the use of the machine learning methods I mentioned. Of course, the patent was property of the university at the time, but we in-licensed it and developed it into our RheumaKit platform."

Arthritis is a disease that causes pain and inflammation of the joints. In the EU alone, each year 1.5 million new patients are affected with either rheumatoid arthritis or osteoarthritis, or one of the many other forms of the disease. A particular difficulty with arthritis is that in its early stages, when patients start to experience the first symptoms, for some of those patients, the doctors are not able to identify the underlying form of the disease. For those patients, that means effective treatment cannot be started. In addition, for the patients who are diagnosed with rheumatoid arthritis (RA), various drugs are available, but these only prove effective in roughly 2/3 of the cases. For the remaining third, the choice of treatment thus becomes a matter of trial-and-error, leading to wasteful medical expenses, not to mention the loss in quality of life for patients. In 2015, DNAlytics launched RheumaKit, which was specifically developed to address those issues.

What exactly is RheumaKit?

Thibault Helleputte: "It is an online solution for differential diagnosis of patients with undifferentiated arthritis. In other words: it identifies early on what type of arthritis a patient has, when their doctors are still in the dark about this. It works by doing a genomic analysis of tissue sample extracted from a patient's joint, such as the knee. The data we collect in this way is combined with other patient data, specifically clinical data provided by his or her rheumatologist. All this data is fed into our mathematical model, which then predicts what underlying form of arthritis the patient has. This functionality is available today for clinical use, and we are continuing to work on developing a second functionality for RA patients, which will indicate the most effective treatment option. In addition, with RheumaKit, doctors can also access standard disease evaluation scores and monitor the treatment response and the progression of the disease online."

How does RheumaKit perform compared to rheumatologists?

Thibault Helleputte: "It is important to realise that RheumaKit is specifically designed to disambiguate complex diagnostic cases about which rheumatologists are unsure, when a patient's symptoms are not sufficiently clear to distinguish between various forms of arthritis. So you could say that in such cases, by definition, we do better than rheumatologists. A more relevant way to evaluate the RheumaKit performance is to note that in about 90 percent of these cases, its early diagnosis was proven correct once the disease had progressed. We think that is a very high number. However, the vision is clearly not to outperform rheumatologists, but to provide them with smart tools that will support and enhance their clinical practice!"

I think so too. Does it get even better over time as more data becomes available to learn from?

Thibault Helleputte: "That is a very interesting point. Ideally, that would indeed be the case if you were able to collect feedback about the performance of your algorithm from the field. With such a feedback loop the tool should get better and better. In our situation however, the possibilities to do so are limited for various reasons. The first is technical: the very fact that RheumaKit makes a prediction will influence the way a patient is cared for, and that in turn will influence the symptoms that patient exhibits. Another reason is that the regulatory framework does not allow it. To validate a diagnostic tool and obtain, in Europe, a CE-marking, the performance of the tool must be assessed in a clinical study and then documented. After that the model has to remain fixed, you cannot make it evolve as you would in principle consider with an AI-based tool. Still, what we can do is to accumulate feedback over time, and then regularly introduce updated versions of our tool. So we can have periodic improvements in performance, not a continuous one."

You mentioned you are bridging the worlds of engineering and healthcare. How have medical experts received your solution? Do they trust and accept the recommendations from an algorithm when their own knowledge and experience proves insufficient?

Thibault Helleputte: "They are still the experts in their domain and will remain so. We are just bringing them a new tool that enables them to expand their expertise. However, there is a real interaction. When we want to build a new diagnostic tool based on machine learning, the specifications for that tool must come from the medical side: what specificity and sensitivity of the model are acceptable, what are the relevant data that we need to use to teach the algorithm, and so on. Vice versa, we have become more knowledgeable in the treatment of arthritis, so that we can discuss how our technology can best be integrated in the clinical workflow in order to give optimal results. But at the end of the day, it is still the medical specialist who decides how he or she will apply our tool."

Damien Bertrand: "The main issue with the adoption of our technology is not so much on the level of medical specialists. Our interactions with rheumatologists are generally positive. They provide us with input for our technology roadmap and recognise the value in our approach. Our main challenge is to get RheumaKit accepted into the healthcare systems of the various countries we target. As long as our solution is not established as part of standard procedure in the treatment of arthritis, doctors or patients will not be reimbursed for its use, and it becomes very difficult for doctors to include it in their routine practice."

PATENTING ARTIFICIAL INTELLIGENCE IN THE LIFE SCIENCES

Damien Bertrand: "To be honest, the protection of our IP has not been our biggest challenge so far. We rely on a combination of patents, copyrights and also secrecy; the complexity of what we do as well as the importance of our know-how are our main differentiators to protect us from the competition. That said, the work we did with NLO on writing the paper on 'Patenting artificial intelligence in the life sciences: a practical guide' [*Ed: read the full article on p.22*] gave us a new viewpoint. Typically our mindset has been that when we use well-known and published algorithms in our applications, there is no ground for claiming IP rights. In the future however we will probably review the entire application context more systematically, instead of only the software. The algorithms we use may not always be innovative, but when they are incorporated in a specific approach for a specific purpose, that combination may be innovative and patentable."

'...the regulatory framework to get these innovative, AI-based technologies approved as medical devices is not straightforward...Existing regulations are not geared to such technologies yet.'

Why is it so difficult to include RheumaKit in healthcare systems?

Damien Bertrand: "There are several difficulties. A key one is that the regulatory framework to get these innovative, AI-based technologies approved as medical devices is not straightforward, to say the least. Existing regulations are not geared to such technologies yet, and approval requires a lot of back and forth with the relevant authorities."

Thibault Helleputte: "Fortunately, with new EU-level regulations on medical devices and in-vitro diagnostic tools, the path to approval is becoming clearer. It is now increasingly being accepted that software can be a medical device or a diagnostic tool. There are other challenges too. Some ethical aspects of AI-based tools are very interesting, for example with respect to responsibility for their use. There is a parallel with autonomous driving: if an autonomous vehicle causes a crash and passengers are injured, who is responsible? The same question arises with diagnostic tools driven by AI. If a diagnosis is wrong - which will inevitably occur because no diagnostic tool can be 100 percent perfect - who has the responsibility in case this leads to bad consequences? The doctor or the tool? Today, such AI-based tools provide recommendations and constitute one of many inputs a doctor has to evaluate in his final decision. In such context, the doctor remains responsible. But this might evolve in the future, for example if one imagines a scenario in which hospitals or health authorities stipulated that their doctors had to follow to the tool's recommendations, because it had been proven that these lead to better overall results. Those are very interesting questions for the future."

Another ethical aspect of AI is about the transparency of the algorithms that are used: how should humans be able to understand and control how AI generates certain outcomes?

Thibault Helleputte: "Indeed, we often get questions about the understandability or transparency of the decision processes of these tools. If an AI-based tool makes a recommendation to a doctor, is it important or not that this doctor is then able to explain how the system came to that recommendation? The first reaction of healthcare professionals is usually to say: "Yes, we need to understand." However, if you then ask them to explain how a painkiller works exactly, they can't either. I think that to a certain extent we must indeed be able to explain how our tools work. But if at some point AI-based tools have been validated through extensive clinical trials, just like any other medical solution, then it is fine not to understand the details of the decision-making process. There is also an important trade-off to be made here. Some AI tools are intrinsically easy to interpret and their decision-making processes can be tracked very easily. Others are much more complex and it is almost impossible to follow exactly how they arrive at their decisions, but in some cases these tools are much more powerful. So sometimes we will have to choose between how effective we want a solution to be versus how intelligible we want it to be."

In addition to the RheumaKit product, your business model also involves consultancy services. There are some impressive examples of consultancy projects on your website. Is there a particular project that best shows how powerful your approach to bringing data science to healthcare can be?

Damien Bertrand: "I remember a project we did for one leading pharmaceutical company in Belgium some years ago. They were running a clinical trial for an immunotherapy targeting melanoma, and were observing a very mixed response from their patient group. They essentially asked us to understand why some patients were responding to the treatment and others were not. We received a huge set of data from the company containing information on over 50,000 biomarkers for each of the 200 to 300 patients. Our job was to find the smallest set of markers that, prior to treatment, would predict if a patient would respond positively to it or not. We had to do this blindfolded so to say: labels had been removed from all of the markers and we had no idea what any of the data meant. We were able however to identify a set of 33 markers that predict treatment response very effectively. Some of the results from this collaboration gave rise to a patent application for a method to classify cancer patients as responders or non-responders to immunotherapy. I think this is a very powerful example of the value that advanced data science techniques can bring to medical research."

Thibault Helleputte: "Another area where our capabilities can be very powerful is biomanufacturing. For the more complex drugs that are on the market nowadays, the production process often involves the use of living entities like viruses or cell cultures. At that level of complexity, things become less predictable. You do the exact same thing twice, but still the results will exhibit some level of variability. Pulling all the data from a production line about raw materials, automation and quality control data, sensor data and so on, and building a multi-variate model of that production line helps you to improve yield and quality in biomanufacturing. This is a field where we are more and more active."

How can you scale up both the product and the consultancy parts of your business model?

Thibault Helleputte: "There is an ongoing clinical trial for the RheumaKit, and the future will depend on the results of that study, as well as on the possibilities for getting our solution reimbursed for patients. Our consultancy activities are growing and we are introducing products that we can re-use to leverage our capabilities in this area. As an example, the analytics tools that are used for improving bio-manufacturing are packaged into a software suite that can be easily deployed and enable ourselves and our clients to automate the data analysis."

Where do you see DNAlytics in five years?

Thibault Helleputte: "We want to grow, of course. If you look back five years and see where we are now, it is clear that the medical and healthcare sectors have come to see that data science can create value for them. Data analytics and AI will be more and more integrated into various parts of their businesses, and our ambition is to play a part in that evolution..."

AI versus COVID-19, part II

How is DNAlytics involved in the fight against COVID-19?

Thibault Helleputte: "We have been supporting the Belgian health authorities in monitoring hospital capacity and demand. We have access to the data about the resources of each hospital, we know how much of those resources are being used and what the demand will be based on the expected development of the number of COVID-19 cases. With this information we created a dashboard that provides the authorities with an up-to-date view of the situation. That proved very useful for the management of the outbreak at the peak of the crisis, for example to elaborate scenarios for the optimal distribution of patients over hospitals or to support purchasing decisions for new equipment."

Where is the AI part in that?

"First, one has to realise that before you can begin to apply AI, you need to perform a huge amount of work to clean, validate and understand your data. Only then can you think of doing smarter things with the data. Our expertise in improving data quality in the healthcare environment is why we have been asked to help with monitoring COVID-19. Secondly, of course everyone wants to use AI and predictive analytics to make forecasts, but in the case of COVID-19 we were very reluctant to dive into that. Indeed, a machine learning model requires a constant and stable set of hypotheses. And in this crisis that has clearly not been the case. For example, screening and testing policies may change from one day to the next. We've seen that in Belgium, where at first only medical professionals were tested, but then it was decided to test much larger groups in the population. But if you feed the model the number of positive cases under one testing scenario, the numbers it predicts based on that will not mean much under a different scenario."

Wim Naudé has published a review article on AI versus COVID-19 in which he concludes that AI so far has not been very effective in predicting the speed and patterns of the outbreak [Ed: read the interview on p.4]. Would you agree with that?

"Yes, for the reasons I just outlined. The best thing we can do now to answer requests for forecasts is to provide scenarios rather than exact predictions. We say: if this and this and this hypothesis is kept constant, then this is what we think will happen. And we do not go further than five or six days ahead, otherwise it would be just guessing."

NLO in the Spotlight

At NLO and NLO Shieldmark, we are proud to have been further recognised this year for our unbroken record of professionalism, quality and service via several prestigious industry awards and recommendations. We would like to take this opportunity to thank our clients and peers for their trust and appreciation.

Financial Times

The Financial Times recommended NLO in the fields of Biotechnology & Food, and Chemistry & Pharmaceuticals in their "Europe's Leading Patent Law Firms 2020" report.

IAM Patent 1000

The IAM Patent 1000: "The World's Leading Patent Professionals" identifies the top patent practitioners in key jurisdictions around the globe. In the 2020 edition of IAM Patent 1000, NLO and 10 of our patent attorneys received a 'highly recommended' ranking for 'Prosecution' in The Netherlands and a 'recommended' for 'Prosecution' in Belgium.

WTR 1000

NLO Shieldmark was recommended in the latest WTR 1000 guide, amongst some of the world's leading trademark legal services providers. "*One of the largest full-service IP consultancies around, NLO Shieldmark combines in-depth technical knowledge with thorough legal insights to provide a winning formula for clients. A consulting firm, rather than a filing factory, the young and growing team provides 21st century solutions.*"

MIP IP Stars

The prestigious MIP IP STARS is the leading specialist guide to IP law firms and practitioners worldwide. NLO and NLO Shieldmark were both awarded a Tier 1 ranking in the 2020 IP STARS in the field of patent prosecution and trademark prosecution in the Netherlands.

FOR MORE INFORMATION VISIT WWW.NLO.EU