

# PORTRAITS OF RESEARCHERS

SPW RECHERCHE PUBLISHING

[VOLUME 5]



Alexandra LACROIX and Pierre DEMOITIÉ,  
programme managers

## INTRODUCTION

In January 2022, the first issue of «portraits of researchers» was published.

This publication continues the work that has already begun and profiles the PhD's who have come to Wallonia from all over the world to work in our universities, university colleges and research centres, in collaboration with a company.

These mixed careers are a real asset for them and for the host institutions.

Indeed, innovation remains a crucial issue for companies, enabling them to cope with a slowdown in demand, rising production costs and shortages of certain materials, while at the same time meeting new needs in a context of increased competition.

Various authors agree that increasing the quantity of R&D is a necessary (but not sufficient) precondition for growth in innovation and better economic performance.

The research projects presented in the following pages highlight, each in their own way, these innovative projects for our region, which will have a significant impact on a researcher's career.

In March 2023, the European Commission agreed to a two-year extension of its contract with the Walloon Region. This means that the BEWARE programme will come to an end in August 2027 and new calls for proposals can be launched. Other researchers will also be hired.

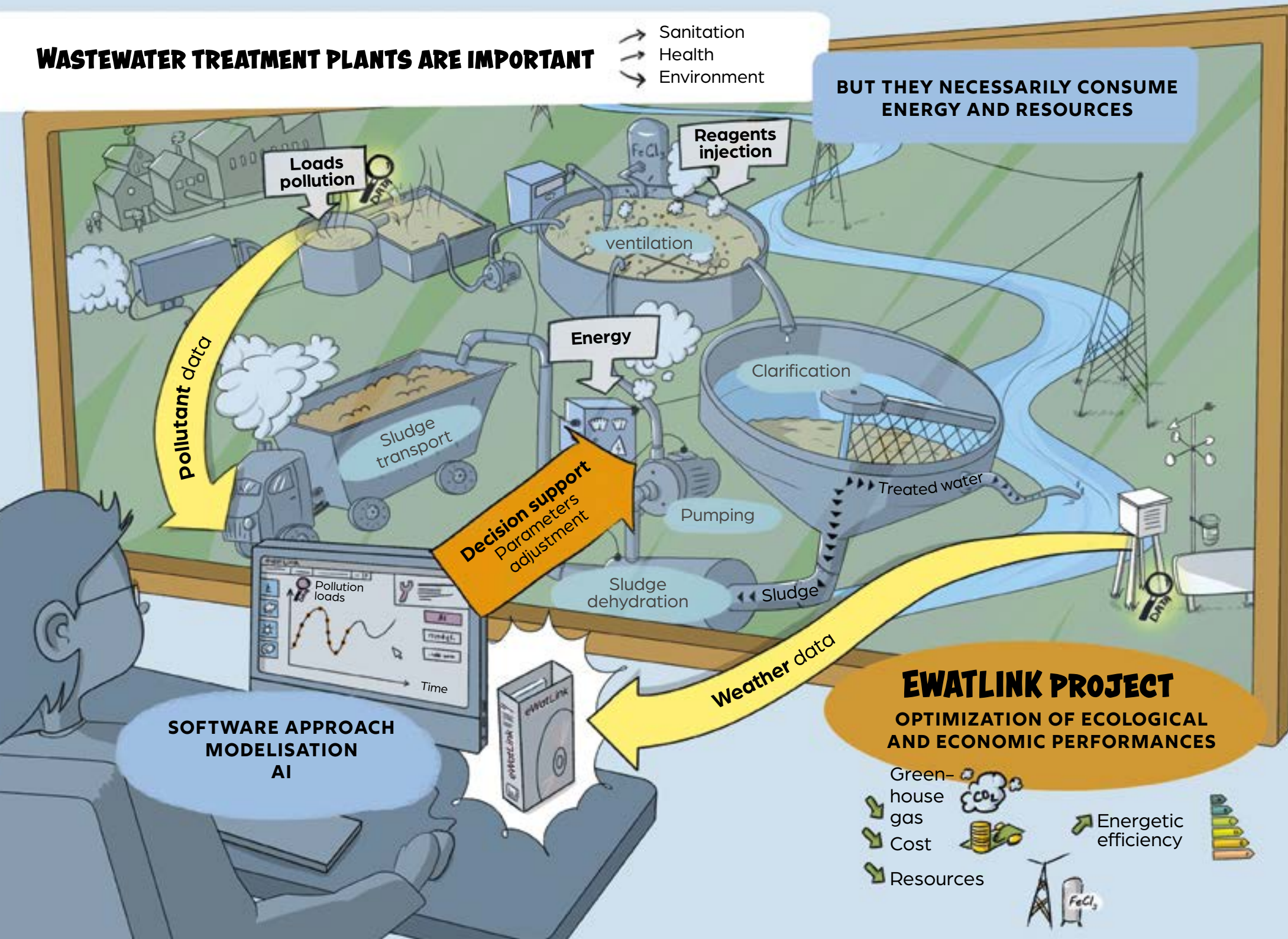
The Commission has also conditionally agreed to an extension of the researchers' individual contracts. This extension, of between one and six months, will make it possible to finalise a project that may have been interrupted for external reasons beyond the control of the researcher and the host institutions, such as the health crisis.



# WASTEWATER TREATMENT PLANTS ARE IMPORTANT

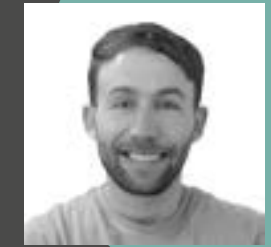
- Sanitation
- Health
- Environment

**BUT THEY NECESSARILY CONSUME ENERGY AND RESOURCES**



# TAHER ABUNAMA

COUNTRY OF ORIGIN	PALESTINE
COUNTRY AT TIME OF SUBMISSION	SOUTH AFRICA
DURATION	36 MONTHS
PROMOTORS	
CEBEDEAU (DR ANTOINE DELLIEU)   <a href="http://WWW.CEBEDEAU.BE">WWW.CEBEDEAU.BE</a>	
SOCIÉTÉ PUBLIQUE DE GESTION D'EAU - SPGE (NICOLAS STAELENS)   <a href="http://WWW.SPGE.BE">WWW.SPGE.BE</a>	



## TOWARDS MORE EFFICIENT TREATMENT PLANTS

Taher Abunama completed his Bachelor's degree in civil and environmental engineering at the Islamic University of Gaza, Palestine, in 2012. Unusually, he did not continue directly to a Master's, but started to work at the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA). His knowledge of water delivery systems and water pollution allowed him to manage the supply of water to refugee camps in the Gaza Strip. In 2015, he moved to Malaysia, where he embarked on a PhD at the University of Malaya. The researcher then used artificial intelligence to model the amount of residual water released from waste treatment centres. *"The goal was to develop a model to simulate and predict the amount of leachate - residual liquid that comes from the percolation of water through a material - from treatment centres. This amount depends on the quantity of wastes treated, their composition, the weather, etc.* describes Taher Abunama. *During the four years of my PhD, I also worked on river pollution and wastewater composition in wastewater treatment plants at the Department of Civil Environmental Engineering of the University of Malaya. I was looking to predict whether these waters contained more organic pollutants, phosphorus pollutants or nitrites, for example, so that the plant could anticipate the type of treatment to be used."*

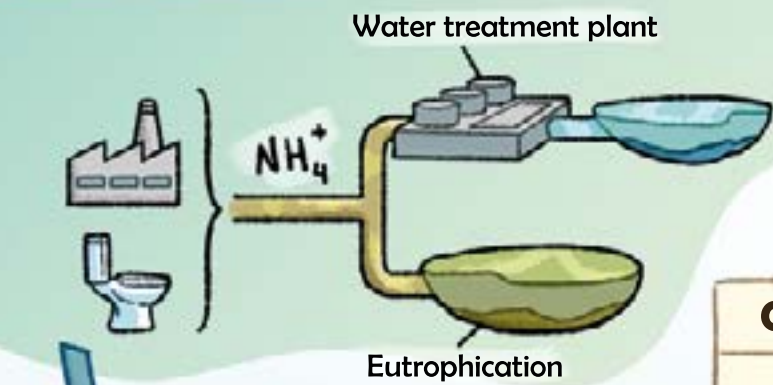
In 2020, the researcher flew to South Africa, more specifically to the Institute for Water and Wastewater Technology of the University of Durban. He stayed there for two and a half years to conduct work on wastewater treatment modelling. The objective was to improve the efficiency of wastewater treatment plants using artificial intelligence. During this period, Taher Abunama was also involved in a project related to the Covid-19 epidemic. It studied the correlation between the amount of RNA from the virus in the wastewater of a plant and the number of contaminations recorded around this plant. He applied to the BEWARE programme in October 2021 and began the project in September 2022. *"I immediately connected with the EWATLINK project because its content is very close to my area of expertise and publications, he said. The idea of being more interested in technical than purely theoretical aspects also appealed to me, as did the possibility of talking to different industrial and information technology partners."*

### THE EWATLINK PROJECT

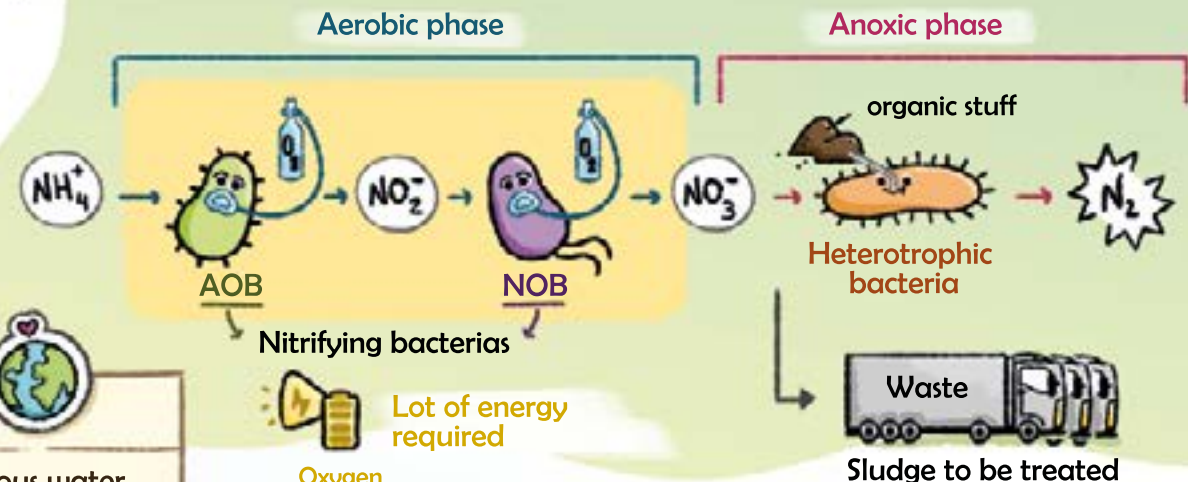
Aims to improve the performance of water treatment plants. Taher Abunama is involved in the development of software based on advanced optimisation algorithms such as fuzzy logic and neural networks, and allowing the simulation and visualisation of the different processes involved in a wastewater treatment plant. The tool developed in collaboration with CEBEDEAU and SPGE, with the Bastogne Rhine wastewater treatment plant in Wallonia as a case study, should eventually become a real-time control panel. The software will assist the operators in their work and allow the digitisation of certain processes. The solution will also play a role in data collection (quantities of wastewater, electrical consumption of pumps, use of heaters, etc.) to monitor energy expenses related to the operation of the infrastructure. Taher Abunama is therefore seeking to reduce the electrical consumption of wastewater treatment plants as much as possible without losing efficiency and while minimising the carbon footprint. Lastly, it must be possible to duplicate the project developed in Bastogne in any other treatment centre.



**ISSUE :**  
water pollution by nitrogen



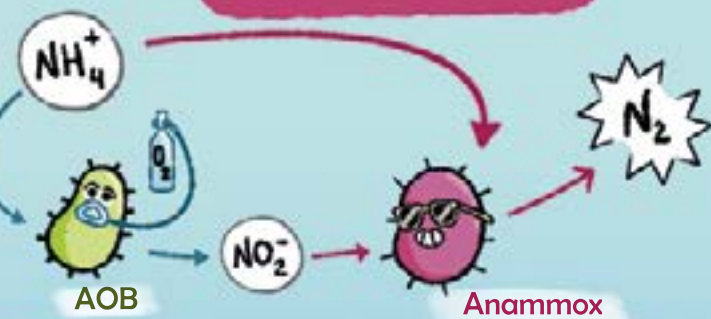
**CURRENT APPROACH**



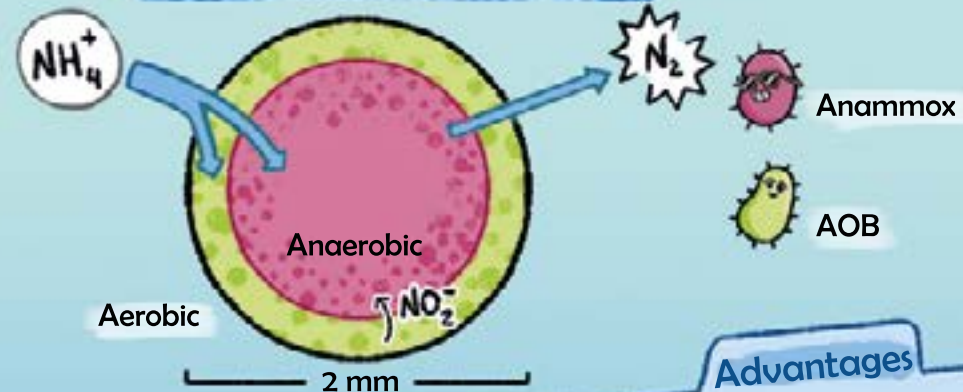
**GOAL :**  
Making nitrogenous water treatment more sustainable through an innovative biological process

**GRANAMOX**

**BACTERIUM ANAMMOX**



**GRANULATION OF BACTERIAS**



**Advantages**

- Reduced need for ventilation and therefore energy consumption
- No need for organic matter → less waste and sludge to treat
- Reduced operational costs

**Advantages**

- Creation of an oxygen-free niche for Anammox
- Better sedimentation
- Reduction of investment costs
- Possible reuse of industrial equipment
- Coupling of the nitrification and the Anammox process in a single reactor

**TIAGO AKABOCI**

COUNTRY OF ORIGIN	BRAZIL
COUNTRY AT TIME OF SUBMISSION	SPAIN
DURATION	34 MONTHS
PROMOTORS ▼	
	CEBEDEAU (DRE HETTY KLEINJAN)   WWW.CEBEDEAU.BE
	EXELIO (JUSTINE KEMPGENS)   EXELIO.BE

**FINDING THE OPTIMAL CONDITIONS FOR THE BIRTH OF ANAMOX**

Tiago Akaboci obtained his Bachelor's degree in environmental engineering from the UniAmérica University of Foz do Iguacu (Brazil) in 2010. He continued with a Master's degree in the same discipline at the Federal University of Santa Catarina, also in Brazil, and then headed to Spain to begin a PhD at the University of Girona. Tiago was interested in water treatment through the use of biological processes, so without the use of chemicals. Specifically, he learnt about a process called Anammox, which removes nitrogen from wastewater. "The presence of nitrogen in the water limits the oxygen available to living beings in the ecosystem and promotes eutrophication, which is the proliferation of algae that feed on this nitrogen," he says.

After completing his PhD in 2019, Tiago Akaboci returned to Brazil to teach environmental engineering at San Catarina State University. In 2021, he went on to do a post-doctoral year on the treatment and recovery of wastewater and sludge generated by agro-industrial processes, particularly in the food industry, at the University of Vic - Central University of Catalonia near Barcelona. "I took part in European projects aimed at recovering nitrogen and phosphorus from wastewater and sludge, says Tiago Akaboci. The goal was to produce organic fertilizers from these nutrients. To do this, I used the biological process called biodrying and physical processes based on membranes that separate the nutrients from the water so that it can be reused."

The doctor then applied to the BEWARE programme to work on the GRANAMOX project. "During my academic career, most of the projects I worked on were more basic science, but I always felt I lacked experience in how to bring Anammox technology to the industry, outside the laboratory. The BEWARE programme, which brings together academic and industrial partners, allows me to develop these skills. I am also very comfortable with the Anammox process but there is still a lot to study and develop. Lastly, I like change. Going to Belgium as part of this programme allowed me to discover a different work environment, language and cultural context."

**THE GRANAMOX PROJECT**

Is based on the Anammox process, which allows the removal of nitrogen from wastewater in a way that is biological and low-energy compared to other techniques currently used. In this process, the Anammox bacteria feed on the nitrogen in the wastewater. Tiago Akaboci seeks to determine the optimal conditions that promote the growth of the bacteria to be used.

Anammox grows more slowly than most other bacteria. The process therefore requires more time and monitoring to treat the water effectively. However, because these bacteria grow very slowly, they tend to naturally form aggregates (to protect themselves) of around a millimetre or more. These aggregates, called granules, are interesting because after feeding on nitrogen, their density makes them sink to the bottom of the water tank to be recovered, allowing the easy recovery of the treated water. The objective of GRANAMOX is to find the ideal conditions to control and promote the growth of these Anammox bacteria granules, depending on the type of wastewater, in order to obtain a robust and efficient treatment process. The company exelio is developing the technique on a large scale. Its objective is to market it as a new option for Belgian industrial wastewater treatment plants - in particular those in the agri-food sector - and municipal wastewater plants.

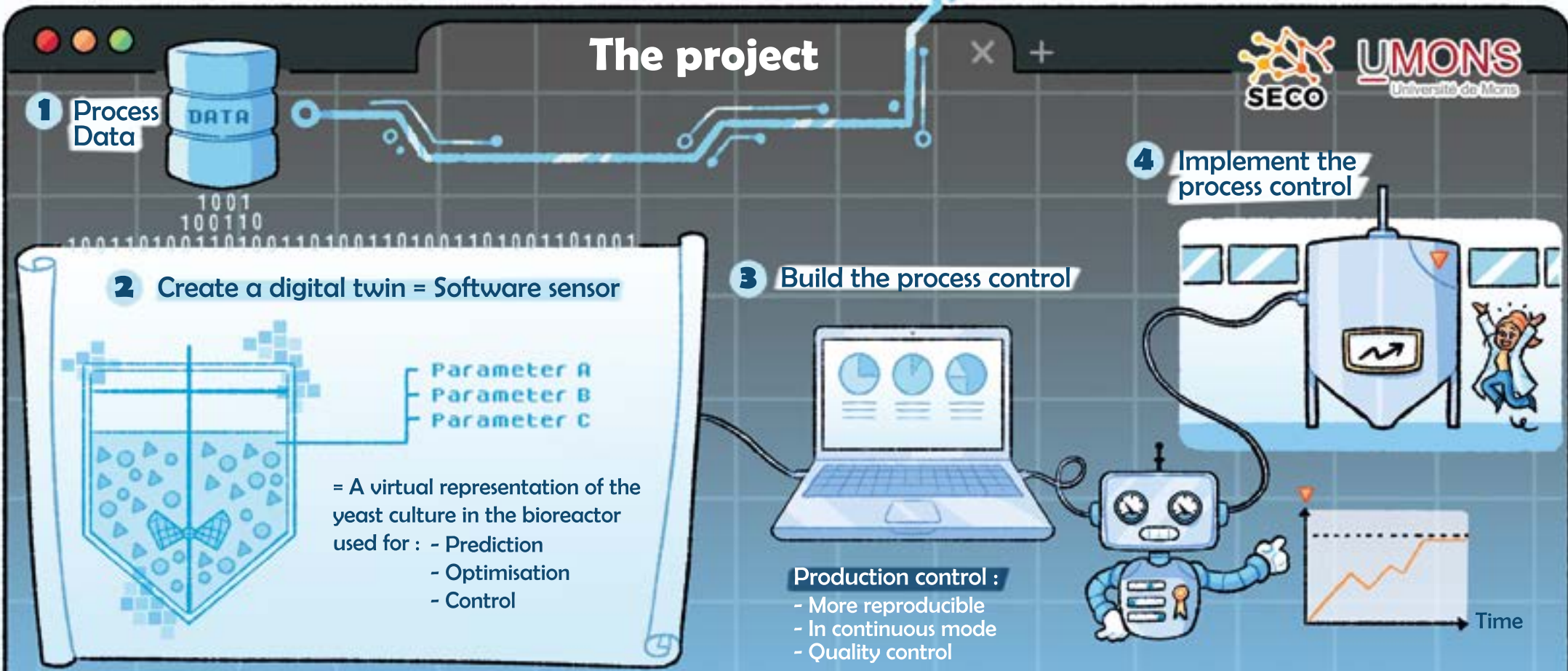
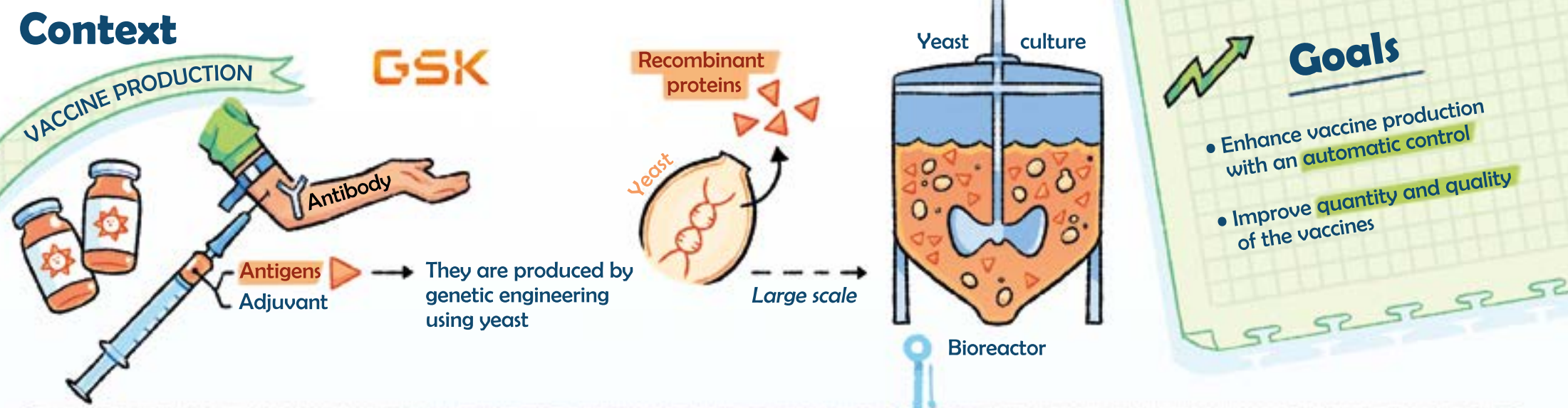






# MICAELA BEVIDES CASTRO

COUNTRY OF ORIGIN	PERU
COUNTRY AT TIME OF SUBMISSION	PERU
DURATION	36 MONTHS
PROMOTORS	
UNIVERSITÉ DE MONS (PROF. ALAIN VANDEWOUVER)   WWW.UMONS.BE	
GSK (DR GAËL DE LANNOY)   BE.GSK.COM	



## EFFECTIVE VACCINES THANKS TO YEAST

Where did you study?

**MB** - I began my undergraduate studies at the Pontifical Catholic University of Peru (PUCP) in Lima. I then moved to Brazil, where I obtained my Master's degree in electrical engineering at the Pontifical Catholic University of Rio Grande do Sul in Porto Alegre in 2010. I developed robust control systems for five-phase electric motors. The goal was to intelligently control the current delivered to the machine to obtain more power while using less energy. I then went to Belgium to complete a PhD on robust control at the University of Mons.

What exactly did your doctoral research involve?

**MB** - Until the end of my thesis in 2015, I sought to apply my robust control mechanical theory to the production of quality microalgae that could be used as a basis for biofuel. Algae biofuel, or algae oil, is an alternative to liquid fossil fuels. My goal was to simulate the growth of algae in detail using a mathematical

model to understand how they produce and accumulate the lipids that serve as a basic component of biofuel.

What did you do next and what led you to the BEWARE programme?

**MB** - First of all, I returned to Peru and spent four years teaching electrical installation control at PUCP and the University of Engineering and Technology of Lima. Between 2019 and 2021, I changed subjects by becoming involved in a State project dedicated to the preservation of Peruvian cultural heritage funded by the World Bank. I implemented three machines to control the optimal temperature and humidity for the conservation of archaeological objects. My former thesis director then told me about the TWINYEAST project, which is very similar to my PhD research. I applied because the collaboration with GSK in this project offered me the opportunity to pursue my research with specific equipment made available for high-quality industrial production, equipment that is not found in Peru.

### THE TWINYEAST PROJECT

Aims to optimise the productivity of yeast cultures for the generation of recombinant proteins for vaccine development. The cultivation of yeast in bioreactors requires the monitoring of the concentration of certain metabolites present in the culture medium, to optimise the growth and production conditions. However, industrial processes involve the use of bioreactors at different scales as well as sophisticated instrumentation systems. The acquisition of real-time experimental data on these systems remains a challenge at the present time. This is why it is interesting to develop dynamic mathematical models that can be used as a basis for the design of controllers of crop conditions and software sensors (that reconstruct information not directly measured). In the context of the BEWARE project, Micaela Benavides is developing this type of estimator, now called numerical twins, taking into account data collected during numerous experimental tests. To develop this model, the researcher is using process data collected from numerous tests. Subsequently, the mathematical model, estimators and testing using the available sensors will allow the automation and optimisation of yeast culture productivity. The researcher is developing her system in the bioreactors of the vaccine manufacturer GSK, in partnership with the SECO laboratory of the University of Mons.



## I. CONTEXT

Did you know ?

Most cancer cells consume a lot of glucose

<sup>18</sup>F FDG → A diagnostic agent that detects high glucose consuming cells

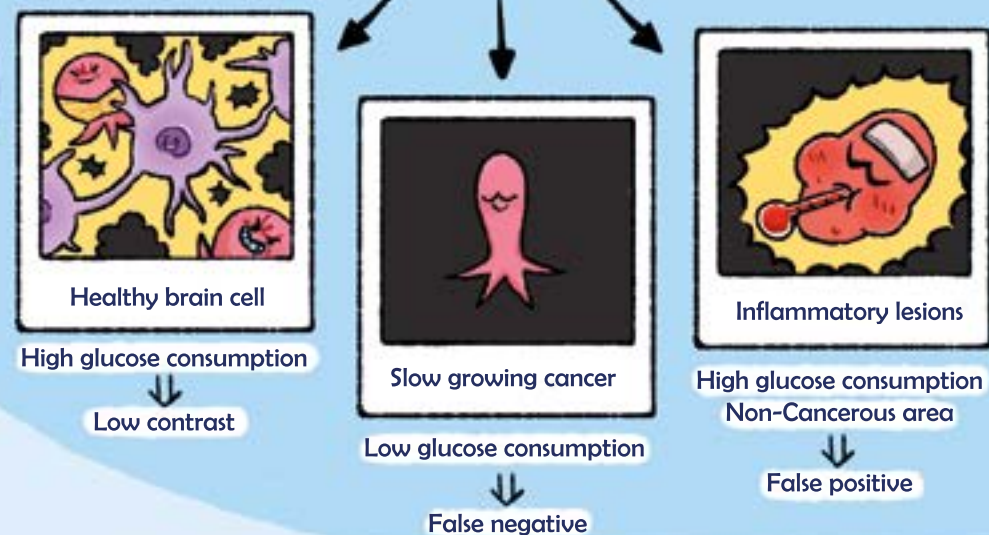


Biomedical imaging

It is possible to detect some cancers

## II. RESEARCH ISSUES

3 major limitations to this diagnosis



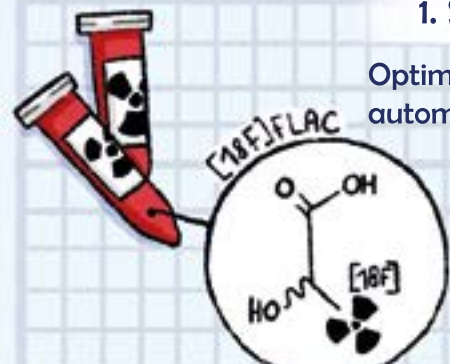
## III. PROJECT

Assess the preclinical value of [<sup>18</sup>F]Flac  
The radiotracer tracks lactate consumption, an alternative fuel for cancer cells

## IV. RESEARCH PLAN

### 1. Study of the radiotracer

Optimization of radiochemistry for automated production of [<sup>18</sup>F]Flac



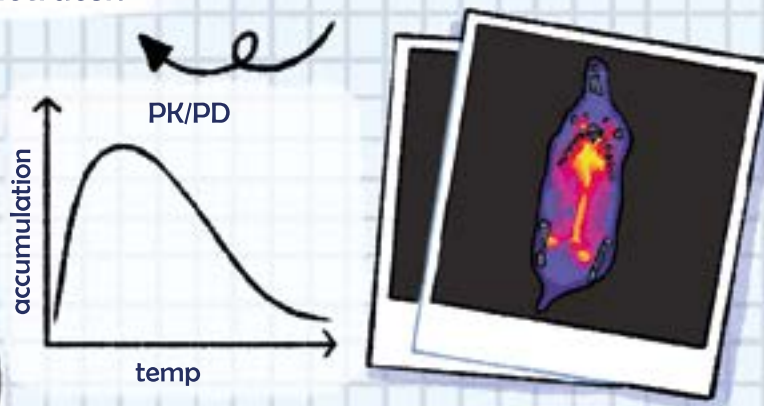
Radiochemical and metabolic stability

Telix  
UCLouvain

### 3. Compare the two radiotracers

### 2. Preclinical and clinical studies

Study of the radiotracer on mice and then humans if good results



## MAURICIO DA SILVA MORAIS

COUNTRY OF ORIGIN	PORTUGAL
COUNTRY AT TIME OF SUBMISSION	POLAND
DURATION	24 MONTHS
PROMOTORS	
	UNIVERSITÉ CATHOLIQUE DE LOUVAIN (PROF. PIERRE SONVEAUX)   UCLouvain.BE
	TELEX PHARMACEUTICALS (DR SAMUEL VOCCIA)   TELIXPHARMA.COM

## A LACTATE TRACER FOR MEDICAL CANCER IMAGING

Mauricio Da Silva completed his Master's degree in Medicinal and Biological Inorganic Chemistry at the Faculty of Sciences of the University of Lisbon and at the Technological and Nuclear Institute in Sacavém in Portugal. Between 2006 and 2008, he prepared molecules radiolabelled with <sup>99m</sup>Tc, a metal used for diagnosis in nuclear medicine. The objective is to detect the first lymph node in which cancer cells may accumulate during the process of metastasis - when cancer cells spread throughout the body away from the initial site. The researcher then continued his work during a PhD at the same institutions between 2009 and 2013. He designed and validated radiotracers containing <sup>99m</sup>Tc for non-invasive detection of melanoma. To do this, the researcher tracked the distribution of radioactive compounds in mice using an imaging technique called single photon emission computed tomography (SPECT).

Mauricio Da Silva then embarked on a first post-doctoral fellowship in the Department of Chemical Biology at University College London. Until 2017, he developed a chemical platform to prepare homogeneous antibody-based drugs, mainly for the treatment of breast cancer. Over the next three years in Department of Imaging Chemistry & Biology at King's College London, he developed a peptide-based platform to monitor the efficacy of cell therapies in murine models of cancer.

In 2020, Mauricio Da Silva then accepted a position as an assistant professor at the University of Wrocław (Poland). The research focus on development of chemical tools that help quantify metal (zinc and iron) content in different cellular compartments. This would help to understand the development of degenerative diseases. The second line of research involved identifying new molecules with a strong affinity for metals. Mauricio Da Silva then embarked on the F18FLAC project of the BEWARE programme, "The main reason I applied to this programme is that radiotracer development is one of my passions. The project will expand my knowledge in medicinal chemistry and radiochemistry for the design of non-metal probes for diagnostic applications. In particular, I am acquiring new skills in the preparation and biological evaluation of fluorinated probes for preclinical and clinical studies."

### THE F18FLAC PROJECT

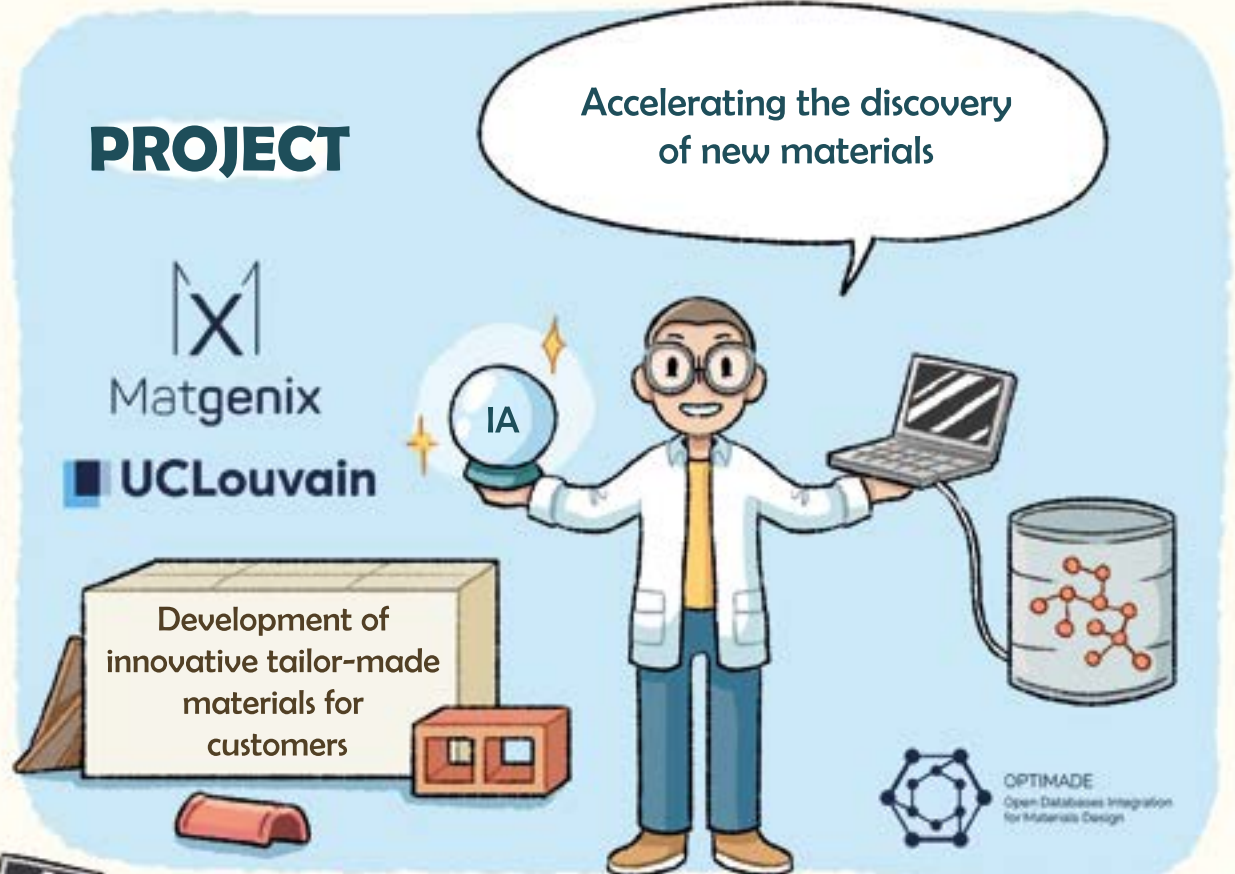
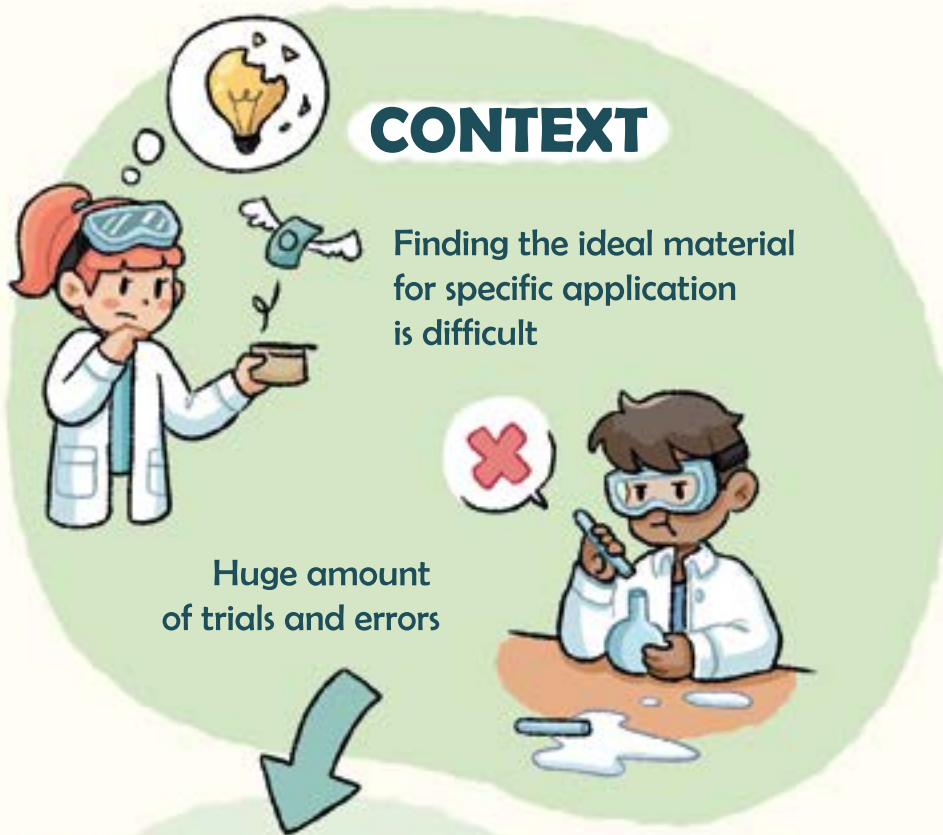
The metabolic radiotracer currently used in the clinic, [<sup>18</sup>F]FDG, only allows the detection of cancers or lesions that consume a large amount of glucose. However, cancer cells can also use lactate as fuel during tumour growth or in response/resistance to therapy.

The 18FFLAC project's aims at the assessment of a radiotracer called [<sup>18</sup>F]Flac, a lactate derivate labelled with fluorine-18, to detect cancer using nuclear imaging technique positron emission tomography (PET). Mauricio Da Silva also plans to track lactate flux and the expression of key transports in murine models of cancer by PET. Comparative imaging studies with [<sup>18</sup>F]FDG will determine the potential of [<sup>18</sup>F]Flac to be used as companion radiotracer on cancer diagnostic.

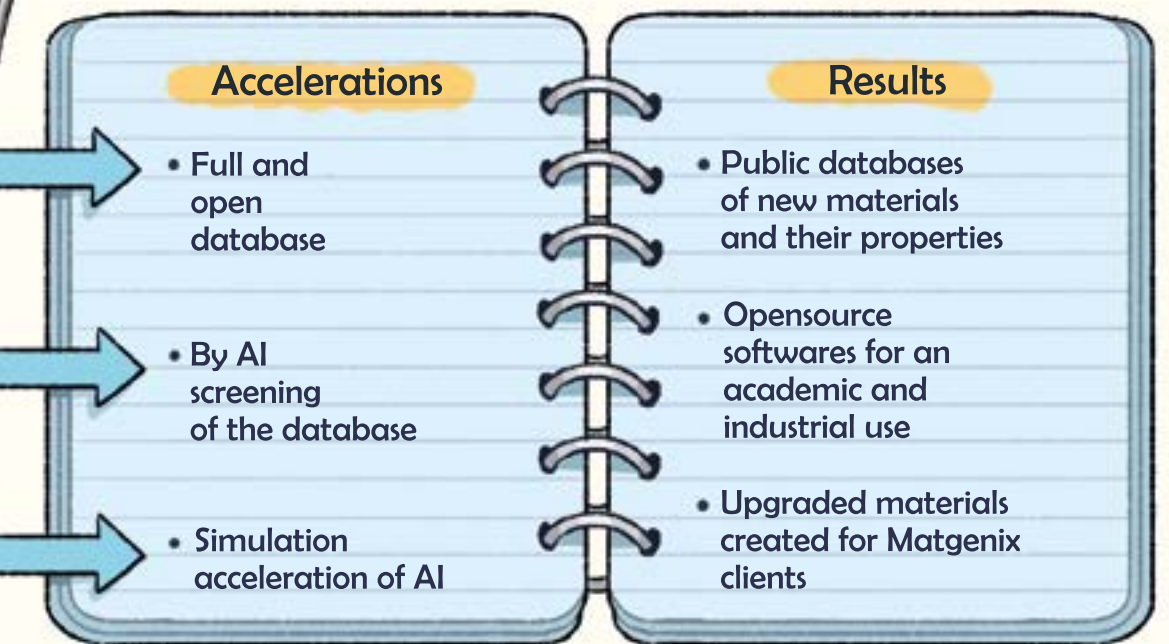
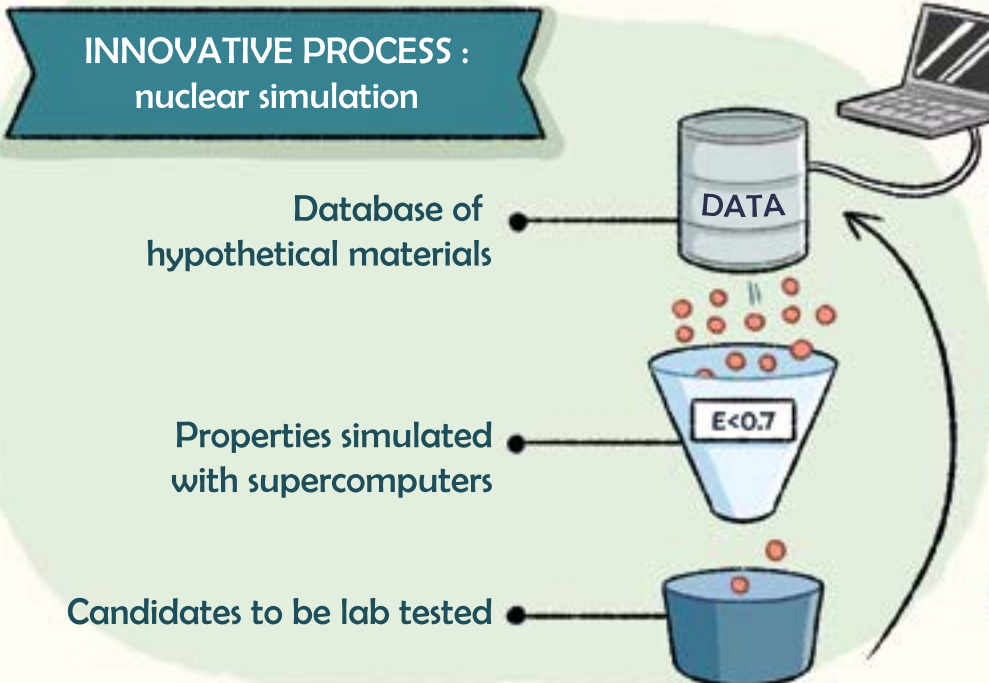
The researcher is developing a protocol to prepare [<sup>18</sup>F]Flac in a clean (no impurities), fast and high-yield way, leading to the production of future preclinical batches and study the radiochemical stability. He will also characterize different cell lines of human cancer to generate the best animal model for imaging studies.







**INNOVATIVE PROCESS : nuclear simulation**



**MATTHEW EVANS**

COUNTRY OF ORIGIN	UNITED KINGDOM
COUNTRY AT TIME OF SUBMISSION	UNITED KINGDOM
DURATION	36 MONTHS
PROMOTORS	
UNIVERSITÉ CATHOLIQUE DE LOUVAIN (PROF. GIAN-MARCO RIGNANESE)   UCLouvain.BE	
MATGENIX (DR DAVID WAROQUIERS)   MATGENIX.COM	



**MATERIAL DESIGN AND MACHINE LEARNING**

Can you summarise your academic background?

**ME** - I first obtained a Master's in theoretical physics at the University of Manchester in the UK. My thesis involved studying the properties of graphene, a two-dimensional crystalline material made of only carbon atoms and whose stacking leads to graphite. The properties of graphene are not yet well known and are the subject of a great deal of research, but it already has applications in optoelectronics (for example, for touch screens and electronics).

In 2015, I went to the University of Cambridge to do a one-year Master's in scientific computing. These skills were necessary for me to start a PhD dedicated to the prediction of crystal structures at the same university. In short, I was using computer simulations to discover new materials, including more durable materials for making batteries for electric vehicles and the power grid. For example, I looked for new formulations for sodium-ion and potassium-ion batteries.

What direction did you take after your PhD?

**ME** - The Covid-19 epidemic broke out while I was still based in Cambridge. I started to work with UCLouvain but remotely from England. Together with an international group of researchers, we developed a network of databases, for cataloguing crystal structures (OPTIMADE), open to all researchers and industries. We hope that this data sharing will accelerate the development of new materials for many applications.

Why did you apply for the BEWARE programme at the end of 2021?

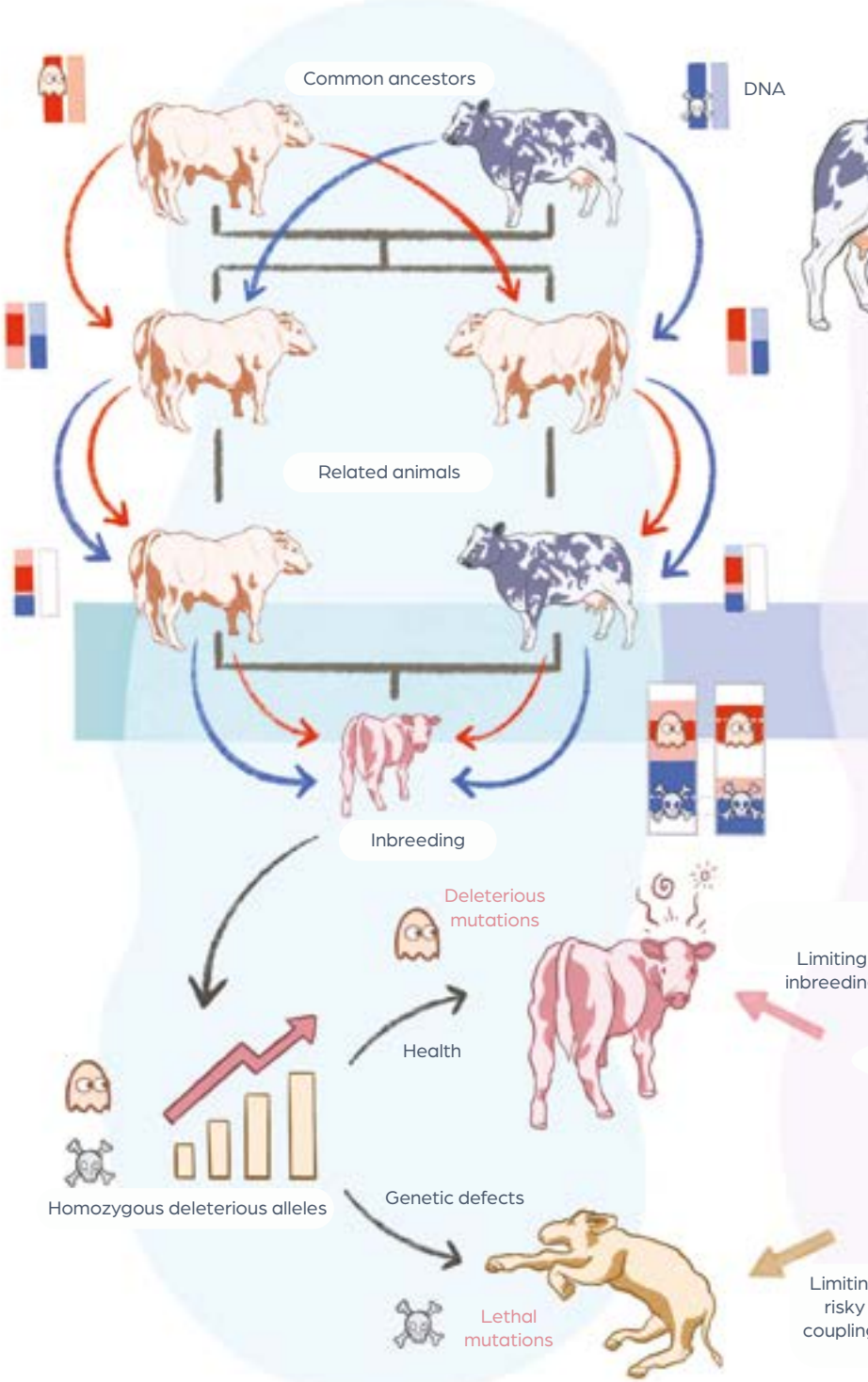
**ME** - The MLXLMD project was a great opportunity for me to move to Belgium and finally meet the research community I had been working with remotely for the past few months. It was also an opportunity for me to use my research for industrial applications with a view to sustainability.

**THE MLXLMD PROJECT**

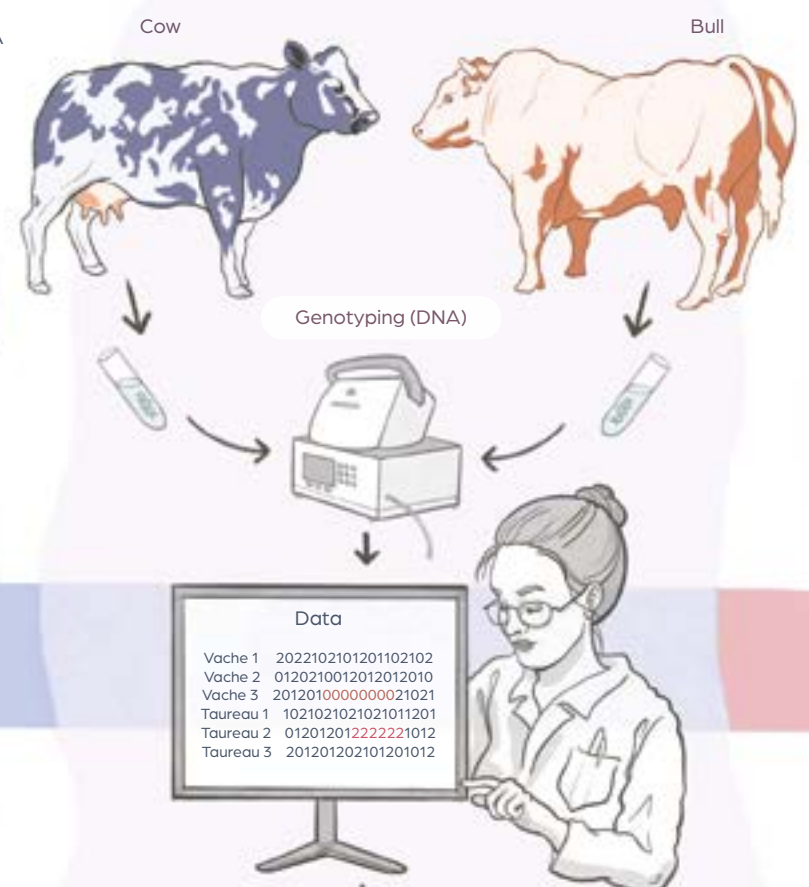
Aims to use artificial intelligence to discover new materials. Until ten years ago, the discovery of new materials was primarily based on experimental approaches and trial and error. This process was particularly time-consuming and costly, and the successes owed a great deal to serendipity. The development of simulations and the increase in computer power have reduced the time required and the role of chance, by predicting which new materials might be interesting to study. The last decade has therefore seen the appearance of databases containing tens of thousands of results of these simulations. As these databases remain computationally time-intensive, the MLXLMD project aims to further accelerate the process. Matgenix uses different databases, including that developed by Matthew Evans during his thesis at the University of Cambridge. Today, the researcher is using artificial intelligence to identify interesting new materials and performing the corresponding simulations to create a new database. It will be open to the public and will be used by industrialists working in research and development in the world of chemistry or materials, in particular by Matgenix customers such as BASF or Umicore.



**INBREEDING RISKS**



**PREDICTING INBREEDING OF A MATING**



**STATISTIC MODEL TO PREDICT HOMOZYGOUS SEGMENTS**

$$C(x, y) = P(x_{j1}, x_{j2}, \dots, x_{jk}) P(x_{k1}, x_{k2}, \dots, x_{kn}) \prod_{l=1}^k P(x_{lj})$$

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**SOFTWARE WITH THE GENOMIC TOOLS**



Bull	Predicted inbreeding	Risks
BULL 1	10%	👤 🦴
BULL 2	20%	👤 🦴
BULL 3	25%	👤 🦴
BULL 4	5%	👤 🦴



**NATALIA FORNERIS**

COUNTRY OF ORIGIN	ARGENTINA
COUNTRY AT TIME OF SUBMISSION	ARGENTINA
DURATION	24 MONTHS
PROMOTORS	ULIÈGE (DR TOM DRUET)   WWW.GIGA.ULIEGE.BE INOVÉO (PATRICK MAYERES)   WWW.AWEGROUPE.BE

**FROM ARGENTINEAN BEEF TO BELGIAN BLUES!**

After a Master's degree in agricultural sciences at the University of Buenos Aires, Argentina, and a thesis on the genetics of gamete formation in a species of a hematophagous fly, Natalia Forneris wrote a PhD thesis at the same university. Here too, she devoted it to genetics. "Since 2014, I have worked first as a PhD student, then as a junior researcher and lastly as a lecturer in the 'animal breeding and genetics' group at the Faculty of Agronomy," she explains. This group is interested in the development of methods in genetic evaluation, including the definition of selection objectives. "This has allowed me to acquire expertise in genetic evaluation and I am now involved in all the beef cattle genetic and genomic evaluation processes that are regularly carried out by the group for the Brangus breed in Latin America and the Brahman and Limousine breeds in Argentina," continues Dr Forneris. She adds, "I also had the opportunity to spend six months in France at the National Institute for Agricultural Research in Toulouse, where I worked with real and simulated genomic datasets to estimate relationships between animals using various methods."

After returning to Argentina, where she stayed for two years, Dr Forneris decided to head back to Europe and spend a year and a half in Spain. "During my stay at the Centre for Research in Agricultural Genomics in Barcelona, I was involved in the development of software that simulates genotypes from real sequencing data."

Prior to applying for a BEWARE research position, which she learned about through her current sponsor, the researcher was focused on quantitative genetic methods for genomic prediction suitable for beef cattle in Argentina. "I recently submitted\* a manuscript in which the objective was to estimate the level of inbreeding and inbreeding depression for growth traits (birth weight, weaning weight and finishing weight) and scrotal circumference, a reproduction-related trait, in Brangus cattle using pedigree, genomic and combined methods," she explains.

She continued, regarding her stay at the University of Liège, "The project offered me a real opportunity to develop new models for predicting inbreeding from genomic data, since the academic sponsor has a great deal of experience in this field, as well as to develop tools for managing recessive deleterious alleles, several of which have already been identified by the Animal Genomics Unit". The project will also contribute to improving the sustainability of the sector by optimising aspects related to inbreeding and genetic diversity. (\* the manuscript is now published)



**THE FITSEL PROJECT**

In livestock farming species such as cattle, inbreeding results from high selection intensity and the massive use of elite sires. In Belgian Blue (BBB) cattle, inbreeding levels are currently managed by pedigree-based approaches, and several recessive genetic defects have been reported in recent years, highlighting the need for optimal management.

Inbreeding leads to significant economic losses and a decline in genetic diversity.

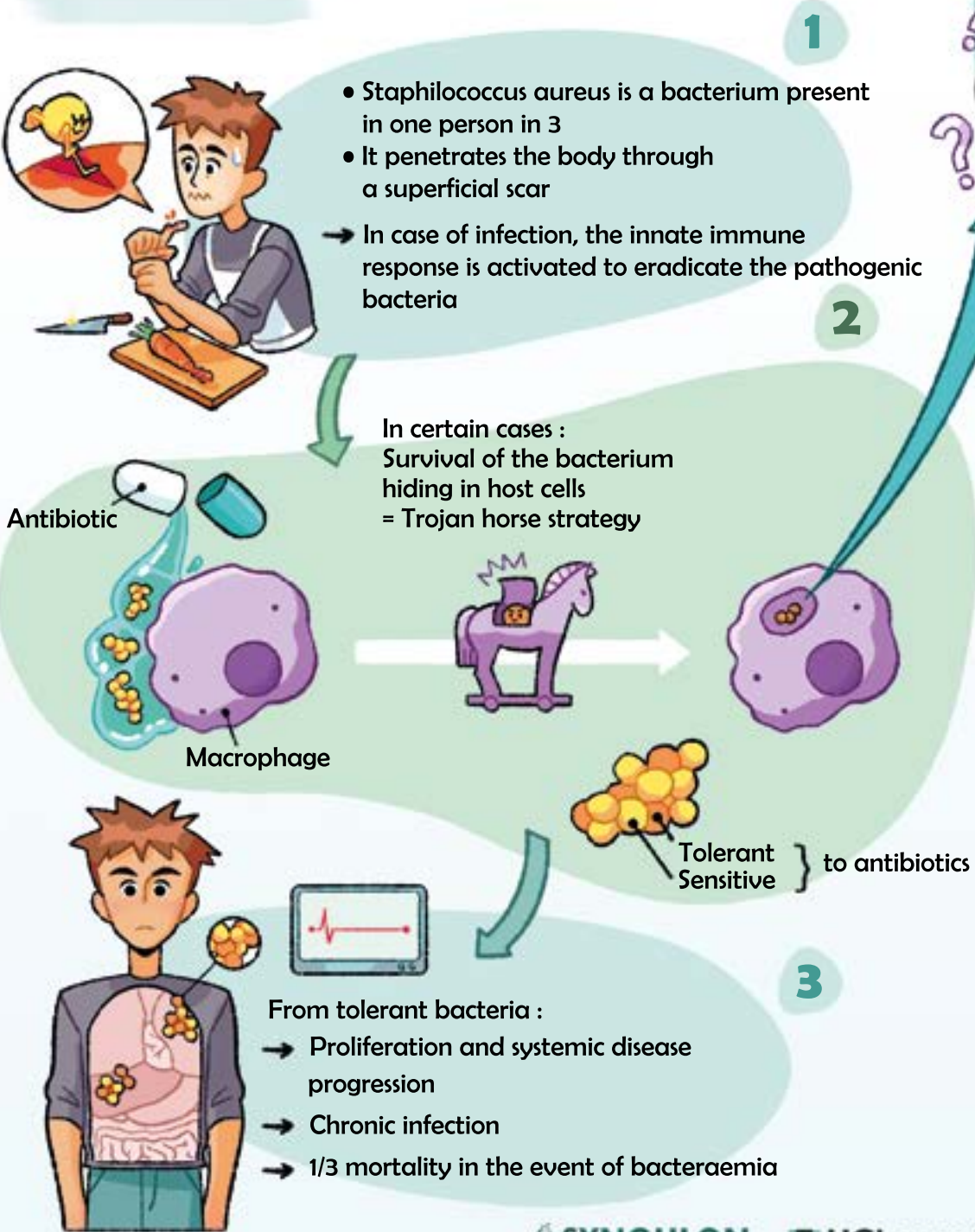
The objective of the FITSEL project is to develop a genomic tool for mating plans, a software that predicts genomic inbreeding coefficients and the risks associated with high-impact recessive deleterious variants (stillbirth or embryo loss).

These genomic predictors will be completely new to the BBB cattle breed, as none are currently being implemented.

This project will be a first step in leading Inovéo and Walloon beef farmers towards the optimal management of their herd in terms of genetics, using the economic index.



# Context



# Research topics

- How do bacteria survive in the macrophage lysosome ?
- Why are these bacteria insensitive to antibiotics when they are intracellular ?



## HYPOTHESES

- 1) Bacteria go into dormancy
- 2) They become persistent
- 3) Antibiotics do not penetrate the macrophage lysosome
- 4) Induction of bacterial stress responses in the lysosome, which then protect them against antibiotics

## Solution envisaged in this project

1. Combining antibiotics with bacteriocins (= antimicrobial peptides produced by bacteria against other competing bacteria)



2. Encapsulate the bacteriocins in liposomes and deliver them to the interior of macrophages, where the persistent bacteria remains



# FRED GOORMAGHTIGH

COUNTRY OF ORIGIN	BELGIUM
COUNTRY AT TIME OF SUBMISSION	SWITZERLAND
DURATION	36 MONTHS
PROMOTORS ▼	
	UNIVERSITÉ CATHOLIQUE DE LOUVAIN (PROF. FRANÇOISE VAN BAMBEKE)   UCLouvain.BE
	SYNGULON (DR PHILIPPE GABANT)   SYNGULON.COM



## BACTERIOCIDES, AN ALTERNATIVE TO THE ERADICATION OF INTRACELLULAR STAPHYLOCOCCUS AUREUS

What are the highlights of your academic career ?

**FG** - I am originally from Belgium and I obtained my master's degree in bioengineering in 2011 at the Université Libre de Bruxelles (ULB). My Master thesis was in partnership with the company GSK on the optimisation of recombinant protein production - such as insulin - in bioreactors. The next logical step was to start a PhD, also at the ULB, where I chose to focus on molecular biology, and in particular on how a few bacteria could operate a phenotypic switch allowing them to sustain lethal doses of antibiotics in the absence of genetic mutations. I attempted to answer this question by focusing on the mechanisms of the bacterium *Escherichia coli* (*E. coli*) for surviving two commonly used classes of antibiotics:  $\beta$ -lactams and fluoroquinolones. I was able to show that the predominant model in the scientific literature was wrong. This led to the retraction of several publications and cleared the air in the scientific community. During this PhD, obtained in 2015, I also developed a high-resolution microscopy system for real-time - minute-by-minute - monitoring of bacterial division and survival to antibiotic treatment. We were among the first in the world to be able to observe one of these famous

antibiotic-persistent bacteria directly through a fluorescence microscope.

You then went on to do two post-doctorates ?

**FG** - Yes, I did the first one in the same laboratory as my thesis so that I could completely finalise the microscopic imaging platform. Then, between 2019 and 2022, I worked at the Infectious Diseases Clinic at the University of Basel in Switzerland. I studied the virulence mechanisms of salmonellosis and how to develop new vaccines and antibiotics against Salmonella bacteria.

It was then that you applied to the BEWARE programme...

**FG** - I wanted to get involved in more applied therapeutic research while retaining my independence to pursue more fundamental work at the same time. It is with this in mind that I wrote the CRITIC project. I contacted the Louvain Drug Research Institute (LDRI) of UCLouvain to submit the idea, which was accepted and then selected. It is the logical continuation of my research.

### THE CRITIC PROJECT

Addresses antibiotic resistance. The phenomenon is constantly growing and the need to create new antibiotics is becoming increasingly important. CRITIC uses the weapons produced by the bacteria themselves: small peptides called bacteriocins. Billions of bacteria live side by side in the microbiota in our colon or on the skin. When they come into contact with a "competitor" for their food, they produce weapons, the famous bacteriocins, to eliminate this competitor. One of the best-known bacteriocins is nisin, produced by *Lactococcus lactis* and widely used as a food preservative under the code E234. Frédéric Goormaghtigh is seeking to identify new bacteriocins capable of specifically attacking *Staphylococcus aureus*, the cause of frequent painful local infections that can sometimes degenerate into chronic and systemic infections that are impossible to treat with antibiotics and can be fatal. Syngulon chemically produces many different bacteriocins that the researcher uses in his laboratory tests.



# JIMÉNEZ GONZÁLEZ HANSER STEVEN

COUNTRY OF ORIGIN	COLOMBIA
COUNTRY AT TIME OF SUBMISSION	BRAZIL
DURATION	24 MONTHS
PROMOTORS	
	UNIVERSITÉ LIBRE DE BRUXELLES (PROF. JOËL GOOSSENS)   WWW.ULB.BE
	MANGO GEM (DR BEN RODRIGUEZ)   WWW.MANGO GEM.COM

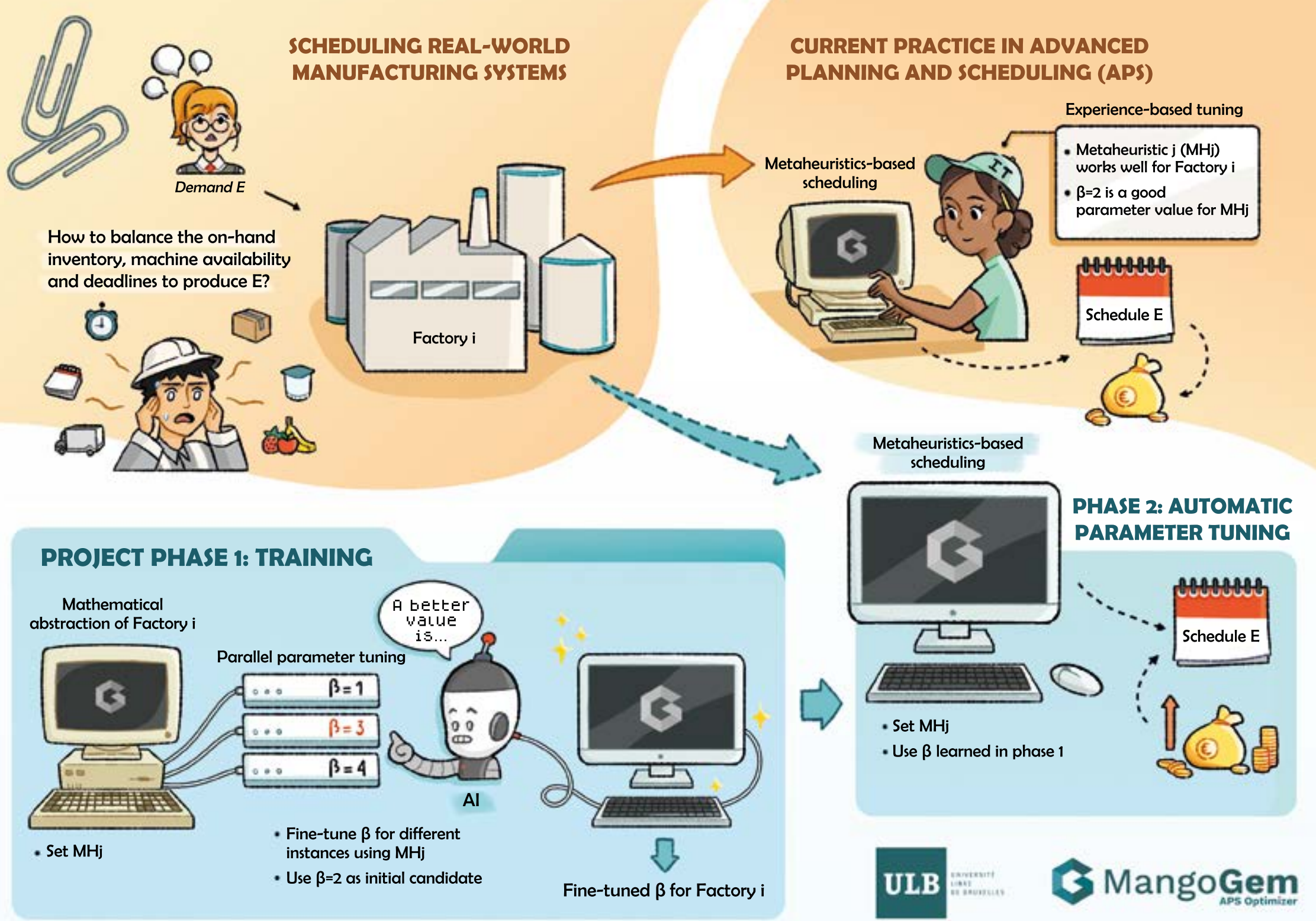
## THE PRALINEH PROJECT

Aims to optimise the use of resources (machines, time, labour, raw materials, etc.) in the manufacturing industry in order to maximise productivity. This task, also called industrial scheduling, is already being performed by commercial software based on metaheuristic algorithms. However, the efficiency of these algorithms currently depends significantly on the value of manually determined mathematical parameters. Testing these different parameters is very time-consuming and can lead to errors and a lack of reproducibility. Hanser Jimenez Gonzalez is therefore developing an algorithm for the automatic calibration (tuning) of these parameters, which allows them to be selected more quickly to improve resource allocation and increase the productivity of manufacturing processes. To do this, the researcher uses artificial intelligence and parallelisation techniques. He uses the experience of the Walloon software company *MangoGem*, which is dedicated to advanced planning and scheduling optimisation, as well as the knowledge of Joël Goossens, a Professor at the Université Libre de Bruxelles, in combinatorial optimisation, scheduling algorithms and real-time computing.

## IMPROVE SCHEDULING WITH AUTOMATICALLY CALIBRATED PARAMETERS

Hanser Jimenez Gonzalez earned a Bachelor's degree in food engineering from the University of Córdoba in Colombia in 2015. He then moved to Brazil, where he completed a Master's degree and a doctorate in industrial engineering. During his Master's, he worked on the optimisation of the demand distribution in drop shipping systems - the marketing of items from a third-party supplier by a reseller on an e-commerce site. Hanser Jimenez Gonzalez developed an algorithm that allocates orders among the stakeholders in a drop shipping system to optimise inventory usage, fulfil more orders and increase revenue for online retailers. To extend his work he considered supply disruptions such as those observed during the Covid-19 pandemic and worked on an improved machine-learning-based algorithm.

During his PhD, he continued in the same vein to optimise the maintenance of complex systems using machine learning. "I developed a general predictive maintenance model applicable to different types of industries, such as nuclear power plants, offshore installations, aerospace, the oil and gas industry and hospitals, he explains. The goal is to know which maintenance actions to apply to each machine during each inspection, in order to avoid critical breakdowns and reduce the overall maintenance cost." It was when he was nearing the end of his PhD in mid-2021 that Hanser Jimenez Gonzalez heard about the BEWARE programme, and more specifically the PRALINEH project. "I was immediately drawn to the idea of learning about the constraints of real-world manufacturing processes. Using artificial intelligence to improve industrial scheduling in a real-world setting is very motivating to me. It was the perfect project for me, says the doctor. I am also passionate about language learning and travelling. As a Colombian, I am fluent in Spanish, but I also speak fluent Portuguese and English thanks to my studies in Brazil. This project was an excellent opportunity to also learn French and discover a new culture."





## Context

Workers from the pharmaceutical industry operate in stressful and highly regulated environments



### Main stress factors:

- Repetitive tasks
- Detailed documentation
- Constraining gears

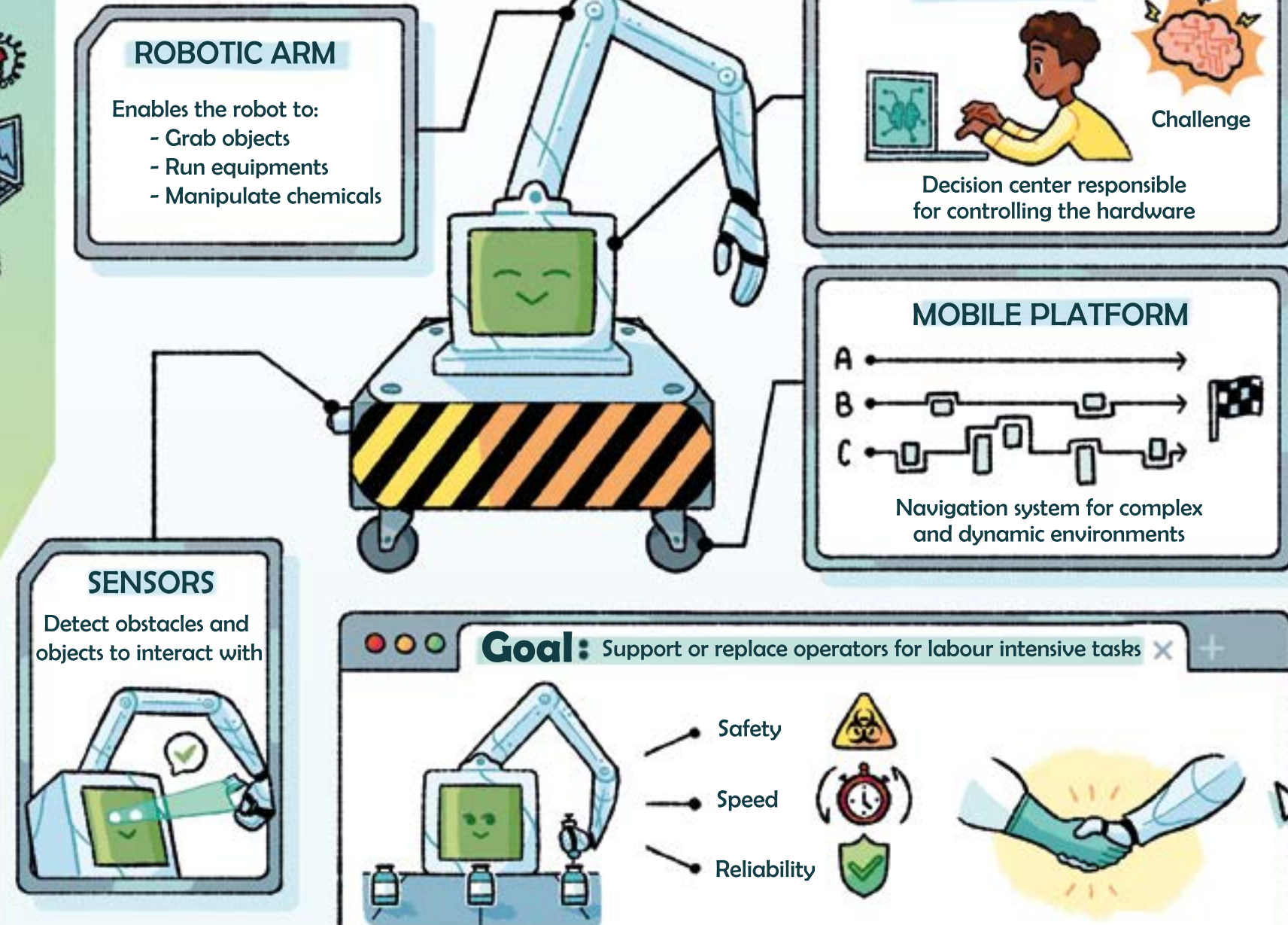


### Consequences:

- Job quit rate ↑↑
- Personnel shortage ↑↑

## Project

Design an autonomous robot to support production in the pharmaceutical industry



## MUHANAD HAYDER MOHAMMED

COUNTRY OF ORIGIN	IRAQ
COUNTRY AT TIME OF SUBMISSION	BELGIUM
DURATION	36 MONTHS
PROMOTORS	
	UNIVERSITÉ DE NAMUR (PROF. ELIO TUCI)   WWW.UNAMUR.BE
	CILYX (DR GREGORY REICHLING)   WWW.CILYX.EU



## A ROBOT TO SERVE THE PHARMACY

Muhanad Hayder Mohammed Mohammed graduated from the University of Baghdad in 2003 with a degree in Electrical Engineering. He then moved to India to complete a Master's degree in computer science at Savitribai Phule Pune University, during which he specialised in the development of software for industry. Afterwards, Muhanad Mohammed returned to his native Iraq to work as a lecturer at the University of Kerbala from 2008 to 2013. It was there that he became particularly interested in robotics and artificial intelligence.

While still attached to the University of Kerbala, the roboticist then headed to Wales (UK), where he completed a PhD at Aberystwyth University. His aim was to use artificial intelligence to enable robots to collaborate. *"The idea was to carry a heavy load as far as possible,"* says Muhanad Mohammed. *The difficulty is that robots do not communicate with each other and do not 'see' each other. It was therefore necessary to combine genetic algorithms inspired by Darwinian theory and artificial neural networks.* The researcher based his work in particular on the social behaviour of ants. In January 2018, Muhanad Mohammed successfully obtained his PhD under the supervision of Prof. Elio Tuci, and together they secured funding from *Qinetiq*, a UK-based company, to support a new project based on the findings and results of Muhanad's doctoral research. The roboticist then returned to Iraq, where he resumed his work as a lecturer at the University of Kerbala. Using his expertise in computer science, electronics and artificial intelligence, he created a robotics laboratory where students train in programming.

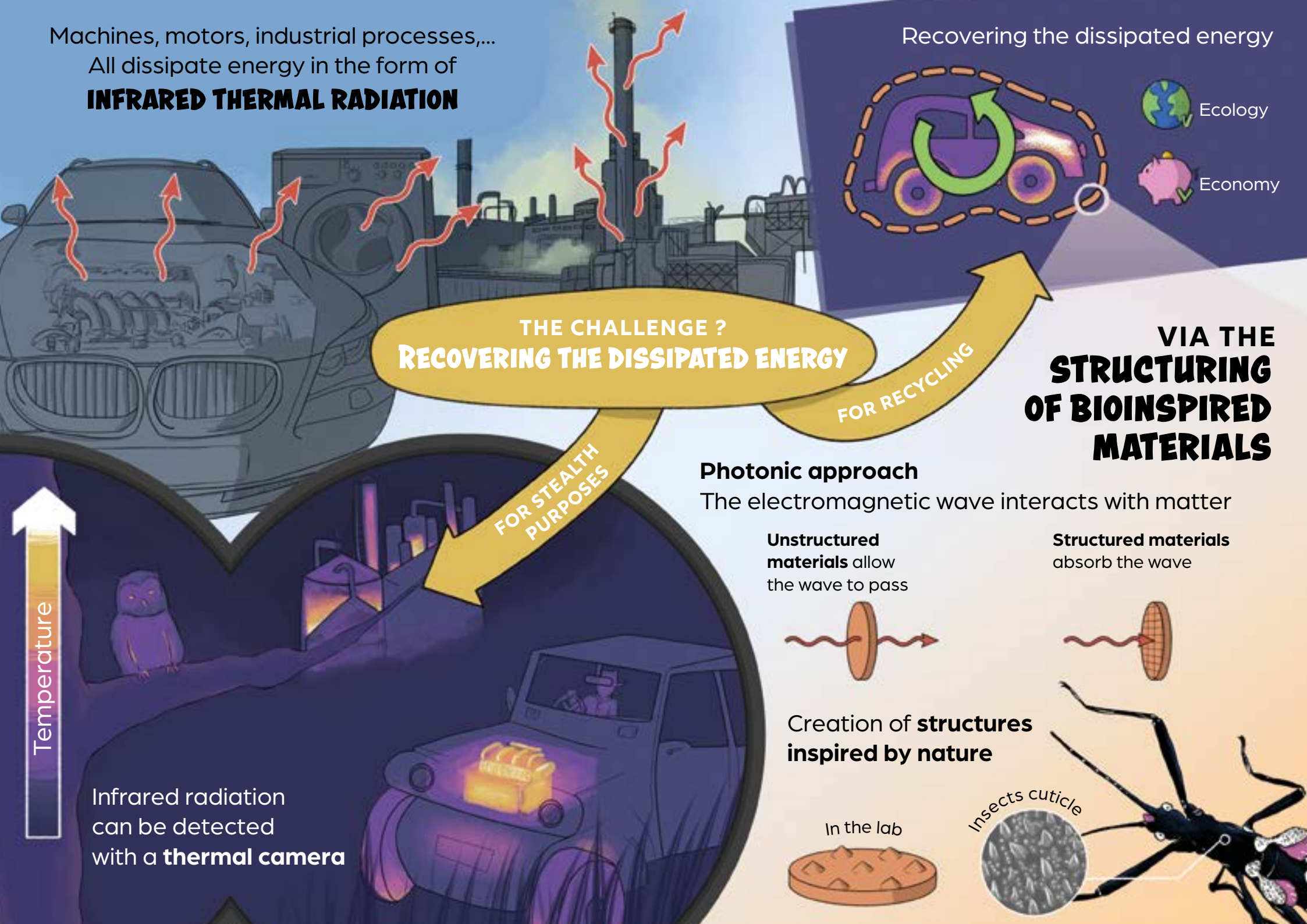
In 2019, Muhanad Mohammed worked with Aberystwyth University to secure funding from the British government for a pilot study for the United Nations. *"Students were teaching teenagers between the ages of 13 and 16 to assemble and programme robots in the lab. We were impressed by the level of complexity of the tasks they were able to code,"* he says. Unfortunately, the second phase of the project had to stop because of Covid-19. Muhanad Mohammed therefore decided to embark on a post-doctorate at the University of Namur in 2021. He worked with the company *VOID* to create an art installation in which 20 robots interact and play an ever-changing musical composition thanks to artificial intelligence. Lastly, in July 2021, the researcher applied for the ILABBOT project as part of the BEWARE programme. Work began in August 2022. *"I wanted to apply my knowledge of artificial intelligence to real industrial applications. So ILABBOT was the perfect opportunity!"* exclaims Muhanad Mohammed.

### THE ILABBOT PROJECT

Aims to use robots and artificial intelligence to help the pharmaceutical industry. The objective is to enable robots to perform tasks currently performed by humans, such as handling dangerous substances. The biomedical sector spends considerable sums of money training blue collar workers who soon leave due to the stressful work environment (wearing protective glasses, overalls, constant vigilance, etc.). Thanks to a collaboration between the company *Cilyx* and the University of Namur, the ILABBOT project aims to automate production processes using the autonomous mobile robot *HelMo*, which would reduce the expenses involved in training the teams and allow production 24 hours a day. Muhanad Hayder Mohammed is developing the artificial intelligence solution in a virtual environment using a simulator provided by the Swiss group *Stäubli*. The technology will then be implanted into the physical robot manufactured by *Stäubli*. In the future, *Cilyx* could sell this solution to its customers, including the British multinational *GSK*.



Machines, motors, industrial processes,...  
All dissipate energy in the form of  
**INFRARED THERMAL RADIATION**



## SÉBASTIEN MOUCHET

COUNTRY OF ORIGIN	BELGIUM
COUNTRY AT TIME OF SUBMISSION	BELGIUM
DURATION	36 MONTHS
PROMOTORS ▼	
	UNIVERSITÉ DE NAMUR (PROF. OLIVIER DEPARIS)   <a href="http://WWW.UNAMUR.BE">WWW.UNAMUR.BE</a>
	DEFENCE INDUSTRIAL PARTNER (CONFIDENTIAL)

### CAPTURING THERMAL ENERGY USING A PHOTONIC APPROACH

Sébastien Mouchet completed all his higher education at the University of Namur in Belgium. He started with a Bachelor's degree in physics, then continued with a Master's degree in physical sciences with a focus on optics and photonics. It is there that he began to be interested in studying colours in the living world. In particular, he analysed the iridescence, i.e. the change of colour with the angle of observation generated by constructive and destructive interferences, as in soap bubbles. This iridescence is found in nature, in the wings of butterflies and birds as well as in beetles, for example. During his Master's degree, obtained in 2011, the researcher was particularly interested in the Brazilian beetle *Entimus imperialis*, the wings of which appear mat green to the naked eye but with shades of green, red, blue, yellow and orange under the optical microscope.

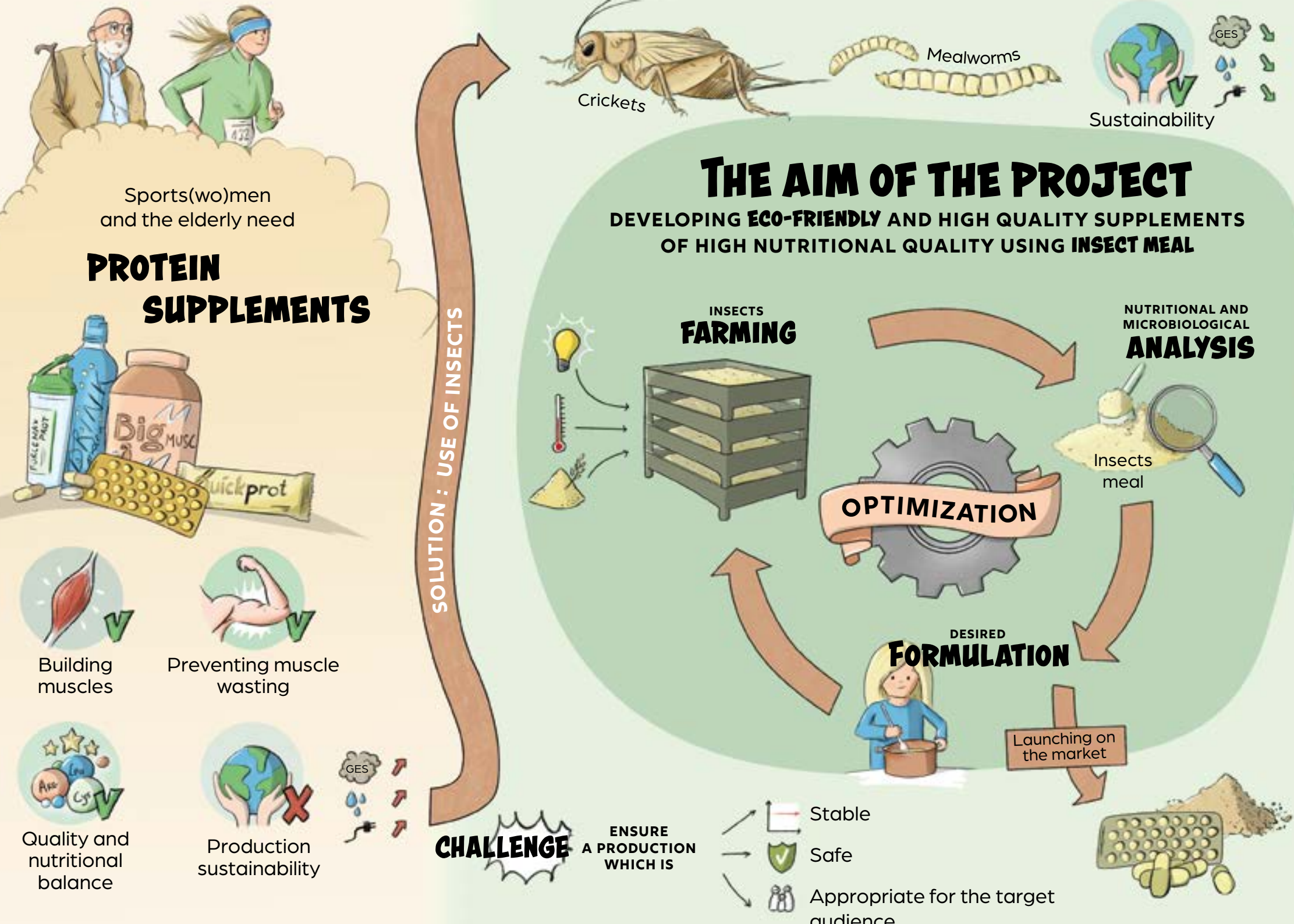
The Belgian researcher then pursued his PhD studies. He studied the colour change of insects in contact with different gases and vapours, water or ethanol for example. He sought to explain the physical and chemical phenomena behind the colour change of the *Hoplia coerulea*, a blue insect that gradually turns green on contact with water vapour, and instantly turns green on contact with liquid water. "I also developed a demonstrator with UCLouvain: a bio-inspired visual gas detector that uses the colour change to indicate the presence of water or ethanol. We can imagine other applications for this, such as detecting carbon monoxide in a house," says Sébastien Mouchet. He then spent four and a half years at the University of Exeter in Devon (England), still working on natural photonic structures, but this time exhibiting fluorescence, and on their interaction with ultraviolet light. In June 2020, the researcher returned to the University of Namur for the second part of this study. The following year, he took part in a project financed by the Walloon Region in which he developed bird-safe glazing for buildings. This glazing is bio-inspired by the butterfly's natural photonic structures that reflect ultraviolet light seen by birds - not humans. At the same time, Sébastien Mouchet applied to the BEWARE programme and was selected with his IRABSORBER project, "This project allowed me to work on a subject on which I had accumulated a few ideas in the past without really getting started. I jumped at the opportunity to carry out this research, which touches on one of the major challenges facing humanity today: the production of green energy."

#### THE IRABSORBER PROJECT

Focuses on controlling infrared radiation using photonic structures found in nature. Black butterflies and insects, for example, have the ability to harvest light and therefore ambient heat to maintain their body temperature. Sébastien Mouchet's work under IRABSORBER is inspired by natural photonic structures, the properties of which have already been demonstrated in the scientific literature, to develop coatings capable of absorbing nearby infrared radiation. This radiation, emitted by electronic equipment and vehicle engines, could be recovered and converted into another form of energy, such as electricity. Controlling thermal losses can also find an application in the search for furtivity, to avoid detection by thermal cameras. It is this type of application that interests the project's industrial partner in the field of defence. The University of Namur ensures that the results of IRABSORBER are used in other fields.







# ALEXIA NECTOUX

COUNTRY OF ORIGIN	FRANCE
COUNTRY AT TIME OF SUBMISSION	JAPAN
DURATION	36 MONTHS
PROMOTORS	HAUTE ÉCOLE LIBRE MOSANE (DRE BIRGIT QUINTING), WITH HAUTE ÉCOLE CONDORCET (DR MATHIAS GOSSELIN)   WWW.HELMO.BE HEDELAB (JEAN TANIMOMO)   WWW.HEDELAB.BE



MORE



## TODAY'S MENU: INSECTS!

Alexia Nectoux is an agronomist with 2 complementary Master's degrees, one in health and human nutrition from Bordeaux, and the other in food science from Quebec. Her field of expertise has always been focused on subjects related to food and health, from the recovery of by-products from the agri-food industry by taking advantage of their nutritional value and their benefit for human health, to the assimilation and effects on health of citrus polyphenols. "My master's thesis topic was to investigate the nutritional value of shellfish cooking water, so it can be used it as an ingredient with health benefits (antioxidant, antibacterial, etc.) that can be used in food preparations," she recalls.

However, it was in Japan where she decided to begin a PhD, following a four-month university exchange. "I chose Kyushu University because this inter-university partnership had just been proposed, and I saw it as a unique opportunity to discover Japan from the inside, through the academic world, she explains. The experience, although difficult due to all the cultural differences, was really enjoyable and I decided to return to Japan for my PhD. It was very rewarding both personally and professionally, and it allowed me to develop my adaptability, flexibility and open-mindedness."

During her PhD, the candidate researcher took part in several associative activities: for two years she was part of the student

committee for the internationalisation of the university, of which she was Vice-President, then President. At the same time, she was part of the student team in charge of running a language exchange programme, including one year as the programme leader.

"Shortly before the end of my PhD, I was looking for job offers on a Japanese website that advertises job opportunities both in Japan and abroad, she recalls. They included the BEWARE programme... I inquired and sent off a CV that was circulated among the research units in Wallonia."

This was how her profile piqued the interest of two universities, Condorcet and Helmo, which set up the INSECTA project in collaboration with the industrial partner, Hedelab.

"During the research project, I will have a twofold objective, emphasises the researcher. On the one hand, to expand my knowledge of nutritional analysis by receiving support and training in the determination of proteins levels, fatty acids, vitamins and minerals, and on the other hand, to familiarise myself with insect farming (especially mealworms and crickets), which includes the whole culture around their use in the world, especially in human food, as well as the methodology, parameters and good farming practices."

### THE INSECTA PROJECT

Currently, most dietary protein comes from animal sources. However, livestock farming is a polluting activity due to the large quantities of water used directly (watering) and indirectly (production of hay, fodder), not to mention the fact that it is also a major source of greenhouse gases.

There is therefore a need for high quality proteins with a lower environmental impact.

INSECTA is studying a new source of protein, namely insects, to develop a protein-rich dietary supplement that meets the specific needs of elderly people and athletes. Its objective is to study the impact of different farming parameters on the nutritional composition of insects and to optimise the insect meal manufacturing process in order to guarantee a constant, safe composition adapted to each target group: elderly people to compensate for natural muscle loss, and athletes to promote muscle growth.

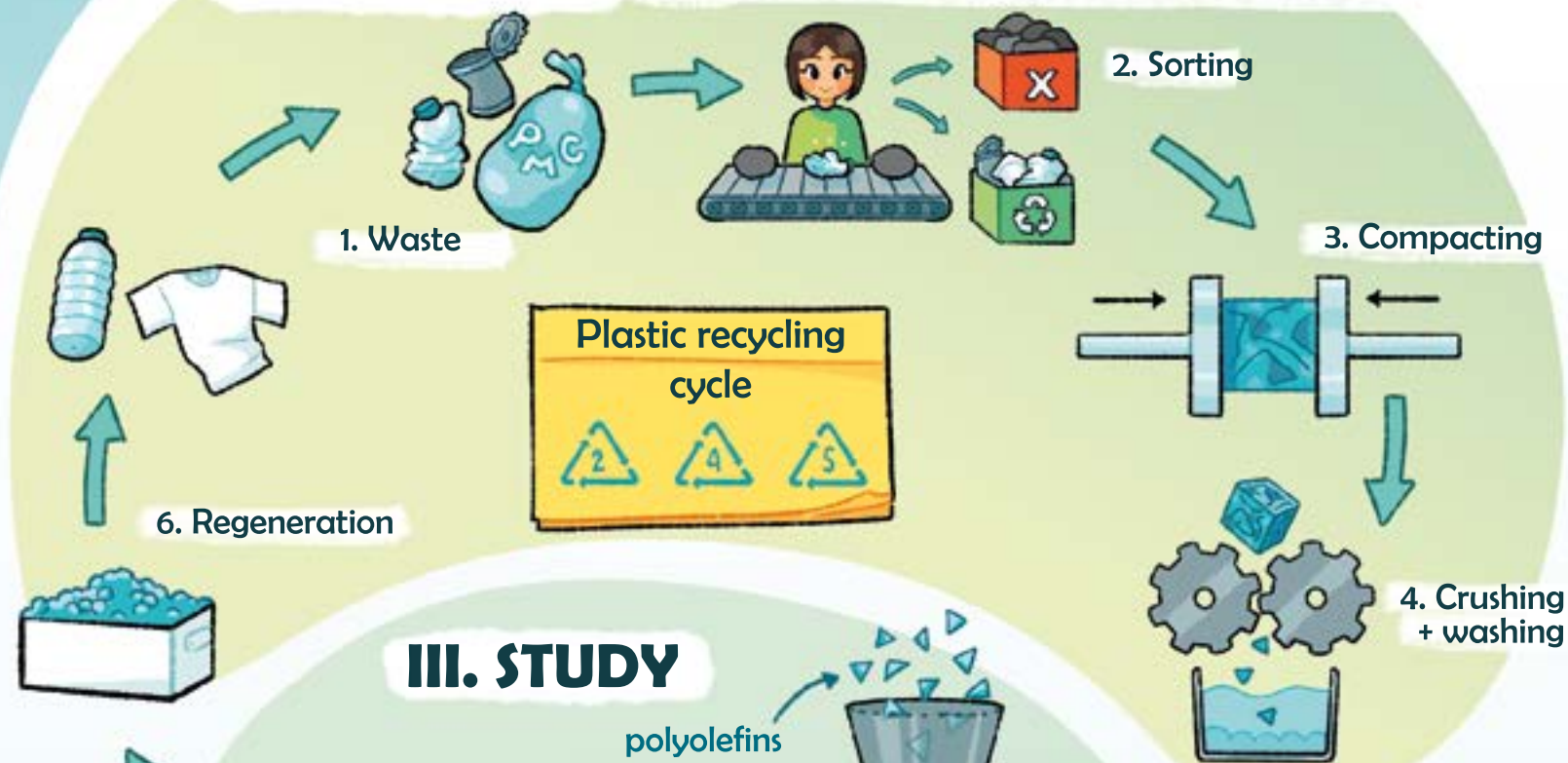


## I. CONTEXT

Micro-plastics pollution



## II. SOLUTION : IMPROVING OF MECHANICAL RECYCLING



## III. STUDY

### TEST IN LAB

mini extruder



Large-scale application



### Degradation mechanisms

- Different ways of degradation
- Dominant degradation mechanism

## JONÁS JOSÉ PEREZ BRAVO

COUNTRY OF ORIGIN	VENEZUELA
COUNTRY AT TIME OF SUBMISSION	ARGENTINA
DURATION	18 MONTHS
PROMOTORS ▼	
	UNIVERSITÉ DE MONS (PROF. JEAN-MARIE RAQUEZ)   WEB.UMONS.AC.BE
	TOTALENERGIES (MAGALI VACHAUDEZ)   TOTALENERGIES.BE

## END-OF-LIFE PLASTICS: HOW TO RECYCLE THEM ?

What did your Master's degree in chemical engineering consist of ?

**JPB** - I received my Master's degree in 2014 from the University of Zulia in Maracaibo, Venezuela. My work focused on the engineering, processing and thermomechanical characterisation of polymers. The objective was to develop new biocomposite materials from biopolymers and clay. Biopolymers are macromolecules derived exclusively from living organisms, or polymers synthesised from renewable resources.

What subject kept you busy during your PhD ?

**JPB** - While writing my engineering thesis at the University of Buenos Aires, Argentina, I focused on the preparation of biocompatible polymers of natural and synthetic origin. From 2014 to 2019, I used these macromolecules to develop biofertilizers and chemical fertilizers. I studied in detail the physicochemical properties of the developed polymers and focused on their application to controlled release systems for chemical (urea) and biological (bacteria) fertilizers.

Did you continue as a post-doctoral fellow ?

**JPB** - In 2019, I was awarded a post-doctoral fellowship by the National Council for Scientific and Technical Research (CONICET), the main science and technology promotion agency in Argentina, to work at the Faculty of Pharmacy and Biochemistry at the University of Buenos Aires. More specifically, I was interested in the modification of biopolymers using green solvents. I also added nanoparticles to obtain nanostructured composites in order to provide innovative solutions for water treatment, thanks to the phenomena of adsorption and photodegradation of organic pollutants.

Why did you choose to take part in the BEWARE programme ?

**JPB** - I applied for the BEWARE grant when I was living in Argentina. This interdisciplinary and cross-sectoral research project will give me a unique and essential set of skills, knowledge and behaviours so that I can become an excellent thermoplastic polymer science engineer. The use of industrial and laboratory equipment to process plastics, as well as test instruments to analyse them, is particularly formative.

### THE RE(X)CYCLING PROJECT

Aims to increase the recyclability rate of the polymers known as polyolefins. These thermoplastic polymers are plastics that are found in bags, agricultural films, milk carton linings and electrical cables. The project aims to understand how to recycle them better, and globally to find ways to reduce the use of plastics produced from petroleum in order to combat the pollution they cause. Jonas Perez Bravo analyses how virgin polyolefins (new plastics) degrade during mechanical recycling processes (grinding, washing, separation, drying, regrinding, compounding, reprocessing). The researcher is developing a comprehensive model of how the parameters inherent in virgin polyolefins affect their recyclability, such as the speed of processing or temperature.

This interdisciplinary and intersectoral project is being carried out by two partners: the University of Mons and TotalEnergies. The TotalEnergies Group supplies different types and grades of polyolefins on which the degradation tests are performed. TotalEnergies also facilitates access to industrial operational resources. The Group hopes that this innovation programme will eventually improve its plastic waste recycling and recovery processes.





# LLERETNY RODRIGUEZ

COUNTRY OF ORIGIN	CHILE
COUNTRY AT TIME OF SUBMISSION	CHILE
DURATION	32 MONTHS
PROMOTORS	ULIÈGE (PROF. ALAIN VANDERPLAASCHEN)   WWW.DMIPFMV.ULG.AC.BE/VETIMMUNO
	BIO-SOURCING (BERTRAND MEROT)   WWW.BIO-SOURCING.COM



## IMPROVING GOAT HEALTH FOR BETTER THERAPEUTIC PROTEINS IN THEIR MILK

Born in Cuba but with Chilean nationality, Lleretny Rodriguez holds a Master's degree in biology from the University of Havana. "After graduation and until 2004, I worked as a researcher in the transgenesis and animal cloning group at the Center for Genetic Engineering and Biotechnology of Havana, she explains. In 2005, I moved to Chile, where I joined the reproduction laboratory of the Department of Livestock Sciences of the Faculty of Veterinary Sciences of the University of Concepción."

There, Dr Rodriguez was involved in a range of research related to animal biotechnology, specifically reproductive biology in farm animals, studies on gene expression in embryos produced in vivo and in vitro, general embryology and genetic transformation methods of farm animals. "My main specialisations are embryo micromanipulation and cell and molecular biology, she continues. I have also become familiar with basic molecular biology techniques for using recombinant DNA technologies such as microarrays and gene cloning."

The researcher, currently at the University of Liège, produced the first (and only to date) cloned animal in Chile and the first in vitro fertilised cats in 2008. She has also collaborated on a line of research focused on the use of mesenchymal stem cells as a regenerative treatment for various pathologies in animals as well as studying the role of inflammation in endometriosis and mastitis.

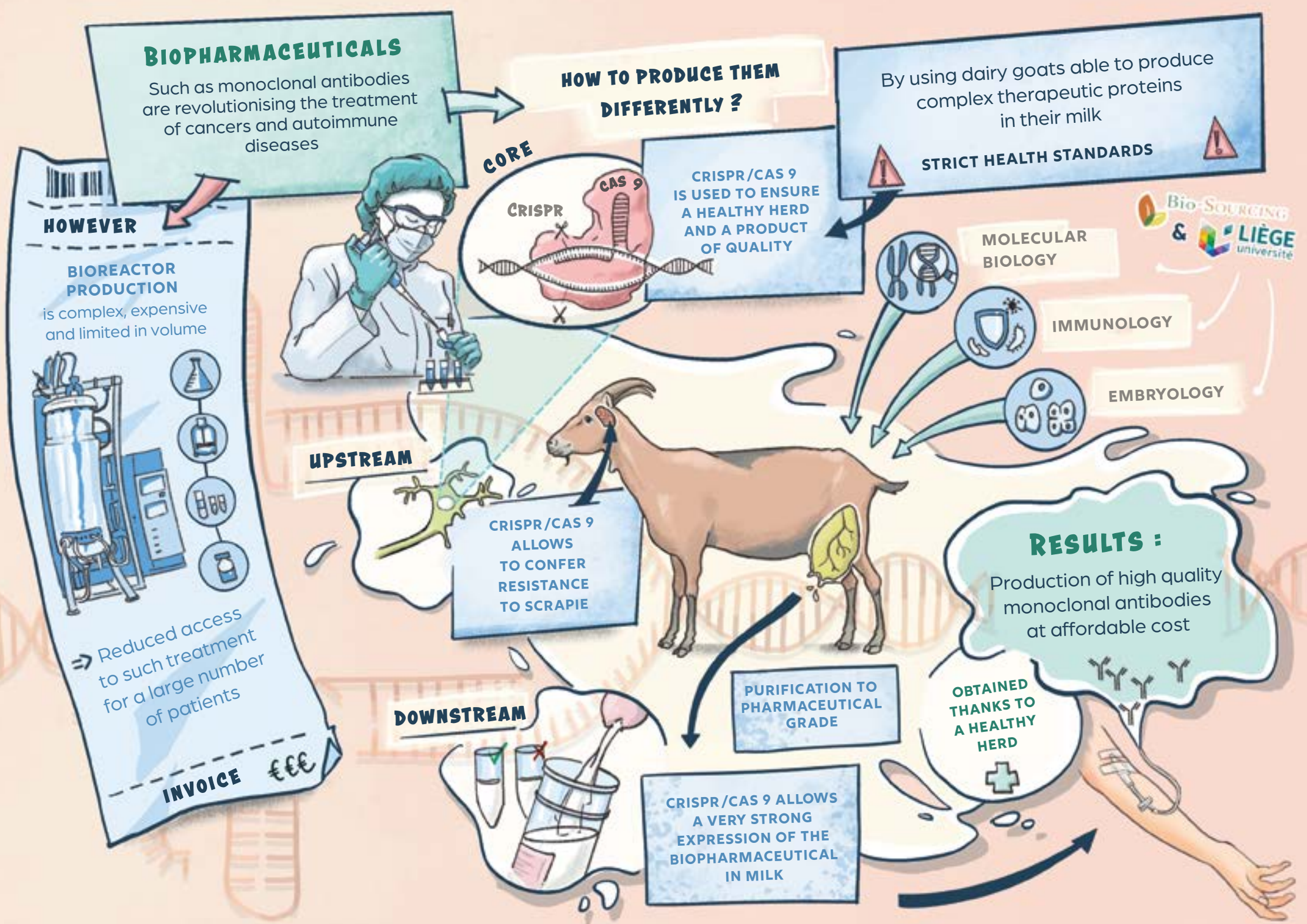
At the end of 2021, Dr Rodriguez decided to leave Chile. "I learned of the BEWARE programme through the company BioSourcing, with which I was in regular contact." A joint project was therefore set up with the Faculty of Veterinary Medicine. "This was a wonderful opportunity for me, especially since my husband was able to accompany me and find a job in Belgium as well. We moved to the Liège region with our two daughters. My theoretical training will be supplemented by an approach to molecular and biological techniques for the production of genetically modified cell lines," she added.

### THE GOATS SAFE PROJECT

Biopharmaceuticals, such as monoclonal antibodies, are revolutionising the treatment of many diseases. This is the case for certain types of cancer and autoimmune diseases.

The vast majority of these drugs are produced by culturing mammal cells in bioreactors, which often results in high production costs that considerably limit access to this class of drugs. Specialised dairy species, such as goats, can produce complex therapeutic proteins in their milk and offer a viable alternative for large-scale biopharmaceutical production. Three products are already registered by European and American regulatory agencies. To this end, strict sanitary controls must be in place to ensure that no pathogens affect either the health of the producing animal or the quality of the end product. The objective of this project is to use the latest genome editing techniques to improve the health status of goats using two connected strategies.

The first approach is to use a gene editor to confer natural resistance to scrapie, a neurodegenerative prion disease in our goats, and the second is to trace early inflammation resulting from infections in biological samples such as milk.







Debris represent not only an environmental problem, but also an issue for the safety of active satellites.



The main goal of the research is to find new approaches to evaluate the risk of collisions within the population of objects in orbit and how to mitigate this risk.

Space around the Earth is crowded with artificial satellites and (for the most part) debris.

THE MAIN TOPICS OF RESEARCH :

1 Space resident population

2 Network representation

3 Description and analysis of uncertainties

4 Machine Learning and data-based dynamics

5 Formulation of ecological risk score



MATTEO ROMANO

COUNTRY OF ORIGIN	ITALY
COUNTRY AT TIME OF SUBMISSION	ITALY
DURATION	24 MONTHS
PROMOTORS	
	UNIVERSITÉ DE NAMUR (PRE ANNE LEMAITRE)   WWW.UNAMUR.BE
	AEROSPACELAB (BENOÎT DEPER)   WWW.AEROSPACELAB.BE

HEAD IN THE STARS

You know about European funding...

MR - After a Master's degree in space science at Politecnico di Milano, I began a PhD, also in Milan, thanks to a grant from the European Research Council (ERC), in collaboration with the European Space Agency as part of a Networking and Partnering Initiative which, as its name indicates, aimed to strengthen collaborations between the Agency and European universities. During my thesis, I had the opportunity to supervise students for a few months and, above all, to spend a year in Germany, in Darmstadt, at the European Space Operations Centre (ESOC) of the ESA.

My experience in the space field has grown over time. Over the years, I have specialised in orbit propagation and uncertainty modelling for space objects. I had many opportunities to interact in a stimulating international environment that included space engineers, planetary scientists, physicists and applied mathematicians.

Then came the BEWARE programme !

MR - Yes, my Italian promotor knows the promotors from the University of Namur which is hosting me and that is how

the collaboration began. It was difficult because Covid-19 delayed the start of the project by about a year. Nevertheless, it is now on the right track as the academic and industrial research lines proposed in this project are strongly linked and focused on a "real world" result, namely the design of a new space data viewer and analyser based on network theory. We can therefore say that the first practical results are beginning to emerge.

In fact, recently, in July 2022, you participated in COSPAR 2022. Can you tell us why you are in Athens ?

MR - COSPAR (Committee on Space Research) is a council that promotes space research at international level and advises intergovernmental organisations, where appropriate, on space research and on the development of scientific and technical standards for space research, including planetary protection and space situational awareness. This year's (in 2022) COSPAR Assembly was the ideal platform to present WALSAT and its objectives, especially as representatives of space agencies and other decision-making bodies were present.

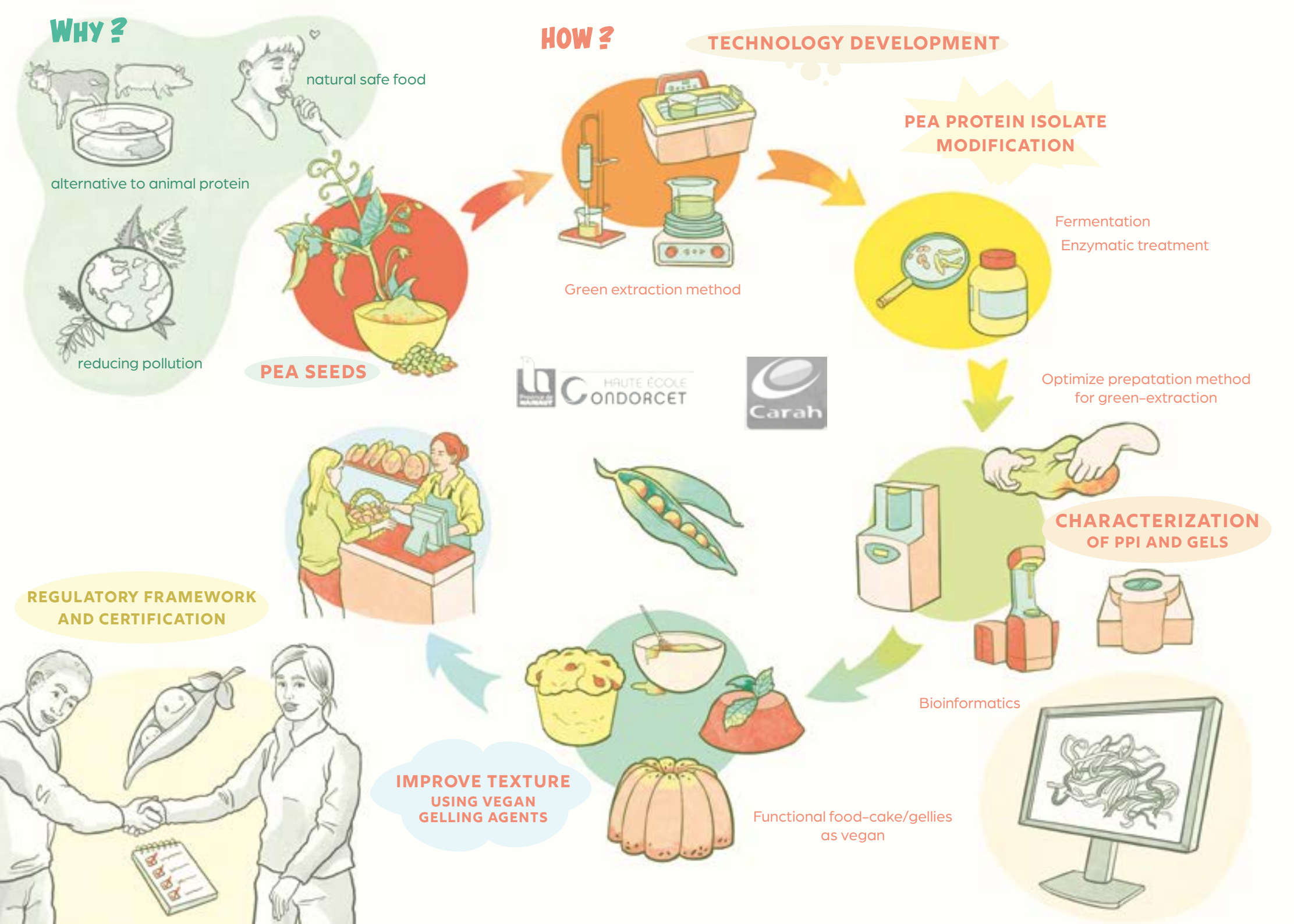
THE WALSAT PROJECT

The WALSAT (WALlonia Space Awareness Technology) project aims to develop innovative approaches, techniques and algorithms in the field of traffic management and space situational awareness, with the ultimate goal of better describing the complexity of this environment. Software to better understand, manage and advance spatial traffic protocols will be prototyped by combining tools from dynamical systems theory, network science and machine learning.

The disruptive thinking and approach are based on representing the population of catalogued space objects as a network, from which the overall understanding of the risk of orbital collision can be derived. The partnership between the University of Namur and Aerospacelab makes it possible to establish a centre of expertise in Wallonia on the space decision-making processes on a perennial scientific basis. This project is in line with space environmentalism and the urgent need to make this ecosystem a long-term sustainable resource.







## MINAXI SHARMA

COUNTRY OF ORIGIN	INDIA
COUNTRY AT TIME OF SUBMISSION	ESTONIA
DURATION	36 MONTHS
PROMOTORS ▾	
HAUTE ÉCOLE CONDORCET ET CARAH (DRE DÉBORAH LANTERBECQ)   WWW.CONDORCET.BE	
PURATOS (NICOLAS GUILLEMIN)   WWW.PURATOS.COM	



MORE



## PEA PROTEINS IN YOUR CAKES

How did you choose to stay in the Province of Hainaut?

**MS** - After a master's degree in food science and technology at Chaudhary Devi Lal University, located in Sirsa, 250kms from Delhi, I started my doctoral degree in 2015 in Dairy chemistry at ICAR-National Dairy Research Institute in Karnal, India. Later I worked at Ludhiana (India) for 2 years (2015 to 2017). Subsequently, I was lucky enough to work as Assistant Professor, for two years (2017 to 2019), at Eternal University, in Baru Sahib, in northern India.

I was very interested to get an experience abroad, especially in the field of research, and I was hired by Estonian University of Life Sciences, Estonia, as a Senior Research Fellow for 2 years and 3 months (2019-2021). Here, I worked in the area of agri-food waste valorization for their natural pigments potential and food application using nanoencapsulation delivery systems. At the beginning of 2021, I discovered the BEWARE program, submitted a project and then landed in Wallonia!

What were your main tasks at the University of Tartu?

**MS** - My research in Estonia, with teaching responsibilities, led me to explore the green extraction strategies for agri-food waste valorization to produce plant-based natural

pigments and to develop the functional foods by incorporating plant-based ingredients. This work pushed me to replace "petro-derived" or "animal derived" colorants from food chain with natural pigments, and to promote the use of plant-based nutrients in food formulations in order to empower the nutritional security and food sustainability.

How does the current project fit into this research?

**MS** - PEAPROTGEL is really an innovative project which consists in designing a gelling agent of plant origin. In pastries, this type of product is very frequently used, often of animal origin. Yet we are moving towards a greener economy with strong consumer demand for vegan products. To make this product, we will extract proteins from peas, whose use is quite widespread and whose value is exceptional.

My previous experience which has, in particular, focused on the characterization of plant-based value-added nutrients, modification of proteins to enhance functionality, application of plant-based bioactive compounds in food product development, new food product development and characterization, will be of great use to develop vegan-based gelling agents to replace the animal-origin gelling additives.

### THE PEAPROTGEL PROJECT

Sensitized by a balanced diet and by animal well-being, consumers induce a demand for plant-based products which continues to increase.

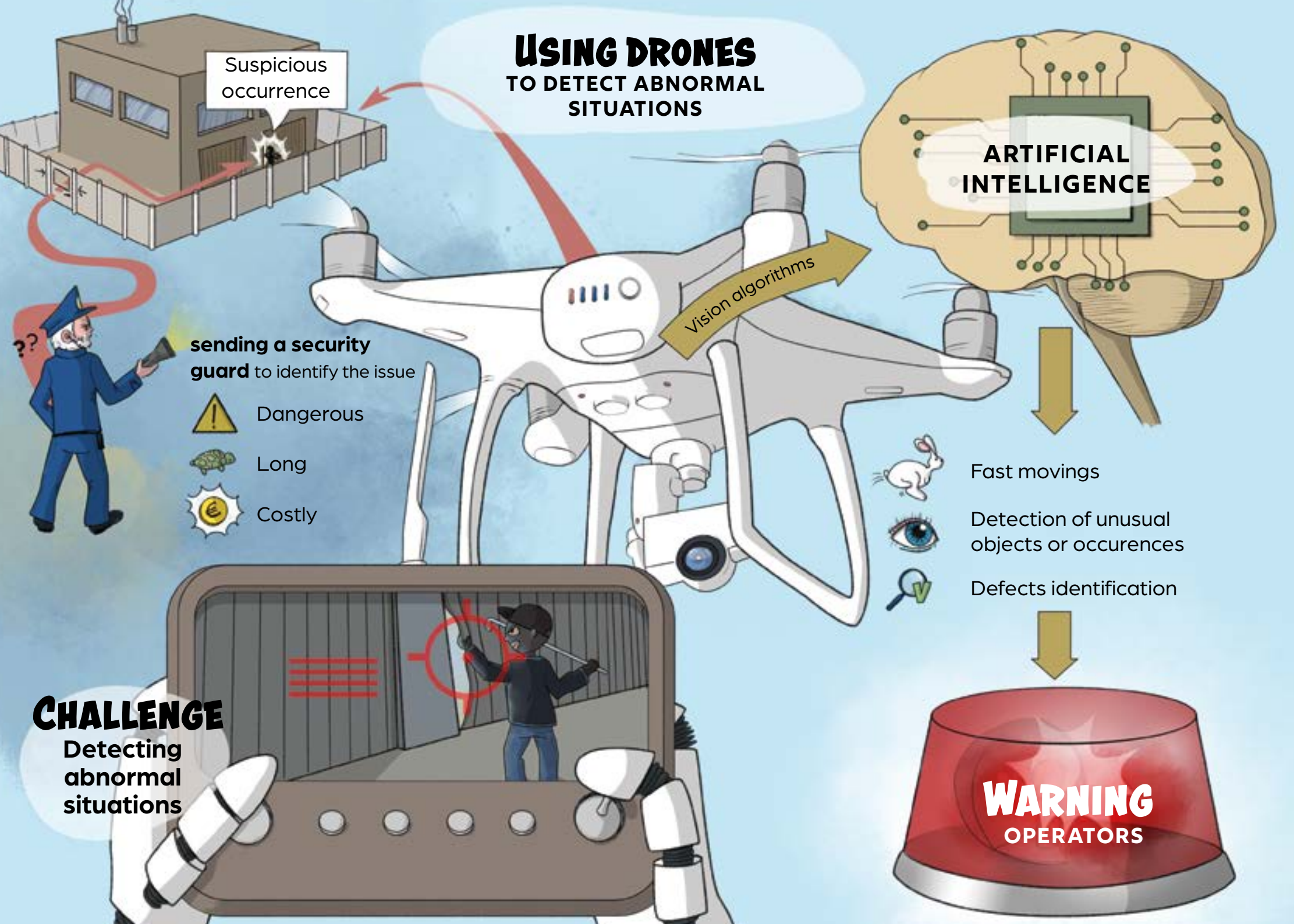
There is therefore a need for plant-based alternatives to replace animal products in the food supply chain. Vegetable proteins are an important part of a healthy diet in today's world due to their major protein content.

In addition, these proteins would be more economical and above all respond to the pressure of a majority of consumers.

Pea protein, in particular, has enormous potential as a food additive.

Thus, the PEAPROTGEL project proposes a first approach in the extensive use of pea proteins as gelling agents in food applications. This research project is beneficial to global food industries as it represents an alternative to gelling agents of animal origin and increases the visibility of the use of vegetable proteins in Europe which further promotes green consumerism.





## MOHAMED TAZIR

COUNTRY OF ORIGIN	FRANCE
COUNTRY AT TIME OF SUBMISSION	FRANCE
DURATION	24 MONTHS
PROMOTORS ▼	
	UNIVERSITÉ DE MONS (PROF. THIERRY DUTOIT)   WEB.UMONS.AC.BE
	SKY-HERO (DR ALEXIS FRANCK)   SKY-HERO.COM

### DRONES TO CHECK ABNORMAL SITUATIONS

Mohamed Lamine Tazir is an automation engineer. He studied engineering at the École nationale polytechnique in Algiers, Algeria, between 2007 and 2012. The student specialised in automation and robotics and completed his engineering studies with an internship at the Centre de développement des technologies avancées (CDTA) in Baba Hassen, south-west of the Algerian capital. He worked on planning the trajectory of a mobile robot in a complex environment, using genetic algorithms, i.e. artificial intelligence inspired by the crossing of chromosomes. Mohamed Lamine Tazir then flew to France, and more specifically to the Pierre-et-Marie-Curie University (Paris VI). "It was the logical consequence of my schooling to come to France, as robotics engineering posts are rare in Algeria", says the researcher. In Paris, he completed a one-year master's degree in intelligent systems and robotics, an essential step before embarking on a doctorate.

Between 2014 and 2018, Mohamed Lamine Tazir worked on a thesis dedicated to locating autonomous cars. "My aim was to use Lidar, i.e. a 3D laser system, to determine the position of an autonomous car with an accuracy of the order of a centimeter, whereas GPS technology can only do this to the order of a meter", explains the roboticist. We have managed to achieve this centimeter-level accuracy, which has led to the publication of several articles in peer-reviewed journals". After his doctorate, the researcher turned his attention to various R&D projects. He first worked for six months on a European project for Airbus. He developed trajectory planning techniques for a robot that looks for faults on an aircraft by turning around it autonomously, avoiding static and dynamic obstacles. Then, from 2019 to 2021, the engineer began to take an interest in drones in his work for the Microdrones group company *mdlInfinity*. He is designing drone localization algorithms for locations with poor or no GPS signal, such as covered industrial sites, mines or dam mouths. "A former colleague at the Ecole Polytechnique then told me about the activities of the Information, Signal and Artificial Intelligence Laboratory at the University of Mons, explains Mohamed Lamine Tazir. It was perfectly in line with my work on drones, which is why I applied for the BEWARE programme. I've been taking part in the VIEWSKYMODEL project since October 2021."

#### THE VIEWSKYMODEL PROJECT

The VIEWSKYMODEL project aims to enable drones to detect abnormal situations in the context of surveillance of unpopulated areas, such as industrial sites or warehouses. Mohamed Lamine Tazir is developing the artificial intelligence algorithms needed to achieve this. These algorithms, based on deep learning and artificial neural networks, must be capable of detecting and identifying abnormal or dangerous objects and events to improve safety on construction sites: weapons, people running or forcing open a door, etc. Initially, Mohamed Lamine Tazir is focusing on the detection of people and objects in an indoor environment, including people with masks on their faces, carrying rucksacks, holding pallets, chairs, boxes, etc. He plans to make the detection process progressively more complex. The researcher plans to make the events to be detected progressively more complex. *Sky-Hero*, a Belgian drone manufacturer, is taking part in VIEWSKYMODEL. It is currently developing the third version of its drone (*Loki III*) and hopes to benefit from the project's software advances. It is also testing sensors, manufacturing supports for these sensors and contributing its expertise on the mechanical aspects. *Sky-Hero* is also participating in another project with Mohamed Lamine Tazir as part of Win2WAL (a Walloon research programme), with the aim of developing algorithms for autonomous drone navigation.







# CHRISTIANE THEN

COUNTRY OF ORIGIN	GERMANY
COUNTRY AT TIME OF SUBMISSION	GERMANY
DURATION	24 MONTHS
PROMOTORS	
UNIVERSITÉ DE LIÈGE (PR FRÉDÉRIC FRANCIS)   WWW.GEMBLOUX.ULG.AC.BE/ENTOMOLOGIE-FONCTIONNELLE-ET-EVOLUTIVE	
STRUBE (BRUNO DEWULF)   WWW.STRUBE.NET	

## NATURAL INSECTICIDES FOR BEETS !

Dr Then is certainly European and cosmopolitan! After a Master's degree in biology at the University of Göttingen in central Germany, which included a long internship in Venezuela, she began her research career in Hamburg at the Bundesforschungsanstalt für Forst- und Holzwirtschaft (German Federal Centre for Forestry and Forest Industries) with research on the ecophysiology of seedlings and saplings in the context of sustainable management systems for tropical forests in Africa.

She continued to study trees in the canopy, this time in moderate latitudes, in Austria and Bavaria, and studied the effect of ozone and drought on trees and their biochemical defences.

Inspired by the biochemical "inner life" of plant leaves, in 2010, she headed for Barcelona, thanks to an Intra-European Fellowship grant, as part of the Marie Curie Actions. This arrangement no longer exists, but it allowed an experienced researcher to leave their country for another country in Europe to conduct research. "It was also at this time that my career took a turn towards genetics and molecular biology, she recalls. While there, one of my work objectives was to quantify the expression of relevant marker genes in order to understand shade signalling pathways and networks on the plant."

After Spain, Dr Then spent five years in Montpellier, at the National Institute for Agronomic Research (INRAe). "While there, I worked on the transmission of phytoviruses by aphid vectors,

*vector-virus-plant interactions and plant defence mechanisms. My main project was the functional analysis of a P2 protein in the transmission of the Cauliflower mosaic virus (CaMV), which affects cauliflower plants by causing a kind of mottling on the leaves."*

In another somewhat similar project, she tested whether viral infection with persistent viruses altered aphid-induced calcium signalling and whether this had an impact on transmission. "To do this, I used real-time fluorescence microscopy."

In mid-2018, she returned to Germany, to the Julius Kühn Institute in Lower Saxony, to work on new viral diseases (nanoviruses) in the pea and faba bean "to obtain more information about virus spread under natural conditions and evaluate resistance mechanisms in faba beans, infection patterns were studied in experimental field plots," she explains.

Today, Dr Then is in Gembloux working on a selection of beets to resist certain yellowing diseases induced by several virus species "Several international collaborations are planned during my two years here, including with the virology laboratory of the National Research Institute for Agriculture, Food and the Environment in Colmar (INRAe), the Technical Institute for Beet (ITB) in Paris, and the Royal Belgian Institute for Beet Improvement (IRBAB), in Tienen." concludes the researcher.

### THE APHIDVIRBEET PROJECT

Is at the heart of varietal selection and the understanding of plant-aphid-virus interactions for identifying the mechanisms involved. Based on a broad screening of varieties, two viruses will be targeted as models: BMVY for *Luteovirus* and BYV for *Closterovirus*. Two aphid species, *Myzus persicae* and *Aphis fabae*, will be used as vectors for these viruses. Viral transmission rates will be calculated for the different combinations using ELISA (Enzyme-Linked Immuno Sorbent Assay) tests. Two resistant varieties will be selected for the study of varietal effects on host acceptance by aphids and feeding and the fecundity behaviour, reproduction and propagation of virus-infected aphids depending on the plant variety. Lastly, qualitative and quantitative diagnostic tools to detect viruses in aphid vectors will be developed to better assess the dynamics of virus transmission and understand aphid-virus-plant interactions.

### PURPOSE OF THE PROJECT :

1 Finding a variety of **BEETROOT** that is **RESISTANT** to **JAUNDICE** (viral disease) and **APHID VECTORS**

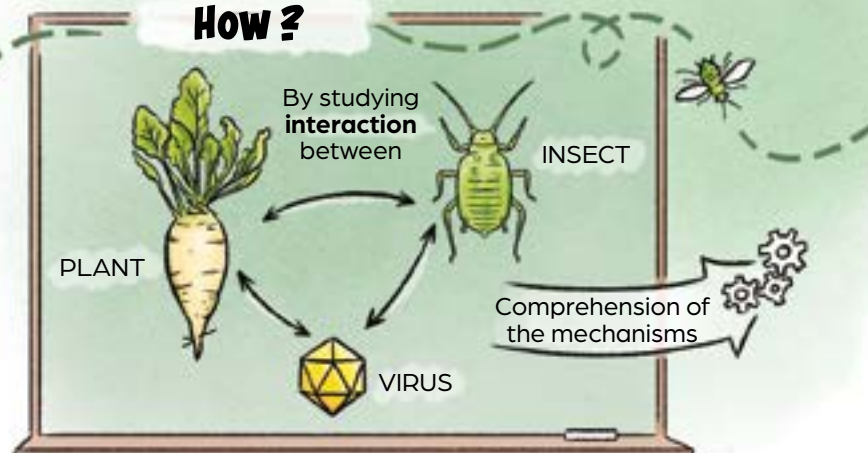


2 **CREATING A DIAGNOSTIC TOOL** to identify :  
 • the viral load  
 • the type of virus (4 possibilities)

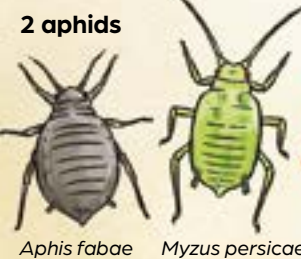
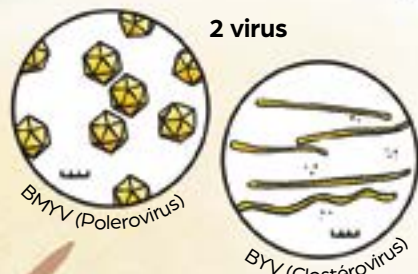
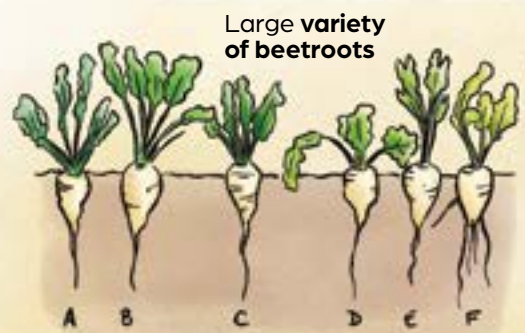
### WHY ?



### HOW ?

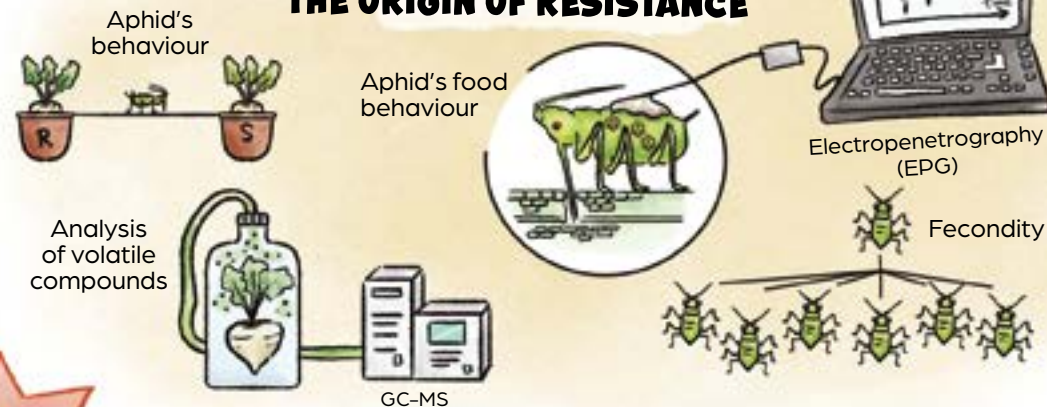


### PHASE 1 : SCREENING

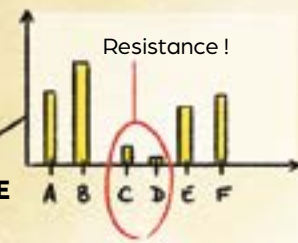
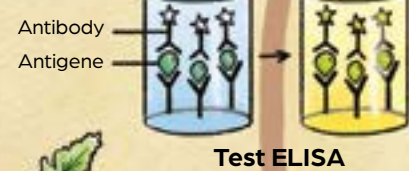
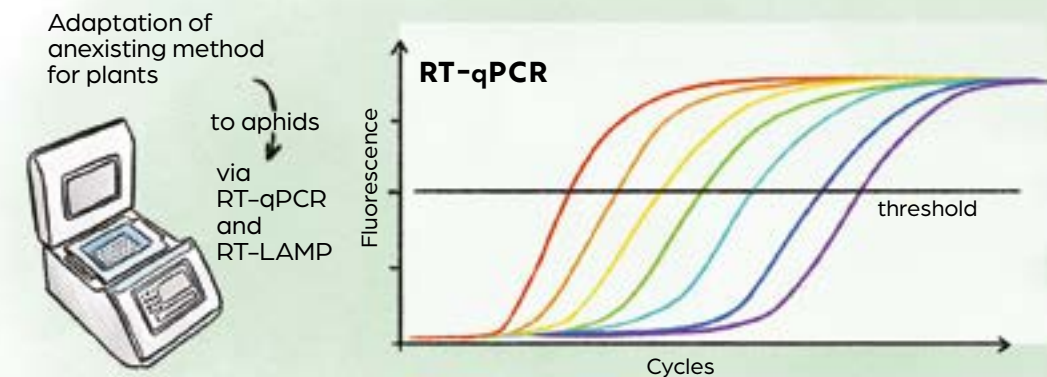


CHALLENGE = viral coinfection

### PHASE 2 : UNDERSTANDING THE ORIGIN OF RESISTANCE



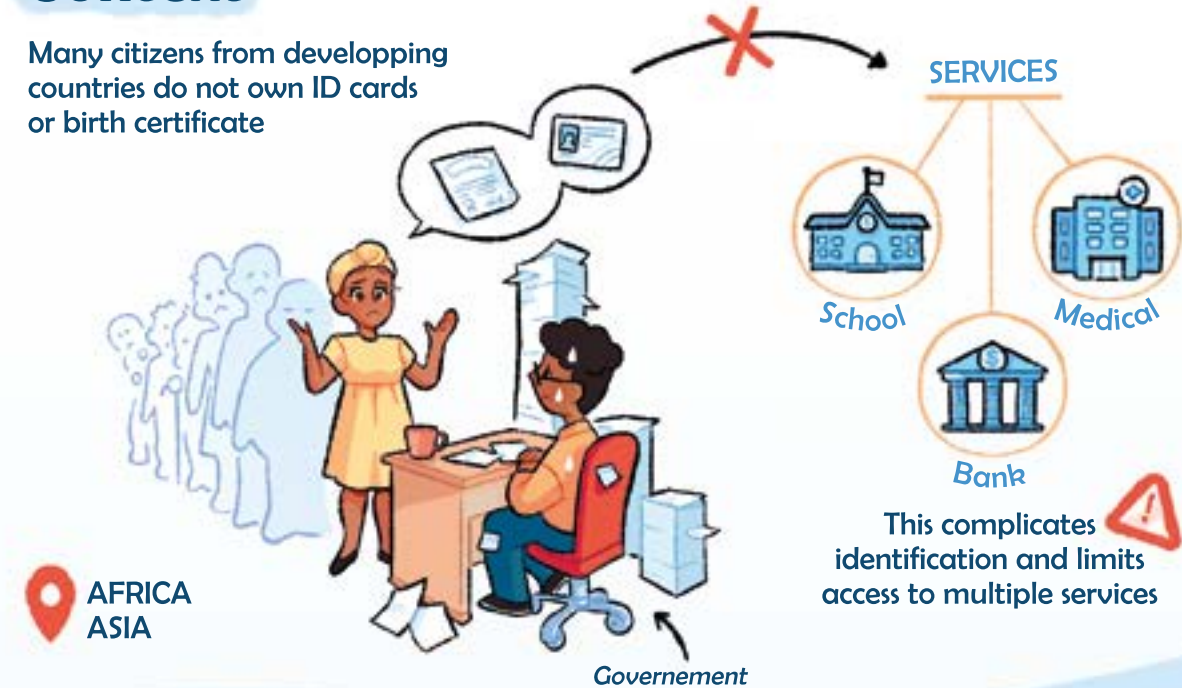
### PHASE 3 : DETECTING THE VIRUS IN APHIDS





## Context

Many citizens from developing countries do not own ID cards or birth certificate

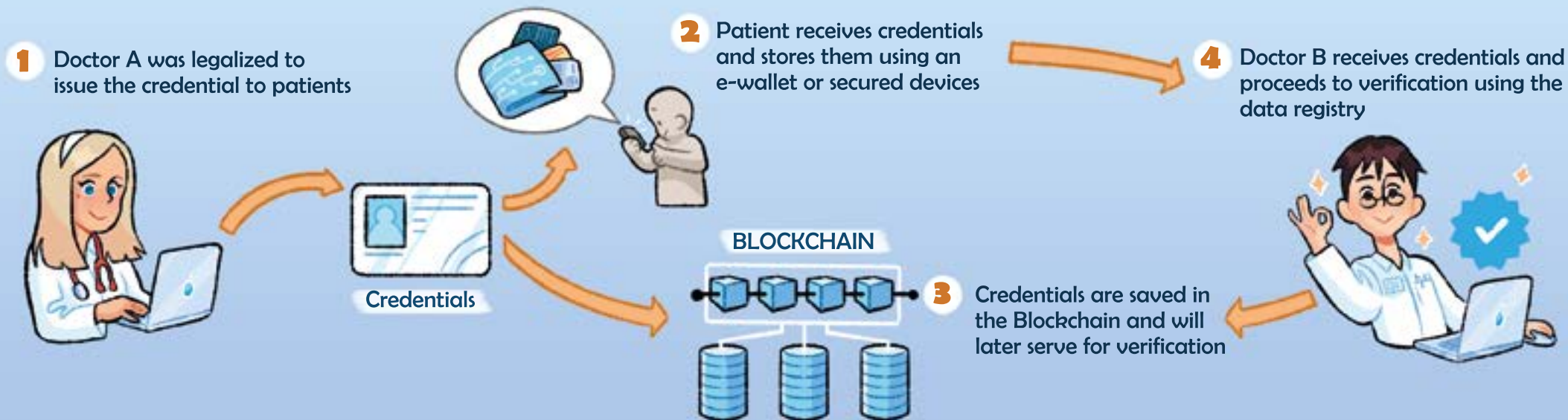


## Project

Build an information system based on Blockchain Technology to decentralize citizen identification in developing countries



## Example of application in the medical field



## DARA TITH

COUNTRY OF ORIGIN	CAMBODIA
COUNTRY AT TIME OF SUBMISSION	CAMBODIA
DURATION	36 MONTHS
PROMOTORS ▼	
	UNIVERSITÉ DE NAMUR (DR JEAN-NOËL COLIN)   WWW.UNAMUR.BE
	SAVICS (XAVIER MORELLE)   SAVICS.ORG

## VERIFIABLE REFERENCES FOR CONFIDENCE ACCESS

Dara Tith completed a Master's degree in data mining and its applications in the field of data security at the Institute of Technology Cambodia (ITC) in Phnom Penh from 2014 to 2015. During this period, he also had a full-time internship at the University of Namur in Belgium, where he programmed various data mining models related to data privacy, including the Markov Decision Process, the Association Rule Learning, and Naïve Bayes. The objective of this project was to analyze the behavior of accessing to data by physicians in healthcare settings. After completing his Master's degree, Dara Tith went to Japan in 2017 to pursue a Ph.D. in information and communication engineering at the Tokyo University of Technology. He specialized in developing a blockchain model for securing and preserving patient data in hospitals from 2017 to 2020.

In 2020, Dara Tith returned to his home country to fill a lecturer position at ITC. He created blockchain models specifically dedicated to securing the blood donation system in Cambodia. In parallel, he taught information security and software development at the Cambodia Academy of Digital Technology. At the end of 2021, he started working for the Cambodian government to improve the digitalization of financial processes. To do this, the researcher closely studied the policies used in Europe and Singapore. At the same time, Dara Tith applied to the BEWARE program's VECTRA project and was selected, "I wanted to increase my knowledge of blockchain-related application development and I felt that this program would be a great opportunity to meet new people and improve my project management skills through collaboration with several organizations. I also wanted something new, and I am looking forward to the challenge of the VECTRA project. I am convinced that this work will bring many positive developments to the digital identification system throughout the world."

### THE VECTRA PROJECT

Aims to create an information system that enables digital authentication of an individual's identity without the need for physical documents such as passports or ID cards. The use of a decentralized system based on blockchain technology would facilitate identification, especially in developing countries where identity documents are not widely available. Individuals could easily and securely prove their identity using an electronic device such as a smartphone or tablet or secured storage such as smart card. Trusted individuals such as doctors or lawyers could provide user identification information without the need for a centralized organization. In countries where ID cards are prevalent, the decentralized blockchain-based system would be advantageous since its data is immutable, and accessible even if the physical document is lost. Savics operates two medical data-related systems, DataToCare and MediScout, which collect data on diagnoses and patients at the health facility level and identify patients who are yet to be followed up. Savics plans to integrate the solution developed by Dara Tith into these systems to identify patients and distribute medical data.

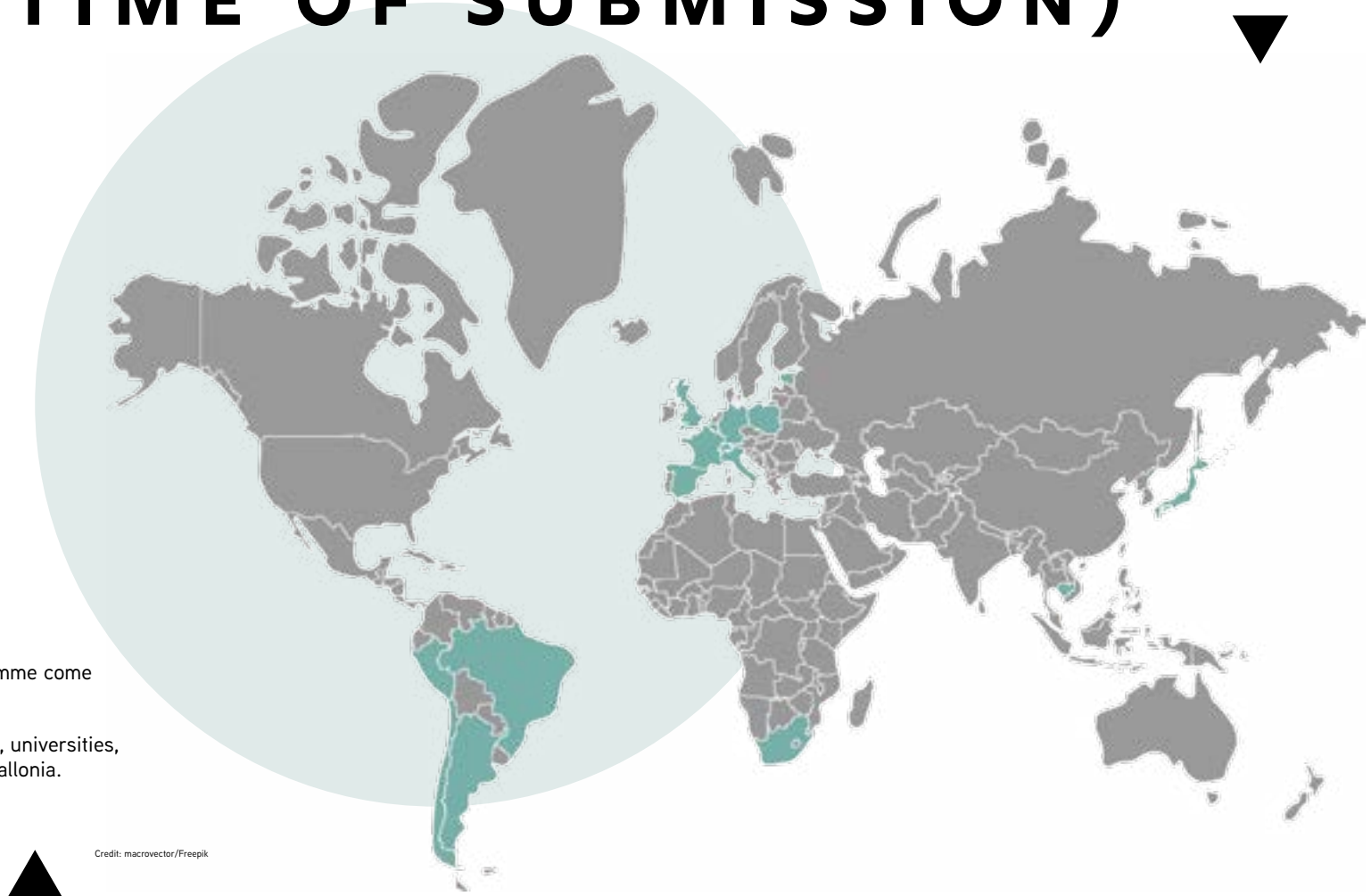




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▶ DA SILVA MORAIS Mauricio	pp. 10-11
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▶ TITH Dara	pp. 38-39

# GEOGRAPHICAL VIEW (AT THE TIME OF SUBMISSION) ▼



Researchers engaged by the BEWARE programme come from all continents.

They contribute to the influence of companies, universities, university colleges and research centers of Wallonia.

Credit: macrovector/Freepik



# GEOGRAPHICAL VIEW (NATIONALITIES OF RESEARCHERS) ▼



Credit: macrovector/Freepik

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The BEWARE programme is an initiative of Wallonia and benefits from a cofunding of the European Commission.

The objective of this programme is to attract high-level researchers within of our universities, university colleges, research centres and companies.

To do this, a large budget has been mobilized because the ambition of Wallonia is to recruit between sixty and seventy researchers from all over the world with their expertise for the benefit of Walloon R&D players.

Their research topics are varied, as will be read in this brochure: health, biotechnologies, space, environment... selected after a rigorous selection by a panel of foreign experts.

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