

22  
|  
23



**POLYTECH**<sup>®</sup>  
**ORLÉANS**

Ecole d'ingénieurs de l'université d'Orléans



# STUDENT PROJECTS CATALOGUE

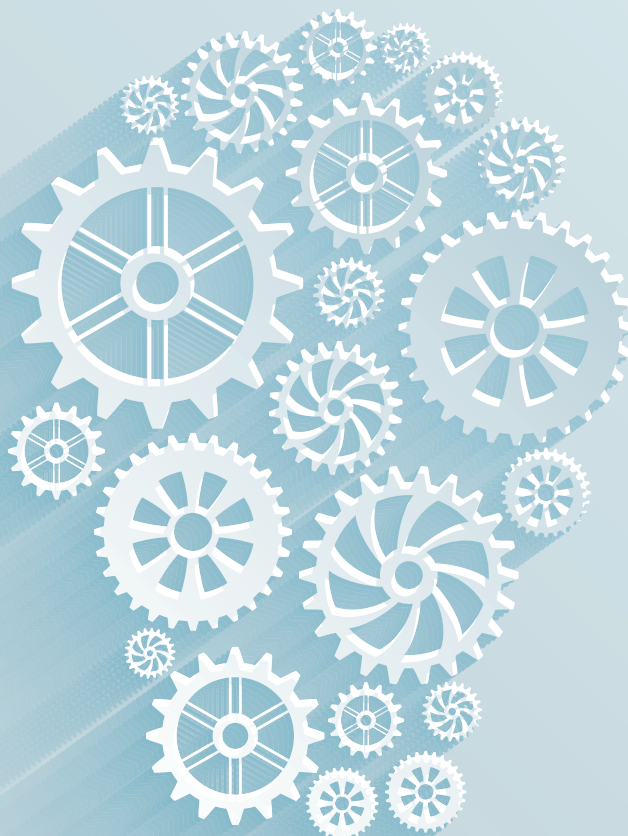


# Student Projects Catalogue

Polytech Orléans

**2022**

**2023**



# POLYTECH ORLÉANS

Ecole Polytechnique de l'université d'Orléans

Direction management des formations, prospective et innovation pédagogique

☎ 02 38 49 24 20

✉ [direction.formations.polytech@univ-orleans.fr](mailto:direction.formations.polytech@univ-orleans.fr)

## SITE LÉONARD DE VINCI

8 rue Léonard de Vinci  
45072 ORLEANS cedex 02

---

## SITE GALILÉE

12 rue de Blois, BP 6744  
45067 ORLEANS cedex 02

---

## SITE DE CHARTRES

21 rue de Loigny-la-Bataille  
28000 CHARTRES



# Contents

<b>Message from the director</b> .....	<b>9</b>	programming and piloting missions .....	<b>29</b>
 <b>Civil engineering</b> .....	<b>10 48</b>	Block release training as an assistant works manager, Colas Chartres .....	<b>30</b>
Analysis of the concrete structures condition from photos using AI .....	<b>12</b>	Techniques for Capturing the existing .....	<b>31</b>
incorporating old foundation piles into a network of rigid inclusion system .....	<b>13</b>	Response to the COLAS consultation for the Quai de Jemmapes .....	<b>32</b>
Preliminary design of a roundabout in BRIARE (45) .....	<b>14</b>	Creation, diversion and renewal of networks .....	<b>33</b>
Design of a covered trench for the improvement of the Marseille-Provence airport .....	<b>15</b>	Creation of an urban logistics space in Paris .....	<b>34</b>
Setting in situation of design office in tracing : case study on the Larcher springs .....	<b>16</b>	Coordination and piloting during the construction of a 120-appartements building .....	<b>35</b>
Upgrading of recycled aggregate washing fines in the manufacture of new concrete .....	<b>17</b>	Fighting musculoskeletal disorders .....	<b>36</b>
Development of a method for quantifying total phosphorus content in peatlands. Application in a hydro-ecological restoration context .....	<b>18</b>	Management of the new "La Banque Postale" site in Olivet .....	<b>37</b>
Rehabilitation of the Place du Vexin in Meulan-en-Yvelines .....	<b>19</b>	Planification and Supervision of a Rail Replacement Week .....	<b>38</b>
Formulation and characterization of a rapeseed-lime mixture .....	<b>20</b>	Monitoring and maintenance of grain storage structures .....	<b>39</b>
Feasibility study for a composting center .....	<b>21</b>	Realization of operating procedures in ecological engineering .....	<b>40</b>
Characterization and quantification of the uncertainty of the mechanical behaviour of fresh concrete for 3D printing .....	<b>22</b>	Assistant for the site supervisor for the construction of an administration building with the association of metal and wood .....	<b>41</b>
Study of the launching of a superstructure in coffer .....	<b>23</b>	Civil works engineer on a work-study program on a construction site .....	<b>42</b>
Energy rehabilitation study of an industrial building built in 1991 .....	<b>24</b>	Carrying out energy rehabilitation operations in an occupied site: choice of building priorities for the establishment of a detailed work plan .....	<b>43</b>
Impact of the dryness on the building's foundations .....	<b>25</b>	Rehabilitation of a self-storage building near Toulouse .....	<b>44</b>
Formulation of cement with low carbon content by the use of concentrated suspensions .....	<b>26</b>	Construction of customer connections, occasional earthworks and on-call work .....	<b>45</b>
Work-study assistant price study .....	<b>27</b>	Realization of technical embankments on the site of the former Saint Louis hospital in Evreux .....	<b>46</b>
Program manager in new real estates .....	<b>28</b>	Junior civil structural engineer .....	<b>47</b>
Immersion in construction projects,		3D printing of cementitious materials based on recycled sands .....	<b>48</b>

## **Engineering physics and embedded systems** \_\_\_\_\_ **49|62**

Innovative medical lighting module .....	<b>50</b>
Developing an API between a router and a circuit board .....	<b>51</b>
Key Hive : smart key box with limited individual key access .....	<b>52</b>
The three-dimensional realignment of a scanning lidar .....	<b>53</b>
Gonio-reflectometer trailer .....	<b>54</b>
Motion detection on RIOT OS .....	<b>55</b>
Microplasma process for local removal of organic materials .....	<b>56</b>
Laser experimentation implantation in order to proceed to plasma diagnostics .....	<b>57</b>
Camera emulation on an FPGA (bio-medical application) .....	<b>58</b>
Implementation and evaluation of an AI model on different FPGA Boards .....	<b>59</b>
Design and implementation of a mesh BLE 5.1 network for temperature with PT100 .....	<b>60</b>
SensoVerse a more inclusive communication system for deaf people in metaverse .....	<b>61</b>
Development of immersive sensors to monitor the mechanical performance of underground mining backfills .....	<b>62</b>

## **Industrial engineering applied to cosmetics, pharmacy and food processing** \_\_\_\_\_ **63|91**

Development of specifications for the creation of a liquid packing line for the International Cosmetics House of Cosmetic Valley .....	<b>64</b>
Problem-solving on packaging line .....	<b>65</b>
Losses of mascara juice on manufacturing and packaging department .....	<b>66</b>
Small kaizen project about flexible hoses used in the production area .....	<b>67</b>
Reduction of changeover time between 2 production orders .....	<b>68</b>
Continuous improvement of the Packaging/	

Depackaging of Chromatography columns at the BioProduction site of Huningue at Novartis .....	<b>69</b>
Optimisation of ink cartridge use on production lines .....	<b>70</b>
Introducing the general service department .....	<b>71</b>
Develop, maintain and improve the compliance and performance of the Brive plant's laboratories .....	<b>72</b>
Updating of specifications .....	<b>73</b>
Reduction of the time devoted to repairs in the "parts and components" sector .....	<b>74</b>
Continuous improvement of production workshops by optimizing drug production processes, updating documentation and implementing action plans following audits by health authorities .....	<b>75</b>
Continuous improvement on blister packaging lines .....	<b>76</b>
The operator loads of the packaging lines .....	<b>77</b>
Quality Validation of equipment cleaning and disinfection instructions .....	<b>78</b>
Replacement of production equipment .....	<b>79</b>
The purchase of a washing basket and its associated trolley for the complete automation of a washing system .....	<b>80</b>
Creation of a quality document that describes how to validate all modes of transport from our factory .....	<b>81</b>
Continuity of activities as part of a production line shutdown .....	<b>82</b>
Carrying out a risk analysis, following the SHAP method, for each situation noted in the explosion protection document .....	<b>83</b>
Spare parts obsolescence management .....	<b>84</b>
DUFFAY's preparation in order to get one HSE certification .....	<b>85</b>
Management and stock control .....	<b>86</b>
How to optimize the internal communication strategy ? .....	<b>87</b>
Increased production capacity and optimised storage to continue to meet growing customer demand .....	<b>88</b>

Reorganization of the offal department during a change of machine to improve productivity and working conditions ..... **89**

Yield improvement ..... **90**

Implementation of a tracker to monitor and reduce product losses in production ..... **91**



### **Innovations in design and materials** ..... **93|106**

Automatic trolley for resin application ..... **94**

Solving an uncontrolled acceleration problem during a vibration qualification test ..... **95**

Rebound modeling in an electrical relay ..... **96**

A400M tyre wear prediction tool ..... **97**

Aircraft wheel handling equipment ..... **98**

A400M aircraft antenna protective sock ..... **99**

Finite Element Modeling and Artificial Intelligence ..... **100**

Covering box containing blood bags dropped by drone ..... **101**

Fluid/structure and Gravel/structure interaction on the Abaqus Software, by using SPH and DEM method ..... **102**

Ceramic foam filter study ..... **103**

Design of an inertial mechanism for aircraft seats ..... **104**

Modeling of an infrared emitter's thermoradiative properties ..... **105**

Thermal modeling of an insulating flask ..... **106**

### **Internet of Things** ..... **107|108**

Introducing the internet of things into production lines ..... **108**



### **Production management** ..... **111|122**

Interactive management tool for maintenance activities ..... **112**

Implementation of a test bench for the testing of emission control system components ..... **113**

Industrialization of a new project ..... **114**

Optimization of the working methods of a trimming line ..... **115**

New program production launch in the automotive industry ..... **116**

Compliance for the storage of explosive products ..... **117**

Decrease the production scrap ..... **118**

Paint sealant reduction project ..... **119**

Achieve a very precise cut of the leather ..... **120**

Creation of a digital and autonomous tool to drive the assembly department ..... **121**

Relocation of a storage area ..... **122**



### **Smart building** ..... **123|134**

Electricity supply of a methanation unit, Lugère, Loiret ..... **124**

Renewal of a High Voltage A line (20kV) ..... **125**

Creation of an indicator calculation tool ..... **126**

Deployment of video surveillance equipment on 19 municipalities ..... **127**

Restructuring of school life center and the high school forum ..... **128**

Ecological transition of Vendôme Territories ..... **129**

Organize and supervise BMS projects ..... **130**

A new operating room in an outpatient surgery unit for a Paris hospital ..... **131**

EcoStruxure Automation Expert software validation ..... **132**

Design and implementation executive ..... **133**

Smart city engineer ..... **134**



### **Technologies for energy, aerospace and engine** ..... **135|156**

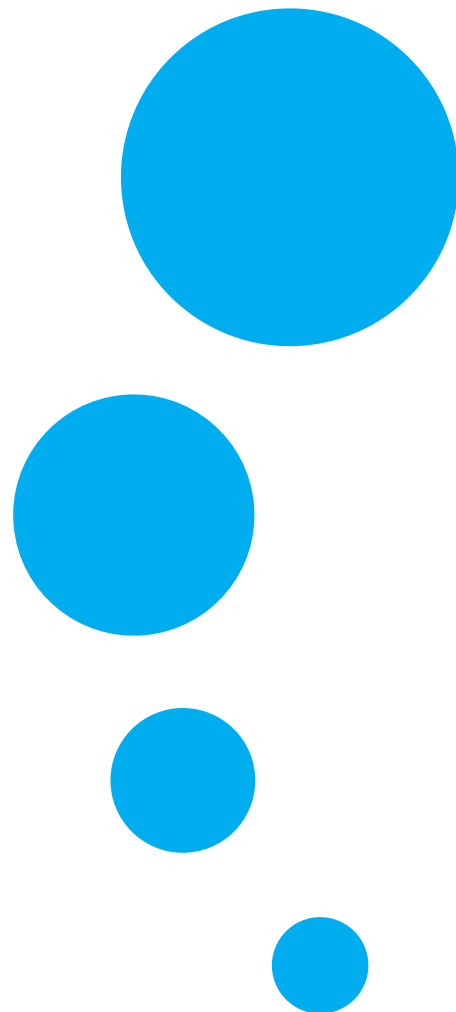
Autoconsumption: optimization by criteria, performance and environmental impacts ..... **136**

Vented bowl optimization ..... **137**

Energy transition of the headquarters of the company AXEREA ..... **138**

PAPEE-3 Thrust Vector Control (TVC) of a small-scale airbreathing vehicle .....	<b>139</b>
Development of a Micro-Factory in battery manufacturing for the retrofit of thermal vehicles .....	<b>140</b>
Retrofit of piston diesel/gasoline engines to run on hydrogen .....	<b>141</b>
Qualification of a black globe temperature measurement device .....	<b>142</b>
Contribution of road texture to vehicle fuel consumption .....	<b>143</b>
Optimization of a portable hydrogen- powered charging station .....	<b>144</b>
Optimization of heat consumption on air compressors .....	<b>145</b>
Project n°16 : Design of a multi-energy station in CVL .....	<b>146</b>
Design of a heavy-duty vehicle retrofit unit : Diesel to Methane .....	<b>147</b>
Study of technologies and solutions for the production and consumption of renewable hydrogen .....	<b>148</b>
Gelled fuel for air-breathing propulsion .....	<b>149</b>
Numerical simulation of a Waverider during an atmospheric reentry .....	<b>150</b>
Study and characterization of a parachute for artillery ammunition .....	<b>151</b>
Optimization of the suction performance of a fluid suction system by numerical simulation .....	<b>152</b>
Characterization of a detachment on a ramp and its control with a sweeping jet .....	<b>153</b>
Optimization of a Dual-Bell Nozzle for Rocket Engines .....	<b>154</b>
Study of combustion's stability in condensing boilers .....	<b>155</b>
Optimization of a cast iron cast .....	<b>156</b>

The final year projects forum .....	<b>159</b>
Our remarkable equipment .....	<b>160</b>
Index of students .....	<b>162</b>
Index of participating companies and institutions .....	<b>165</b>



## For further information

Direction des Relations  
Entreprises, Stages,  
Innovation, Formation  
Continue  
12 rue de Blois, BP 6744  
45067 Orléans cedex 2

☎ +33 2 38 49 48 48

✉ [relations.entreprises.  
polytech@univ-orleans.fr](mailto:relations.entreprises.polytech@univ-orleans.fr)

# Message from the Director

One essential element of the activities of any engineering school is the maintenance of partnerships with businesses and institutions in the local community and beyond. Thanks to its close ties to such organizations, Polytech Orléans can guarantee the employability of its graduates (of which 90% find a first job within three months of receiving their degree), accurately adapt its programmes to respond to the changing needs of the business and scientific community, and acquire the most up-to-date equipment, materials and software.

Our partners also benefit from these exchanges by receiving high-level scientific expertise as they welcome hundreds of our students in internships each year and avail themselves of the educational facilities and equipment we can provide.

To prepare for their entry into the professional world, fifth-year students at Polytech Orléans are required to prepare and complete a project according to the specifications established by an engineer working in the field. For Polytech, these projects validate the body of technical and managerial competencies acquired by students during their years in our programme. For our industrial partners, the students' projects permit them to test systems, confirm new ideas, and create prototypes, among other valuable research outcomes.

Publishing a yearbook that brings together in one volume the overviews of all fifth-year industrial projects is a concrete way of presenting the entirety of the fields of activity in which graduate engineers of Polytech Orléans will work. It is also a way for our business partners to evaluate the assistance which Polytech can bring to them. Our ambition is to highlight the achievements realized in collaboration with businesses and institutions and to encourage development of new industrial partnerships.

Regine Weber-Rozenbaum,  
Director, Polytech Orléans





# Civil Engineering





# Analysis of the concrete structures condition from photos using AI

Civil engineering

**Ben-moumen Badr/Boukhal Ayman**

Academic supervisors : Dashnor Hoxha/Duc-phi Do  
Industrial supervisor : SIMON Olivier



B. BEN-MOUMEN



A. BOUKHAL

Chemicals pathologies



Company/institution : Antea Group

## OBJECTIVE/MOTIVATION

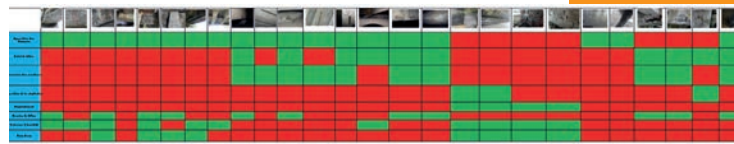
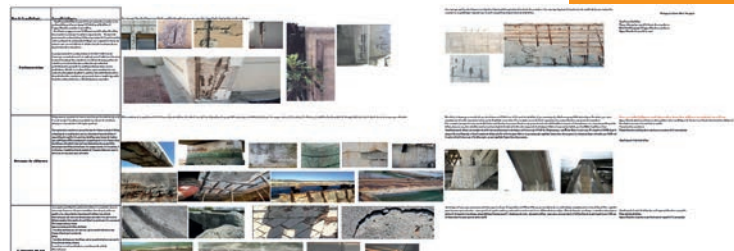
Our project consists in producing a flowchart based on an artificial intelligence approach to determine the possible pathologies of concrete structures (unreinforced, reinforced, prestressed) from real photos. Initially, we should establish the different databases (apparent cracks in the concrete skin with their associated characteristics, possible pathologies with their characteristics of the structure in relation to the accompanying cracks, the analysis methods (destructive, non-destructive) and identification of these pathologies). Then, from photos of real pathologies, we qualify the cracks and the other codifiable elements (colors, algae, traces of corrosion). These abnormality analysis are then used as input data for online software to get feedback on possible pathologies (determine which pathology is most likely to be from the photos we have).

## RESULTS

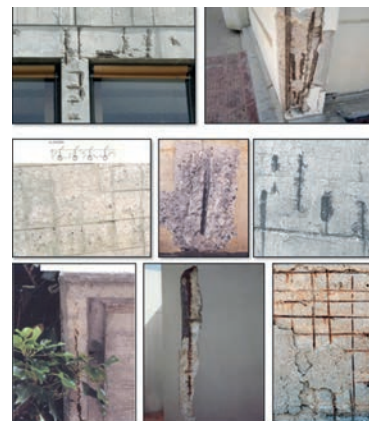
The first phase of the project was dedicated to search about the most common pathologies that affects concrete structures. We started by looking for the documents that can provide us with concrete structure's pathologies, their causes, their consequences... Then, we collected the maximum of pictures of every pathology. We found two categories of pathologies : mechanical and chemical pathologies. We sorted the results that we found on two excel files. Afterwards, we sorted all the pictures that we have in multiple folders with the name of every category. Finally, we created 2 tables : they contain each a category of the pathologies with all its pictures put horizontally and all the pathologies vertically, and for every picture we marked on green if it contains the pathology and on red if it doesn't. The goal of those tables

is that they'll allow us, using the AI, to compare a real photo with the ones in our database and tell us with pathologies exist or not in the real photo.

**KEYWORDS :** pathologies, database, photos, cracks , concrete structures.



Database



Synthésis pathologie

Contact : badr.ben-moumen@etu.univ-orleans.fr/ayman.boukhal@etu.univ-orleans.fr



# Incorporating old foundation piles into a network of rigid inclusion system

Civil engineering



Company/institution : Antea Group

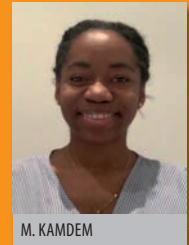
**Abdullah Gamal KHALLAF/ Manuela KAMDEM**

Academic supervisors : HOXHA Dashnor/ALMOHAMAD Dalia

Industrial supervisor : ANTOINET Eric



A.G. KHALLAF



M. KAMDEM

## OBJECTIVE/MOTIVATION

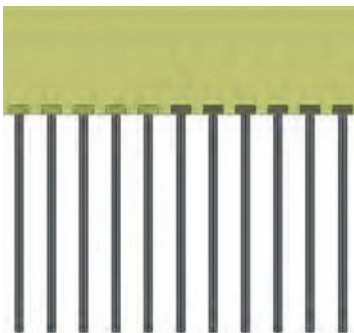
In Geotechnical Engineering, rigid inclusion refers to a technique used to improve the load-bearing capacity and stability of soil. Rigid inclusions are typically made of materials such as concrete, steel, or composites and are inserted vertically into the soil to a specified depth. [ASIRI reference]

Our study aims to evaluate the feasibility of reusing old deep foundations in a network of rigid inclusions, given the policy of limiting urban expansion and the growing trend of repurposing old commercial or industrial sites after deconstruction. This approach involves utilizing the existing foundation piles as rigid inclusions.

To address this challenge, we plan to explore a technical solution by using Plaxis 2D modelling and manual calculation to determine the necessary network of additional new inclusions. This solution will ensure that the structure has the required bearing capacity and minimum settlement.

## RESULTS

Soil improvement techniques are used to enhance the geotechnical properties of weak subsoils,



thereby ensuring the stability of superstructures. These techniques are particularly important in the context of urbanization, where real estate investments and development are accelerating.

To verify the allowable pile load, we used both Plaxis 2D static load test modelling and the Cone Penetration Test (CPT) method. Through these methods, we calculated the total pile length to be between 12.5 and 13 m, and the ultimate pile load capacity.

Modelling was carried out in two different ways in order to show the comparison between both : (A) soil volume pile B) embedded beam pile, the calculation has showed significant differences. We assumed a rigid inclusion grid spacing of 2\*2.5 m with a platform thickness of 1.2 m, Our results indicated that increasing the grid spacing decreased the improvement factor.

**KEYWORDS :** rigid inclusion, soil improvement, deep Foundation.

Rigid Inclusion Model and Dimension



Contact : [abdullah.khallaf@etu.univ-orleans.fr](mailto:abdullah.khallaf@etu.univ-orleans.fr)/[manuela.kamdem-djuikom@etu.univ-orleans.fr](mailto:manuela.kamdem-djuikom@etu.univ-orleans.fr)

# Preliminary design of a roundabout in BRIARE (45)

Civil engineering



Company/institution : Conseil départemental du Loiret

**Camille ABDUL SHAMAD / Camille HENIN**

Academic supervisors : Elise REMOND / Laurent JOSSERAND  
Industrial supervisors : Clément FAUCHEUX / Christophe SEGRET



C. ABDUL SHAMAD



C. HENIN



View of the old crossroads

## OBJECTIVE/MOTIVATION

The Department of Loiret mandated us in order to carry out the pre-project phase of a roundabout. This operation aims at redesigning the junction between two roads, the RD2007 and the RD50. This project is part of the safety policy of the Loiret departmental council. Indeed, the goal is to identify the intersections, or areas of the road that cause accidents, in order to reduce accidents and make the roads safer. This roundabout will improve the visibility of the crossroads, the visibility of the crossroads and will reduce the speed of the road users.

The expected deliverables include several elements ranging from the pre-project notice, a geometrical and structural dimensioning of the roundabout, a stormwater management solution, management of existing networks.

All these elements allowed to carry out a precise phasing as well as a global budget of the whole development.

## RESULTS

Working on the preliminary project of the creation of a roundabout was enriching and it allowed us to complete our training. Indeed, our option being more focused on the building, this project consolidates our knowledge of public works. Carrying out the pre-project phase from start to finish allowed us to understand all the steps and needs of a development project. Moreover, the various meetings organized with the Loiret departmental council were instructive. Indeed, it was a real opportunity for us to exchange with professionals of the public works world.

**KEYWORDS :** roundabout, safety, design, layout, budgeting.



View of the roundabout proposal

Contact : [camille.henin@etu.univ-orleans.fr](mailto:camille.henin@etu.univ-orleans.fr) / [camille.abdul-shamad@etu.univ-orleans.fr](mailto:camille.abdul-shamad@etu.univ-orleans.fr)

# Design of a covered trench for the improvement of the Marseille-Provence airport

Civil engineering



Company/institution : The Engineering School of the University of Orleans (Polytech Orléans)

**Baptiste CHARTIER/Rovatiana RANDRIANASOLO**

Academic supervisor : Elise REMOND



B. CHARTIER



R. RANDRIANASOLO

## OBJECTIVE/MOTIVATION

The main purpose of this project is to design a trench, that would go under the Lavandiers roundabout of the Marseille Provence Airport (AMP). The need behind this huge project is to improve its quality of service, and in particular to anticipate traffic growth. The process is mainly the making of plans, the technical notice, the measurements and the financial estimate. In order to do that, we have to examine geotechnical reports, special technical specifications (Setra, Cerema...), Autocad files and many others. In addition, we have to model the trench on softwares such as Plaxis and Autocad. We chose this topic because it's a real situation case, with real challenges, 3D modelling, a complex construction site, that would allow us to learn more about real design projects.

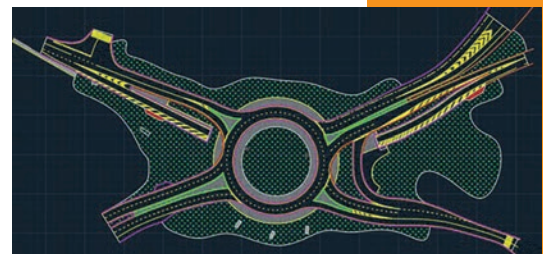
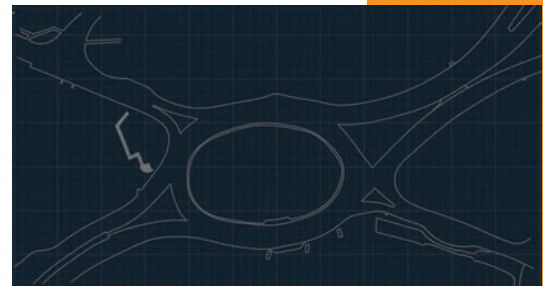
## RESULTS

During the project, we had to calculate the dimensions of the trench and suggest a design, we leaned on a few standards of Setra and Cerema. We also had to identify risks that might be implied regarding the trench: floods, land movements, earthquakes, swelling of clays... In addition, modelling the cross section on Plaxis

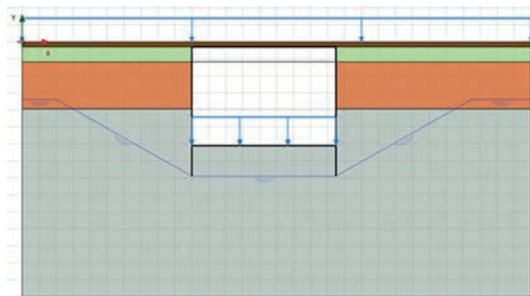
was meant to compare the results of momentums and deformations it gave with the results we obtained, by doing the calculations by ourselves. We had to model the whole construction site as well, on Autocad, which contains the trench, all the electrical system and pipe networks, roads, road signalling, and many other important elements. For the final part, we were able to do a calculation of the construction site, in order to establish a financial estimate of the project.

**KEYWORDS :** design, 3D modelling, geotechnical analyses, site costing, planning.

Lavandiers roundabout before work



Lavandiers roundabout after work



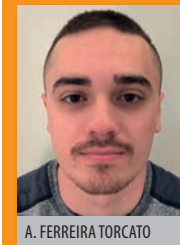
Cross section of the covered trench

Contact : [baptiste.chartier.45@outlook.fr](mailto:baptiste.chartier.45@outlook.fr)/[rovatiana.randrianasolo@gmail.com](mailto:rovatiana.randrianasolo@gmail.com)

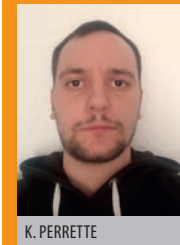


# Setting in situation of design office in tracing : case study on the Larcher springs

Civil engineering



A. FERREIRA TORCATO



K. PERRETTE

**Alexandre FERREIRA TORCATO/Kevin PERRETTE**

Academic supervisor : Christian DEFARGE

Industrial supervisor : Nevila JOZJA



Company/institution : R&D Expertise and Transfer Unit CETRAHE (University of Orléans)



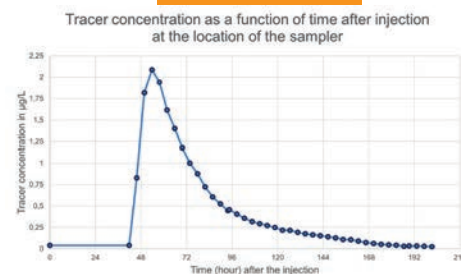
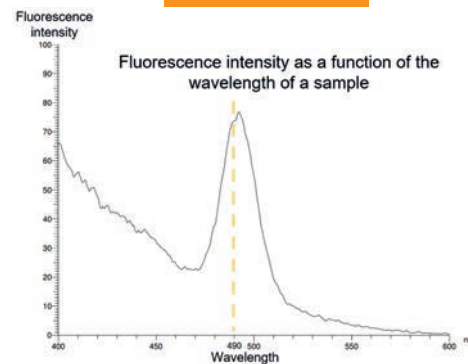
the tracer concentration in the water over time. This curve allows us to highlight the rapid arrival of the tracer at the sampling point (46 hours after injection), then its attenuation over time until its complete disappearance after 8 days. These results are interesting because the speed of propagation of the tracer is characteristic of strong soil drainage, which can represent high geotechnical risks.



## OBJECTIVE/MOTIVATION

An artificial tracing is an experimental procedure aimed at making apparent and observable the actual movement of underground water in an aquifer. To do this, the use of a tracer, often fluorescent, is necessary. The behavior of groundwater plays a major role in the behavior of surface water. Thus, carrying out such tests makes it possible to develop a better knowledge of the local hydrogeology by detecting underground links between losses and resurgence points, ultimately allowing us to better manage surface water. In this project, artificial tracing was applied to characterize the karstic networks between the Larcher source and the Limère Dolines Departmental Park.

**KEYWORDS :** artificial tracing, water resource, karstic networks, sinkhole risk.



## RESULTS

Once the injection was done, we installed an automatic sampler near the Pie. This tool allowed us to take water samples at regular intervals. Using a spectrofluorometer, we were able to detect the presence of tracer in the water. Then, we quantified the tracer concentration in each sample. Given that we know the time of collection of these samples, we can draw a curve which describes the evolution of

Contact : [alexandre.ferreira-torcato@etu.univ-orleans.fr](mailto:alexandre.ferreira-torcato@etu.univ-orleans.fr)/[kevin.perrette@etu.univ-orleans.fr](mailto:kevin.perrette@etu.univ-orleans.fr)

# Upgrading of recycled aggregate washing fines in the manufacture of new concrete

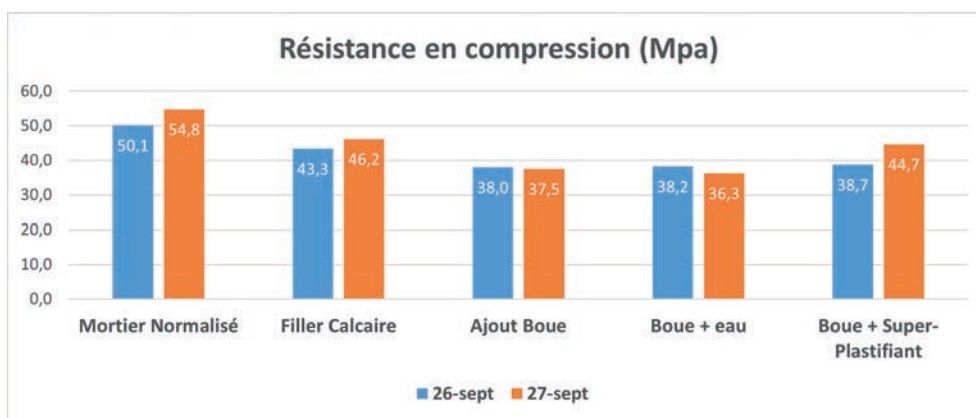
Civil engineering

Nina DAVIN/Baguilou HELIM

Academic supervisors : Sébastien REMOND/Naima BELAYACHI



Company/institution : Polytech Orléans



Comparison diagram of compression resistance of different mortar types

Average mortar spreading

## OBJECTIVE/MOTIVATION

The aim of our project is to find a possible use for a washing sludge extracted at the end of a process of washing recycled aggregates. Two possible uses have been perceived from the beginning: as a partial cement substitute in the same way as the limestone filler or used in the manufacture of road binders. The objective is therefore to study in a laboratory the possibilities of valorization of this sludge in partial cement substitution but also the characteristics specific to it.

This project topic is an important topic because it is anchored in a spirit of total recycling within an area champion any category of pollution and greenhouse emissions.

## RESULTS

Precisely determining the final utility that could be attributed to this sludge is difficult in view of the time allowed for this project but however our tests were able to provide some information on the "capacities" of the sludge.

Once dried, it has the same particle size as that of a limestone filler. In the case of cement substitution, only the sludge strongly lowers the resistance of manufactured mortar. However, by adding water or superplasticizer for a strength like a standardized mortar or with substitution of filler, the mortars manage to equalize the resistance obtained when using limestone fillers. The dried sludge could therefore be considered as a mineral addition although it requires superplasticizer to obtain the same resistance and thus be used as a substitute or in the manufacture of road binder. But some questions remain before guaranteeing its use.

**KEYWORDS :** dried sludge, cement substitution, recycling.



Specimen preservation mechanism before testing

Contact : [nina.davin@etu.univ-orleans.fr](mailto:nina.davin@etu.univ-orleans.fr)/[baguilou.helim@etu.univ-orleans.fr](mailto:baguilou.helim@etu.univ-orleans.fr)



# Development of a method for quantifying total phosphorus content in peatlands. Application in a hydro-ecological restoration context.

Geoenvironmental engineering

**AIT MAHMOUD** Walid/**EL GHASSAL** Othmane

Academic supervisor : Christian Défarge

Industrial supervisor : Juliette Mazon



Company/institution : Université Orléans-CNRS/INSU-BRGM, ISTO, CETRAHE



W. AIT MAHMOUD



O. GHASSAL

## OBJECTIVE/MOTIVATION

Peatlands are important carbon sinks, as they store large amounts of carbon. However, disturbances such as drainage and land use change can transform peatlands from carbon sinks to sources of carbon for the atmosphere. Restoring the ability of peatlands to store carbon is therefore a crucial step in addressing climate change. To ensure that these restoration efforts can be integrated into the emerging carbon economy, it is important to evaluate the impact of restoration work on the carbon stock and the vegetation that contributes to it. The response of plant communities may depend on the availability of nutrients, in particular phosphorus (P). Therefore, it is essential to develop a reliable quantification method to accurately measure the P stock in peatlands. This



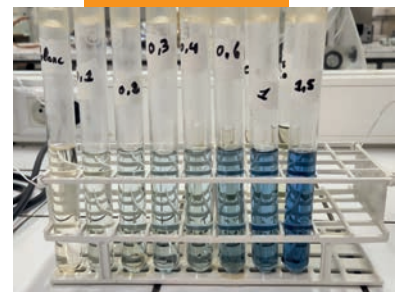
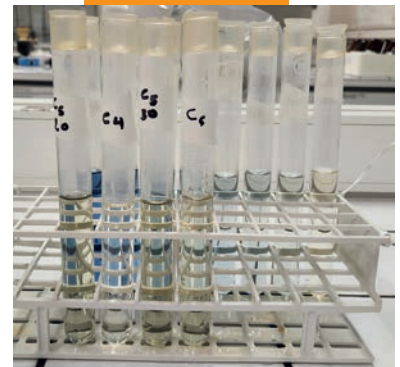
study was conducted on the Guette peatland in Sologne, which has undergone hydro-ecological restoration works as part of the CARE PEAT project.

## RESULTS

The objective of our project was to develop a reliable method for quantifying the total phosphorus in peat cores. Among the 14 soil phosphorus extraction methods applied to 50 agricultural soils from Central Europe examined by Wuenscher et al. (2015), we chose the "total phosphorus" method, based on extraction by 1 mol/L HCl after calcination (550°C; 1 h) during 16h because it extracts the most amount of P in soil. After extraction applied to 4 samples issued from a peat core from La Guette peatland, P

in solution was analyzed in solution by Murphy and Riley method (1962). The results obtained from this method ( $\leq 0.03$  mg P/g), were significantly lower than those obtained from other peatlands. A more recent method cited by Rodier (2009) was thus tested, after redrying the samples at 105°C, and grinding them with a mortar to favor a better extraction of P. Nonetheless, the results were much lower than those obtained from the previous methods. The Murphy and Riley method must thus be retested on redried and ground samples.

**KEYWORDS** : care peat, peatlands, total phosphorus, hydro-ecological restoration.



Contact : [walid.ait-mahmoud@etu.univ-orleans.fr](mailto:walid.ait-mahmoud@etu.univ-orleans.fr)/[othmane.elghassal@etu.univ-orleans.fr](mailto:othmane.elghassal@etu.univ-orleans.fr)

# Rehabilitation of the Place du Vexin in Meulan-en-Yvelines

Civil engineering

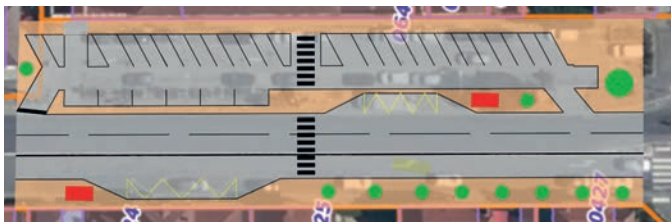
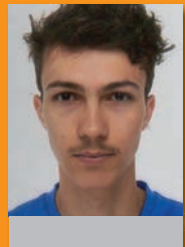
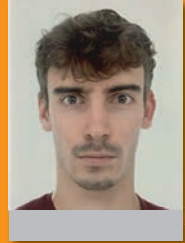


Company/institution : Iris Conseil

**Cédric Vatel/Etienne Maurin**

Academic supervisor : L. Josserand

Industrial supervisor : M. Lucy



## OBJECTIVE/MOTIVATION

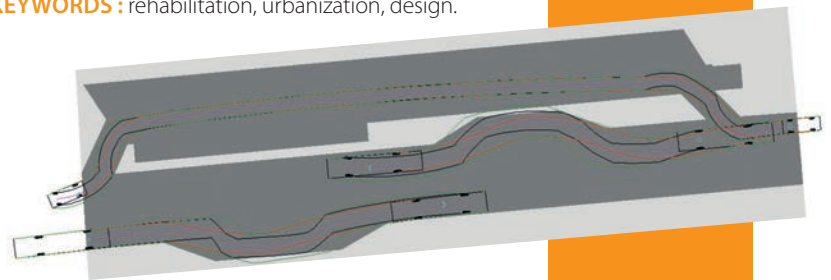
The purpose of the project is to propose a new layout for the Place du Vexin in Meulan-en-Yvelines. The current layout creates a number of problems, particularly in terms of traffic and safety. We have suggested several designs that would solve the existing problems, the three designs proposed are our variants. For each of them, we have put forward different ideas that suggest different approaches depending on the starting criteria. Firstly, we analysed the existing configuration. A documentary soil survey was carried out to give us a better understanding of the constraints of the project. We also researched the networks and calculated the traffic. For the selection of the solutions, we were able to rely on the help of Mr. Lucy who represented the contractor.

## RESULTS

The final design proposal is the result of a new approach which consists in diverting the traffic into a parallel street, allowing us to reduce the number of lanes in the Place du Vexin. We then take advantage of this space saved to increase the width of the pedestrian walkways and to make the bus stops safer. Our solution also allows us to increase the number of parking spaces by 10%. However, the traffic diversion brings an excess of vehicles into a street that is usually not very busy, which

would require a redesign of the street, and a change in the habits of the residents. We therefore modelled the solutions using different software such as Autocad and Mensura. Firstly, to have a schematic of our solution, then to have a 3D rendering of the solution including the stormwater networks and the vehicle gyration.

**KEYWORDS :** rehabilitation, urbanization, design.



Contact : [cedric.vatel@etu.univ-orleans.fr](mailto:cedric.vatel@etu.univ-orleans.fr)/[etienne.maurin@etu.univ-orleans.fr](mailto:etienne.maurin@etu.univ-orleans.fr)



# Formulation and characterization of a rapeseed-lime mixture

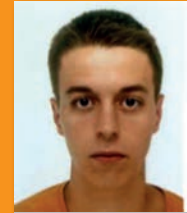
Civil engineering

**MOSSMANN Valentin/WEBER Sylvain**

Academic supervisor : BELAYACHI Naïma



Company/institution : Polytech



V. MOSSMANN



S. WEBER



Sample of a rapeseed-lime mixture

project started in mid-September and will end in early March, ( so a 6-month period).

## RESULTS

Firstly, we carried out various mechanical tests on the samples. With the results we conclude that the more additives, the more the stress of our samples decreased. For example, a sample without additive resists a stress of 0.185 MPa, while a sample with 0.5% additive has a stress of 0.151 MPa, which decreased the stress of our materials by 18%.

Secondly, we prepared samples for thermal characterization. These tests were quite long because we could only measure the samples in the heat flow

meter (HFM) one by one to obtain their thermal conductivity. We realized how time-consuming the use of HFM is because we had to test three samples for the same mixture and average the results. Our thermal results were more contrasted than the mechanical ones. We found that the thermal conductivity between our mixtures did not change much despite the difference in additive concentration.

**KEYWORDS :** bio-composite, rapeseed, lime, insulation of building.



Preparation of the water tests



Preparation of the mechanical tests

## OBJECTIVE/MOTIVATION

The objective of the project is to characterize several mixtures based on lime, rapeseed and additives to propose an insulating material for the energy rehabilitation of buildings. This is an experimental approach to the recovery of plant waste in the Centre Val de Loire region, which consists in proposing insulating materials and characterizing them in detail to determine their thermal, hydric and mechanical properties for comparison with the criteria used in the building. The study is part of the research activity of the LaMé laboratory which focuses on the design of bio composites based on sunflower and rapeseed aggregates. A technical-economic study will be carried out at the end of the project and compared with various bio-based blocks (like hemp) on the market. The

Contact : [valentin.mossmann@etu.univ-orleans.fr](mailto:valentin.mossmann@etu.univ-orleans.fr)/[sylvain.weber@etu.univ-orleans.fr](mailto:sylvain.weber@etu.univ-orleans.fr)



# Feasibility study for a composting center

Civil engineering

**Sologne  
Ingénierie**

Company/institution : Sologne Ingénierie

**Juliette GUERIN/Valentine PENEL**

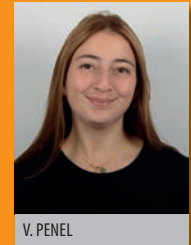
Academic supervisor : Xavier BRUNETAUD

Industrial supervisor : Michel ROTAT

Selected participant  
17<sup>th</sup> annual final year projects forum



J. GUERIN



V. PENEL

## OBJECTIVE/MOTIVATION

Our project consisted in studying the Sologne region to determine if it would be interesting to build a composting center there, and if so, where it would be located. To do this, we had to do some research and a lot of referencing, particularly on wastewater treatment plants, to determine whether the needs of a future composting center could be met. This allowed us to work in a completely different way than we were used to. We are satisfied with this project because we were able



Aeration system of the Soullans composting centre



Containers of the Soullans composting centre

to develop our method of searching for information and we learned a lot about the principle and the needs of a composting center. Furthermore, we succeeded in achieving our main objective, which was to find out if it would be interesting to build a composting center, but especially within what limits and constraints.

## RESULTS

Through our research, we were able to obtain a complete listing of the existing wastewater treatment plants in our study area, as well as the amount of sludge they produce and their destination (composting or agricultural spreading). We found that there were already composting centers in our area, which recovered sludge from some treatment plants. Thanks to these data and the company's requirements (3,500 T of incoming sludge needed per year), we were able to develop several hypotheses and proposals concerning the location of a future composting center and the limits of our different proposals. Our main limit is to convince the composting centers that send their sludge for agricultural spreading to send it for composting, despite the higher cost that this would generate. This would be the continuation of our work, which we did not have the time to complete.

**KEYWORDS :**  
composting,  
research, feasibility,  
Sologne Ingénierie.

Map legend

- Proposition\_2
- Proposition\_1
- Stations\_Epandage\_sup\_1000
- Stations\_Epandage\_inf\_1000
- Stations\_compost\_inf\_1000
- Stations\_compost\_sup\_1000
- ▲ Centres\_existants
- Villes
- Coursdeau
- autoroutes
- Axes\_secondaires



Part of the result  
of our work

Contact : julietteguerin99@gmail.com/valentine.penelraymond@gmail.com

# Characterization and quantification of the uncertainty of the mechanical behaviour of fresh concrete for 3D printing

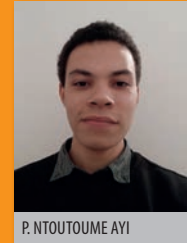
Materials

**Paul Ntoutoume Ayi/Gnonle Bahi**

Academic supervisors : Sébastien Remond/Duc Phi Do

Company/institution : Darcy lab

Selected participant  
17<sup>th</sup> annual final year projects forum



P. NTOUTOUME AYI



G. BAHİ

## OBJECTIVE/MOTIVATION

In the context of concrete 3d printing, many stability problems arise. Printed structures do not always resist their own weight. The numerical method would make it possible to simulate a 3d impression with a concrete evolving over time and for this, it is essential to be able to predict the behaviour of the concrete during its impression (in the first hours). It is in this context that our project fits. The objective of the project was to carry out a maximum of measurements on fresh concrete, to finally be able to characterize the evolution of the concrete during its setting after a statistical analysis

Casagrande box shear test



of the results. For this, we carried out shear tests, ultrasonic tests and different compression tests on an identical mortar but at different instants to identify, the evolution in time of Young's modulus, and of the shear strength.

## RESULTS

During this project, we were therefore able to establish measurement protocols for ultrasonic, shear and compression tests for concrete at early age. The results obtained were satisfactory insofar as the evolution in time of the fresh concrete properties were consistent with the results provided in the literature. A Bayesian analysis allowed us to quantify the uncertainty of these properties by determining the posterior probability distributions and to incorporate our knowledge of the parameters identification. It allows to better consider the uncertainty of the measurements and to reduce bias in the results. These data finally made it possible to justify the use of Casagrande box in the shear tests and the ultrasonic measurements according to the protocols carried out during the project. The rest of the process will be done through an increase in the number of measurements carried out and new measurement methods allowing to determine other fresh concrete properties or to reduce the uncertainties on the previous measurements.

**KEYWORDS :** concrete 3d printing, laboratory measurement.



Compression test with hydraulic press

Contact : paul.ntoutoume-ayi@etu.univ-orleans.fr/gnonle.bahi@etu.univ-orleans.fr

# Study of the launching of a superstructure in coffer

Civil engineering

**Aussert Charles/Bourgeois Alexandre**

Academic supervisors : Remond Elise/Remond Sebastien



Company/institution : Orléans Métropole

## OBJECTIVE/MOTIVATION

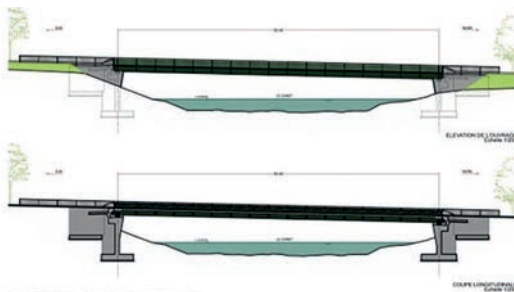
The objective of our project is to validate the launching of the Cotelte bridge. The Cotelte bridge passing over the Loiret has a span of 50 meters without intermediate piles. The deck is built entirely on the ground. A forbreak need to be used in order to set up the deck on the two abutments. The goal of this project is to validate this forbreak at the ULS and the SLS. The kinematics of the launch will be studied on Robot software and the launch will be modeled, considering the geometry of the superstructure, to validate the characteristics of the launching organs. We were very motivated by this project because the bridge construction it's an aspect very specific and very technic of civil engineering. Studying the launch of the deck was very interesting and challenging.

## RESULTS

After six months of project, we were able to design both the deck and forbreak on robotbat software and then to calculate the launching. One big part of the project was to find the good solution to model the forbreak, but the most challenging was to simulate the dynamics of the launching on a

static software. Thanks to this model we were able to find the deflection and the stress applied in the structure. In parallel we performed calculations by hand to compare the results. When we compared it we realized that the results found with the manual calculation were very close to the results found with the software. Thanks to that we were able to validate the launching of this deck over the Loiret River.

**KEYWORDS :** launching, bridge, construction, stress, span, deflection.



Caption

Contact : [feraoirj.fdsnfo@univ-orleans.fr](mailto:feraoirj.fdsnfo@univ-orleans.fr)



# Energy rehabilitation study of an industrial building built in 1991

Civil engineering



Company/institution : Amphenol Antenna Solutions

**CHRETIEN Emma/HOUTIN Samantha**

Academic supervisor : Naima Belayachi

Industrial supervisor : Claire Ghassemzadeh

Selected participant  
17<sup>th</sup> annual final year projects forum



E. CHRETIEN



S. HOUTIN

## OBJECTIVE/MOTIVATION

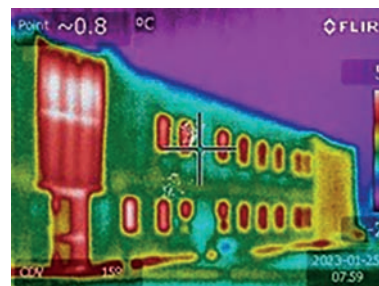
The purpose of this project is to deal with the thermal rehabilitation of an industrial building located in Amboise. This study consists in providing several insulation propositions in order to its lower energy consumption.

For that, a calculation of the initial energy consumption of the building was obtained using the Passive House Planning Package, the PHPP software. The obtained figure can pinpoint the prevailing situation and the renovation that could be provided.

Another objective is to suggest a solution that could be considered by the company for the renovation of its building. The evaluation of the depth of needed isolation was computed using U-Wert calculation. For instance, in this study it could be considered adding a polystyrene-based insulation or wood-fibre. Changing the type of glazing is also a part of a solution.

## RESULTS

First of all, to detect the main heat losses, we ran out a thermal camera study. This method uses



Heat losses

Industrial building

Contact : [emma.chretien@etu.univ-orleans.fr](mailto:emma.chretien@etu.univ-orleans.fr)/[samantha.houtin@etu.univ-orleans.fr](mailto:samantha.houtin@etu.univ-orleans.fr)



# Formulation of cement with low carbon content by the use of concentrated suspensions

Civil engineering



Company/institution : Polytech Orléans

**Xavier BERTON/Paul GREARD/Marion OGER**

Academic supervisor : Elise REMOND



X. BERTON



P. GREARD



M. OGER

## OBJECTIVE/MOTIVATION

Today, cement manufacturing is the source of 7% of the world's CO<sub>2</sub> emissions. Cement is the real glue of concrete and plays an essential role in its resistance by providing a high level of compactness. Industrial by-products are used today as substitutes at different rates to limit the use of clinker, the result of cement manufacturing. These substitutions are above all made with an ecological aim but often imply lesser mechanical properties. The objective of this project is to study the optimal granular stacks of these new materials that can play the role of cement. We are interested in the optimal compactness of the mortars tested, in the selection and interaction between fillers, water and other powders, in the implementation of protocols allowing the measurement of these optimums as well as in the impact of the admixture on the behavior of the material.

of water for the two calcareous fillers available in the laboratory. Manual approaches have been tested but not retained because of the large uncertainties involved. The protocols developed will soon be tested with different dosages of superplasticizer and for mortars containing variable rates of filler. These different tests will allow us to determine the optimal relative proportions of fillers (or silica fume), water and superplasticizer.

## RESULTS

For the moment, 4 protocols have been carried out to measure the optimal compactness of the powders available in the laboratory. Two of them, the liquidity limit test of the Casagrande device and the Vicat probe test, have given the most plausible results: these tests have been standardized and can be carried out, following our protocols, for the study of granular stacking of fillers and powders. We therefore know the optimal compactness and the associated amount



**KEYWORDS :** mortars, cement, rheology, grain size distribution, new materials.



Contact : [xavier.berton@etu.univ-orleans.fr](mailto:xavier.berton@etu.univ-orleans.fr)/[paul.greard@etu.univ-orleans.fr](mailto:paul.greard@etu.univ-orleans.fr)/[marion.oger@etu.univ-orleans.fr](mailto:marion.oger@etu.univ-orleans.fr)



# Work-study assistant price study

Civil engineering



L. BERNARD

**Léa BERNARD**

Academic supervisor : Kevin BECK  
Industrial supervisor : Benoît HERTZOG



Company/institution : Sogea Environment



the schedules... I was also able to estimate a project to recycle the water in contact with the concrete laitance. This water will be conveyed into decantation tanks and then sent back to a waiting basin to be reused on site. This project was enriching because, at the same time, it mixed a part of civil engineering and also the public works and hydraulic part, two other poles present within my company. This allows me to have a more global vision of all the trades.

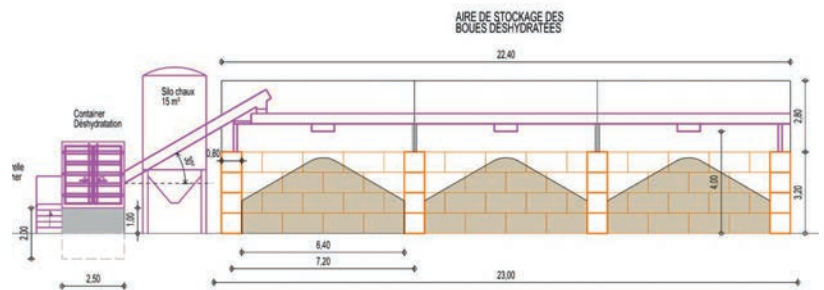
**KEYWORDS :** price study, civil engineering, industrial buildings, discovery.

## OBJECTIVE/MOTIVATION

I am lucky enough to be doing a work-study program with Sogea Environment, which allows me to learn everything about the job of a price-study engineer, as well as to learn about a part of work management. The price-study office is important because it is the one that allows you to get contracts for work sites, you have to manage the requests for consultation with the suppliers, make briefs, think about certain technical solutions and of course have a more attractive file than the competitors. I have the chance to be able to assist a site manager, especially with the administrative part of the job, which gives me a greater insight into the trade and allows me to learn more about the technical aspects of the job.

## RESULTS

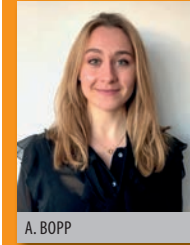
I was able to calculate the cost of a project based on Obermodern to create slabs and a sludge storage area, partly on my own. We obtained the contract and now I am in charge of all the preparation of the site, like reconsulting some companies, updating



Contact : [lea.bernard@etu.univ-orleans.fr](mailto:lea.bernard@etu.univ-orleans.fr)

# Program manager in new real estates

Civil engineering



A. BOPP

Rehabilitation site for the construction of housing in Orléans



Company/institution : Clares Immobilier

**Alice BOPP**

Academic supervisor : Kevin BECK  
Industrial supervisor : Louis CESAREO



3D visualization of the JEAN PERRIN operation

## OBJECTIVE/MOTIVATION

At the end of my 4th year at Polytech Orléans, I had the opportunity to discover the company Clares Immobilier, a subsidiary of Crédit Agricole, which I joined in September 2023 for a one-year internship. Studying mainly the structural aspect of buildings, I wanted to discover a job that would allow me to follow an operation from the purchase of the land to the delivery to the client. My objective in joining Clares was to discover the position of program manager in new real estates and to be able to gain autonomy during the year. I wanted to be able to acquire knowledge in the field of real estate, in particular in the administrative and financial aspects of a project, which is complementary to my studies. The versatility of this position has allowed me to intervene in all the stages of a program realization.

## RESULTS

Thanks to my manager and my tutor, I have the opportunity to follow several operations. The one I am responsible for consists of the construction of a 25-housing unit building sold in VEFA, in their future state of completion. I therefore can interact with

many stakeholders, starting from the client for the implementation of the operation, the architects for the design of the project, the notaries, the urban planning departments and my colleagues to complete the projects. I can therefore ensure the administrative, financial and commercial follow-up of programs purchased by social landlords. In addition, I can follow two other operations that will be delivered soon. This allows me to apprehend the different missions to be carried out to complete an operation by verifying the financial balance of the latter as well as by preparing the administrative documents required for the signature of the bill of sale.

**KEYWORDS :** VEFA, social landlord, programs.

Construction of 25 collective housing units in Saint-Jean-de-Braye: Preparation of the foundations



Construction site in Patay, delivery of the model home



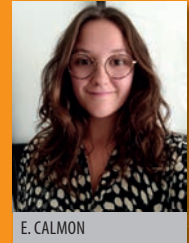
Rehabilitation site for the construction of housing in Orléans

Contact : [alice.bopp@etu.univ-orleans.fr](mailto:alice.bopp@etu.univ-orleans.fr)



# Immersion in construction projects, programming and piloting missions

Civil engineering



E. CALMON

**Calmon Elise**

Academic supervisor : Xavier Brunetaud

Industrial supervisor : Pascal Masson

Company/institution : Oxylium



Construction project of 50 apartments.



Building energy renovation project

## OBJECTIVE/MOTIVATION

The main objective of my professional immersion in the Oxylium company was to develop and put into practice the theoretical knowledge acquired during my educational training at Polytech Orléans. Oxylium was a way for me to learn more about project management in the construction industry. This versatile company with a human dimension was ideal to allow me to participate to the following missions: programming, project management assistance, piloting, and coordination as well as execution management. The main objective of my professional immersion was to understand and participate to programming and OPC missions in order to better understand and grasp project management in the building industry.

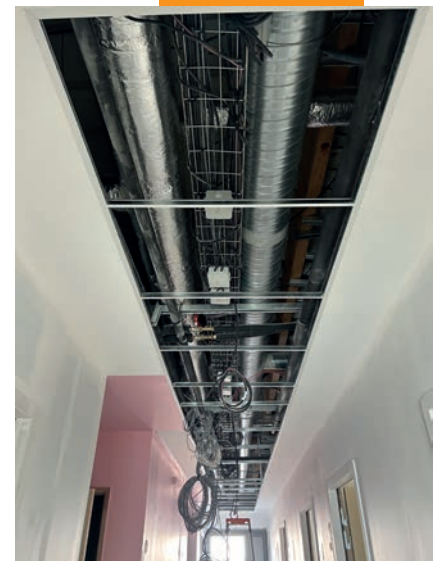
## RESULTS

In programming: I realized the technical diagnosis of housing present in the surroundings of 2

schools. I went on the spot to see the global state of the building (insulation, window, roof, ...). I was then able to carry out the diagnosis and the programming by proposing axes of improvement for the buildings: addition of a thermal insulation, change of the joineries, repairs of the grounds... I then carried out the quantity and the costing of work so that the owner can see the work envisaged and its costs.

In Planning, Control and Coordination (OPC): I learned to manage a construction site, to lead a construction site meeting and to write the meeting report. A big part of my mission of piloting was to supervise the progress of the companies as well as the good execution of the works.

**KEYWORDS** : OPC, programming, planification.

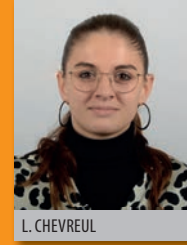


Verification of progress and conformity

Contact : [elise.calmon@etu.univ-orleans.fr](mailto:elise.calmon@etu.univ-orleans.fr)

# Block release training as an assistant works manager, Colas Chartres

Civil engineering



L. CHEVREUL

**Laure CHEVREUL**

Academic supervisor : Elise REMOND  
Industrial supervisor : Julien FILLEUL



Company/institution : Colas



## OBJECTIVE/MOTIVATION

The purpose of my work-study program at Colas was to allow me to discover more about the public works sector within the operations of the agency I worked for. To that end, I was able to work in two different positions: as an assistant site supervisor and also as an assistant site manager. After my previous internships, I felt the need to mix these two professions in order to comprehend the reality of the field while keeping in mind the challenges of a public works site. So I was in charge of working on the construction of a logistics centre for a company as well as on a construction site for the creation of an oil mill in the Beauce region.

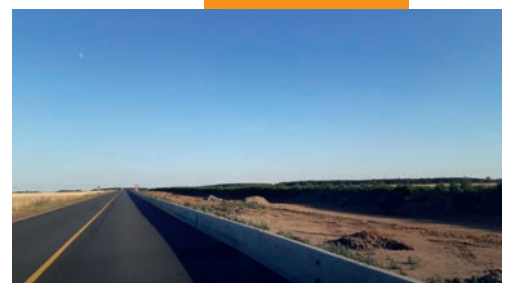
## RESULTS

On the sites, I learned many work techniques such as gravelling, carrying out various masonry works, or installing pipes. Lately, I have been able to gain autonomy by finalizing the implantation with the GPS stick of the construction site of an oil factory

and by guiding the workmen on the various networks to set up.

In the agency, I was able to carry out a certain number of consultations with the suppliers as well as the measurements for various work sites. In addition, I met with several clients with different needs (pavement repair, pothole repair) in order to provide them with price quotes. Regularly, I am in charge of the environmental follow-up of a work site in the Dunois area for which the objective is to obtain a certification of sustainability by meeting various environmental requirements. To this end, I drafted various documents such as monthly energy consumption monitoring and environmental action plans.

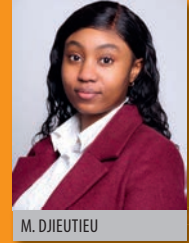
**KEYWORDS :** pipes, environment, worksites, buildings, masonry.



Contact : [laure.chevreul@etu.univ-orleans.fr](mailto:laure.chevreul@etu.univ-orleans.fr)

# Techniques for Capturing the existing

## Civil engineering



M. DJIEUTIEU



Company/institution : BOUYGUES BATIMENT GRAND OUEST

**Mégane DJIEUTIEU**

Academic supervisor : Xavier BRUNETAUD  
Industrial supervisor : Franck QUEVILLON

### OBJECTIVE/MOTIVATION

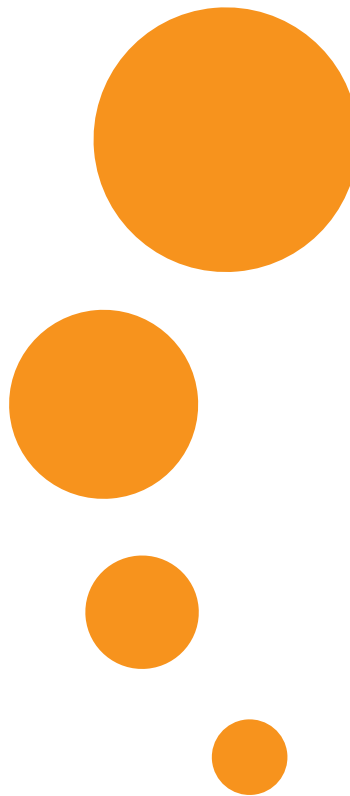
After a 4th-year internship at Bouygues Bâtiment Grand Ouest as a BIM (Building Information Modeling) assistant engineer, I wanted to find out more about this job, which was still unknown to me. So, in agreement with the company, I decided to complete my engineering course as a BIM engineer in the same company. As far as the missions are concerned, I was able to carry out two separate missions. A first, a 6-month mission in the office which consisted in increasing my skills in the use of software and the deployment of digital tools on energy rehabilitation and new construction tenders. Then, I was given a second mission on the site of the CHU of AMIENS - PICARDIE as a BIM manager and a works manager. This project consists of the extension of the critical care and intensive care unit and the new construction of the radiotherapy unit.

### RESULTS

The last few months spent in the company's BIM department have been very rewarding in the sense that I have gained knowledge about the uses of BIM and developed my technical jargon. I have been working mainly on energy refurbishment projects and my role has been to deploy digital solutions to carry out site visits, site surveys and site walks using software such as DALUX FIELD for site visits. As the input data was incomplete, I had to make 3D surveys of the exterior facades to obtain a point cloud. The latter is used with the REVIZTO software to make the costing more reliable. From my point of view, I think that it is easy to find innovative solutions but the difficulty lies in the exploitation process. As far as my feedback is

concerned, I am very satisfied both professionally and on a human level. Indeed, I keep on learning from my colleagues about what BIM is.

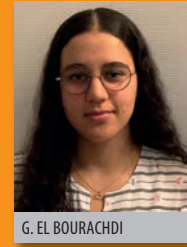
**KEYWORDS :** BIM, construction, capture of existing, implementation.



Contact : megane.djjeutieu-djjeutieu@etu.univ-orleans.fr

# Response to the COLAS consultation for the Quai de Jemmapes

Civil engineering



G. EL BOURACHDI

**Ghizlane EL BOURACHDI**

Academic supervisor : Laurent JOSSERAND  
Industrial supervisor : Edouard DRAPERON



Company/institution : AXIMUM

## OBJECTIVE/MOTIVATION

The main objective of my position is to respond to tenders with the most competitive technical, financial and environmental values.

Indeed, the price study, representing a pre-project phase, engages the client and the company on solutions that can be constructive in terms of quality, energy and ecology as they can be entertaining.

The Quai de Jemmapes project represents a model that makes it possible to understand the steps to achieve the objectives expected by the company. We responded to this offer as part of a consultation by COLAS. Indeed, we had to quantify two chapters: the marking of the road in hot plaster and the street furniture. The rendering will be in the form of an estimate accompanied by the technical sheets of all the products that we will use in the costing.

## RESULTS

First of all, I started by reading all the technical documents in order to understand the customer's needs. Then I consulted METALCO ; a street furniture company required by the client ; which provides bike racks, benches and garbage cans.

The next step is to take measurements to check that the quantities indicated by the customer are consistent with those on the plans and the CCTP. Consequently, I found a difference for the panels in the sense that there are only 22 supports, i.e. sometimes 2 panels are fixed on the same support.

After having received the feedback from the consultations, I produced the estimate for a new price study software from the COLAS group called QDV. Finally, I gave the estimate with the technical sheets to my tutor to check them and send them

to the client. The choice of the contract holder will be made within three months.

**KEYWORDS :** costing, consultations, drafting of technical briefs.

référence		désignation				quantité					
code origine	type	numéro d'ouvrage	code ressource	libellé	UD	non étudié	titre	formule usg	commentaire usg	réfusal formule	quantité durée
1				CHAPITRE 1 - TERRASSEMENTS -							
1.1				travaux de terrassement, marquage par							1,500
1				ou signalisation							
1.1.1				Totale pour le poste							
1.1.1.1				Marquage							
1.1.1.1.1	Ono		EAC-Surf	Passage piétons, trottoirs, revêtements,	M2			[Ouvr]		18,800	18,800
1				travaux de voirie							6,940
2	ART			CHEF DE CHANTIER - CONTREMAITRE	H			8,25		8,250	1,135
3	ART			APPLICATEUR	H			9		8,000	1,140
4	ART			POURCHON MARQUAGE	JO			1		1,000	0,140
5	ART			RENDREUR FONDON ENDUIT A	JO			1		1,000	0,140
6	ART			RAC	CHAUD						
7	ART			COTTEA VR	SM13032 - SM13032	WG			[Matr] [DOSERAC]	480,000	67,000
8	ART			BELLES MISE	8-RES CIRCUITS MBS	WG			[Matr] [DOSERAC]	40,000	8,400

Quotation extract on QDV



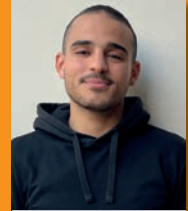
Extract from the road plan

Contact : ghizlaneelbourachdi123@gmail.com



# Creation, diversion and renewal of networks

Civil engineering



M. EL GOSS

**Mehdi EL GOSS**

Academic supervisor : Duc Phi DO  
Industrial supervisor : Jamal BENTALEB



Company/institution : EIFFAGE GENIE CIVIL RESEAUX



## OBJECTIVE/MOTIVATION

During this period within the EIFFAGE Group, and more precisely with EIFFAGE Infrastructures civil engineering networks (EGCR), I was able to deepen my theoretical and practical knowledge and to acquire a little more experience in technical terms and on how to manage a building site. Our worksites aim at the creation, the diversion and the renewal of the networks in sanitation, drinking water, cold network as well as heating. I had to contact different suppliers to make various orders. In addition to that, I had to contact the various participants in the building site at precise times in order to ensure the continuity of the work not to delay the construction site. I also had to carry out very specific tasks such as invoicing projects, making estimates and carrying out measurements. Organization, relational and rigour were the capacities I had to show to carry out my work.

## RESULTS

This period was very enriching for me on a professional level because I was able to discover different sites with different stakes and particularities, which allowed me to acquire a very rewarding experience within a large group like EIFFAGE. I also learned that unforeseen events can occur at any time, and that it was essential to develop a spirit of anticipation and reflection to face and overcome them. Finally, communication and coordination between the team members are essential, as this allows for the proper management of the site and indirectly for its success.

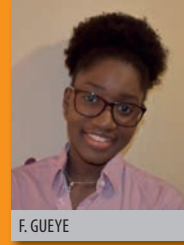
**KEYWORDS :** networks, works management, sewerage, drinking water.



Contact : mehdi.el-goss@etu.univ-orleans.fr

# Creation of an urban logistics space in Paris

## Civil engineering



F. GUEYE

**Fatoumata Gueye**

Academic supervisor : Duc Phi Do

Industrial supervisor : Christophe Cocheril



Company/institution : BC.n

ELU Keller

### OBJECTIVE/MOTIVATION

At the end of the fourth-year internship that I did on a site of the CBI company, a subsidiary of the Vinci Construction company, I signed a professional training contract. Thanks to this experience, I am becoming more and more familiar with the world of construction, especially with the field works. As an assistant work supervisor, I am a part of the ELU Keller project. This operation consists of the creation of an urban logistics area in a parking lot owned by the La Poste group. In recent years, e-commerce has grown significantly, resulting in an explosion in the number of product deliveries. However, there is still one step that needs to be optimized : the last mile. It is the last step of the e-commerce supply chain, when the package is delivered to its final destination. That's why La Poste Immobilier wanted to invest in the development of a 100% electric Urban Logistics Space in order to ensure the last mile.

### RESULTS

During this first part of my work-study program,

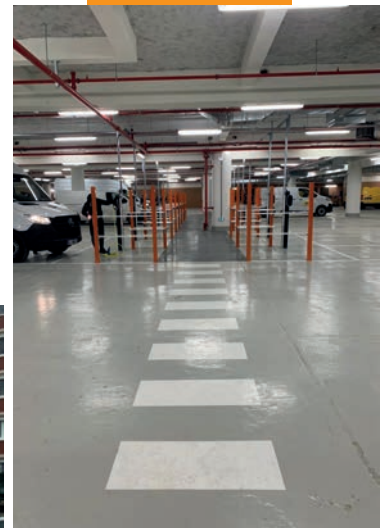
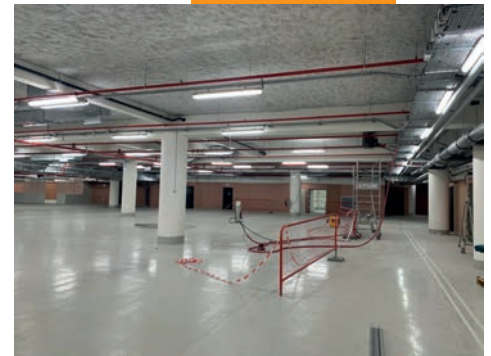
Facade of the Keller building



which lasted 6 months, I was involved in important missions such as the supervision of structural work and all trades, as well as the management of subcontractors. Moreover, I participated in the operations leading to the delivery of the project and I built up the File of the Executed Works as well as the file of deliveries of the different actors of the Project. Besides the managerial and technical part, I was interested in the administrative and financial aspects with the setting up of estimates. Several of my plans of identification were used to better visualize the work to be done and carried out by the subcontractors, and were presented during the financial points. These numerous tasks have allowed me to learn so much about the job. I have developed a great versatility due to my involvement in various and varied missions.

**KEYWORDS :** construction, renovation, building, urban logistics platform.

Keller square slab



Keller Urban logistics platform

Contact : [fatoumata.gueye@etu.univ-orleans.fr](mailto:fatoumata.gueye@etu.univ-orleans.fr)



# Coordination and piloting during the construction of a 120 appartements building

Civil engineering



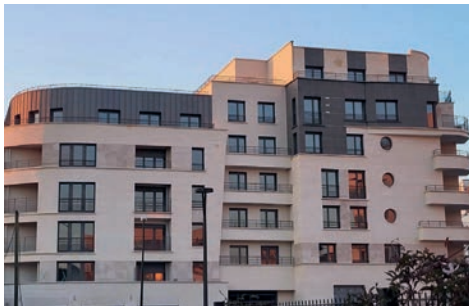
B. HERINGER

**Benoît HERINGER**

Academic supervisor : Duc Phi DO

Industrial supervisor : Jérémie MAZURAS

Company/institution : CAOM Batiment IDF



## OBJECTIVE/MOTIVATION

I have always wanted to directly experience what I have been learning all throughout my life and I have always liked being and working outdoors. Thus, I have always been attracted to working on a construction site. What the company CAOM Batiment offered me was what everything I ever dreamed of, that is piloting and coordinating construction sites by being in direct contact with the workers and the construction, following the advancement of the work and checking the quality of the final products. This gives me the opportunity to put into practice my various teachings,



and acquire a more practical and professional knowledge, be it directly in construction, or in the different relationships among all the people working on the project, together with how to maintain or make these relationships evolve.

## RESULTS

During my professional experience at CAOM Batiment I learned a lot on many aspects. First and foremost, by being immersed in the professional world for a long period of time, I've learned a lot on the technical level, with the various tools available to coordinate the interventions and the workers, or with the many building processes I did not know about, or even the legislation and the rules that regulates buildings and construction. I have also learned a lot on a human/social level, with the many interactions between the operators and the workers, or how to interact with clients and how to talk someone into helping you or doing you a favor, based on how you established good relations with them before. This period also helped me to definitely confirm my choice of career because I really felt like I was doing what I liked.

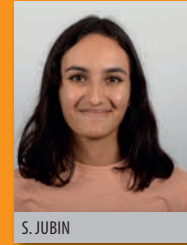
**KEYWORDS** : construction, coordination, precision, learning.



Contact : [benoit.heringer@etu.univ-orleans.fr](mailto:benoit.heringer@etu.univ-orleans.fr)

# Fighting musculoskeletal disorders

Civil engineering



S. JUBIN

**Shivani Jubin**

Academic supervisor : Céline Mallet  
Industrial supervisor : Bruno Ehanno



Company/institution : Eiffage Route IDFCO

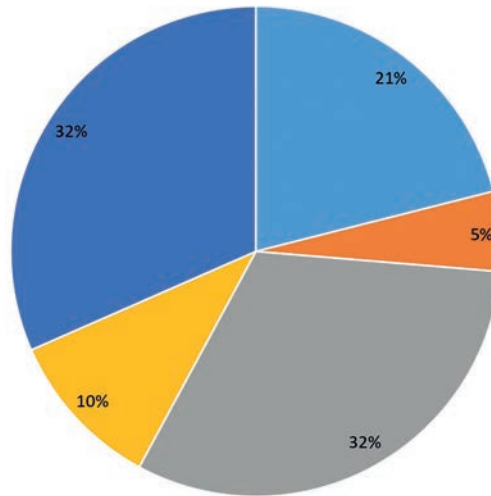
## OBJECTIVE/MOTIVATION

During my first few months of my professional training contract, I had to work on the implementation of muscle warm-ups within our teams on site. Indeed, the working conditions on site present many risks. Most of the following behaviours : carrying heavy loads, repetitive movements, standing work, hard postures favour the appearance of musculoskeletal disorders that are often irreversible. The aim was to evaluate the physical condition of our teams and to set up a protocol to be transmitted and applied each morning by the employees on site.

## RESULTS

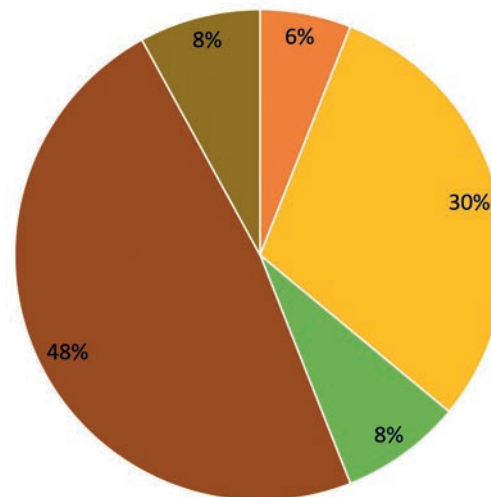
The project began with the evaluation of the pains encountered by all our teams (location and intensity). These data are correlated with the age of the employees as well as their practice of sports or not, and consultations with a health professional (osteopath, physiotherapist) if any. Statistics were drawn up from these various surveys. Finally, a warm-up protocol was set up by a physical trainer from Umaniz, the company we are working with. This 8-minute protocol is adapted to the problems encountered and has been taught to all our teams on site on three occasions. In each team, two referents will be chosen to follow a training course and learn the protocol to be able to carry out the warm-up every morning. In the long term, the aim is to help employees to reduce the pain and to better take care of their bodies

**KEYWORDS :** musculoskeletal disorders, muscular warm-up, physical health, worksite, teams.



Physical pain : upper part of the body

- Hands/Wrists
- Elbows/Forearms
- Shoulders/Arms
- Neck
- No pain



Physical pain : lower part of the body

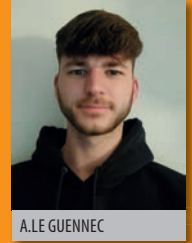
- Top of the back
- Knees/ Legs
- Hips/ Thighs
- Bottom of the back
- No pain

Contact : [feraoirj.fdsnfo@univ-orleans.fr](mailto:feraoirj.fdsnfo@univ-orleans.fr)



# Management of the new "La Banque Postale" site in Olivet

Civil engineering



A.LE GUENNEC

**Alan Le Guennec**

Academic supervisor : Dashnor Hoxha  
Industrial supervisor : Yvon Le Borgne



Company/institution : IBK INGENIERIE

## OBJECTIVE/MOTIVATION

The objective of my professional contract is to manage the construction site of the new "La Banque Postale" site in Olivet, next to the Lorette tram stop. Developed on a plot of 18000 square meters, it will represent an area of 10000 square meters of offices, spread across three buildings, and is expected to be delivered in June 2023. I work closely with the project manager to coordinate the on-site companies with the client's expectations. The stakes are high for me because the building delivery dates are very tight. It is necessary to ensure that the companies respect the imposed schedule while providing quality work. I have to make sure of it every day. I am proud to take part in this large-scale project, and I am convinced that the skills and knowledge acquired during this year will benefit me in the future.

## RESULTS

Three months before the building delivery, the schedule is relatively being respected. The companies in charge of the technical lots are slightly behind, and efforts must be made to ensure nothing hinders their progress. However, some issues persist, and solutions must be found as soon as possible. The companies are relatively understanding, and everyone is doing their best to ensure the smooth running of the project. My next major task is the completion of the Preliminary Reception Operations. It is during this stage that the construction project management team identifies the companies' reservations. This corresponds to the different tasks that need to be rectified by the companies, such as repainting. Next, weekly reports must be transmitted to the companies so they can rectify these reservations. This way, the building delivery will go smoothly.

**KEYWORDS** : site supervision, project management, planning.



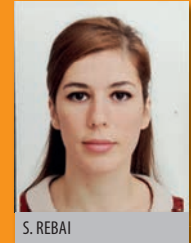
Contact : [alan.le-guennec@outlook.fr](mailto:alan.le-guennec@outlook.fr)





# Monitoring and maintenance of grain storage structures

Civil engineering



S. REBAI

**Sabrina REBAI**

Academic supervisor : Naima BELAYACHI

Industrial supervisor : Antonio TEIXEIRA



Company/institution : AXERREAL

Example 2 of monitoring by deformation sensors

## OBJECTIVE/MOTIVATION

As part of my Civil Engineering and Geo-environmental training, I had the pleasure to carry out an internship within the agro-industrial cooperative group AXERREAL which was followed by a professional training contract. Bringing a fresh eye and being a force of proposal is my main objective during my missions which consisted of the diagnosis of pathologies and project management. I also aim to develop, and above all to put to good use, all the theoretical knowledge that I acquired during my training at Polytech Orleans.

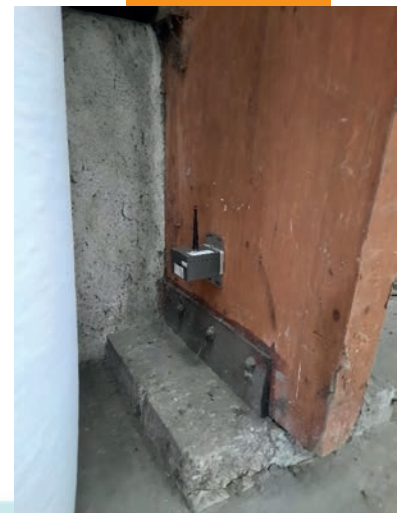
The diversity of the subjects I have encountered as well as their complexity has allowed me to learn more about this field which is not known in the world of civil engineering. Being thirsty to discover new horizons, I did not hesitate embark into my missions and to go beyond my limits.

meetings with the various project actors, etc.). I improved my level of writing technical reports and minutes.

I also had the opportunity to propose technical solutions for rehabilitation subjects, to participate in innovation subjects facilitating the diagnosis process.

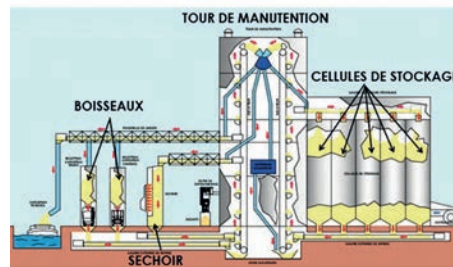
Today, halfway through my professional training contract, I have gone from being an assistant engineer trainee to being a project manager. I am very satisfied with this experience which has made me grow.

**KEYWORDS :** diagnosis of pathologies, strength of proposal of adapted corrective actions, computer assisted maintenance management, project management.

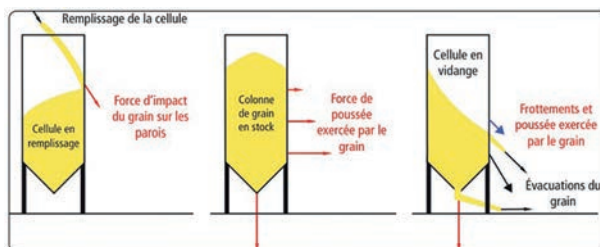


## RESULTS

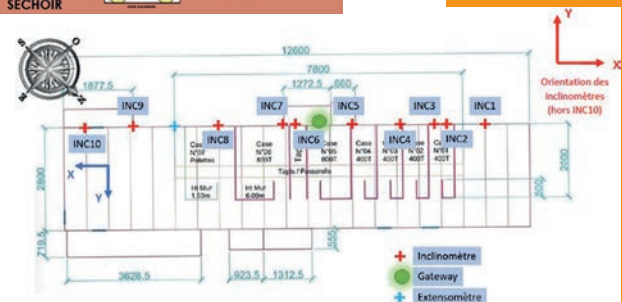
My involvement in my missions allowed me to gain significant responsibilities at the level of the management of projects very quickly. During my various missions, I led work sites and diagnostic visits alone. I also developed my public speaking skills thanks to the various meetings I was able to lead (safety meetings, site follow-up meetings,



Presentation of a grain storage silo



Loads acting on the cells of a silo

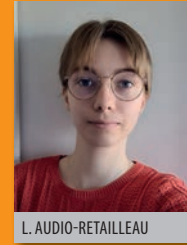


Example of monitoring by deformation sensors

Contact : feraoirj.fdsnfo@univ-orleans.fr

# Realization of operating procedures in ecological engineering

Ecological engineering



L. AUDIO-RETAILLEAU

**Léna Audio-Retailleau**

Academic supervisor : Christian Défarge  
Industrial supervisor : Fabien Josseaume



Company/institution : COLAS



access. In conclusion, these method sheets will be useful in the future to enable the company to be more competitive when customers analyze their responses to calls for tender and to improve its environmental impact.

**KEYWORDS :** rehabilitation, river, operational mode.



## OBJECTIVE/MOTIVATION

In the context of my last year at Polytech Orléans in Civil Engineering and Geo-Environment, I am now a student on work-study programs for COLAS in Rennes. Traditionally, COLAS carries out public works, but the Rennes agency is starting a new activity in ecological engineering and remediation with the desire to diversify into new activities. It is in the context of the development of this new sector that I am in charge of the production of operating procedures. These methods will be used during the constitution of the files of answers to the calls for tender.

## RESULTS

With the help of the different sections of special technical specifications, I had to describe each operation, the objectives and the steps. In addition to the technical steps to achieve the objective of the form, it is obviously necessary to consider the ecological problems generated by the site. Indeed, COLAS Rennes mainly works on maritime and river routes like port or lock, which implies paying a particular attention to the fauna, the flora and to the



Contact : [feraoirj.fdsnfo@univ-orleans.fr](mailto:feraoirj.fdsnfo@univ-orleans.fr)



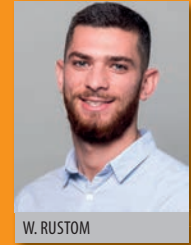
# Assistant for the site supervisor for the construction of an administration building with the association of metal and wood

Civil engineering

**Wadih RUSTOM**

Academic supervisor : Xavier BRUNETAUD

Industrial supervisor : Camille GROUX



W. RUSTOM



Company/institution : OBM Construction



## OBJECTIVE/MOTIVATION

The objective of this project was to build an administration building for the University of Orleans and specifically for the IUT Orleans. The building is essentially made of wood and metal for the structure whereas the foundation is in reinforced concrete. The main objective is to assist the site supervisor who is responsible for the site. I aim to combine my technical knowledge acquired through my academic coursework and my practical skills, and furthermore enhance my professional knowledge and abilities such as social skills, and communication and organizational skills.

## RESULTS

To assist a supervisor responsible for the site was challenging for me, because I have such

responsibilities to deal with. The construction site I worked at during my professional contract is a construction of a 2-floor building of around 1 100 square meters as surface. I had the chance to see and supervise every phase of this project and as result of that, I acquired the required skills such as monitoring all sub-contractors and required inspections, supervising and coordinating additional contracted personnel as necessary and finally inspecting each phase of work to determine if quality standards are met and that trades are completed on schedule.

**KEYWORDS :** construction, building, wood, metal, reinforced concrete.



Contact : [wadih.rustom@etu.univ-orleans.fr](mailto:wadih.rustom@etu.univ-orleans.fr)

# Civil works engineer on a work-study program on a construction site

Civil engineering



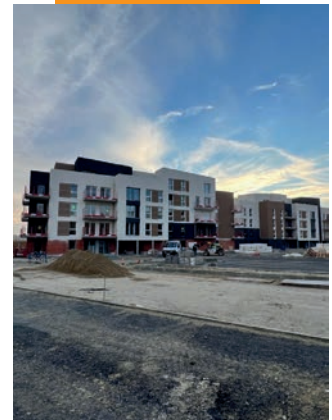
C. SAGA

**Cedric SAGA**

Academic supervisor : Naima BELAYACHI  
Industrial supervisor : Gerald MAYAUD



Company/institution : SOGEA CENTRE



## OBJECTIVE/MOTIVATION

After a gap year during which I carried out two work management experiences in order to discover the profession a little more closely, it seemed obvious to me to continue my last year in a work-study program. I thus joined SOGEA CENTRE, a Vinci Construction group company, advocating values with which I fully identify.

This experience aims to make me develop different skills needed for a civil works engineer under my industrial tutor's supervision. For this, I take advantage of all the knowledge and skills I was able to develop during my engineering training at POLYTECH ORLEANS. My academic tutor ensures that my missions meet the requirements for my training.

Part of a team of 3 managed by my industrial supervisor, our role is to implement all the means necessary for the construction of 110 flats.

## RESULTS

As an apprentice, I get various missions from my tutor and the two other members of the team.

- ▶ I inform about safety and environmental rules and ensure their compliance by all operating teams
- ▶ I participate in the planning and coordination of the works and ensure their proper execution in accordance with the schedule. The use of Lean Management plays a major role here.
- ▶ I manage a sub-contractor in the planning and execution of the work but also on the administrative and financial level.
- ▶ I follow delivery procedures and coordinate the lifting of the main contractor's reservations by the subcontracting companies concerned.

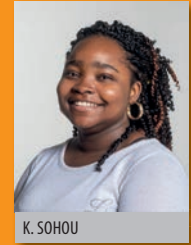
These missions aim to make me operational at the end of my work-study program.

**KEYWORDS :** works site, management, construction, engineering, lean.

Contact : [sagacedric@etu.univ-orleans.fr](mailto:sagacedric@etu.univ-orleans.fr)

# Carrying out energy rehabilitation operations in an occupied site : choice of building priorities for the establishment of a detailed work plan

Civil engineering



K. SOHOU

**SOHOU Karyn**

Academic supervisor : Kévin BECK  
Industrial supervisor : Alban PELLOILLE



Company/institution : France Loire

## OBJECTIVE/MOTIVATION

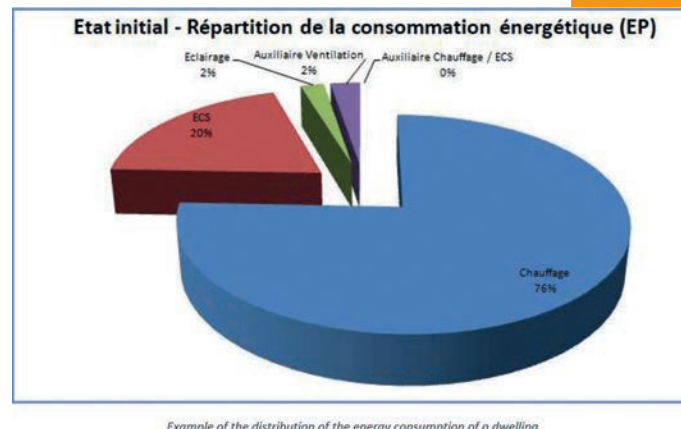
The main objective of social housing is to preserve the social mix of neighborhoods, by offering moderate rents below a regulatory ceiling. France Loire, the company in which I am doing my block release training, is a major player in social housing in the Loiret and Cher departments. Within the Rehabilitation and Urban Renewal pole belonging to the Technical Direction of the Heritage, I hold the position of Heritage Operations Manager (HOM). The HOM ensures the carrying out of rehabilitation operations and improvement/maintenance works of the patrimony, from their definition (elaboration of the works operations), until the reception of the works while ensuring the progress of the works. My main mission is to intervene in the energy rehabilitation operations of buildings, which aim to improve the heritage as a whole and to respect the legal constraints (climate-energy law).

## RESULTS

An energy rehabilitation operation consists in improving the energy performance class. After a census of the DEP (Diagnostic of Energy Performance) of the buildings of the company's real estate stock, it was decided to move those classified as G to a minimum class D (class imposed by the climate-energy law). To do this, there are various solutions that consist of improving the building envelope and/or improving the technical equipment (installation of a heat pump or installation of external thermal insulation). However, before carrying out the work (which is done on an occupied site) and following the initial studies (thermal diagnoses...), my mission consists of piloting and analyzing the work to be carried out in cooperation with all the departments concerned (internal and external). The work proposals consider

criteria such as the targeted energy performance, the safety of the buildings, the financial balance, the location of the building and its stakes (within the framework of an urban renewal project (in Bourges in particular), AFB (Architect of the French Buildings) zone...).

**KEYWORDS :** social housing, energy rehabilitation.

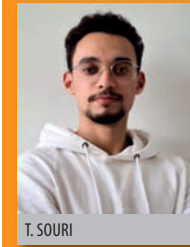


Contact : bellesohou@gmail.com



# Rehabilitation of a self-storage building near Toulouse

Civil engineering



T. SOURI

**Taha Souri**

Academic supervisor : Laurent Josserand  
Industrial supervisor : Cedric Sourbes



Company/institution : Axess

The project's planning



Future visual of the project

## OBJECTIVE/MOTIVATION

As part of my apprenticeship at Axess group, I hold the position of assistant project manager. Therefore, I had the chance to prepare the launch of a new project for the rehabilitation of a self-storage building located near Toulouse. First of all, I created the documents that outline the technical specifications for the services. Then, based on the scope of work and technical specifications, I created a tender package that outlines the requirements for the project. Using our network and research capabilities, I made a list of potential contractors that have the expertise and experience required for each service, to whom I sent the tender package. A few days later, we reviewed the proposals received and evaluated them based on their price and their accuracy with our specifications. Then we worked with the contractors to adjust their offers better and negotiate their price and the terms of their contract further.

## RESULTS

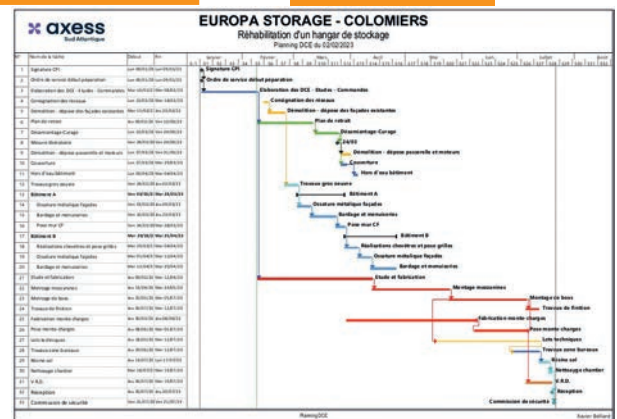
Once negotiations are completed, we award the contracts to the companies that best meets the project's requirements and has the lower price.

The objective of my mission is to get the most of proposals possible which will create the

concurrency needed between the companies. This concurrency is the most importance key in order to reduce the amount of their proposals and save so as much as possible in the budget allocated.

With the help of my colleagues, I have succeeded to find those companies and got their best offers. Unfortunately, we have surpassed the goods lift's budget because its price estimation was wrong. Yet we could have made it up in other purchases such as asbestos removal and RVN (VRD) services.

**KEYWORDS :** self-storage building, construction rehabilitation, project launch, services purchases.



Site installation plan (PIC)

Photo of the current facade

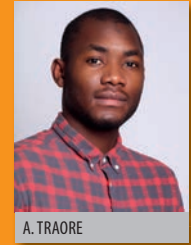


Contact : taha.souri@etu.univ-orleans.fr



# Construction of customer connections, occasional earthworks and on-call work

Civil engineering



A. TRAORE

Aboubacar TRAORE

## OBJECTIVE/MOTIVATION

ERS carries out grouped work for the construction of customer connections, occasional earthworks and on-call work.

My recurrent missions are the creation of budgets to open new cases, of partial accounts for invoices. I also have the responsibility to carry out the various compaction tests before the rehabilitation of the roadways on the different burial sites.

The purpose of these tests is to control the quality of execution of the work in accordance with article 7 of the order of June 22, 2007, from the minister of ecology, development and S sustainable development.

We aim to provide elements to help in the decision on the acceptance or refusal of the works carried out.

The compaction control has the following specific objectives :

- ▶ Checking the thickness of the compacted layers,
- ▶ Checking the norm defined by section within the framework of the C.C.T.P.
- ▶ Defining the compacted zones presenting a compaction defect.

## RESULTS

We refer for the interpretation to the case catalog specific to the penetrometer used,

The penetrogram is



compared to the position of the relevant limit and refusal lines to check if the compaction is as expected.

If not, it will help to determine the severity of the anomaly and its location on the height scale.

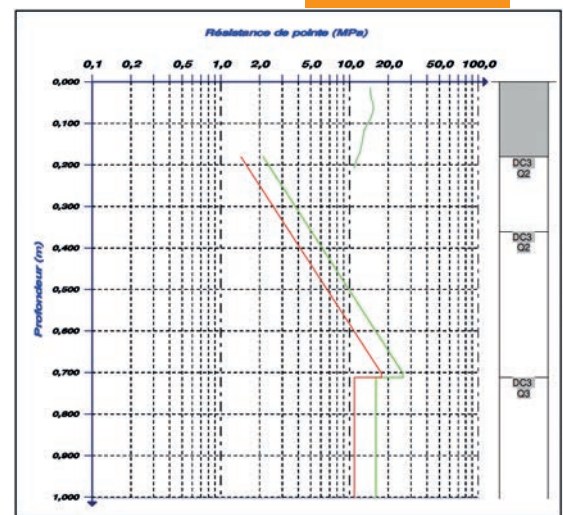
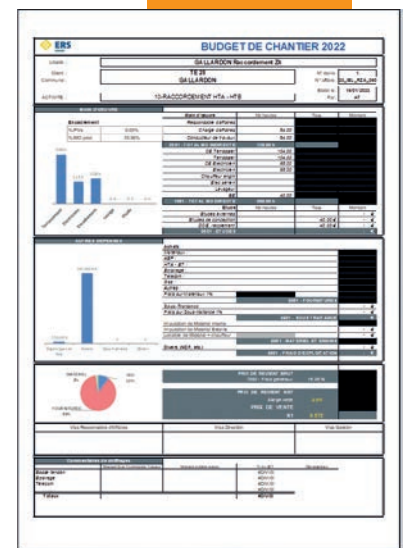
The result of the control is negative when the following anomalies are noted in the sense of XP P 94-063 and XP P 94-105 standards (see appendix 1) :

- ▶ backfill zone: anomalies of types 3 and 4
- ▶ asphalt zone: anomalies of types 2,3 and 4.

In these cases, we ask for a new compaction of the anomaly areas.

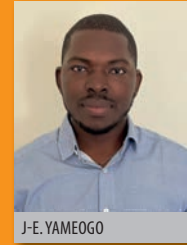
For each test, we carry out a situation plan and a test report including graphs with penetration curves, and any information allowing the interpretation of the result.

**KEYWORDS :** Quality control, Network burial, Compaction test.



# Realization of technical embankments on the site of the former Saint Louis hospital in Evreux

Civil engineering



J-E. YAMEOGO

**YAMEOGO Wendlassida Jean Etienne**

Academic supervisor : Elise REMOND

Industrial supervisor : Stanislas MEJ



Company/institution : Colas France

## OBJECTIVE/MOTIVATION

During my year of professional training contract at Colas Val-de-Reuil, one of the establishments of Colas Île-de-France Normandie, I held the position of assistant works manager. With the help of my works supervisor, I managed the construction of a number of sites, in particular the former Saint Louis Hospital in Évreux, for which VIAMAP was the project manager and SHEMA the contracting authority. This is a technical backfill site. The hospital was deconstructed in 2020 and will be replaced by a major housing project. Colas is involved in the preparatory work (removal of asphalt from the dismantling of the roadway, concrete blocks and stones from it and asbestos waste) and the construction of earthworks (backfill/excavation) with the installation of a subgrade to accommodate the housing.

10 trucks 8x4/day, a V5 compactor, 2 shovels etc.

**KEYWORDS :**  
works manager,  
earthworks,  
management,  
budget, planning.



## RESULTS

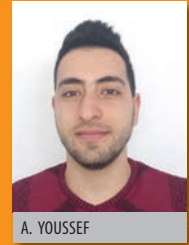
The first stage consisted in preparing the site, in particular defining the techniques and methods of execution with the site manager, sending out consultations, drawing up the provisional budget and planning, drafting the PPSPS and drafting the application forms for approval of supplies. The second stage consisted in carrying out the work. The preparatory phase was carried out in November 2022 and the earthworks phase in 2023. For the earthworks, materials were exchanged with the ZAC du long Buisson, another Colas Val-de-Reuil site located 5 km away. In fact, 11 200 m<sup>3</sup> of A1 clay soil were treated and sent to the former hospital site, compared with 5 665 m<sup>3</sup> of excavated material taken from the former hospital to the ZAC for the construction of a merlon. After backfilling, the subgrade was laid in GNT 0/63 on geotextile. This was an interesting site that mobilised 2 bulldozers,



Contact : [wendlassida.yameogo@etu.univ-orleans.fr](mailto:wendlassida.yameogo@etu.univ-orleans.fr)

# Junior civil structural engineer

## Civil engineering



A. YOUSSEF

**Ahmad YOUSSEF**

Academic supervisor : Naima BELAYACHI

Industrial supervisor : Ramona BADR



Company/institution : EGIS Centre Ouest

**OBJECTIVE/MOTIVATION**

For four years, Polytech Orléans has been offering fifth-year civil engineering students the opportunity to intern at a company of their choice. This seemed like the perfect opportunity for me to gain more work experience as an engineer, instead of just the standard six-month internship required in the fifth year. As a result, I have been employed by 'Egis Bâtiments Centre Ouest', a civil engineering design office for various types of buildings in Orléans. My primary responsibility is to design a housing scheme, including creating building plans and writing technical clauses. Currently, I am working on a project for a large luxury perfume manufacturing and packaging plant on an 18-hectare plot. The project involves constructing a new industrial building that will combine production spaces with employee areas. This internship has provided me with invaluable experience that will help me advance my engineering career.

a vast array of theories and practices, making it a constantly evolving field with endless possibilities. As a structural engineer, assuming the right roles and responsibilities is crucial. The primary focus of structural engineering is on designing and ensuring the physical integrity of structures such as buildings, tunnels, dams, and bridges. A structural engineer is responsible for creating structures that guarantee safety and durability throughout their service period. While architects develop building plans based on size, shape, and usage, it is the responsibility of structural engineers to uncover and resolve any technical issues that may arise during and after construction. Currently, I am working on a project, where I am tasked with calculating according to Eurocode 2 and optimizing the steel sections needed for various reinforced concrete structures.

**KEYWORDS :** structure, reinforced concrete, civil engineer, eurocode 2.

**RESULTS**

Structural engineering falls under the broader discipline of civil engineering and encompasses

Venette Usine  
Parfums

Contact : o22010533@etu.univ-orleans.fr



# 3D printing of cementitious materials based on recycled sands

Civil engineering

**Guillaume Chonier/Arthur Patinote**

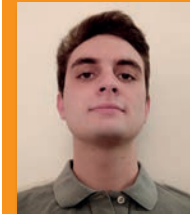
Academic supervisors : Sébastien Rémond/Elise Rémond



Company/institution : Polytech Orléans



G. CHONIER



A. PATINOTE

## OBJECTIVE/MOTIVATION

Our project refers to 3D printing of cement materials based on recycled sands. More precisely, our project consists in developing a non-reactive mineral ink based on limestone filler for example. This ink will allow us to carry out "test" prints by reusing the same material several times in a row. We will then try to print test bodies, from materials developed in another project. Our project is more precisely divided into several milestones :

Milestone 1 : Formulation in the laboratory and characterization in the fresh state of the test ink.

Milestone 2 : Handling of the robot and the 3D design software.

Milestone 3 : Printing of the proof bodies and setting of the printing parameters with the test ink.

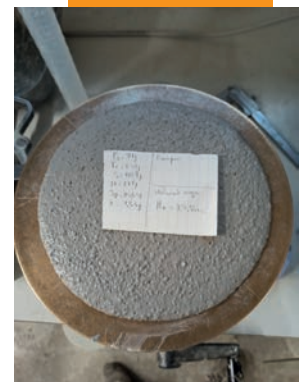
Milestone 4 : Printing of the "durability" proof bodies. / Milestone 5: Printing of the "mechanical" proof bodies

## RESULTS

The first part of our project consisted in formulating a printable mortar based on recycled sand. We succeeded in finding a formulation answering the various criteria characterizing this kind of material.

In a second time place, our objective was to find the formulation of a reusable ink from limestone filler. This work were very difficult because the use of limestone as a replacement for cement is a little known and little explored subject. However, by testing different formulas, we managed to create a non-reactive material with chemical properties almost identical to those of mortar. However, our work is not complete because there are still many reactions in our mixture that we cannot explain. Further research on the chemical reactions between the limestone filler and the admixtures would be necessary. But the totality of this work would deserve to be the main subject of a future project.

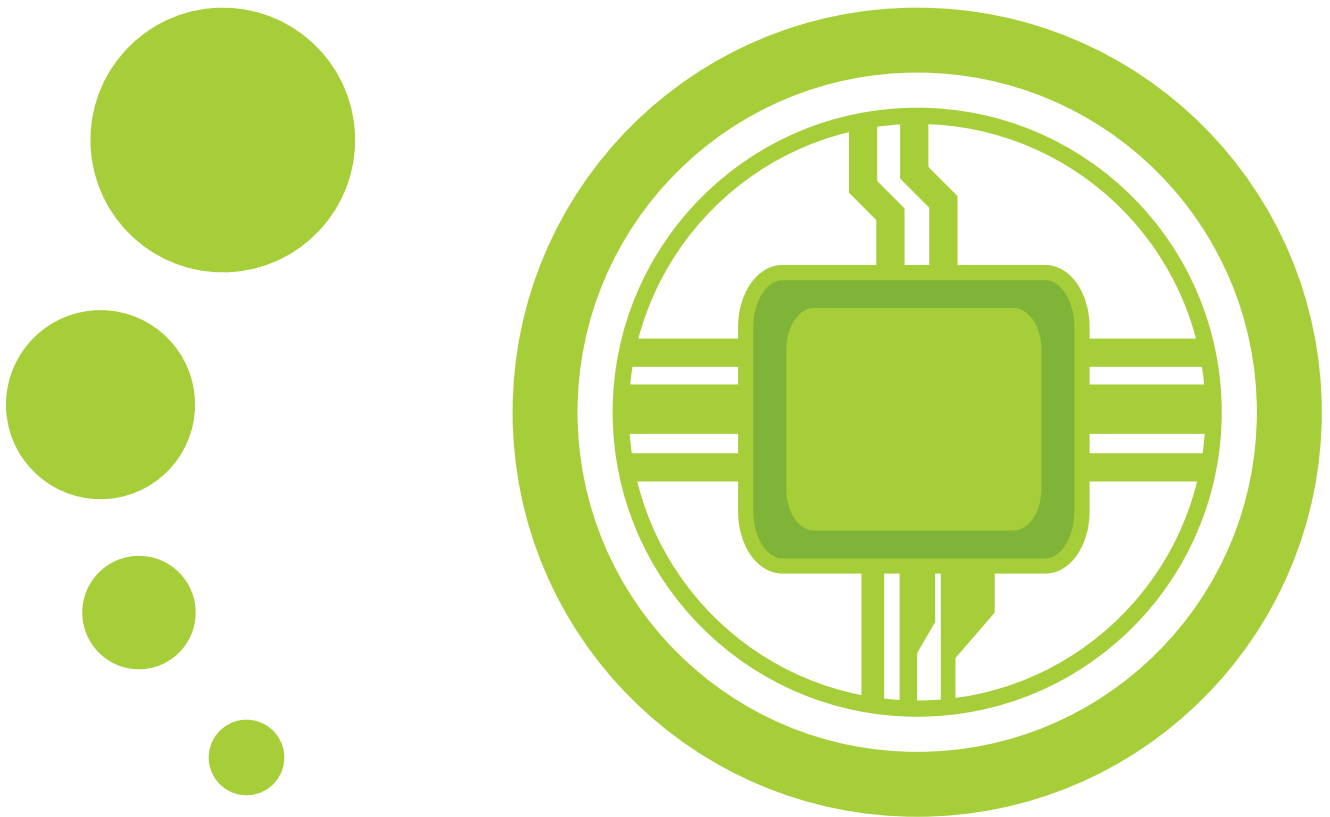
	Mortier n°9	Mortier n°10	Mortier n°11	Mortier n°12
Filler Calcaire	725	725	725	725
Fumée de Silice	80 (10%)	80 (10%)	80 (10%)	80 (10%)
Sable	1128	1128	1128	1128
Eau	201	241	261	251
Super-plastifiant	12,08 (1,5%)	12,08 (1,5%)	12,08 (1,5%)	12,08 (1,5%)
Viscosant	1,61 (0,2%)	1,61 (0,2%)	1,61 (0,2%)	1,61 (0,2%)
Étalement moyen	12,25	15,8	18	17,2
Impression	Imprimeable, bonne tenue	Imprimeable, bonne tenue	S'écoule seul de la seringue, tombe au bout de 5 couches	Imprimeable, bonne tenue
Remarque	Mauvais étalement mais bonne tenue	Mauvais étalement mais bonne tenue	Mauvais étalement, mauvaise tenue	Bon étalement, bonne tenue



Contact : gchonier@gmail.com/arthurpatinote@icloud.com



Engineering  
**Physics and  
Embedded Systems**



# Innovative medical lighting module

Industrial engineering

**Baptiste Schoonbaert/Isaline Ndobi A Dong Nzie Boyer/Maxence Philippe**

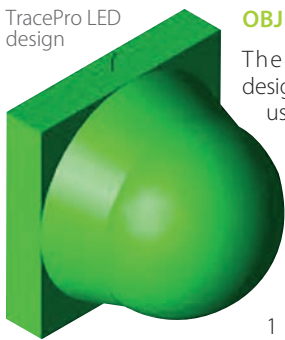
Academic supervisor : Sophie Rager

Industrial supervisor : Cecilia Valteau

**MAQUET**  
GETINGE GROUP

Company/institution : Maquet SAS

TracePro LED  
design



## OBJECTIVE/MOTIVATION

The project consists of designing a module for lighting used in an operating room.

For this module, space constraints were given, and the LEDs were provided. The project's objective is to obtain an illumination spot diameter of 20 cm at 1 m. To achieve this, it is necessary to select a standard

lens from a manufacturer's catalogue, but also to design the module containing LEDs and lenses. It is therefore imperative to design and manufacture a support that allows the lenses to be held at a

specific distance from the LEDs to achieve the photometric objectives. For this purpose, an electronic board on which the LEDs are soldered must be made. Finally, to obtain a functional LED lighting module, the different components must be assembled, and tests must be carried out to check that the module is working properly.

## RESULTS

First, we did the optical part by using Tracepro. To do this, we modelled LEDs with CAD (Computer Assisted Design), made ray files to match the chosen LED, and then checked that the data in TracePro matched those in the datasheet. Then we tried several lenses and with a catalogue we determined the standard model of a lens to focus the beam and obtain the desired result of diameter spot  $\phi$  with  $d$  as its distance.

Then we designed the PCB (Printed Circuit Board) routing according to the number, type, and position of the LED, and the thermistors. For the mechanical part, a support to hold the lenses above the PCB was designed in Creo.

Finally, we are assembling our module and preparing the compliance tests to check whether the designed prototype meets the criteria of the technical specifications.

**KEYWORDS:** lighting, medical, optic, mechanic, electronic.



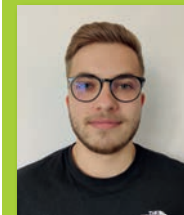
Surgeons and Maquet SAS medical lighting



B. SCHOONBAERT



I. NDOBI



M. PHILIPPE

Edmund Optics lenses



Contact : [baptiste.schoonbaert@etu.univ-orleans.fr](mailto:baptiste.schoonbaert@etu.univ-orleans.fr)/  
[isaline.ndobi-a-dong-nzie-boyer@etu.univ-orleans.fr](mailto:isaline.ndobi-a-dong-nzie-boyer@etu.univ-orleans.fr)/[maxence.philippe@etu.univ-orleans.fr](mailto:maxence.philippe@etu.univ-orleans.fr)

# Developing an API between a router and a circuit board

Electrical engineering



N. JEHANNO

**Nathan Jehanno**

Academic supervisor : Rodolphe Weber  
Industrial supervisor : Antoine Bourneron

Company/institution : Novo Nordisk

## OBJECTIVE/MOTIVATION

The project is about developing an interface (API) for a new Router that the Guinault company bought to replace the old ones.

To do so I had access the new tektonika router (RUT955), a circuit board used by Guinault, a ST-link v2 debugger and several antennas.

The first step was to develop a python code to recover certain pieces of information from the router and another to modify the PIN code of the simcard.

The next steps were to adapt those codes in C, which is the language used to configure the circuit board in the STM32CubeIDE software and to flash the program in the circuit board.

## RESULTS

The expected outcome of the project is a well-functioning API that allows the user to retrieve information from the router and to modify some parameters in anticipation for the replacement of all the previous routers used by Guinault on their different units.

In the end, even though the development of the C class was left partially incomplete, the code in Python, was finished and is working well. I discovered and learned about lots of new tools such as JSON API and HTTP requests which I'm sure are going to be useful in my career.

**KEYWORDS :** API, JSON, HTTP requests, router.



Contact : [nathan.jehanno@etu.univ-orleans.fr](mailto:nathan.jehanno@etu.univ-orleans.fr)

# Key Hive : smart key box with limited individual key access

Electrical engineering

**SOMMIER Etienne/DE MASSOL Georges/DI PERI Thomas**

Academic supervisor : M. CHETOUANI



Company/institution : Keyhive

## OBJECTIVE/ MOTIVATION

The goal of this project is to create a limited access key box.

A user with an authentication badge will scan it to open the box. He then has access to the keys to which he has been authorized. By pressing the button next to the key, the key is released.

If the user wants to put a key back in, he can press the button again to raise the mechanism and insert the key ring up to the limit switch, blocking the key ring.

If a user tries to force the box, a motion detector triggers an alarm.

Access to the keys is managed by an administrator on an Android application. This application communicates with the box via Wi-Fi.

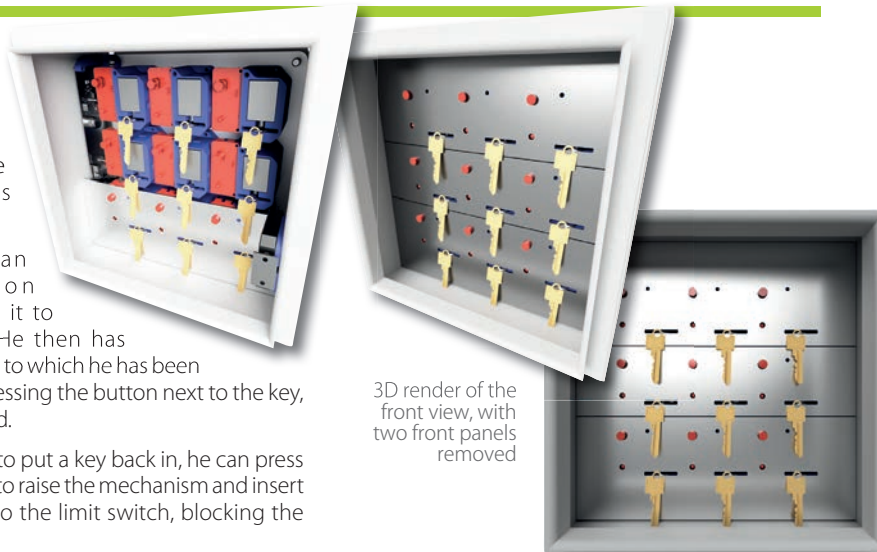
## RESULTS

For the mechanical part, the whole key box has been modeled in 3D and assembled.

For the electronic part, cards have been designed and prototypes have been made and tested. They are fully operational.

For the software part, an application for management of the box was created and a database containing the users was also created.

**KEYWORDS:** electronic, software, application.

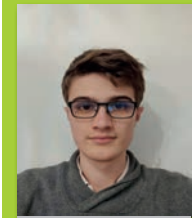


3D render of the front view, with two front panels removed

3D render of the Key block view : the key block board in red, with its button and LED. The key is held with a solenoid



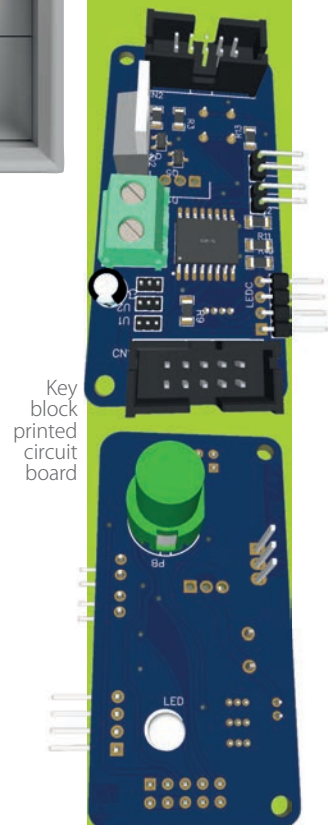
E. SOMMIER



G. DE MASSOL



T. DI PERI



Key block printed circuit board

Contact : [etienne.sommier@etu.univ-orleans.fr](mailto:etienne.sommier@etu.univ-orleans.fr)/[georges.de-massol@etu.univ-orleans.fr](mailto:georges.de-massol@etu.univ-orleans.fr)/[thomas.di-peri@etu.univ-orleans.fr](mailto:thomas.di-peri@etu.univ-orleans.fr)



# The three-dimensional realignment of a scanning lidar

Electrical engineering

**Cheick DIABY/Robin BOUCHARD/Yasmine HAMMACHE**

Academic supervisor : Sylvie TREUILLET

Industrial supervisor : Dominic CHAMPNEYS

**VAISALA**

Company/institution : VAISALA



C. DIABY



R. BOUCHARD



Y. HAMMACHE



## OBJECTIVE/MOTIVATION

The precise measurement of wind direction is important for a variety of industrial and scientific applications, ranging from weather forecasting to climate monitoring, and wind energy. However, traditional methods of measuring wind direction using anemometers can be limited in their accuracy and scope. To enhance these methods, the company VAISALA has developed a system that offers a highly accurate way to measure wind direction, but its reliability depends on accurate calibration.

The proposed project aims to improve calibration of a device by using computer vision techniques to match reference points in a camera image with another image that those carry reference points.



The resulting calibration will significantly enhance the accuracy of the device measurements, with new possibilities for the development of wind energy and other applications.

## RESULTS

The project has progressed in several stages. First, we researched and selected two algorithms for reference points detection and matching: algorithm 1 and algorithm 2. Then we implemented and tested them using python programming language.

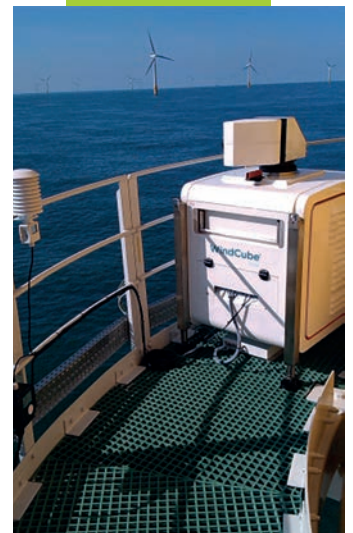
### ► The first algorithm

This algorithm is now capable of detecting reference points in the camera's images. However, because of some specific parameters, the matching part is not properly working now. We need to understand the possible problem and find the best way to optimize the matches, considering these parameters.

### ► The second algorithm

Concerning the blob detection, the algorithm can detect keypoints in both images and match them, with the possibility to fix the number of points we want to detect. The algorithm also provides information on the position of the detected points. However, the matching can produce some incorrect matches due to the similarity between points, leading to errors in the alignment of our device. So, it is important to make improvements to the matching part in order to reduce the matching errors and to have a better accuracy of the keypoints positions in order to perform the calibration of the device.

**KEYWORDS :** wind Lidar, Lidar beam calibration, camera pose estimation, mapping, object detection and matching.



Contact : [cheick.diaby@etu.univ-orleans.fr](mailto:cheick.diaby@etu.univ-orleans.fr)/[robin.bouchard@etu.univ-orleans.fr](mailto:robin.bouchard@etu.univ-orleans.fr)/[yasmine.hammache@etu.univ-orleans.fr](mailto:yasmine.hammache@etu.univ-orleans.fr)

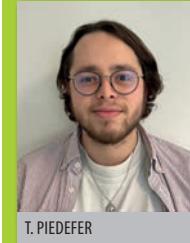
# Gonio-reflectometer trailer

Embedded system engineering (lighting design)

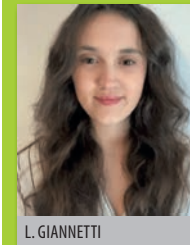
**Tom PIEDEFER/Laura GIANNETTI/Tahina RALALA**

Academic supervisor : Christophe CACHONCINLLE

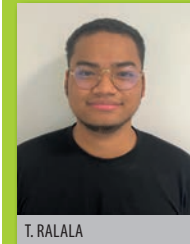
Industrial supervisor : Camila LE BERTRE



T. PIEDEFER



L. GIANNETTI



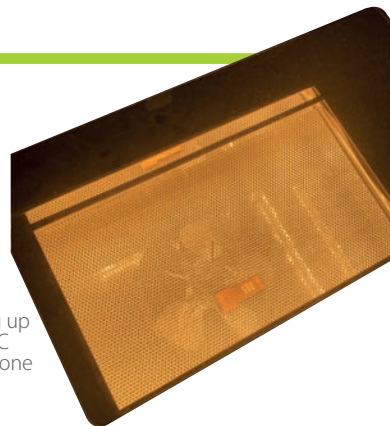
T. RALALA

## OBJECTIVE/MOTIVATION

What we are looking for in that project is to know how light reflects on the ground. This can be done thanks to an on-board system inside a trailer being able to calculate and to transmit to the driver the luminance coefficient of the road (or specifically its coating) without leaving the vehicle. This multidisciplinary project indeed gathers several engineering aspects which makes it more interesting than one might expect at first glance. Speaking of multiple domains, wireless communication, lighting design and structure modeling are the three different parts required here to meet customers' expectations as well. That's why building a functional prototype is the best way to keep all the focus on that project because of just realizing some simulation part or a feasibility study means boring stuff in our mind.

## RESULTS

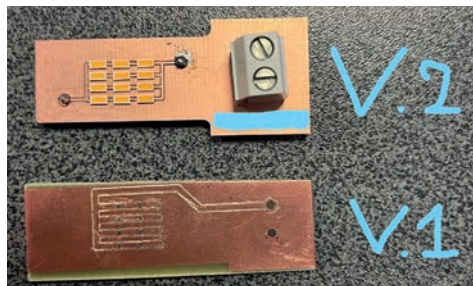
As this project is at the beginning, we don't have any results yet. However, building a prototype being able to get the luminance coefficient needed and its interface enabling it to control the system are the sought-after deliverables that we have to give to the company at the end. We expect to have a



It was heating up to 210°C for this one

functional user interface that will display the measured values in addition to the date and the GPS position of the system as well. Thanks to that, the user could get all he wants without going out of the car. If the project works well, measured luminance should correspond to those measured during the simulations. A first version of the PCB receiving the LEDs has been made which will permit a first test to be started. This part is for emulating a light source which will be reflected by the ground to eventually get that coefficient after some calculation.

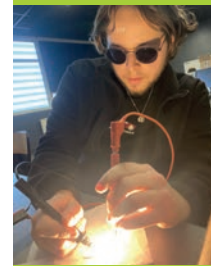
**KEYWORDS :** on-Board luxmeter, wireless, reflectivity, lighting design, multidisciplinary.



Comparing the first version of our PCB to the newest one



Oven for soldering LEDs to printed circuit board



Tom trying to light up the LEDs on the PCB (after the oven stage)



Tahina trying to put on the glue for welding (before the oven step)



Laura trying to put on the glue for welding (before the oven step)

Contact : [tom.piedefer@etu.univ-orleans.fr](mailto:tom.piedefer@etu.univ-orleans.fr)/[laura.giannetti@etu.univ-orleans.fr](mailto:laura.giannetti@etu.univ-orleans.fr)/[tahina.ralala@etu.univ-orleans.fr](mailto:tahina.ralala@etu.univ-orleans.fr)





# Microplasma process for local removal of organic materials

Industrial engineering

**BERESSI Théo/LHERMITE Pierre-André**

Academic supervisor : DUSSART Rémi

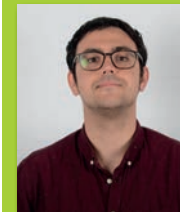


Company/institution : Polytech Orléans

Selected participant  
17<sup>th</sup> annual final year projects forum



T. BERESSI



P-A. LHERMITE

## OBJECTIVE/MOTIVATION

Packaging is one of the essential industrial steps at the end of microcomponent fabrication. It is necessary to both protect the microdevice and connect the microscopic world to the macroscopic one. The aim of this project is to develop and test a new concept based on a microplasma to elaborate fine packaging systems in microelectronics. In particular, this innovative process should be able to optimise the production performances. This project will consist of removing organic polymer layers locally with high resolution using microplasmas generated by micro-discharges. The objective of removing these layers locally is to avoid additional steps and make the process simple and less expensive.

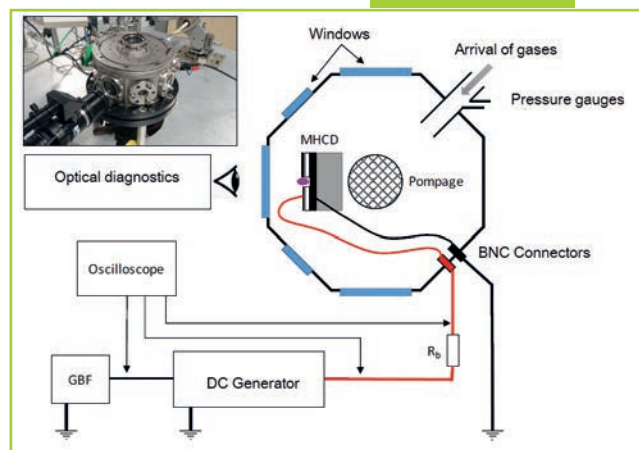
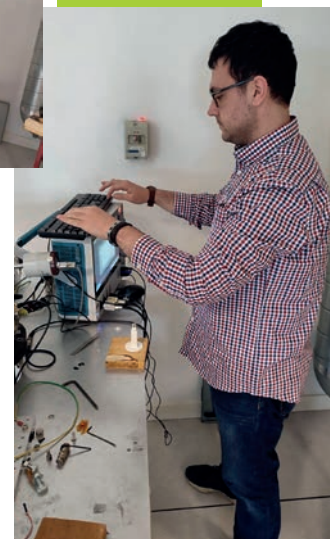
## RESULTS

Before testing the process, intermediate tasks have been carried out: recover data via an oscilloscope, conceive a system holder, and create a camera holder to observe the micro-discharge. We then moved on to the tests: we first verified that our

micro-discharges were stable in helium gas environment. After that, we performed the same tests while adding a small amount of O<sub>2</sub>

to create reactive species. We found the limit of oxygen content to be about 1%, above which the discharge becomes unstable and difficult to maintain. However, the removal does not yet seem to have occurred despite the short distance between the microdischarge and the sample. Two options remain: design a system to pass a gas through the micro-discharge, which will project the plasma created against the samples or bias the samples so that the plasma propagates naturally towards them.

**KEYWORDS :** etching, removal, microdischarge, plasma.



Contact : [theo.beressi@etu.univ-orleans.fr](mailto:theo.beressi@etu.univ-orleans.fr)/[pierre-andre.lhermite@etu.univ-orleans.fr](mailto:pierre-andre.lhermite@etu.univ-orleans.fr)

# Laser experimentation implantation in order to proceed to plasma diagnostics

Industrial engineering



B. SOLER

**Baptiste Soler**

Academic supervisors : Titaina Gibert/ Rémi Dussart



Company/institution : Polytech Orléans

## OBJECTIVE/MOTIVATION

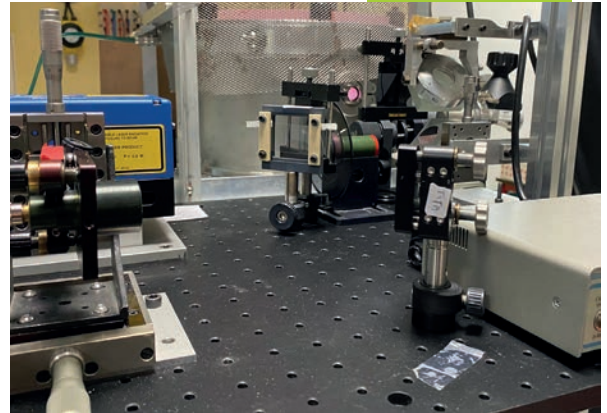
In a research context, for Polytech Orléans, the objective of this project is to design an optical assembly in order to proceed to plasma diagnostic. RF argon plasma is a useful tool in microelectronic and the precise quantification of metastable Ar species is crucial. Laser absorption measurement is an accurate and complete diagnostic. A tunable monomode infrared laser beam passes through the Ar plasma. The wavelength is accurately tuned on the absorption transition of the metastable at 811,5311nm. The plasma will create some metastable Argon atoms with high energy and those metastables will interact with and absorb some of the laser. Plasma temperature and metastable density are deduced by measuring the intensity and the width of the absorption signal leading to a better optimization of the plasma conditions.

## RESULTS

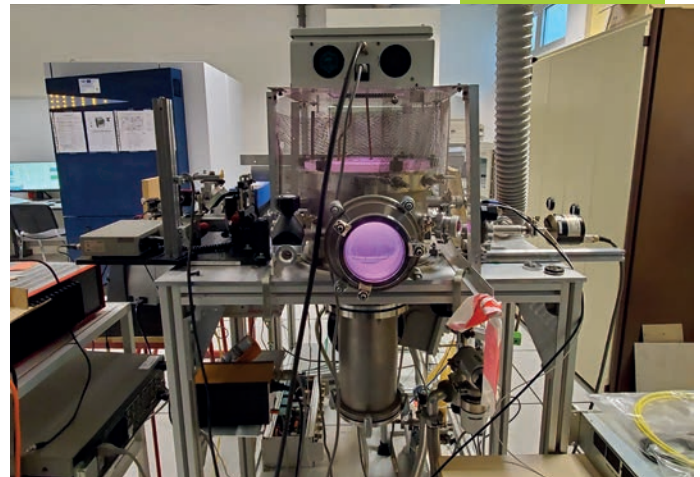
The optical bench has been designed and assembled. A control line and an active line are functional. Measurement have been done, clear and repeatable results are being acquired. Optimization, noise reduction, understanding of the problems are in process.

**KEYWORDS :** laser, plasma, absorption, optical bench.

Optical assembly



Adjustment of the assembly



Argon plasma

Contact : [baptiste.soler@etu.univ-orleans.fr](mailto:baptiste.soler@etu.univ-orleans.fr)



# Camera emulation on an FPGA (bio-medical application)

Electrical engineering

**Julien Chapel/Léo Marmande**

Academic supervisor : Christophe Alayrac

Industrial supervisor : Vincent Bodin



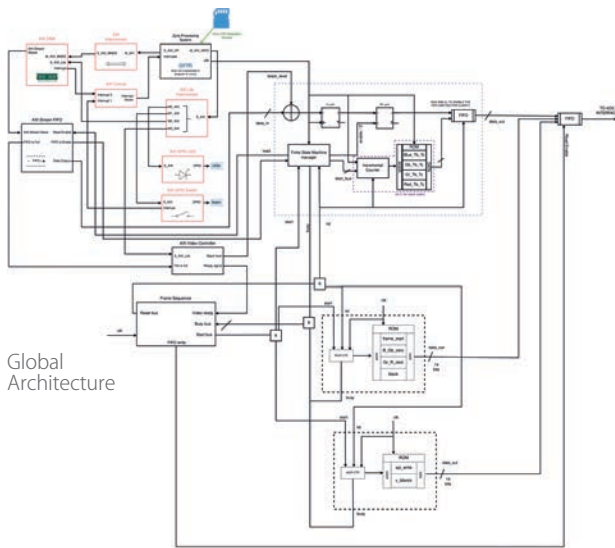
Company/institution : Axess Vision Technology



J. CHAPEL



L. MARMANDE



controlling device. As this is merely an introduction to an internship, the team will focus on generating the signal for a fixed image (without parameters).

### RESULTS

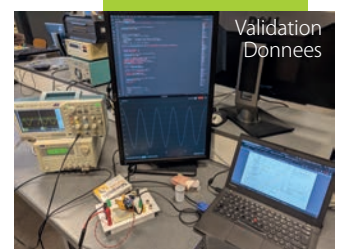
The first results obtained by the team come from simulations ran through the developing software. The image-loading system, using the FPGA chip and an ordinary processor to load the image from a SD Card, is functional and can transmit the data to the signal-generating subsystem. This last subsystem is composed of multiple blocks : the fixed signal generation, the image conversion to an analogic signal, and the assembly of those two to construct

the main output. The fixed part is validated, using Python scripts and FPGA simulation. The image conversion is validated through Python, and is undergoing design. The global architecture is fully designed, and will be tested once each block has been validated.

**KEYWORDS :** FPGA, bio-medical, emulation, electronics.

### OBJECTIVE/MOTIVATION

This project aims to fully emulate an endoscopic camera, with image control, in order to test its displaying device, which is the surgeons and nurses during a medical operation, it was developed by the Axess Vision Technology company. The camera is emulated using an FPGA chip (an electronic component whose electrical circuit can be redesigned using a proper language and software) and a Digital to Analog Converter (to replicate its output signal). Thus, the delivered system will load a chosen image, add digital noise and change its contrast if prompted, it will then generate the output of the camera taking these three variables into account. The signal is composed of three successive parts : reading from the controlling device, sending the Bayer-filtered image using a specific protocol, and writing to the



Contact : [julien.chapel@etu.univ-orleans.fr](mailto:julien.chapel@etu.univ-orleans.fr)/[leo.marmande@etu.univ-orleans.fr](mailto:leo.marmande@etu.univ-orleans.fr)



# Implementation and evaluation of an AI model on different FPGA Boards

Electrical engineering



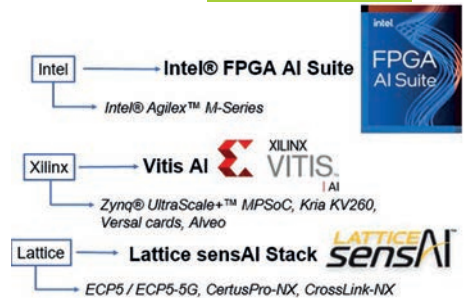
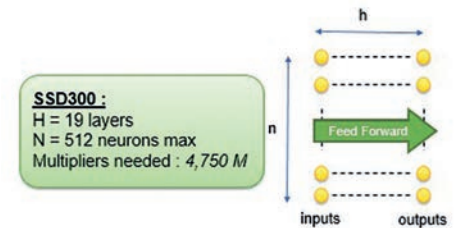
A. KONGYRBAYEVA

**Aigerim Kongyrbayeva**

Academic supervisor : Christophe ALAYRAC  
Industrial supervisor : Christophe ALAYRAC



Company/institution : Cresitt Industry



## OBJECTIVE/MOTIVATION

The project consists of researching different families of FPGA Boards to, in the end, implement an AI model. The AI model is aimed at detecting faces and counting the number of people in a camera. This model's performance was already tested on Raspberry Pi 3 and Jetson NANO, and now the objective is to evaluate it on an FPGA board.

The reason for that is that FPGA boards allow us to do the same tasks quicker than on GPU or CPU boards thanks to its reprogrammable circuits, parallelism, and its on-chip memory. In addition, it has an advantage in its low consumption. So the objective is to find several FPGA boards with parameters which are suitable to integrate the AI model.

## RESULTS

The expected outcome is a comparison of the AI's performance on different FPGA platforms. A table of criteria for the FPGA characteristics for the integration of this particular AI is important in the end. However, as it is only a two-month project there is no time to do the implementation part. So the expected result of the project was changed to the state-of-the-art solutions. Finally, the delivery of the project will be a documentation with proposed solutions and steps to finish the idea. The study allows us to find important key features of boards to implement any other AI models in the future.

**KEYWORDS :** FPGA boards, ai model, multipliers, on-chip memory.

Contact : aigerim.kongyrbayeva@etu.univ-orleans.fr

# Design and implementation of a mesh BLE 5.1 network for temperature with PT100

Industrial engineering



E. AFFITCHIN



J. N'GUESSAN

**Eric AFFITCHIN, Justin N'GUESSAN**  
Academic supervisor : Rodolphe Weber



Company/institution : Polytech Orléans

## OBJECTIVE/MOTIVATION

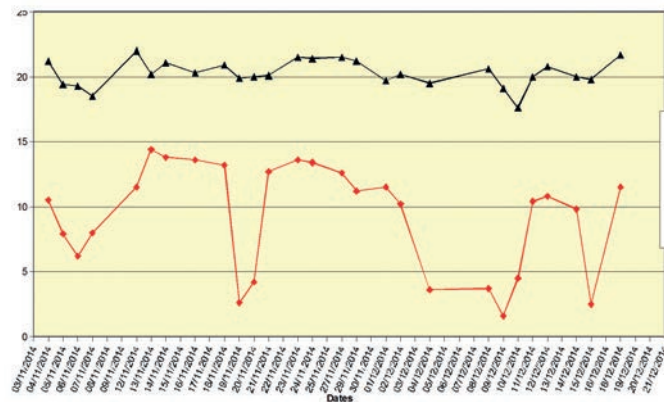
Our project is focused on bio-waste composting. To make a good compost, some standards have to be respected. In particular, the compost hygienization, which consists in eliminating the possible pathogenic agents present in the organic waste, is mandatory. This is done by compost self-heating where high temperatures must be reached for a certain period of time. Our system is a network of autonomous temperature sensors. Our project is to set up a reliable network based on Bluetooth Low Energy (BLE 5.1).

## RESULTS

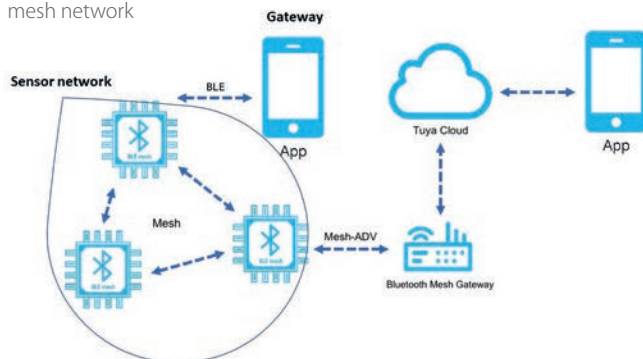
We set up a BLE 5.1 mesh network using two EFR32BG22 boards. We programmed these boards in C using Silicon Labs' Simplicity studio software. And for the tests we generated values to ensure that the transmissions took place between the two cards.

**KEYWORDS :** compost, mesh network, BLE 5.1.

temperature curve of the compost over time



mesh network



Contact : [eric.affitchin@etu.univ-orleans.fr](mailto:eric.affitchin@etu.univ-orleans.fr)/[yoboua-justin.nguessan@etu.univ-orleans.fr](mailto:yoboua-justin.nguessan@etu.univ-orleans.fr)

windrow monitoring

# SensoVerse a more inclusive communication system for deaf people in metaverse

Electrical engineering

**Lesly Thion/Wenze Xu/Romain Pajon**

Academic supervisor : Rodolphe Weber  
Industrial supervisors : Patrice Aubinaud/Jim Smith

3<sup>rd</sup> place and Innovation price of 17<sup>th</sup> annual final year projects forum



Company/institution : Atos



L. THION



W. XU



R. PAJON

logo projet  
sensoverse



## OBJECTIVE/ MOTIVATION

Nowadays, there are still inequalities for people with disabilities, such as with deaf people. They can't do some of the same jobs and activities that everyone does in their daily life like making appointments, doing outdoor activities, attending a public service or even playing online and going into the metaverse. Our idea is based on establishing a more inclusive communication system in the metaverse. This system would allow deaf people to communicate with other users via gloves that would translate sign language into a sequence of words which are understandable by everyone in the metaverse. Moreover, beyond reducing inequalities in everyday life, there is also an excellent value for metaverse companies

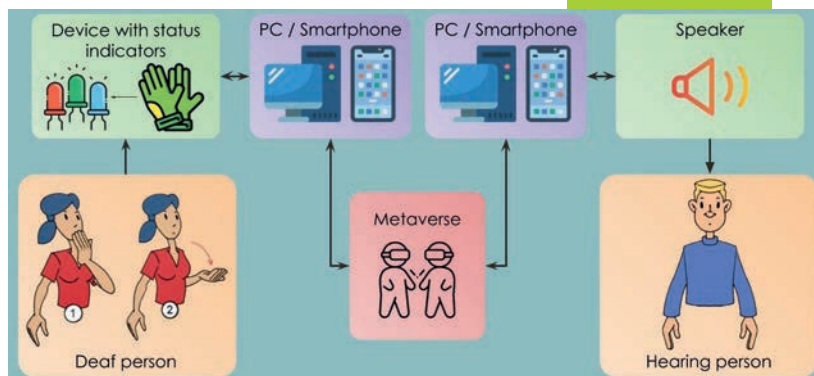
that will be able to reach a new clientele and for companies that wish to use the metaverse they will be able to make it more easily usable by everyone.

## RESULTS

The result is a system consisting of a pair of gloves with sensors, battery, microcontroller and wireless module on the gloves. There is also a software program that can be run on a PC or smartphone and two patches. The deaf person must put the gloves on and attach the two patches on her where she wants. The only requirement is that one of them is on the right and one on the left of the body. In order to have a good detection of gestures, the system needs to be calibrated each time it's switched on and every 15 minutes during operation by a series of gestures. The system is currently able to recognize about twenty gestures such as "hello", "Are you OK?" and "thanks" and "you", to make complete sentences such as "Hello, how are you?" and transmit it in audio.

**KEYWORDS :** metaverse, deaf, translator.

SensoVerse



Contact : [lesly.thion@etu.univ-orleans.fr](mailto:lesly.thion@etu.univ-orleans.fr)/[wenze.xu@etu.univ-orleans.fr](mailto:wenze.xu@etu.univ-orleans.fr)/[romain.pajon@etu.univ-orleans.fr](mailto:romain.pajon@etu.univ-orleans.fr)

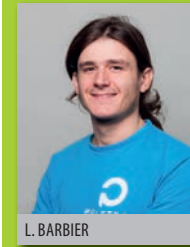


# Development of immersive sensors to monitor the mechanical performance of underground mining backfills

Electrical engineering

**BARBIER Louis**

Academic supervisor : JENNANE Rachid



L. BARBIER



Company/institution : Polytech Orléans



## OBJECTIVE/MOTIVATION

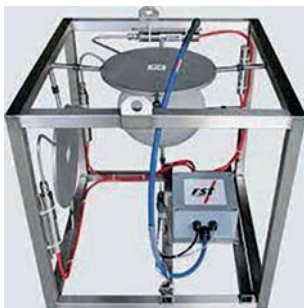
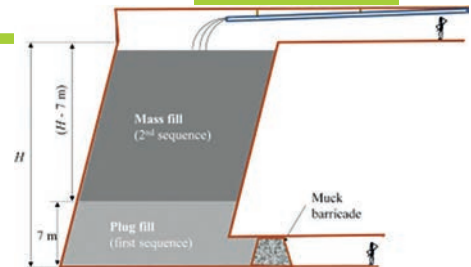
My project is about finding or developing immersive sensors that can be used to monitor the mechanical performance of backfills in underground mines. Backfill is a crucial material used to fill underground voids created during the mining process. It's important to monitor the density, compaction, and mechanical resistance of backfill to ensure the safety and stability of underground mines. The goal of my project is to identify or develop sensor technologies that can measure the mechanical resistance of a thin and homogeneous material in a range of 0 to 2 Mega

Pascal. The sensors should be robust enough to withstand high pressure and loads, cost-effective, and easy to process signals.

## RESULTS

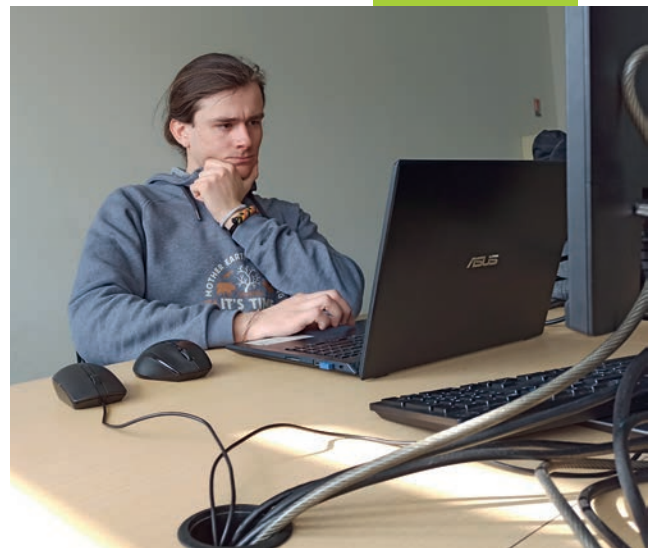
To accomplish this, I will conduct a literature review to understand the current methods and technologies used for monitoring mechanical performance of underground mine backfills. I will then evaluate different sensor technologies such as ultrasonic sensors, strain gauges, and pressure sensors, among others. Based on the sensor requirements and evaluation, I will select the most suitable technology for this specific application.

**KEYWORDS :**  
sensors, backfill.



 **HOLCIM**

 **LAFARGE**



Contact : louis.barbier-mongay@etu.unic-orleans.fr

Industrial  
**Engineering applied to  
Cosmetics, Pharmacy  
and Food Processing**



# Development of specifications for the creation of a liquid packing line for the International Cosmetics House of Cosmetic Valley

Industrial engineering

**Léo Chauvet/Amandine Mangin/Shizhen Wang**

Academic supervisors : Gilles Hivet/Julien Roussel

Industrial supervisors : Ségolène Leloutre/Bintou Samassa



Company/institution : Cosmetic Valley

## OBJECTIVE/MOTIVATION

The Cosmetic Valley is a competitive cluster for the cosmetic perfume industry in the world. It brings together all the actors, territories, and expertise of the sector.

It carries the project of the “Maison Internationale de la Cosmétique” (International Cosmetics House), which will open its doors in 2026 in Chartres. There, companies will be able to discuss and share ideas. The public will be immersed in the excellence of Made in France, its cultural heritage, its industry innovations, and its challenges through a life-sized visit to the cosmetics ecosystem, from the raw materials to the finished product.

Our role is to design a liquid packing line for this Cosmetics House by establishing technical specifications. Our shared challenge with Cosmetic Valley is to have a functional liquid packaging line by 2026 that illustrates the challenges, the professions, and the issues of the packing industry.

## RESULTS

We determined several specifications by establishing multiple decision matrices about : the

packaging and the galenic: a small glass bottle with a light product such as a perfume ; the packing steps, described in detail : arrival of components, filling, assembly of the spray rod, capping, casing, printing of the lot number, boxing, dispatch of the final product, and quality controls ; the form of the model: we are aiming towards a combination of real-life and a functional line, light projection to animate the packing line without exceeding the budget allocated to us, and more detailed video, which highlights consecutively the different steps of packing to explain visitors in a pedagogical way and make the experience more delightful. To make the specifications more visual, we developed multiple 3D models about the different solutions we established to help Cosmetic Valley make its choice.

**KEYWORDS** : cosmetics, packaging line, international, model, international cosmetics house.



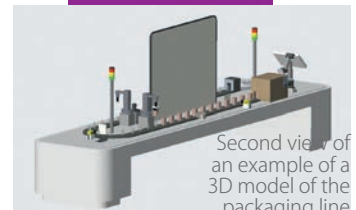
A. MANGIN



S. WANG



First view of an example of a 3D model of the packaging line



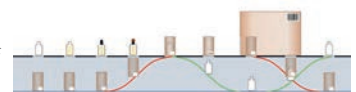
Second view of an example of a 3D model of the packaging line



International Cosmetics House in Chartres



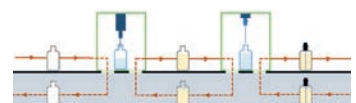
Upside view of the International Cosmetics House



Inside view of the International Cosmetics House



Inside view of the International Cosmetics House



First schematic of a system developed for a model of a packaging line for a museum

Contact : [leo.chauvet@etu.univ-orleans.fr](mailto:leo.chauvet@etu.univ-orleans.fr)/  
[amandine.mangin@etu.univ-orleans.fr](mailto:amandine.mangin@etu.univ-orleans.fr)/[shizhen.wang@etu.univ-orleans.fr](mailto:shizhen.wang@etu.univ-orleans.fr)



# Problem-solving on packaging line

Industrial engineering



Company/institution : Novo Nordisk

**Clara GOIRAND/Xuancen LIU/Yu ZHANG/Madiha FEDDAL**

Academic supervisors : Audrey HIVET/Cécile CAPDESSUS

Industrial supervisor : Camille VENTROU



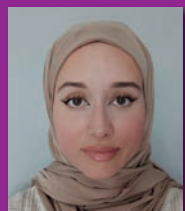
C. GOIRAND



X. LIU,



Y. ZHANG,



M. FEDDAL

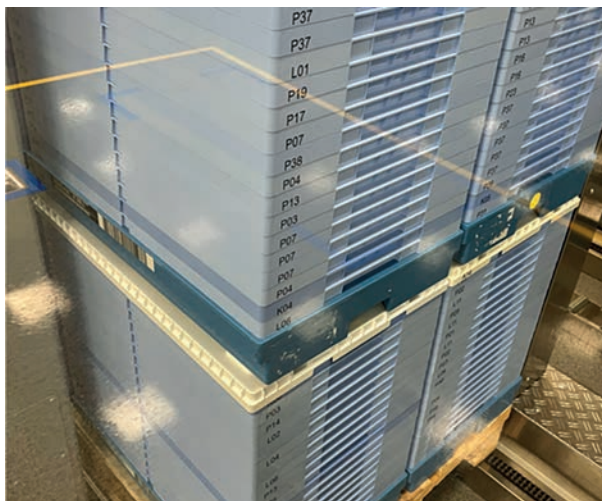
## OBJECTIVE/MOTIVATION

Novo Nordisk is known for the fabrication of diabetes products. We can find these products in the form of a pen. On a pen packaging line several problems were identified, such as pallets being out of alignment, so that they do not fit together, resulting in unstable and misaligned pallets. This creates insecurity for the operators who have to align pallets by hand, which can cause back pain. The instability of the pallets creates the risk that at any moment they could fall and injure a person or break/damage material (hence creating waste). Because of this problem, the company has on this line 50% of pallets presenting a defect, which is not negligible and leads to a loss of time to put back the right pallets as well as money and energy. Therefore, it is necessary to analyze the situation and identify the root causes to implement or at least propose a corrective solution.

## RESULTS

First, we built a cause tree as detailed as possible in order to find the possible origins of the problem, that are called root causes. It was not easy to establish because in order to find as many causes as possible we must be able to think without being influenced. For example, why is this pallet broken ? We should not think directly "because something broke it", maybe it is because of the mould that it broke. Once the diagram was detailed, we presented it to our academic tutors but also to our industrial tutors, who validated it. From this point we thought about the countermeasures we could put in place and sorted them out according to where the problem was and who was able to implement the solution, either Novo Nordisk or the supplier.

**KEYWORDS :** pharmaceuticals, problem solving, packaging line.



Project schematic

Contact : clara.goirand@etu.univ-orleans.fr/  
xuancen.liu@etu.univ-orleans.fr/yu.zhang1@etu.univ-orleans.fr/madiha.feddal@etu.univ-orleans.fr

# Losses of mascara juice on manufacturing and packaging department

Industrial engineering



B. BRUNET

**Béatrice Brunet**

Academic supervisor : Jean Philippe Blondeau

Industrial supervisor : Marion Laine

**L'ORÉAL**

Company/institution : L'Oréal, BRI plant

## OBJECTIVE/MOTIVATION

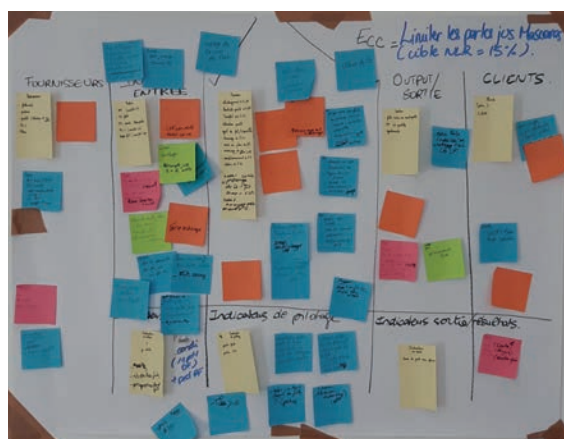
BRI plant is one of the four in L'Oréal's luxury division. Make-up of brands like Yves Saint Laurent or Lancôme is packaged in this factory. The challenges of BRI follow economic and environmental themes. From an economic point of view, it must ensure the profitability of brands. To this end, it aims to reduce the financial share of losses, which is included in the price of the product.

From an environmental point of view, the factory aspires to an environmental transition, which involves a reduction of wastes, part of which is represented by losses on the lines. In this aim, a Green Belt project is set up, to reduce the losses of mascara in the manufacturing and packaging department, by thinking about solutions that respect economic and ergonomic constraints.

## RESULTS

Today, overall losses of the mascara juice are 19% for the year 2022, with a standard, defined by the management department, at 17%. The goal of the Green Belt project is to reduce losses at 15%. This teamwork uses a tool called DMAIC. Define, Measure, Analyze, Improve and Check are the steps for thinking about the issue and eliminate its causes. This team is composed of experts on the subject: production engineer, mascara line operator, producer, technician, process engineer. One part of the project concerns staff working in manufacturing and the other those working in packaging. The project will take 7 months.

**KEYWORDS** : packaging, losses, make-up, performance, green belt.



Contact : [beatrice.brunet@etu.univ-orleans.fr](mailto:beatrice.brunet@etu.univ-orleans.fr)

# Small kaizen project about flexible hoses used in the production area

Industrial engineering



M. DA SILVA FERREIRA

**Mélani DA SILVA FERREIRA**

Academic supervisor : Jean-Philippe BLONDEAU

Industrial supervisor : Axel MAZE-SENCIER

**L'ORÉAL**

Company/institution : L'Oréal



## OBJECTIVE/ MOTIVATION

To elaborate a process fabrication, the operators must introduce raw materials into the fabrication tank using a flexible hose, which is connected to the tank, to suck the raw material into it. But those flexible hoses are not always available (dirty or missing). The challenge is to make sure a define number of flexible hoses is available for every fabrication tank, ready to use. To meet the project's expectations, the first step is to gather information about the daily use of hoses, on each manufacturing tank. After that, the creation of a workshop space to make the flexible hoses would be needed. Training the operators in making the hoses and make sure all new operators get to do it will be essential. Finally, finding a way of controlling the implemented solution, and analyze its efficiency.

## RESULTS

With the help of the operators, I have been able to gather information needed about the daily use of hoses, and I have noticed that several tanks meet the exact same need. The task finding a workshop space has been completed. Indeed, a place already existed in the unit, where operators and technicians are used to make flexible hoses. The next steps are to order every material needed to make enough flexible hose, put the right amount on each tank and tag them (this will be a control to make sure no hoses are missing). The final step will be to train every operator to make a flexible hose and present the new standard of how to use it. The project should be closed by the end of march, after all the solutions implemented have been validated as standardized.

**KEYWORDS :** kaizen, process, flexible hose, production.



Contact : [melani.da-silva-ferreira@etu.univ-orleans.fr](mailto:melani.da-silva-ferreira@etu.univ-orleans.fr)



# Reduction of changeover time between 2 production orders

Industrial engineering



C. FAUPIN

**Charline FAUPIN**

Academic supervisor : Cécile CAPDESSUS

Industrial supervisor : Angèle RIGOLET

**GUERLAIN**

Company/institution : GUERLAIN

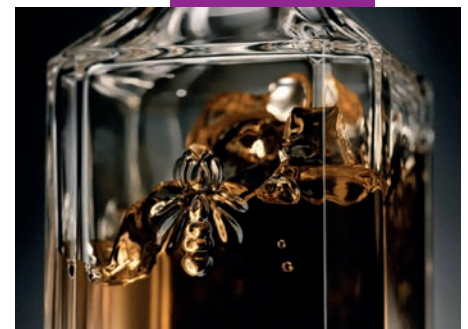
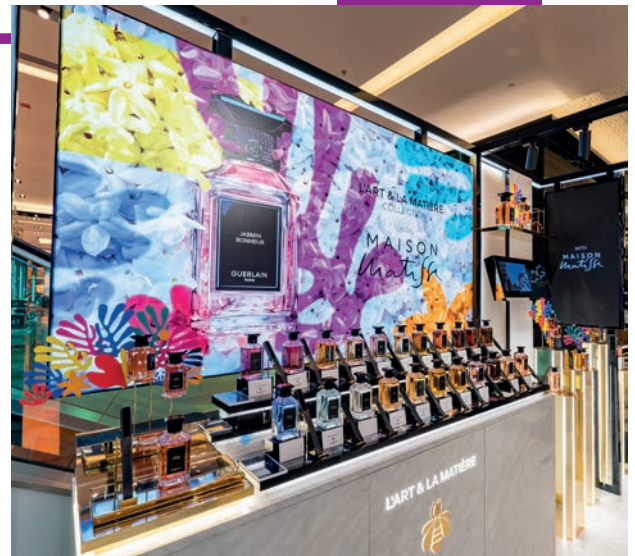
## OBJECTIVE/MOTIVATION

The House of Guerlain was founded in Paris in 1828 by Pierre François Pascal Guerlain. The founder of the House wanted to create unforgettable perfumes, renowned throughout the world. The family house was bought by the LVMH group in 1994. Today, Guerlain's ambition is to strengthen its position as leader in high perfumery. To achieve this, the acceleration of the "L'Art et La Matière" fragrance collection is a priority. With more than 20 fragrances, this collection is produced at the Orphin factory, and my assignment is to reduce the changeover times between 2 production orders on the single line that packages these products. Currently, changeover times are recurrent and can represent 10% of a daily production because the quantities produced are reduced and quality comes first. Thus, product changeover easily becomes time-consuming.

## RESULTS

The Single Minute Exchange of Dies method is the best way to reduce this time. Framed by the AFNOR standard, the objective is to identify the internal

operations that must be done with the machine stopped and the external operations that can be done while the machine is running. After this analysis phase, the aim is to convert a maximum of internal operations into external ones and then to rationalise them. I supervise a project group of 12 people who interact with the line. This project is monitored by the following indicator: the rate of product changeover achieved below the set time target. Once the SMED project is completed, this will allow Guerlain to meet the schedule adherence thanks to a production where time losses are eliminated and reduce inventory as batch sizes are reduced to perfectly match customer demand.

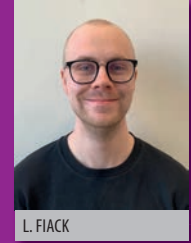


**KEYWORDS:** SMED, format changeover, lean, production, luxury.

Contact : [charline.faupin@gmail.com](mailto:charline.faupin@gmail.com)

# Continuous improvement of the packaging/depackaging of chromatography columns at the bioproduction site of huningue at Novartis

Industrial engineering



L. FIACK

**FIACK Louis**

Academic supervisor : HIVET Gilles  
Industrial supervisor : VERNET François



Company/institution : Novartis Pharma

## OBJECTIVE/MOTIVATION

The Huningue biomanufacturing site is facing increasing demand while its production lines are at saturation point. Within the entire production process, my department, which is responsible for delivering compliant chromatography columns on time, is a bottleneck in production. The main objective is to reduce the Package/Depackage time from the current 2 weeks to 1 week. I also set up a change of a reference of drums into sterile drums to save time. To achieve this, I am carrying out several tasks such as optimizing storage in the room due to a lack of space, or operations to improve ergonomics at the workplace for technicians.

## RESULTS

All the projects I have launched in recent months are underway.

"Change of drums to sterile drums": About half the tasks have been completed, such as the study of the needs, the evaluation of the criteria for the new drums, the contact with suppliers... However, a last-minute change of needs has led to an extension of the project by about 2 months, pushing the end of the project to the end of May. "Ergonomics in the package room": This project groups together several sub-projects such as the installation of holders for safety bars in the room, the modification of parts on the chromatography columns and the development of a support for changing valves. All these projects are at the stage of validation of the quotation with my manager.



**KEYWORDS:** biotechnology, pharmaceutical industry, lean management, chromatography, ergonomics.



Contact : [louis.fiack@etu.univ-orleans.fr](mailto:louis.fiack@etu.univ-orleans.fr)

# Optimisation of ink cartridge use on production lines

## Industrial engineering

**Anis gouami**

Academic supervisor : Stéphane LEROUX  
Industrial supervisor : Christophe LEJAY

Company/institution : Delpharm

### OBJECTIVE/MOTIVATION

Delpharm is currently facing an issue with the changeover time on two of their solid form packaging lines. This process begins at the end of the previous production of the last batch, with the withdrawal of articles and corresponding parts, followed by cleaning, assembly, adjustment of equipment, supply of packaging items, quality checks, and finally, the start-up of the line for the next batch.

To overcome this challenge, Delpharm aims to optimize these steps and reduce the overall changeover time. Interestingly, the dry form manufacturing sector did not have a specific schedule for their activity, relying instead on the packaging schedules for planning their manufacturing workshops.

To address this, Delpharm is exploring ways to streamline their processes and improve efficiency across the entire manufacturing operation. By reducing changeover time, the company can enhance productivity, minimize costs, and ultimately provide better service to their customers.

### RESULTS

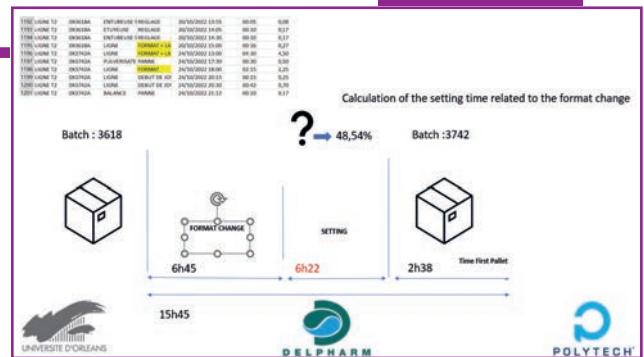
There are 4 results expected. The first one, monitoring of the condition of parts (in good condition, needing replacement or missing to be purchased). Then, a visual recognition of parts by operators changing formats. In addition of this, complete size carts. And to finish a significant reduction in the time required for changeovers

Once the solution is installed, a written procedure describing the method of collecting all the information needed for a size change will be put in place.

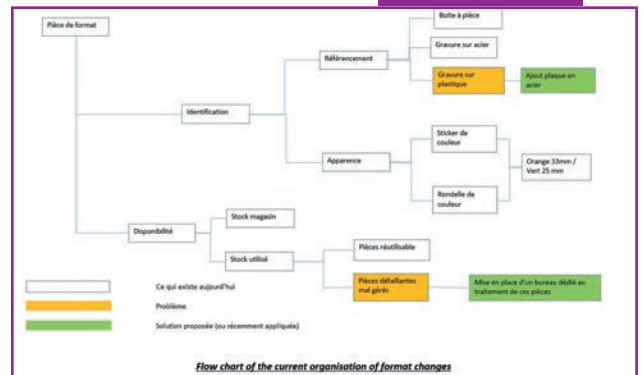
The operators preparing the size carts and the operators performing the size changes will be informed of the new measures concerning the visual identification of the parts, which will be aligned with the size cards on the carts.

Today we are at the "Identification of the parts necessary for each format" stage. We are in a phase of recovering the list of parts necessary for each format for each of the 2 lines, with a view to creating a document grouping them with the most complete data possible.

**KEYWORDS :** continuous improvement.



Example of setting time calculation per extraction



Flow chart of the current organisation of format changes



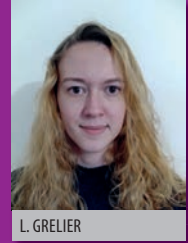
Setting up a solution

Contact : anis.gouami27@gmail.com



# Introducing the general service department

Industrial engineering



L. GRELIER

**Grelier Ludivine**

Academic supervisor : Audrey Hivet  
Industrial supervisor : Deborah Grout

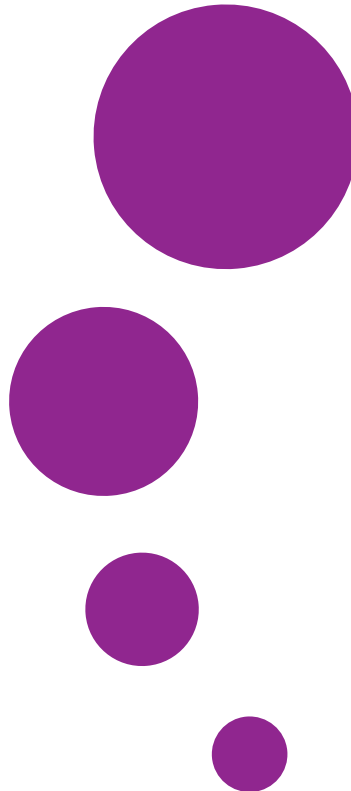
## OBJECTIVE/MOTIVATION

The General services department's mission is to provide leadership and best practices in managing facilities, supplies, maintenance and other support services to the site. They are responsible for activities such as industrial cleaning, pest control, archiving, food service, furniture management, maintenance of green areas, moves, forklift truck, communication with department and city, visual audio, water distribution system. This department is also responsible of the building maintenance department, whose goal is to take care of the housekeeping and the road maintenance. The goal of the company is to provide safe, effective and quality vaccines in the shortest possible time, in sufficient quantities and accessible to all at the best cost. To do so, general service department must ensure the safety of their customers (people on site and patients) and ensure that the building are in a sufficient condition according to the GMP.

## RESULTS

In the general services department, my assignment is to develop quality document management as part of continuous improvement or in connection with a correction following an internal or external audit. With this objective in mind, I am responsible for modifying some document link to the department and for following the department indicator.

**KEYWORDS** : general department.



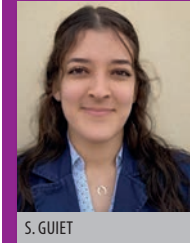
Contact : [ludivine.grelier@etu.univ-orleans.fr](mailto:ludivine.grelier@etu.univ-orleans.fr)

# Develop, maintain and improve the compliance and performance of the Brive plant's laboratories

Industrial engineering

**Sarah Guiet**

Academic supervisor : Jean-Marc Aufrere  
Industrial supervisors : Jacob Levy/Emilie Pejoine



S. GUIET

incubation of the products before the different quality controls



Company/institution : Bledina

## OBJECTIVE/MOTIVATION

The objective is to achieve the highest level of compliance at the laboratory management level based on the Danone standards applicable to their activities (which are based on ISO 17025).

To achieve this, the work must first be planned by identifying the gaps and establishing a conceptual strategy. Then implement it and exploit the output data. Afterwards, periodic reviews with the relevant people are needed to verify that the strategy is robust and effective in correcting the deviations, and finally to act by implementing corrective actions

In order to position ourselves, we have at our disposal an analytical performance evaluation grid which provides us the audit grid and the scoring system. The requirements of the quality management system must be evaluated, following this, we can have access to a percentage of compliance, and the audit status: A – B – C

## RESULTS

The objective is to obtain an audit status of B at the end of 2022 and A during the year 2023.

After a self-assessment that took place in April 2022, the following score was obtained: C: 52%  
The work was based on this internal audit. We had at our disposal the standard grid with the non-conformities as well as the corrective actions to be set up.

In November 2022, two external auditors came to the factory in the quality control laboratories and we obtained the following score: B: 61%  
We have validated the first objective: to move from a C to a B score by the end of 2022.

The perspectives are therefore to resolve the non-conformities following the order of prioritization established in order to hope to reach an A score (Danone excellence) at the end.

**KEYWORDS :** AQ, CQ, management system, standards, compliance, performance.



Air sampling in production area



Disinfection of products before entering the microbiology room

Contact : [sarah.guiet@etu.univ-orleans.fr](mailto:sarah.guiet@etu.univ-orleans.fr)

# Updating of specifications

## Industrial engineering



I. JEAN

**Ilona JEAN**

Academic supervisor : Thomas SAYET  
Industrial supervisor : Gaetan LANDELLE



Company/institution : SODEBO



### OBJECTIVE/MOTIVATION

Specifications are an essential element when referencing a raw material. It defines the specific need for the company's raw materials in relation to the use made on the site. In addition, it is thanks to this document that it is possible to formulate non-conformities when raw materials are received at the production sites.

Recently, all microbiological criteria for raw materials have been updated. Following this modification, it is necessary to update the specifications so that they correspond to company's real expectations concerning the quality of the raw materials received on the production sites.

This update will also make it possible to re-challenge the criteria already present in the current specifications.

In order to be as efficient as possible in this updating, work was carried out on the form of the blank specifications to facilitate their reading and completion. In addition, a process that minimizes updating time while being relevant and efficient has been put in place.

### RESULTS

Many specifications need to be updated. The objective is to update all raw material specifications while prioritizing certain raw materials that are more sensitive than others. The established process should enable the company to update more specifications than with the previous process. This update will be monitored on a weekly basis through selected indicators.

The re-evaluation of the criteria already present in the current specifications will finally lead to relevant specifications corresponding to the new context and objectives of the company.

Once the specifications have been updated, the formulation of non-conformities observed during the delivery of raw materials can be done more easily and serenely by raw materials quality department.

**KEYWORDS :** supplier quality, update, specifications, raw materials, non-conformities.

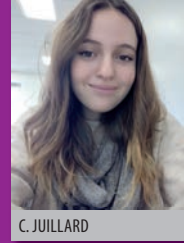


Contact : [ilona.jean@etu.univ-orleans.fr](mailto:ilona.jean@etu.univ-orleans.fr)



# Reduction of the time devoted to repairs in the “parts and components” sector

Industrial engineering



C. JUILLARD



Company/institution : Louis Vuitton

**Coline Juillard**

Academic supervisor : Thomas Sayet  
Industrial supervisor : Samuel Cordonnier

## OBJECTIVE/MOTIVATION

Parts and Components (PCD) is a specific sector of the N°2 workshop in Ducey (50). It has two functions: the first is to produce spare parts that will be assembled on a customer's product in order to repair it: this is the “spare parts” part. The second is to produce the components that will be assembled with the finished products of the production: it is the “components” part.

My assignment concerns the “spare parts” part. During the manufacturing process of a part, errors can be created: these errors lead to repairs. A repair is equivalent to working time without creating added value. The goal of my project is to reduce the time devoted to repairs and thus to guarantee a better “right the first time” production.

## RESULTS

At the moment, a first part of the project has been done. This part concerns the setting up of

an indicator to quantify the number hours devoted to repairs per day. This indicator was created via a PowerBi. It allows to highlight the number of hours according to the sector, to take out the most important defects (those which cause repairs). It also allows to compare the day D and the day D-1.

The following steps are to take in hand this tool and to use it in order to set up action plans. The priorities of the action plans will be elaborated according to the seriousness of the defect and its frequency of appearance. These action plans will allow to reduce the number of hours of repairs per day in the long term and thus to increase the production which is right the first time.

**KEYWORDS :** luxury, quality, spare parts, repairs.



Contact : [coline.juillard@hotmail.com](mailto:coline.juillard@hotmail.com)

# Continuous improvement of production workshops

Production engineering



I. LAPORTE

**Laporte Iléana**

Academic supervisor : Mohamad Fathi Ghanameh  
Industrial supervisors : Franck Perard/Jennifer Bertrand



Company/institution : Laphal Industries

## OBJECTIVE/MOTIVATION

The main objective of my project is to improve the production workshop as a whole. Various fields of action are to be addressed, the first is the optimization of production lines and their manufacturing process. Indeed, for the year 2023, customer demands have increased by 46% for some lines, so improving the performance of each line is essential. Secondly, the general organization of the workshop with changes in planning, team meetings and team management. The last point to improve is the documentation by making it as easy and intuitive as possible for the operators. Documents need to be continuously updated



Bottle filling module for primary packaging

following customer requests or product modifications. Numerous procedures are also necessary to meet the requirements raised during the ansm audit. My projects present several challenges: economic by improving yields, societal to ensure the well-being of teams and quality to meet standards of the pharmaceutical industry.

## RESULTS

For my first work-study period, I carried out an inventory of the production on the 3 main lines: filling and secondary packaging of syrups, filling ampoules and secondary packaging ampoules. Afterwards, I made a dashboard with 4 performance indicators: synthetic yield rate of each line, breakdown of downtimes on production times (technical times, contingencies times and fixed times), origin of technical downtimes and breakdown of fixed times (cleaning, line start-up, line emptying). This allowed us to highlight the most recurrent events that cause us to lose time as well as the modules of each line that cause the most technical downtime. The production manager can identify possible investments on each line and to prioritize the necessary improvements. The budgeting and investment meeting for the new year takes place in March, so the production managers can use my dashboard to justify the necessary investments.

**KEYWORDS** : analysis, optimization, performance, improvement, autonomy.



Blister pack 2ml ampoules for secondary packaging



Sealing ampoules by welding for primary packaging

Contact : [laporteleana@orange.fr](mailto:laporteleana@orange.fr)

# Continuous improvement on blister packaging lines

Industrial engineering



A. LEROUX



Company/institution : Elaiapharm Lundbeck

**Adèle LEROUX**

Academic supervisor : Eric COSTANZO  
Industrial supervisor : Sébastien LARCHER

Elaiapharm Lundbeck Production site



## OBJECTIVE/MOTIVATION

Lundbeck is a global pharmaceutical company headquartered in Denmark and specialized in discovering and developing innovative treatments for brain diseases. I had the opportunity to join the company in their Valbonne site in the Continuous improvement department. As part of the Operational Excellence program, I work on different projects aimed at improving performance & quality.

The monitoring of the OEE as part of the performance follow-up of the factory's packaging lines revealed that there were potential improvements to reach performance targets. The objective of my project is to decrease the proportion of micro-stops and speed losses by 25% on two blister packaging lines in order to increase productivity, work on capacity within deadlines and improve the plan adherence. To lead the project, I am using the Lean 6 sigma DMAIC method. There are 5 steps: Define, Measure, Analyze, Improve and Control.

## RESULTS

The project is still in progress. The first step involved defining the project, its objectives and challenges, its stakeholders, its environment and conducting a risk analysis. Then I moved on to the measurement

stage. I carried out observations on the packaging lines in order to understand, interact with the operators and measure these micro-stops and speed-losses. I also collected additional data from the production tracking software as well as data directly from the machines. I am currently working on analyzing my data and observations to propose improvement ideas to be implemented and achieve the set goal. There is work to be done on the technical micro-stops, the change of packaging items during production as well as quality losses with the ejection of products during production as they are the main causes of micro-stops and speed losses identified.

**KEYWORDS :** Continuous improvement, operational excellence, packaging, performance.



Blister  
Packaging  
of tablets

Contact : [adele.leroux@etu.univ-orleans.fr](mailto:adele.leroux@etu.univ-orleans.fr)



# The operator loads of the packaging lines

Industrial engineering



C. CHIARA LISAI

**Chiara Lisai**

Academic supervisor : Thomas Sayet

Industrial supervisor : Lise Deleuze



Company/institution : L'Oréal – Cosmétique Active Production – La Roche Posay

## OBJECTIVE/MOTIVATION

The theme of my work experience is Lean Management. I work on projects to improve the packaging department. I have been working on the operator load of all the packaging lines. It consists in estimating the occupation rate of the workers, which takes in consideration all their actions, such as supplying the line and doing the quality controls. This rate is an indicator for several important points. It illustrates the workload, so it can be used to check the working conditions of the operators. It also indicates whether the operators have enough time to perform the quality controls correctly. The operator load can justify some investments projects, especially ergonomic projects, as it gives all the details about the workload for each action. The objective is to perform analysis with precision, in order to have reliable numbers.

## RESULTS

The goal is to obtain the operator load for all the lines. It takes me in average fifteen hours for each line. The occupation rate must not go over 85% to ensure the quality of the products and the wellbeing of the workers. The results will be used in different ways. For instance, there are two lines that are filling and packing the same kind of products, but one of them is more recent, and has some technological and ergonomic improvements. Once I am done with both, the results of the analysis will be compared, and the advantages of the new line could be shown. The rate can also be used to see how some future modifications of the lines could improve the working conditions, such as adding a cobot to take care of the heavy boxes of finished goods.

**KEYWORDS :** workload, ergonomics, statistics, quality management.



Contact : chiara.lisai@etu.univ-orleans.fr

# Quality Validation of equipment cleaning and disinfection instructions

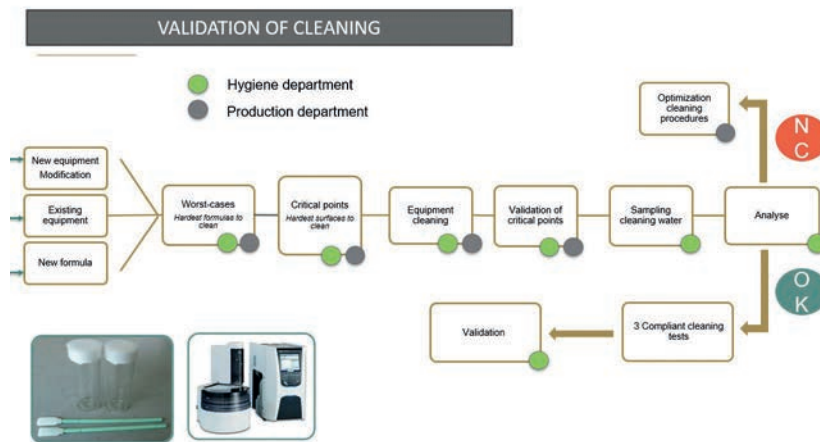
Industrial engineering



L. MORIVAL

**MORIVAL Lisa**

Academic supervisor : VIDAL Jean-Baptiste  
Industrial supervisor : DUPLESSIS-FOURCAUD Amelie



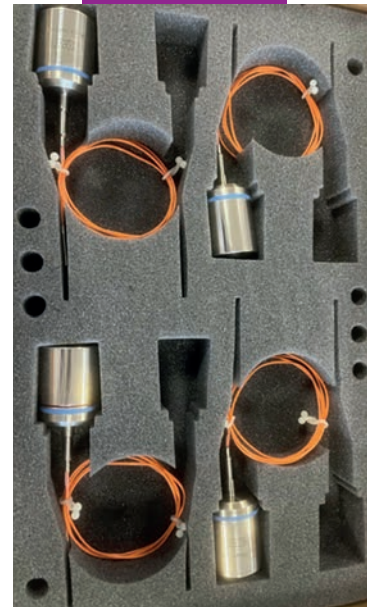
## OBJECTIVE/MOTIVATION

My company is part of a cosmetic group and specializes in biotechnology. The company combines living organism with engineering processes to produce ingredients. These ingredients are destined to other plants also part of the group to make cosmetic goods. It is the only affiliate in the Group able to provide such ingredients, that are microbiologically sensible, so their main objective is to keep it that way. Consequently, they must provide the best quality ingredients to their clients and have irreproachable hygiene in every step of their process. Therefore, my assignment has for motive to ensure that the ingredients produced are not contaminated in any way. With this project, we want to guarantee that our equipment is correctly cleaned and disinfected so they do not become vectors of contamination for our products. For that purpose, I will write and test quality control procedures.

## RESULTS

This assignment is a part of a long-term project that has already been started by a previous apprentice. In the end, the company wants to control the risks of contamination related to the hygiene of their production equipment. To achieve that, there are three main steps. Firstly, we use automatized systems to clean and disinfect our equipment, so we must verify that they are correctly installed and functional (with a list of criteria to check). Secondly, we must verify that each production equipment (tank, bioreactor, filter, etc.) is properly installed and locate their critical points (locations where the cleaning and disinfection might not be effective). Finally, we need to verify that the cleaning and disinfection instructions already written and in place are adequate by testing them and checking if they respect the acceptance criteria identified by the cosmetic group.

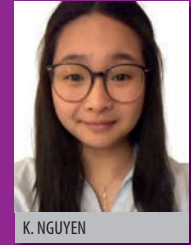
**KEYWORDS** : hygiene, quality, production equipment.



Contact : [lisamorival@gmail.com](mailto:lisamorival@gmail.com)

# Replacement of production equipment

Industrial engineering



K. NGUYEN

**Kimhoa Nguyen**

Academic supervisor : Mohamad-Fathi Ghanameh  
Industrial supervisor : Julien Aures

Intergard product



Company/institution : Getinge, site Intervascular

## OBJECTIVE/MOTIVATION

The Intervascular site is a subsidiary of the GETINGE Group. It has been designing and manufacturing woven and knitted vascular prostheses for more than 20 years, which are distributed and implanted throughout the world. As such, the company is constantly growing due to a strong demand for existing products and new products to be created following a customer request. From a production point of view, the company is continuously renewing its equipment to make the process more robust. That is why projects to replace equipment have been launched, enabling the company to be at the cutting edge of technology. This not only avoids obsolete spare parts, but also avoids production downtime.

## RESULTS

The strategy consists in studying the critical equipment of the production line and reviewing the expected needs of the different departments. The first phase is to evaluate the equipment and then to study the market outside the company.

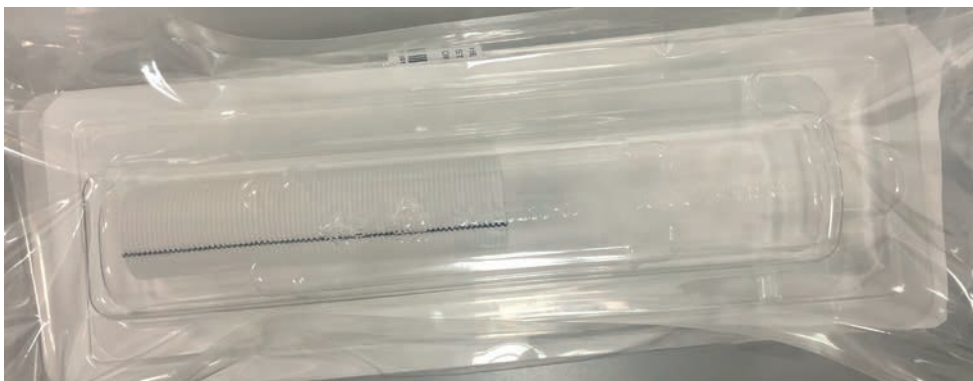
For this purpose, specifications were drawn up to explain the launch of the project on a specific piece of equipment, to define the types of products with the associated parameters and to summarise the requirements of each activity.

From mid-March onwards, the decision on the choice of equipment was to be made. Then, during the manufacturing design of the equipment, it is necessary to fill in forms, make changes to documents and create instructions adapted to the new equipment. Finally, to ensure the commissioning of a new piece of equipment, feasibility studies and equipment qualification are carried out to complete the process.

**KEYWORDS :** project management, production, equipment, performance.



Production line CFM2



Hemashield product



Equipment

Contact : [kimhoa.nguyen@etu.univ-orleans.fr](mailto:kimhoa.nguyen@etu.univ-orleans.fr)



# the purchase of a washing basket and its associated trolley for the complete automation of a washing system

Industrial engineering

**NIMAL Mathilde**

Academic supervisor : Blondeau Jean-Philippe

Industrial supervisor : Clamens Aurore



M. NIMAL

Company/institution : Boiron laboratories

## OBJECTIVE/MOTIVATION

The tube and dose packing area is equipped with an automatic washer. Today, all parts are washed automatically, except cones, plates and elbows commonly called funnels. These three parts are useful for packaging small batches made on four different packaging lines that run in 2\*8, with a morning crew and an afternoon crew. Two batches are produced per packaging line and per team. Every day, 24 funnels are used per packaging line, for a total of 48 funnels, 126 cones plates and elbows. All these parts are washed manually. Hand washing is very difficult, involves ergonomic hazards and can cause cross-contamination.



Les coudes élément 2 composant les entonnoirs

Laundry operators have difficulty handling funnels in the wash tank, and production operators must wait for clean equipment before they can produce again. This project protects operators from the risk of injury, but also saves time and water.

## RESULTS

The aim of the optimization of this washing system is to save time and water. The manual washing time is sixty minutes, and the drying time is six minutes, for a total of sixty-six minutes of manual washing. The estimated automatic washing time is 1 minute. Indeed, the operator must put the basket in the washer and launch the recipe. At the end of washing, he can recover the basket and produce again. He is not mobilized during the entire washing time. The time saving is estimated at 98.5%. Regarding the water saving, the manual washing consumed about 72 liters of water. The automatic washer is composed of several water bins, and the basket must respect a certain soaking time in each bin depending on the recipe. Thus, automatic washing would consume only 15 liters of water.

**KEYWORDS** : hygiene, environment, ergonomics.



Les coudes élément 2 composant les entonnoirs



Les coudes élément 2 composant les entonnoirs

Contact : mathilde.nimal@etu.univ-orleans.fr

# Creation of a quality document that describes how to validate all modes of transport from our factory

Industrial engineering

**Julia Roux**

Academic supervisor : Gilles Hivet  
Industrial supervisor : Sophie Petey



J. ROUX



Company/institution : Vetoquinol



## OBJECTIVE/MOTIVATION

My project was born out of a need, above all legal. Indeed, during an ANSES inspection in 2018, the inspectors found a point of non-compliance in the transport of temperature-controlled products from our industrial site in Lure to the whole of Europe.

Controlled temperature guarantees ideal transport conditions, which, depending on the nature of the products, is carried out at positive or negative temperatures.

Following this point, we have switched all our transports to the EU to controlled temperature and to the rest of the world, only when the country of import required it.

Since the veterinary pharmaceutical regulation is evolving, Vetoquinol decided to carry out a project allowing to create a quality document which

describes the way of validating all modes of transport from the site of Lure.

## RESULTS

The project started in October with a project team composed of various trades.

We held an opening meeting to agree on the

strategy to be adopted and the approach to be presented to the Industrial and Plant Manager in order to obtain their validation.

The idea is to be able to divide the work according to the various modes of transport, the particularities of the products in terms of conservation, and the requirements of each country.

Following this meeting, because of the other projects of the company and the daily tasks, we expect this project to be achieved by August.

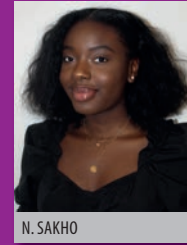
**KEYWORDS :** veterinary pharmaceutical, controlled temperature, transports.



Contact : [julia.roux1@etu.univ-orleans.fr](mailto:julia.roux1@etu.univ-orleans.fr)

# Continuity of activities as part of a production line shutdown

Industrial engineering



N. SAKHO

**Ndeye Sakho**

Academic supervisor : Gilles Hivet

Industrial supervisor : Valérie Ridriment



Company/institution : Lilly

## OBJECTIVE/MOTIVATION

Lilly is an American pharmaceutical group which has one of its production sites in Alsace, specialized in the production of injectables. In B700 building, insulin cartridge is produced by two production lines, CGV1 and CGV3 (Cartouche à Grande Vitesse), in which we have several departments: material preparation, formulation and filling. A chemical dispensing, weighing all the raw materials and excipients of the site is also in B700 building. Due to machine obsolescence and low rate compared to CGV3, CGV1 line will close in June 2023. But its closure triggers a lot of changes of related activities: a part of the material used in chemical dispensing is only washed on the CGV1's washer. And to wash a specific material, a qualification needs to be done on the washer, indeed a simple modification includes a lot of impact on different services. After CGV1's shutdown, is where this flow of material going to be wash?

wash all the material on CGV3's washer. To deal with this issue, two big aspects need to be considered. First, the qualification of the material on CGV3's washer: an exact overview of the qualified and washed material on CGV1's washer and not on CGV3's washer has been done to determine which material has to be qualified on CGV3's washer and which washer options we have (creation or modification of existing wash basket, adaptation of the material used, addition of human resources...). Second, a technical aspect needs to be considered: whether the CGV3's washer has the capability and availability to take over on the remaining quantity to wash in the context of volume increasing in CGV3.

**KEYWORDS :** production, sterile filling, insulin, pharmaceutical industry.



## RESULTS

After an analysis of the problem, two solutions have been identified: keeping the CGV1's washer despite the shutdown or stopping the CGV1's washer and



Contact : [ndeyesakho@icloud.com](mailto:ndeyesakho@icloud.com)



# Carrying out a risk analysis, following the SHAP method, for each situation noted in the explosion protection document

Industrial engineering

Emma Servier

Academic supervisor : Nedia Mrad Koched

Industrial supervisor : Laurent Gridelet



E. SERVIER



Company/institution : Research and Innovation Center of l'Oréal

## OBJECTIVE/MOTIVATION

I am currently employed at the research and innovation center of the L'Oréal group, located in Chevilly-Larue, in the Val de Marne. I joined the EHS department, and more specifically the Hygiene team, composed of 3 people. The context and the issues of my mission are the following: The L'Oréal company has various laboratories at its Chevilly-Larue site, where flammable products are used. These can generate explosive atmospheres (ATEX) and therefore represent a major risk. I'm involved in the update of the DRPCE : the explosion protection document. The update of this document is essential because the company is regularly audited. But also for the safety of the employees, so that they know the risks incurred on the whole of the processes, and to take the proper precautions. My role is based on the realization of risk analysis, for each situation describe in the DRPCE.

## RESULTS

I work at the Research and Innovation Center of the L'Oréal group, located in Chevilly-Larue (94). I joined the EHS department, and more precisely the Hygiene team. The context and the issues of my mission are the following: The L'Oréal company has various laboratories at its Chevilly-Larue site, where flammable products are used. These can generate explosive atmospheres (ATEX) and therefore represent a major risk. I'm involved in the update of the DRPCE : the explosion protection document. The update of this document is essential because the company is regularly audited. But also for the safety of the employees, so that they know the risks incurred on the whole of the processes, and to take the proper precautions. My role is based on the realization of risk analysis, for each situation describe in the DRPCE.



Contact : emma.servier@etu.univ-orleans.fr

# Spare parts obsolescence management

Industrial engineering



Y. ZAHID

**Yahia ZAHID**

Academic supervisor : Thomas SAYET  
Industrial supervisor : Florent MARZAIS

**sanofi**

Company/institution : Sanofi Neuville-sur-Saône

## OBJECTIVE/MOTIVATION



Spare parts stock

My project aims to address an issue related to the use of an old machine that has been salvaged and installed on a new production line. As some components of the machine are likely to be obsolete, finding adequate spare parts for necessary repairs in case of breakdowns could be challenging, potentially leading to a significant increase in equipment downtime. This could result in extended equipment downtime, which can have negative consequences for the company.

The objective of the project is to identify all obsolete parts of the machine, find replacement parts for each of them, and define a storage strategy for these replacement parts. This will enable the company to minimize production losses and maintain the proper functioning of the production line.

## RESULTS

I began the implementation of my project by understanding the design of the machine through consultation of the user manuals and technical schematics. This enabled me to gather all the necessary data in an Excel file organized by technical

station. Based on the collected data, I identified parts with a likelihood of obsolescence with the help of maintenance technicians familiar with the equipment. Subsequently, I consulted the relevant suppliers to confirm the obsolescence status of these parts. To date, I have identified three obsolete parts. My next steps involve collaborating with the supplier to find replacement parts, conducting site visits to ensure that the replacement parts are suitable for the operating conditions, and defining a storage strategy by analyzing demand levels, evaluating costs, and assessing supplier reliability.

**KEYWORDS** : operational maintenance, obsolescence management, inventory management, spare parts.



The machine concerned by obsolescence



Neuville-sur-Saône production site

Contact : yahia.zahid@etu.univ-orleans.fr

# DUFFAY's preparation in order to get one HSE certification

Industrial engineering



F. CENICO

**CENICO Flavie**

Academic supervisor : HIVET Gilles  
Industrial supervisor : DUCLOS Vincent



Company/institution : SAS DUFFAY

## OBJECTIVE/MOTIVATION

DUFFAY is designer, manufacturer and fitters of clean room concept : Doors, selling, glazing & partition. Our clients are companies from pharmaceuticals, and cosmetics industry.

DUFFAY install clean rooms on the client's site, so the company is considered as a subcontractor. Most of these clients have the MASE certification. This certification imposes to have as subcontractors, companies having the same certification. But DUFFAY doesn't have any HSE certification. So, to keep our client we must work to obtain it, and more precisely, adapt the HSE department to the requirements of the MASE certification.

The certification is divided into 5 areas : management engagement, staff qualifications, work preparation and organization, system efficiency, and continuous improvement.

The objective set at the beginning of the project is to reach 80% between the DUFFAY HSE system and the MASE reference system in each of the 5 axes above.

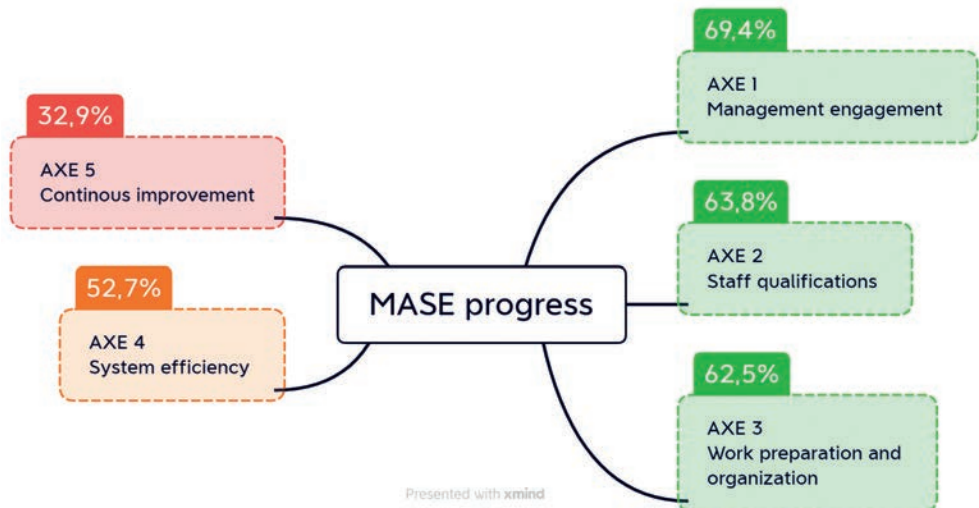
## RESULTS

At the moment, the study phase of the MASE reference system and the audit phase of the company's HSE management are being carried out. Following this, an action plan has been implemented. So, the project is in the implementation

phase of the action plan. This action plan is composed of actions of different types: animation, audit, writing, improvement action. Also, these action concerns all services of DUFFAY.

Another audit system has been performed. The results are between 60% and 68% of conformity for the following areas: management engagement, staff qualifications and work organization and preparation. These results are encouraging. And we are around 40% for the two other areas, respectively system efficiency and continuous improvement. So, our efforts will focus more on these areas.

**KEYWORDS :** hygiene security, MASE reference, project, organization, continuous improvement.



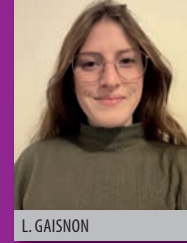
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Contact : [flavie.cenico@etu.univ-orléans.fr](mailto:flavie.cenico@etu.univ-orléans.fr)



# Management and stock control

Industrial engineering



L. GAISON

**GAISON Léonie**

Academic supervisor : HIVET Audrey

Industrial supervisor : LEPINE Julien



Company/institution : SIT

## OBJECTIVE/MOTIVATION

The SIT company carries out projects, this project takes place in a dairy company where we must build a new liquid process line. The objective of this assignment is to analyze the various problems present on the construction site which cause losses of time and money and to set up standard solutions applicable to all other projects. For this purpose, a brainstorming was carried out and then, using the 5M method and the Ishikawa diagram, each problem was categorized according to: environment, material, method, labour and material. After a thorough analysis, a solution was considered for each problem. In general, there



is a lack of stock management procedures, equipment is lost or misplaced, and staff are not trained, which makes it difficult to keep track of what is coming in and going out of the stock and makes it difficult to identify shortages.

## RESULTS

Several tools and indicators have been designed to address these issues. First of all, the staff will be trained to indicate each exit of the stock but also to avoid many useless trips to the stocks. Moreover, an inventory will be carried out in order to follow these entries and exits more simply, the use of KANBAN card could help the management of the stocks but it is still in study phase. It will be essential to study the schedule to organize the deliveries according to the work areas, this will allow a better organization of the space on the site (currently all the material is delivered at the beginning of the site which does not facilitate the organization). Finally, a satisfaction indicator will be set up to study whether the solutions installed are useful for the staff or not. These solutions will be implemented in the coming weeks.

**KEYWORDS:** management, stock, lean manufacturing, indicators.



Contact : [leonie.gaisnon@etu.univ-orleans.fr](mailto:leonie.gaisnon@etu.univ-orleans.fr)

# How to optimize the internal communication strategy ?

## Visual management and internal communication



C. MANIFET

**MANIFET Charlotte**

Academic supervisor : BLONDEAU Jean-Philippe

Industrial supervisor : HAUTIER Laurent



Company/institution : Savencia Fromage&Dairy/Grand'Ouche

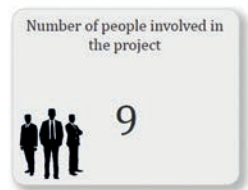
### OBJECTIVE/MOTIVATION

To date, at Grand'Ouche, there is no doubt that internal communication is not relevant. Communication is carried out by regular posting on panels in different areas of the factory. The company, which employs 150 people, needs to put in place effective communication so that everyone has the same information in real time. For the well-being of all employees, it is necessary to have rules for life, safety, hygiene, and the environment. They must all be known by everyone, to work in an environment of trust and quality. For this reason, a visual management and communication project is underway to overcome the current problem of a lack of communication and involvement of employees in the life of the company. The aim of this project is to increase communication to reduce errors, accidents, and loss of time due to potential misunderstandings of information, while introducing new themes such as the environment.

not entirely defined, but focuses on the rate of progress, the number of days meeting the rotation schedule, and the number of weeks meeting the set of standards in place.

### KEYWORDS :

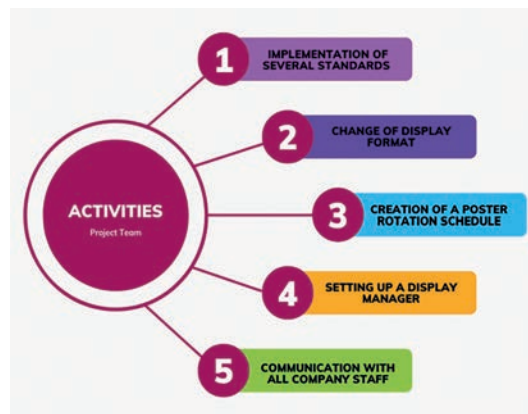
management, communication, standardization, organization, group work.



indicators

### RESULTS

In order to implement visual management, the standardization started with the most important documents, i.e. quality, safety and administration. The other documents will be standardized gradually in collaboration with the managers of each area. Once the graphic charters had been chosen, the display panels for the 5-minute points were completely modified. From now on, specific columns for each piece of information are delimited. A cause tree was created to identify the need for the document and therefore its added value to the display. This makes it possible to determine whether the document is obsolete, whether it should be destroyed or standardized, its usefulness and therefore the location in which it should be placed. The choice of indicators is



Resume of project

Contact : charlotte.manifet@etu.univ-orleans.fr

# Increased production capacity and optimised storage to continue to meet growing customer demand

Industrial engineering

**Jules Nicoleau-Bergeret**

Academic supervisor : Jean-Philippe Blondeau  
Industrial supervisor : Julien Deniau



Company/institution : La Bouledogue



J. NICOLEAU-BERGERET

## OBJECTIVE/MOTIVATION

La Bouledogue is a craft brewery. The annual production volume and the annual sales volume are almost identical, all that is produced is sold. Every year the sales volume increases, which implies an increase in the production volume. The company is reaching a saturation point and might not be able to meet the growing customer demand.

The project that I was assigned was based on the need for the company to continue to satisfy the growing customer demand while maintaining the same structure, i.e. the same building and the same industrial installations (machines, tanks, etc.). It was therefore necessary to find ways to increase production capacity, to have adequate stock management and to improve the ergonomics of certain tasks that could become tedious with increased production.

## RESULTS

The first step was to define the project as a whole. Then, the production lead time was studied to see if it was possible to reduce it in order to increase the production capacity. To reduce the lead time, it is necessary to slightly modify the manufacturing process and therefore the production system. The first action taken was to contact the supplier of the fermentation tanks to find out if it was possible to modify the fermenters. This information was confirmed



by the supplier. This process modification only concerns the production of barrels.

The reduction of production time involves the production of complete batches of kegs, and the ergonomics of the kegging task must be improved. It will therefore be interesting to ask suppliers for quotes for semi-automatic keg fillers.

Concerning stock management, the ABC inventory management method will be used, which allows management efforts to be concentrated on the most important inventory items, while minimising the management costs of less important items. It also allows for better forecasting of storage requirements by focusing on the most critical inventory items.

**KEYWORDS :** production capacity, stocks management, quality, supply chain, ergonomomy.



Contact : [jules.nicoleau-bergeret@etu.univ-orleans.com](mailto:jules.nicoleau-bergeret@etu.univ-orleans.com)

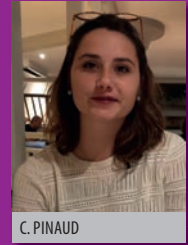


# Reorganization of the offal department during a change of machine to improve productivity and working conditions

Industrial and production engineering

**Chloé PINAUD**

Academic supervisor : Audrey Hivet  
Industrial supervisor : Mathieu LOAS



C. PINAUD

## OBJECTIVE/MOTIVATION

The department packs products in vacuum thanks to a specific machine. This machine has been replaced by a thermoformer. This machine has a great capacity of conditioning however it is difficult to use because the operators do not know how to create the orders to be conditioned. Moreover, the information about the stock to be sold is conflicting. The operators are constantly being disturbed by calls from the sales people to find out what is in stock. There are several contacts and some information gets lost. This creates conflicts between the two departments. The first objective is to develop a production plan to build a stock and establish a packing order. The second objective is to improve communication between the departments by creating a stock sheet.

## RESULTS

The results regarding the production plan are poor. The plan is not done by the production team. They

are used to not prioritizing orders, so they don't see the point of making the plan. The use of the new machine is therefore not functional and does not meet the expectations of the management. Communication has improved slightly, there are fewer order errors.

The results concerning the stock sheet have been satisfactory since November. About 85% of the sheets have been completed since November. However, the traders are still making call in production. Some of them have not understood that it is only necessary to look at the sheet sent. In both cases, there are still big points of improvement to validate the performance of the new organization.

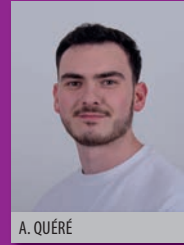
**KEYWORDS :** money, continuous improvement, human, scheduling, conflicts.



Contact : [chloe.pinaud@etu.univ-orleans.fr](mailto:chloe.pinaud@etu.univ-orleans.fr)

# Yield improvement

## Industrial engineering

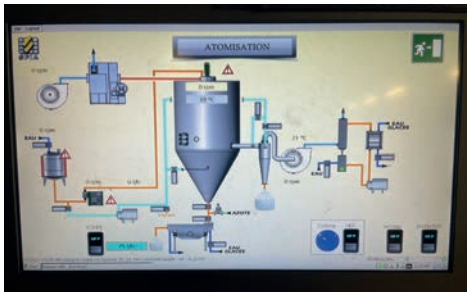


A. QUÉRE

### Quéré Antoine

Academic supervisor : Gilles Hivet  
Industrial supervisor : David Fermon

### OBJECTIVE/MOTIVATION



Use to manufacture products in powder form

At Plantex, we manufacture dry or fluid extracts based on Plantex for the food, animal nutrition, nutraceutical and cosmetic industries. However, numerous losses of dry matter have been reported recently by the in-house quality laboratory. The objective of this last year of the apprenticeship at Plantex is to improve the extraction, concentration, pasteurisation and atomisation yields within the company. This project has economic stakes but also in terms of the company's image with its customers. Using a Lean Management A3 tool, designed for problem solving, solutions will be proposed and tested according to the root causes. The indicators of success are the rate of shrinkage in euros, the rate of yield per machine in percentage and the rate of reduction of total material losses in percentage.

### RESULTS

In order to carry out this project, a Lean Management method specialising in A3 problem solving was implemented on the 4 different types of production equipment present at Plantex. These are macerators, evapo-concentrators, pasteurisers

and spray towers. First of all, in order to improve production yields, the root causes of material losses must be determined. To do this, a Gemba Walk, which means "where the value is created", it is therefore important to get as close as possible to production. By visiting the production operators and their work tools, the causes of losses will emerge. These causes are then classified in an Ishikawa diagram, a fishbone diagram based on the 5M classification. Then, for each potential cause identified, solutions are proposed in order to resolve the loss problems. In the long run, it will be important to minimise the rate of waste in euros because it affects the company's profits, but also to maximise the yield of each machine and to have a material loss reduction rate of less than 5%.

**KEYWORDS** : yield, plants, lean.



Use to concentrate plant extracts

Use to sanitise manufactured products



Use to carry out the plant extraction

Contact : [antoine.quere@etu.univ-orleans.fr](mailto:antoine.quere@etu.univ-orleans.fr)

# Implementation of a tracker to monitor and reduce product losses in production

Industrial engineering



B. THAUVIN

**THAUVIN Bastien**

Academic supervisor : Cécile Capdessus  
Industrial supervisor : Géraldine Thiebaut

Dmaic method

## OBJECTIVE/MOTIVATION

At the end of each year, a meeting is held with the plant manager and the heads of each department to define the priorities of the site for the following year. Following this meeting, 6 priorities were defined. One of these priorities is the fulfilment of our budgetary commitments. In the budget theme we find the global site losses which amount was too much in 2021, these include losses due to non-quality and material losses, of which 40% comes from juice loss alone. The loss budget is based on historical information. If we do nothing, we follow the same trend for the following years. Our goal is to reduce this amount by 700K euros. There is no routine for observing losses in detail, which means that we have no visibility and therefore no way of reducing losses. So the loss tracker project came into being.

## RESULTS

To enable us to complete this project, we carried out a DMAIC. A good part of last year was devoted to setting up the automatic collection of production data as well as to verifying them in order to have data as close to reality as possible, which corresponds to the Measure phase. Once this step had been completed, we were able to analyse the needs of each department in order to create the PowerBI, which will

then be used to animate the results and enable the reduction of losses. The year 2022 did not allow us to have enough data to be able to analyse, however the fact of having put this subject under the spotlight allowed us to have already positive results since for the year 2022 we had 33% less of global losses and approximately 47% came from the losses of the juice.

**KEYWORDS :** cosmetic industry, product losses, DMAIC, automation, power BI.



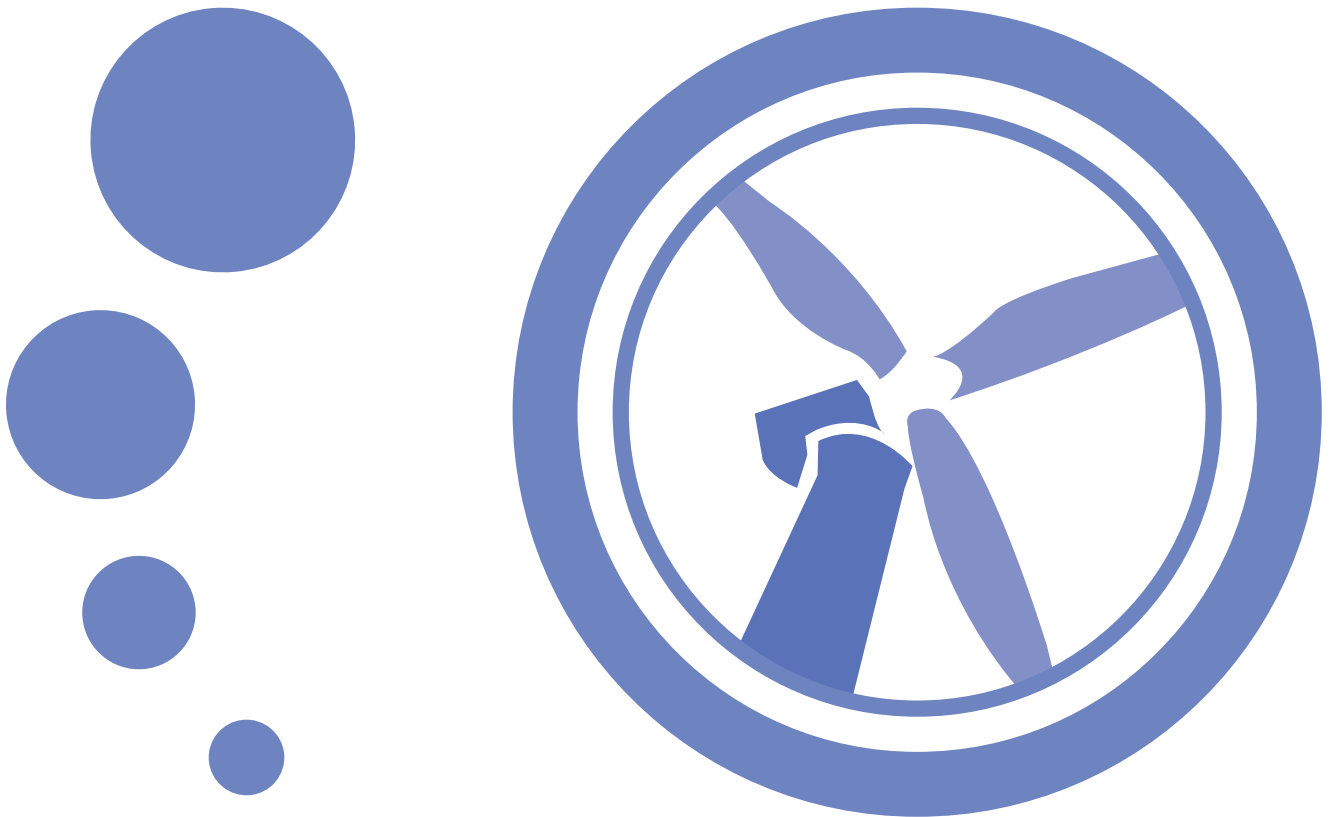
Shampoo

Contact : [bastien.thauvin@hotmail.fr](mailto:bastien.thauvin@hotmail.fr)





# Innovations **in Design and Materials**



# Automatic trolley for resin application

Mechanical engineering



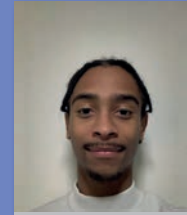
Company/institution : Kemica COATINGS

**Lucas BORGES/Nicolas LEGRAND/Adrien ROY**

Academic supervisor : Estelle Courtial

Industrial supervisor : Tony Baret

**Selected participant**  
17<sup>th</sup> annual final year projects forum



L. BORGES



N. LEGRAND



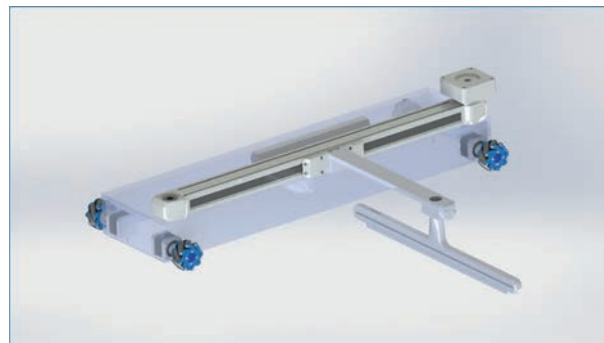
A. ROY

## OBJECTIVE/MOTIVATION



For this project we worked in collaboration with KEMICA COATINGS to design an automatic trolley for resin application. This study was meant to be a first look at what solutions were available for their project to coat a bridge stretching several kilometers.

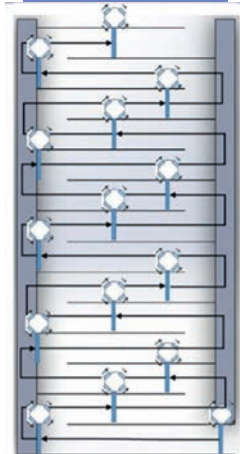
First and foremost, we had to list all the mandatory constraints and functions for an operational system. Then we wrote the specifications and started to look for solutions and the necessary materials. Overall, this project was really fulfilling. It showed us what steps are usually taken when designing such complicated system. The total project was really similar to some tasks asked to a consulting company, a sector that we could work in after Graduating.



## RESULTS

We first started by analyzing the methods to apply the resin. KEMICA COATINGS gave us a rake for the cart. From this rake the resin had to flow evenly depending on the components and thus the debit. We chose to go with the rake on the side of the trolley which forced us to go with an omnidirectional movement. This solution not only allowed us to coat around 95 percent of the surface but also simplified the way to roll the cables back into the system. No rotations are needed when using omnidirectional wheels, they can go to any direction without turning. One of the requirements of the industrial was to fill the entire space so we used a linear axis to move the rake horizontally go from 95 to 99 percent of surface coated.

**KEYWORDS :** industrial, robotics, mechatronics, resin, engineering, automatized trolley.



Contact : [lucas.borges@etu.univ-orleans.fr](mailto:lucas.borges@etu.univ-orleans.fr)/[nicolas.legrand4@etu.univ-orleans.fr](mailto:nicolas.legrand4@etu.univ-orleans.fr)/[adrien.roy@etu.univ-orleans.fr](mailto:adrien.roy@etu.univ-orleans.fr)



# Solving an uncontrolled acceleration problem during a vibration qualification test

Mechanical engineering

**Mohamed SEBTI/Kevin RAOUL**

Academic supervisor : Jean GILIBERT

Industrial supervisor : Jean-Yves LE CALVEZ



Company/institution : Relais électrique du loiret (REL)

## OBJECTIVE/MOTIVATION

Our project involves studying a tool called "EL325 vibration cube". It is used in a test in which electrical relays are fixed on 2 axes (x and z). The whole set is then placed on a vibrating pot. Two sensors are installed, one on the cube and one on the vibrating pot. To test the tool, REL uses a sinusoidal vibration profile in acceleration at frequencies ranging from 10Hz to 3000Hz.

We aim to solve a problem of uncontrolled high-frequency acceleration at the level of the sensor placed on the cube. To do this, the company expects us to conduct an analysis of the proper modes of assembly as well as the application of the vibration profile.

## RESULTS

We have managed to simulate the behavior of the relays by modeling only the fin instead of the complete assembly. This has allowed us to save time and gain a better understanding of the behavior of the relays during the vibration test.

Furthermore, we have identified a natural frequency of the fin that is lower than 3000 Hz, within the frequency range of the vibration test. This discovery is significant as it enables us to better target our analyses and identify possible causes of the uncontrolled acceleration increase. Finally, we think that the sensor problem is no longer present, and we are now focusing on the behavior of the relays to resolve the issue of uncontrolled acceleration increase.

**KEYWORDS :** vibration, testing, finite elements, simulation, analysis.



Contact : [mohamed.sebti@etu.univ-orleans.fr](mailto:mohamed.sebti@etu.univ-orleans.fr)/[kevin.raoul@etu.univ-orleans.fr](mailto:kevin.raoul@etu.univ-orleans.fr)



M. SEBTI



K. RAOUL

# Rebound modeling in an electrical relay

Mechanical engineering



Company/institution : REL Orléans

**SAUZE Guillaume/PRESTI Florestan**

Academic supervisor : Jean Gillibert

Industrial supervisor : Jean-Yves Le Calvez



G. SAUZE



F. PRESTI

## OBJECTIVE/MOTIVATION

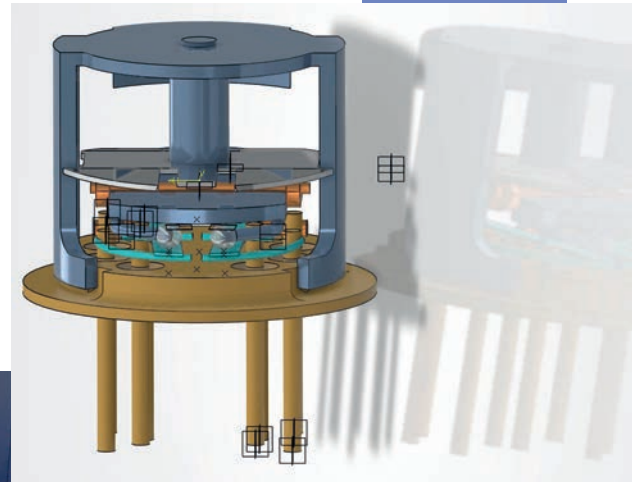
This project consists in the modeling of an electric relay. We started by realizing this model in computer assisted design. This relay has a problem of rebound on connection, that is to say that when closing the contact does not remain fixed in closed position but rebounds. Our task is to simulate and observe the relays to understand, why they fail and how to correct them. The challenges of this simulation are to represent experimental phenomena with the software.

## RESULTS

We created a CAD model of the electrical relay. We adapted this model so that we could apply mechanical forces to it and watch the relay

reactions. The model includes the relay materials which allows us to simulate the resistance to deformation of the materials in a static case. But also their movements and their reactions to solicitations. Finally, we model the relay reaction to electromagnetic forces.

**KEYWORDS :**  
modeling,  
dynamic, rebound,  
deformation.



Contact : florestan.presti@etu.univ-orleans.fr/Guillaume.sauze@etu.univ-orleans.fr

# A400M tyre wear prediction tool

Mechanical engineering



**Valentin BOITTIN / Mathieu GRÉGOIRE**  
 Academic supervisors : Benoit LEROUX/Marie-Laure BOUCHETOU/Sawssen YOUSSEF  
 Industrial supervisor : Lieutenant Rémy BRUNETEAU

Company/institution : Base aérienne 123 Orléans-Bricy



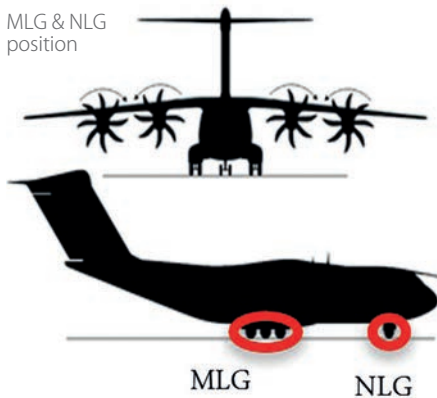
V. BOITTIN



M. GRÉGOIRE

## OBJECTIVE/MOTIVATION

MLG & NLG position



Although the A400M is a state-of-the-art aircraft, one of the main issues is the tyres. They are extremely used worn, more specifically the tyres of the Main Landing Gear, during the different phases of the aircraft's operation, namely take-off, landing, touch and go and towing. They wear out even more quickly when the aircraft must operate abroad and therefore take off and land on rough airfield. This quick wear and tear force the mechanics to do many tyre changes, and can in the worst case scenario, immobilise the A400M in a foreign territory. The ESTA 15.061 proposed to Polytech to create a tool to predict the remaining potential of the tyres.

## RESULTS

To meet the need, the solution chosen was the creation of an experimental design. To do so, we have retrieved several data on from an aircraft doing only runway in France. After a first sorting of

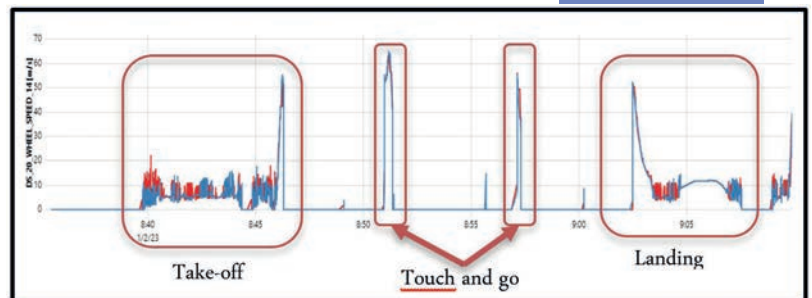
the data to keep only those having an influence on the tyre wear, it is necessary to record the value of each parameter according to the take-off, landing and touch and go phase. The creation of a program coded in Python allows the values of each parameter to be recorded automatically. Coefficients are applied to each parameter, then the sum of the product "parameter value x coefficient" is calculated to obtain the "wear value" for a given flight. The mechanic can therefore use the program to retrieve the data for the aircraft concerned and compare the "wear value" with that of the control aircraft that we have produced to determine the remaining potential of the tyres.

MSN062

FALSE MLG 1 8	FALSE MLG 2 8	FALSE MLG 3 8	FALSE MLG 4 8
FALSE MLG 5 9	FALSE MLG 6 8	FALSE MLG 7 8	FALSE MLG 8 9
FALSE MLG 9 8	FALSE MLG 10 8	FALSE MLG 11 8	FALSE MLG 12 8

**KEYWORDS :** main landing gear, wear, experimental design, state of the art, python.

User interface



Wheel speed data

Contact : [valentin.boittin@etu.univ-orleans.fr](mailto:valentin.boittin@etu.univ-orleans.fr) / [mathieu.gregoire@etu.univ-orleans.fr](mailto:mathieu.gregoire@etu.univ-orleans.fr)



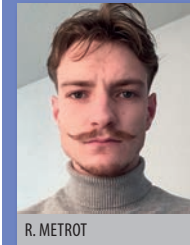
# Aircraft wheel handling equipment

Industrial engineering

**METROT Raphaël/SEBBAR Ibrahim/THERRY TOM**

Academic supervisor : LE ROUX Benoit  
Industrial supervisor : ROUFFIAC Jerome

High schooler's choice  
17<sup>th</sup> annual final year projects forum



R. METROT



I. SEBBAR



T. THERRY

## OBJECTIVE/MOTIVATION

We have been asked to design and prototype a handling device that is capable of helping the mechanics of the air base to take the wheels of the A400M (each wheel is 80kg) from a loading zone to an unloading zone approximately 5m away from the aircraft. Currently, the mechanics store the wheels in a storage rack and when they need them, they lift them with their bare hands and roll them one by one to the aircraft. The problem with this current solution is that because the wheels are heavy and bulky there were some accidents that led to the harm of the mechanics and musculoskeletal disorder. So, the objective of this project is to provide a handling device that facilitates the loading and the displacement of the wheels. It should permit to save time, and respect the French ergonomic law.

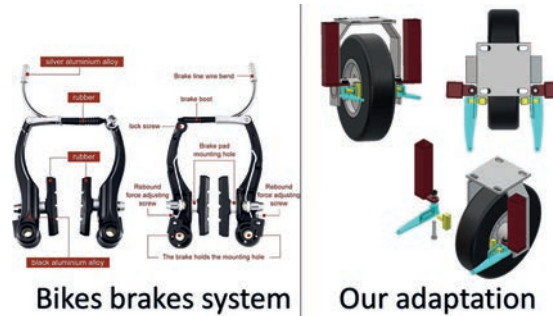
will be greatly reduced, as will the risk of accidents during handling process. For example, to meet ergonomic and safety requirements, we have designed a braking system on the device.

**KEYWORDS :** handling, wheel, plane, ergonomics, Air-Force.



## RESULTS

As a result, we are committed to providing our customer the detailed plans for the handling device. The design of this device is adapted to the means of production present in the air base. This choice of result allows our client to produce as much unity as he wishes. The device we have designed respects the needs as well as the requirements of our customer. Rotation times on wheel changes



Contact : [raphael.metrot37@gmail.com](mailto:raphael.metrot37@gmail.com)/[Ibrahimsebbar1999@gmail.com](mailto:Ibrahimsebbar1999@gmail.com)/[tom.therry@orange.fr](mailto:tom.therry@orange.fr)

# A400M aircraft antenna protective sock

Materials



Company/institution : Air Base 123 Bricy

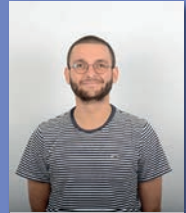
**Arthur PIK/Clément COTTET**

Academic supervisor : Marie-Laure BOUCHETOU

Industrial supervisor : Cédric BOUCHET

First place 

17<sup>th</sup> annual final year projects forum



A. PIK



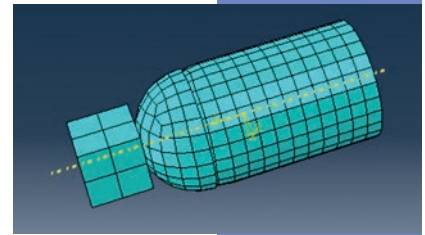
C. COTTET

## OBJECTIVE/MOTIVATION

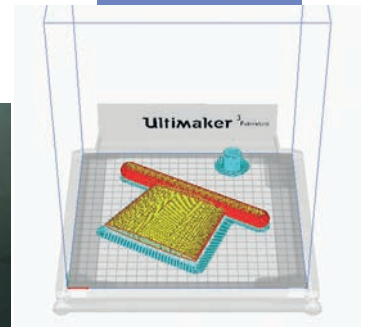
The objective of our project was to produce a protective sock for the antenna of the A400M military aircraft. During operations in rough terrain, the shell designed to protect the antenna was regularly damaged by stone impact. It is therefore necessary to develop a new, more efficient antenna protection. Considering the very specific environments in which the aircraft may operate (temperature, humidity, mechanical constraints, etc.), the material chosen for the protective sock had to correspond to a set of technical characteristics in order to guarantee its integrity, in addition to meeting certain constraints imposed by the client's specifications. To carry out this project, we used project management tools, searched for a candidate material to make the sock, then carried out a design study of the sock and finally carried out tests to justify our choices.

## RESULTS

At the end of the two months of research on this project, a choice of elastomer materials was proposed. A 3D printing manufacturing protocol was also established. Various tests were then carried out in order to determine the properties of the printed material. To complete all these documents, a 3D model of the sock is proposed as well as possible design improvements. In addition, simulation results for the tests that could not be performed are also presented.



**KEYWORDS :** 3D printing, elastomer, shock absorption, transmission.

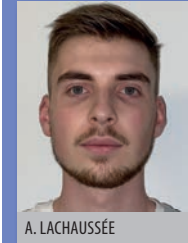


Contact : arthur.pik@etu.univ-orleans.fr

# Finite element modeling and artificial intelligence

Mechanical engineering

**Alexandre LACHAUSSÉE/Lin LAFFICHÉ**  
Academic supervisor : Ridha HAMBLI



A. LACHAUSSÉE



L. LAFFICHÉ

## OBJECTIVE/MOTIVATION

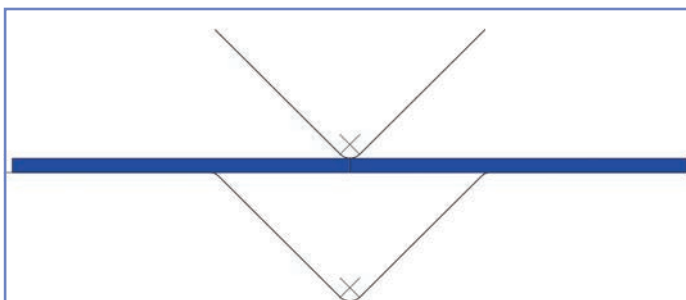
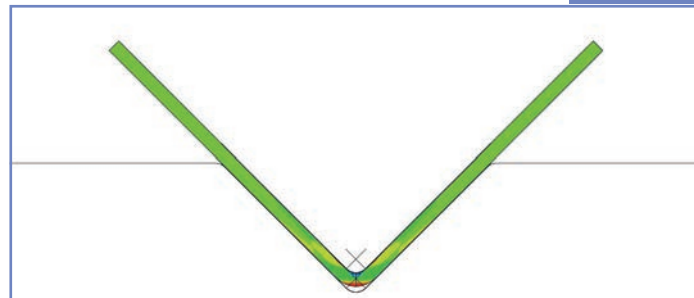
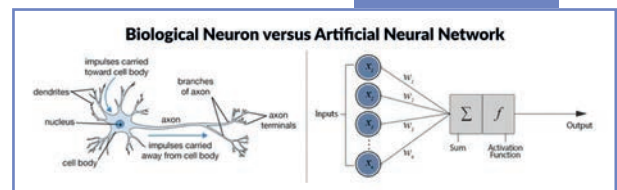
The project is about the use of artificial Intelligence to solve a manufacturing process, V-bending. Once the Abaqus simulation was properly computed with adequate results, the parametric study could begin through the Python Script File as well as the Input File. By modifying these files, data were collected with inputs varying on a range predefined. The next step was to create an AI on NeuroMod which could store and use the outputs to provide the best parameters to match the requirements. This AI is able to learn from the new simulation that it runs to sharpen the results until the most convenient solution is obtained. Finally, we entered the optimal parameters collected by the AI into Abaqus to run a final simulation allowing us to correlate the results.

to verify the proper functioning of the AI, we compared the results obtained from predictions made with NeuroMod with results obtained with Abaqus software. We obtained very consistent results and are therefore satisfied.

**KEYWORDS** : artificial intelligence, finite element method, v-stamping.

## RESULTS

We have successfully completed our project over the courses of these 8 weeks. Firstly, we conducted a simulation of our V-stamping using Abaqus software. We were able to create a database containing all the results intended for the artificial intelligence learning phase. We optimized the learning process to ensure that the margin of error committed by the AI was less than 2%. Finally,



Contact : [alexandre.lachaussee@etu.univ-orleans.fr](mailto:alexandre.lachaussee@etu.univ-orleans.fr)/[lin.laffiche-cousin@etu.univ-orleans.fr](mailto:lin.laffiche-cousin@etu.univ-orleans.fr)



# Covering box containing blood bags dropped by drone

Mechanical engineering

**Nicolas ARNOULD/Reda BOUARFA/Valentine BRETONNIERE**

Academic supervisor : Sawsen YOUSSEF

Industrial supervisor : Julien BOCQUET



Company/institution : Base Aérienne 123 Orléans – Bricy

## OBJECTIVE/MOTIVATION



Drone measuring

Working with the air paratrooper commando section, our objective is to use the knowledge and the experience acquired these last years to create a box that is going to cover blood bags delivered by drone. This project will help us to lead our deadlines, to communicate with the client to give a product that will respond to the needs.

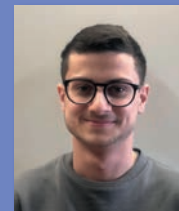
This military project based on a drone which is going to be used to save lives motivated us since the start of the project, that is why we chose this subject.

We have to be rigorous and give as much as we can to perfectly accomplish this project. We use our personal and team skills to get an efficiency teamwork with the optimal tasks assigned for each one. The mechanical engineering aspect of this project is in adequacy with our studies, so it helps us to hold a good motivation all along.

## RESULTS

To choose the materials that we would use for our product, we made a choice matrix that regroups materials that we can use on a 3D printer and the criteria corresponding to the specifications. We finally found that the ABS is the optimal material to use for our product. We created our design about our product on 3D experience, and we did some constraint calculations on Abaqus. We modified the design to get something that meets the client's specifications. We are making our first prototype on the 3D printer of the FabLab of Polytech to test its resistance and his weight which is the main characteristic that we have to control.

**KEYWORDS :** drone, blood, 3D printing, design, dropping.



N. ARNOULD



R. BOUARFA



V. BRETONNIERE



Contact : [nicolas.arnould1@etu.univ-orleans.fr](mailto:nicolas.arnould1@etu.univ-orleans.fr)/[valentine.bretonniere@etu.univ-orleans.fr](mailto:valentine.bretonniere@etu.univ-orleans.fr)/  
[reda.bouarfa@etu.univ-orleans.fr](mailto:reda.bouarfa@etu.univ-orleans.fr)

# Fluid/structure and Gravel/structure interaction on the Abaqus Software, by using SPH and DEM method

Mechanical engineering

**Forêt Arthur/Poncet Simon**

Academic supervisors : Lukas Jakabcin/Jean-Luc Daniel



Company/institution : Polytech Orléans

Selected participant  
17<sup>th</sup> annual final year projects forum



A. FORÊT



S. PONCET

## OBJECTIVE/MOTIVATION

This project deals with particle-based finite element simulation on the Abaqus software. As a reminder, finite element simulation is a widely used process for studying the behavior of different types of physics (mechanical, heat transfer...) of a problem, by modeling the entire model. Fluid and granular modeling are quite complex, and regular methods are not suitable in this case. Therefore, this project is focused on 2 methods, the DEM method and the SPH method. Both methods used particles instead of regular solid elements. The aim of this project is to study those methods, understand how they work and find proper applications to show their capabilities.

## RESULTS

Both methods were computed throughout various applications in the software. In order to demonstrate the suitability of the SPH method, the example of a stair was chosen. This visual effect of water flowing on it supports the idea that in spite of being a solid mechanics software, ABAQUS is able to generate fluid. Furthermore, water jet cutting was used to perform the fluid/structure interaction in an industrial way.

Concerning the DEM method, two examples were provided. The first is a granule filter to prove the efficiency of the method and its capability to generate two different species of particles. For the second one, particles were catapulted on a basic shell to observe the impact on a material structure. This can lead to more complex studies such as rolling of a tire on gravel.

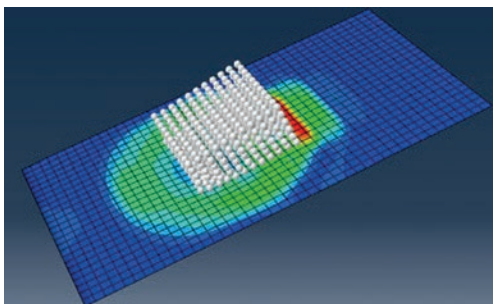
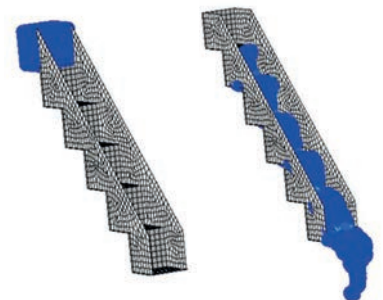
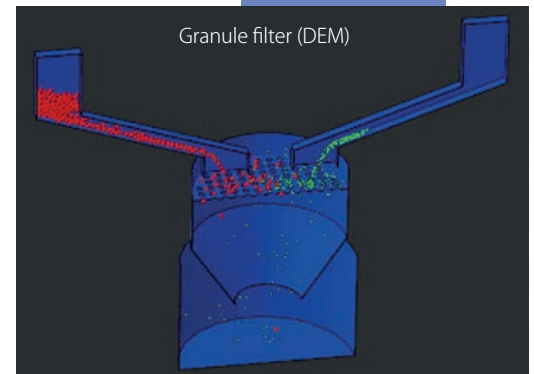
**KEYWORDS :** fluid, particles, simulation, abaqus, gravel.

Script extract of  
DEM interactions

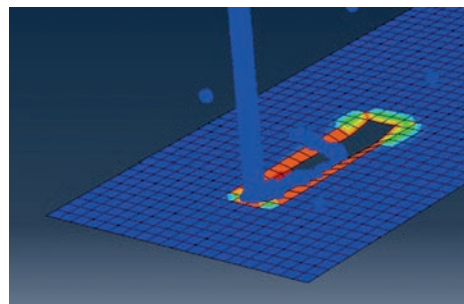
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*Surface Behavior, pressure-overclosure=HARD
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*Friction
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7.54e+06,

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Particles impact on a shell (DEM)



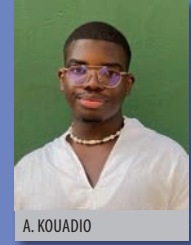
Water jet-cutting (SPH)

Simulation of water falling along stairs

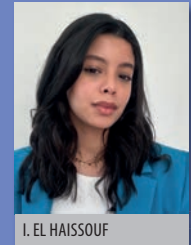
Contact : [simon.poncet@etu.univ-orleans.fr](mailto:simon.poncet@etu.univ-orleans.fr)/[arthur.foret@etu.univ-orleans.fr](mailto:arthur.foret@etu.univ-orleans.fr)

# Ceramic foam filter study

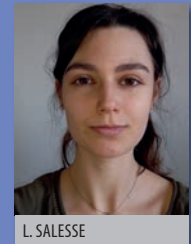
## Materials



A. KOUADIO



I. EL HAISSOUF



L. SALESSE

**Asse Kouadio/Imane El Haissouf/Léa Salessse**  
 Academic supervisor : Emmanuel de Bilbao  
 Industrial supervisor : Frédéric Costes

Company/institution : Transvalor

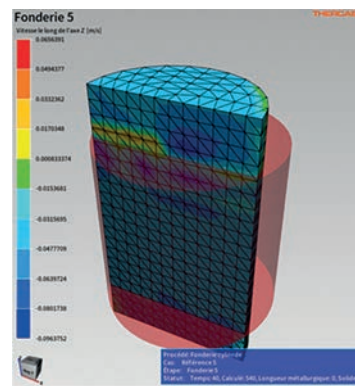
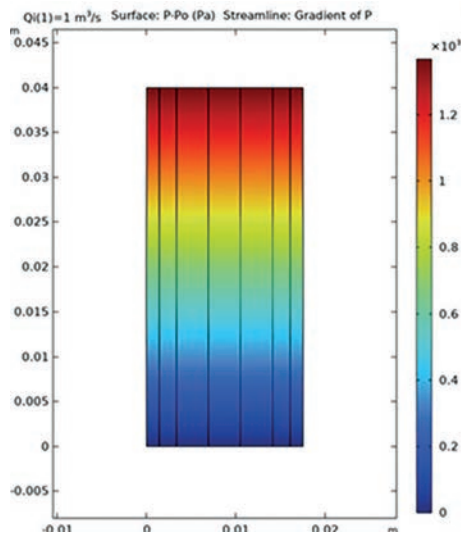
### OBJECTIVE/MOTIVATION

The objective of this project is to study the flow of metal through a porous ceramic filter. This study is done on the company software named Thercast and we must model a metal mold system with a filter and perform calculations to observe the velocity according to the height of metal or pressure in the mold. We also must do the same calculations with the same system on another software used in Polytech named COMSOL. After analyzing the results of the simulations on the two software, we will compare them. This study will allow us to learn a lot of things about the behavior of liquid metal in foundries and ceramic filters. It will also be a way for the company to compare they're software with another one commonly used to simulate many industrial cases.

### RESULTS

We did some measurement in the CEMHTI laboratory that allow us to calculate the permeability of the refractory materials witch are not as porous as ceramic foam filter, but we didn't have foundry filter at our disposal. Then we made our simulation with the permeability valor that we calculated. The objective was to find the same velocity and pressure that during the measurement on Thercast and COMSOL. Indeed, we obtain similar results.

**KEYWORDS :** materials, simulation, measurement, filters, foundry.



Contact : [lea.salesse@etu.univ-orleans.fr](mailto:lea.salesse@etu.univ-orleans.fr)/[imane.el-haissouf@etu.univ-orleans.fr](mailto:imane.el-haissouf@etu.univ-orleans.fr)/[asse.kouadio@etu.univ-orleans.fr](mailto:asse.kouadio@etu.univ-orleans.fr)



# Design of an inertial mechanism for aircraft seats

Mechanical engineering

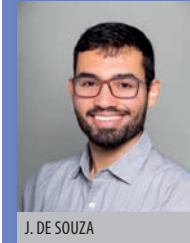
**de Souza João/Placide Maëva/Préaucht Marine**

Academic supervisor : J-M Aufrère

Industrial supervisors : J. Gaudin/O. Lefevre



Company/institution : Safran seats



J. DE SOUZA



M. PLACIDE



M. PRÉAUCHAT

## OBJECTIVE/MOTIVATION



airbus 350

During our final project in engineering school, we had to design an inertial mechanism that unlocks the rotation of aircraft seats during an emergency landing. This aircraft seat unlocking system allows for a reduction in possible damage incurred by the passenger's head during severe deceleration. For reference, a 16G deceleration is equivalent to a 50 km/h impact. Currently, the systems offered by Safran use a mechanical fuse that breaks when the passenger's head collides with the front seatback.

The ultimate design objective is to create a system that triggers the rotation of the seatback prior to impact with the passenger's head. This device will have to undergo the regulatory collision HIC test (Head Injury Criterion), which is used to assess the potential physical injuries resulting from severe deceleration. This test measures the energy absorbed by the head during an emergency landing.



Economy seat

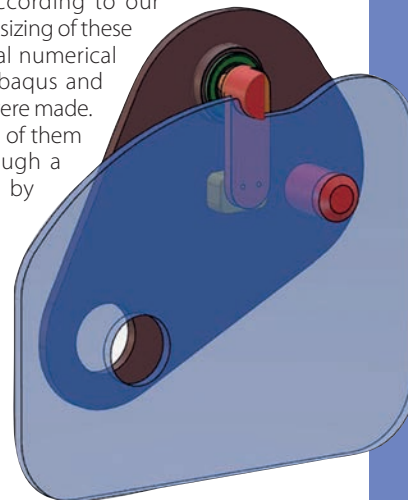
## RESULTS

The specifications established by our industrial supervisor allowed us to work on several different concepts of mechanisms. Several criteria had to be considered, such as the mechanical footprint or the triggering speed.

All the different technical solutions had to exclude the weight of the seatback and the head's impact on the seatback. The main stake is that the system must be able to withstand static effort, such as passenger solicitation, but also to have complete rotation freedom in case of emergency landing. Among the solutions, we offered to the industrial, only three were kept. These designs seemed to be the most promising according to our criteria.

To refine the sizing of these mechanisms, several numerical simulations with Abaqus and designs with Catia were made. The most promising of them will be tested through a prototype realized by Safran.

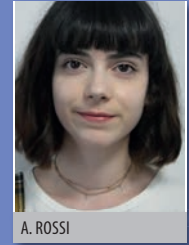
**KEYWORDS :**  
sizing, numerical simulation, inertial triggering.



Inertial mechanism

# Modeling of an infrared emitter's thermoradiative properties

Materials



A. ROSSI

**Karim Halfi/Alice Rossi-Bourcet**

Academic supervisor : M. Malki

Industrial supervisor : M. Malki

## OBJECTIVE/MOTIVATION



Temperature measurement

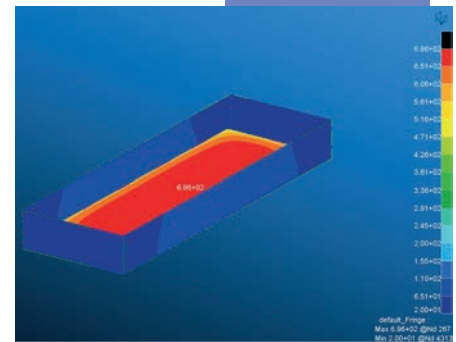
The project supervised by Mr. Malki involves modeling the thermoradiative properties of a ceramic infrared emitter for different industrial applications such as drying and thermoforming in plastics. The project's scope also includes conducting experiments to validate the simulation results. The infrared emitter is composed of a heating plate surrounded by a steel envelope and two alumina bushings, with the aim of finding the optimal conditions for operation in both steady and transient states and conclude on the possible real-world performance of the infrared emitter. The modeling will be done using Patran and Nastran finite element software, with a focus on

determining the optimal geometric arrangement. Indeed, the goal of the project is to determine the ideal operating conditions, specifically the geometric arrangement of multiple infrared emitters in pursuit of achieving uniform heating over time of a surface or a material.

## RESULTS

In order to model the infrared emitter, we used Patran, a software designed for Finite Element Analysis, which includes tools for thermal analysis. The modeling process was divided into two parts. First, we modeled the heater using the software, and then we conducted several experiments to characterize the model. By comparing the results obtained from our modeling with the experimental data, we could evaluate the effectiveness of our model. After completing the modeling phase, we conducted laboratory experiments using mainly type K thermocouples and a thermal camera. The data we obtained from the thermocouples were mostly consistent with the results from Patran, but some discrepancies showed that our model needed to be modified. In particular, certain characteristic values of the materials needed correcting. Concurrently, we researched and acquired the radiation viewfactors using numerical equations as well as results from Patran.

**KEYWORDS :** thermoradiative properties, infrared emitter, temperature, modeling, simulation.



modeling of the emitter

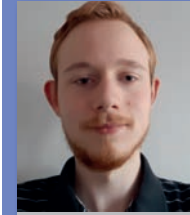


Infrared emitter

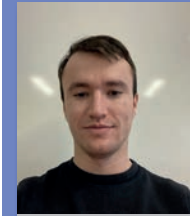
Contact : [karim.halfi@etu.univ-orleans.fr](mailto:karim.halfi@etu.univ-orleans.fr)/[alice.rossi-bourcet@etu.univ-orleans.fr](mailto:alice.rossi-bourcet@etu.univ-orleans.fr)

# Thermal modeling of an insulating flask

Energetics



F. BROEKS



L. HUMBERT



Company/institution : Zéfal

**Flavien BROEKS/Louis HUMBERT**  
 Academic supervisor : Alain GASSER  
 Industrial supervisors : Christophe FLETOUT/Noah LIGIER

## OBJECTIVE/MOTIVATION

Good hydration is essential after physical effort; nothing is more pleasant than drinking a fresh liquid. Hence, the company Zéfal is designing an innovative thermal bottle. This report aims to identify and quantify the various factors for improving the thermal behavior of the water bottle by simulation. The canister will be simulated under two cases. The water is at 5°C with an outside temperature of 35°C, and the other water at 65°C with an outside temperature of 5°C. The final step is to propose different materials to improve the water bottle's performance. To reach these objectives, the water bottle theoretically was studied, and equations were established to describe the behavior of the bottle



Studied canister

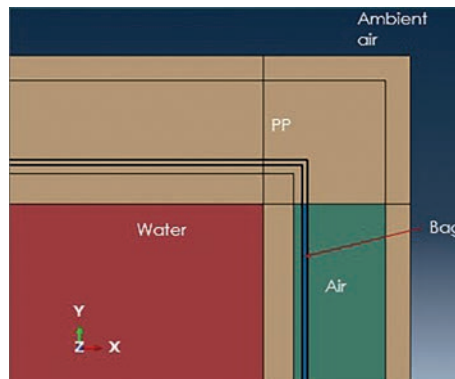
state will only be studied by simulation. The small thickness between each cylinder was a problem for the modelling part. The solution is to make an axisymmetric model. The results obtained by simulation are pretty much like the experimental tests made by the company. We managed to simulate many hypotheses? such as changing the gas or the pressure between the tow layers of the bottle. We also try to fill this gap with a new techno-material (Aerogel). The improvement of the insulated behavior of the bottle were significant (more than 5°C difference after 4 hours with the current bottle)

**KEYWORDS :** thermal, modeling, sports, water, insulation .

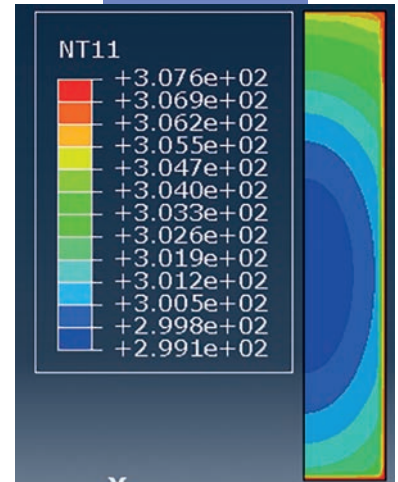
thermally. After that, the bottle must be modelled on the software ABAQUS and the obtained results will be compared with the experimental results given by the company to validate the model. Finally, different materials will be studied to improve the product's thermal performance.

## RESULTS

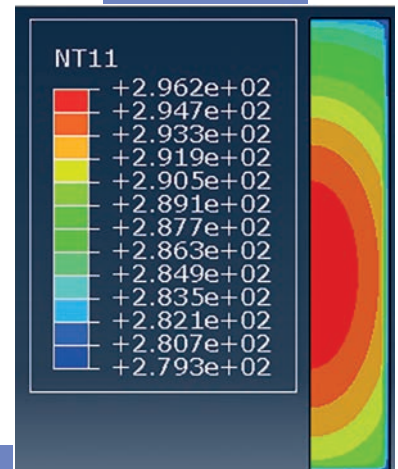
In the theoretical part, thermal equations were established in steady state; they give the thermal resistance and flux in each layer of the bottle. However, the equations in the transient state were too complex and time-consuming to solve. The transient



The different layers of the flask in Abaqus



Temperature fields of cold water left in ambient air at 35°C for 4 hours

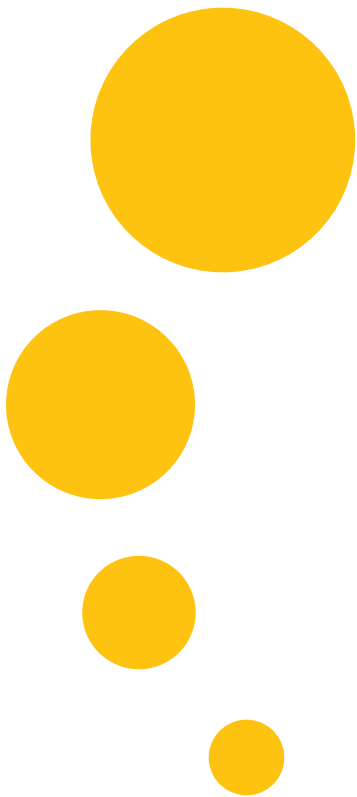


Temperature fields of hot water left in ambient air at 5°C for 4 hours

Contact : [flavien.broeks@etu.univ-orleans.fr](mailto:flavien.broeks@etu.univ-orleans.fr)/[louis.humbert@etu.univ-orleans.fr](mailto:louis.humbert@etu.univ-orleans.fr)



# Internet of Things



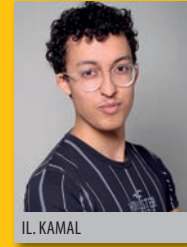
**IoT**

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internet of things

# Introducing the internet of things into production lines

Electrical engineering



I.L. KAMAL

**Ilyas KAMAL**

Academic supervisor : Aladine CHETOUANI



Company/institution : Polytech

Example of what the dashboard is going to look like shiny documentation

## OBJECTIVE/MOTIVATION

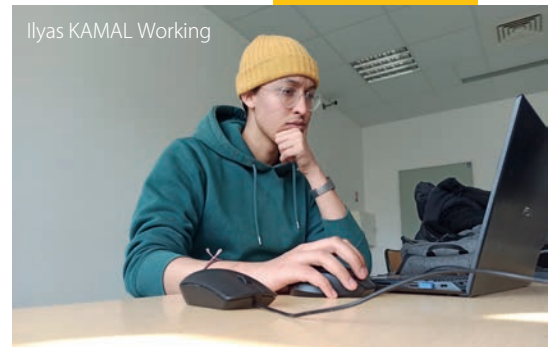
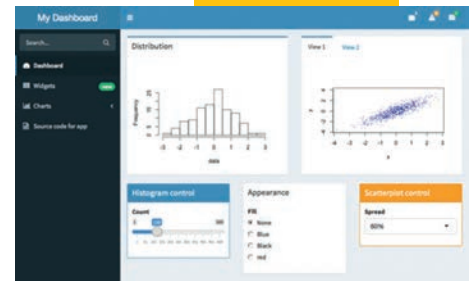
The aim of the project is to leverage IoT technology to optimize production processes, reduce costs, and improve efficiency. This will involve the development of a custom IoT platform to collect and process data from sensors and devices installed throughout the production sites. The platform will provide real-time insights into the production processes, enabling managers to make data-driven decisions to improve efficiency and reduce costs. In addition, a dashboard will be developed to centralize all the data collected from the different sites, providing a comprehensive overview of the entire manufacturing process. Overall, the project is designed to enhance the efficiency of production processes using IoT technology, improving the quality of products and reducing costs.

## RESULTS

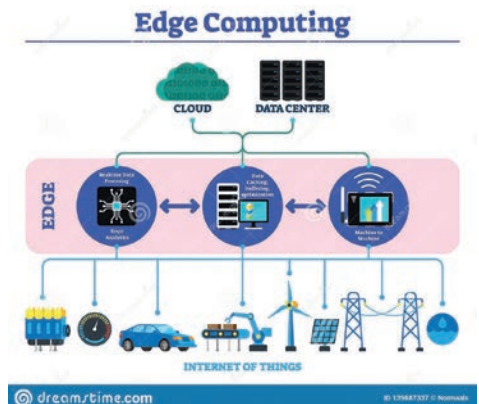
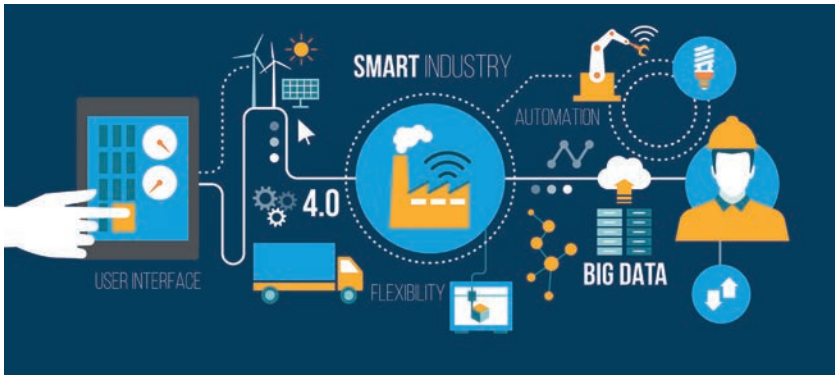
The research conducted for the project focused on the use of IoT technology in the optimization of production processes. The study revealed that IoT technology can be used to collect data from sensors and devices installed throughout

the production sites to provide real-time insights into the manufacturing processes. This can enable managers to make data-driven decisions to improve efficiency, reduce costs, and enhance the quality of their products. In addition, the study highlighted the importance of centralizing all the data collected from different sites to provide a comprehensive overview of the entire manufacturing process. The use of dashboards can aid in this centralization and provide an easy-to-read summary of the data. Overall, the research shows that the use of IoT technology can be a powerful tool in the optimization of production processes.

**KEYWORDS :** data science, Internet of things, web services, machine learning.



Smart industry chart credit-Stratays



Contact : [ilyas.kamal@etu.univ-orleans.fr](mailto:ilyas.kamal@etu.univ-orleans.fr)

Edge computing illustrated by dreamstime ID139687337





Technology  
Innovation

34:23:45:47

Management  
Success  
Innovation  
Solution  
Marketing  
Analysis  
Ideas  
Management

Management  
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POLYTECH  
ORLEANS ECOLE D'INGENIEURS Site Gallée

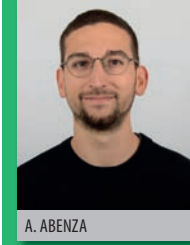


# Production **management**



# Interactive management tool for maintenance activities

Production engineering



A. ABENZA

**Alexandre Abenza**

Academic supervisor : Emmanuel Beurauy  
Industrial supervisor : Thomas Soave



Company/institution : INTERCONTROLE

## OBJECTIVE/MOTIVATION

Apprentice engineer in the maintenance department of Intercontrôle, it's a company specialized in non-destructive testing for the nuclear sector. In the context of digitalization and the upcoming of operational excellence (OpEx) process, I started developing a new tool for scheduling maintenance activities. This tool has also to be interactive and capable to collect operational feedback around these activities. As the previous process was not interactive, limited, and dependent on the human factor, it was generating some errors. That why we needed to automate the planning of maintenance tasks and formalize feedbacks.

## RESULTS

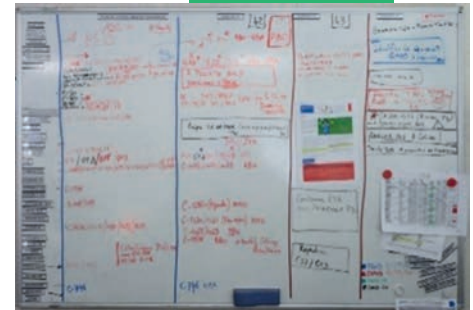
To do that, we acquired an interactive whiteboard that allowed us to make our planning collaborative and to collect feedback from our team. In addition,

during the implementation of this tool, the users were at the heart of its development. I was able to consult them at each phase of the project to build our tool according to their needs; working groups were organized to collect a maximum of weak signals on a daily basis to be able to track them in the tool and then to launch improvement workshops (kaizen 6 points). This tool has enabled us to restore dynamism within the maintenance section and to get the teams more involved in its operation. Our tool has made our planning process more reliable and is helping to increase the performance of Intercontrôle's maintenance.

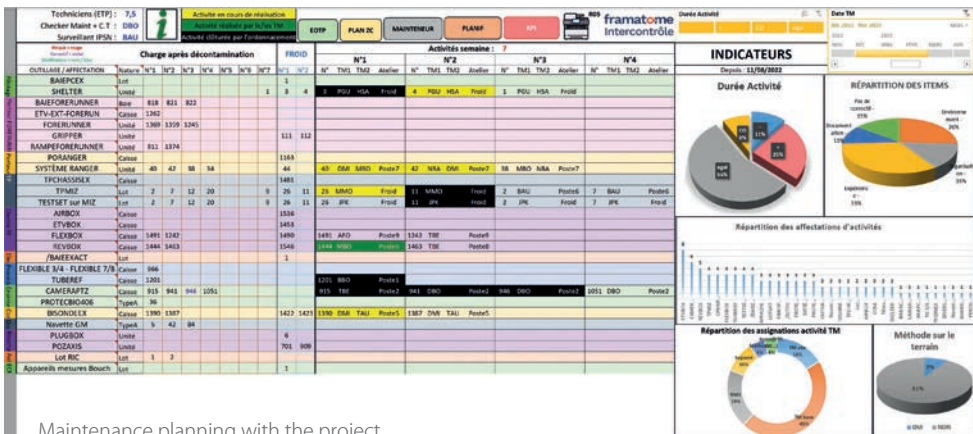
**KEYWORDS :** operational excellence, nuclear, scheduling, digitalization.



QR Code Youtube



Maintenance planning before the project



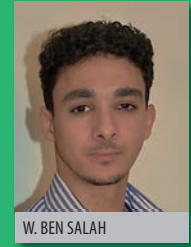
Maintenance planning with the project

Contact : abenza.alexandre@gmail.com



# Implementation of a test bench for the testing of emission control system components

Production engineering



W. BEN SALAH

**Wael BEN SALAH**

Academic supervisor : Philippe GRILLOT  
Industrial supervisor : David BROCHET

Company/institution : JOHN DEERE

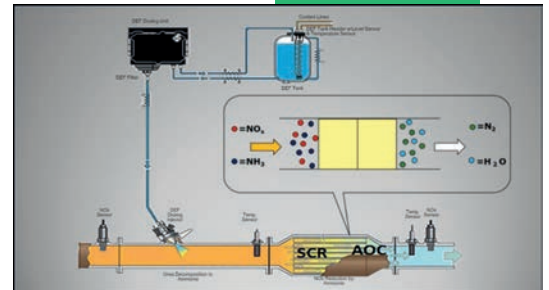
## OBJECTIVE/MOTIVATION



Dashboard (KPI) of test results

tested components, and achieving a financial impact by reducing the number of components returned to the supplier.

**KEYWORDS :** continuous improvement, industrialization, quality, flow and logistics, production management.



Functional principle of the SCR system

The objective of my fourth-year project was to design and implement a test bench for evaluating the mechanical and electrical functionality of components of the exhaust gas pollution control system. The specific focus was on testing DEF (urea) injection modules, injectors, and DEF headers that came from warranty claims made by the dealer network. The aim was to verify the root cause of these component failures and to provide data for creating proactive diagnostic routines.

## RESULTS

To accomplish this, the project involved conducting an analysis of existing statistics on component failures, setting up the test bench with the guidance of an instructor, and creating an operating procedure, database, and dashboard using Power BI software.

As a result, the project contributed to reducing warranty defects through improved diagnosis by dealers, identifying new failure modes on the

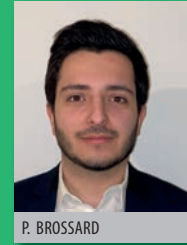


Test bench of DEF Header

Contact : fwael.ben-salah@etu.univ-orleans.fr

# Industrialization of a new project

## Aerospace engineering



P. BROSSARD

**Pierre Brossard**

Academic supervisor : Jean-Marc AUFRERE  
Industrial supervisor : Philippe CALLAULT



Company/institution : Safran Aerosystems

### OBJECTIVE/MOTIVATION



Different tools at the station, standard and designed

My project was to participate in the industrialization of two products that began to be developed in the company in 2020. These two products are hydraulic distributors which allow the opening and closing of the thrust reversers of a private aircraft in development. Attached to the industrialization methods department, my role was to organize the arrival as well as the assembly of the parts that make up the two products. My main mission was to set up the production site taking into account the flows but also the assembly order given by the production instructions as well as creating and validating the tools that will facilitate assembly by the operators. We had to assemble and test the products ourselves to validate certain technical choices.

### RESULTS

During this year, I first defined, ordered and installed the organization of the product assembly room by distributing the different assembly stages on

the different workbenches. I also designed, on 3D design software, specific tools for certain assembly stages because standard tools did not exist, I had them manufactured internally or externally. After receiving the specific and standard tools, I installed them on the workbenches in an organized manner so that the operators could find them quickly and that they were always stored high up. With this implementation, I was able to try my additions by taking part in the assembly of the prototypes which were assembled by the methods department. They were used to carry out conclusive operational tests on test benches.

**KEYWORDS :** industrialisation, hydraulic, aircraft.



Tool example

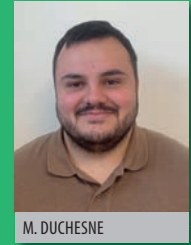


Product assembly area located

Contact : pierre.brossard01@hotmail.com

# Optimization of the working methods of a trimming line

Production engineering



M. DUCHESNE

**Maxime Duchesne**

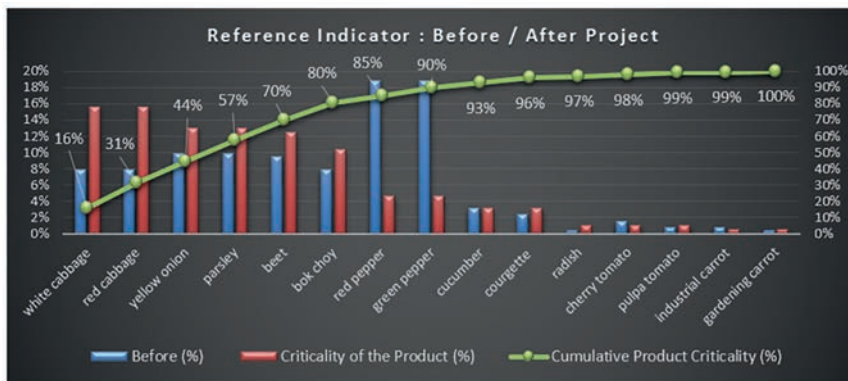
Academic supervisor : Mrs. Grosselin

Industrial supervisor : Mr Guérin



Company/institution : Les Crudettes

## OBJECTIVE/MOTIVATION



Reference indicator : before/after project

Trimming is the first action performed on the raw material by production departments. It removes unwanted material from the vegetables. Every day, the trimming department can process up to 50 tons of vegetable (5,000 boxes). As part of the strategy for the takeaway and community catering industry, I worked on the range linked to the takeaway catering industry. This produce requires special trimming. We cannot therefore produce this range on a conventional production line as it is made in small series and in several processing phases. The objective is to gain in productivity and visibility on this range in order to reduce the cost of production. The challenge for the company is to become more competitive in the takeaway and community catering market that the food industry represents.

## RESULTS

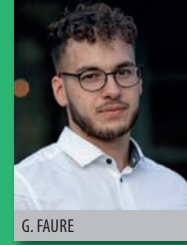
We agreed to start working on two different approaches. The first is to focus on the trimming processes. To do this, it was necessary to sort the references by criticality via an indicator. As the project was not finished, I only dealt with two products. On these, I observed a 33% increase in productivity. To this must be added the 4.1 additional yield points. To achieve these results, I developed a new working tool for the operators in cooperation with the various users. The second area of development is based on the elimination of 'mudas', especially in traceability which was redundant. The Pilot Operators were carrying out the same task in writing and digitally. The paper version was given up.

Contact : maxime.duchesne.45@gmail.com



# New program production launch in the automotive industry

Production engineering



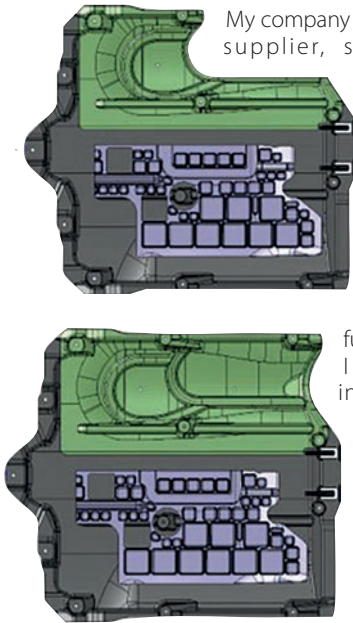
G. FAURE

**FAURE Guillaume**

Academic supervisor : Aicha FONTE

Industrial supervisor : Antoine JOUBIUX

## OBJECTIVE/MOTIVATION



My company is an automotive supplier, specialised in manufacturing composite parts, which aims to produce the lightest possible automotive exterior parts to reduce vehicles' fuel consumption. I joined the industrialization department, which is dedicated to the management of new projects production launch. In my case, these parts were composite

underbody panels for a well-known German car manufacturer.

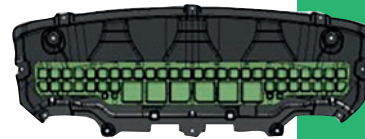
Most of my work was to prepare the start of serial production with the arrival of an all-new robotized production cell, so I had the opportunity to participate to the multiple trials of each machine after receiving them. This step was crucial because it allows us to reveal several problems and to solve them in time but also to optimize new production line's performances. Another part of my job was to set up the standards part as continuous improvement is a crucial element in my company, but it is even more important for a program launch

because we need to create, as soon as possible, a solid base of good working habits for operators.

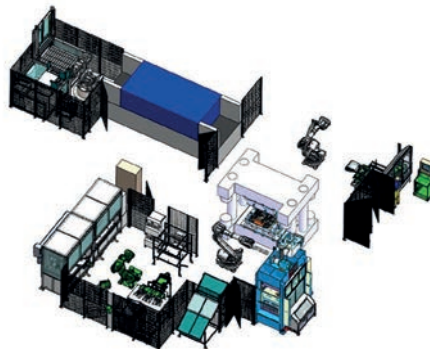


## RESULTS

Right now, we are still in an optimization phase because customer demands are increasing progressively month after month, and to respond to this demand in the future we need to improve the cycle time of the production cell as well as reducing the change of die time and the scrap ratio.



**KEYWORDS :** industrialization, problem solving, process optimisation .



Caption

Contact : [guill.faire@orange.fr](mailto:guill.faire@orange.fr)

# Compliance for the storage of explosive products

Production engineering



P. GRENOUILLON

Storage of explosive products



Company/institution : ASP

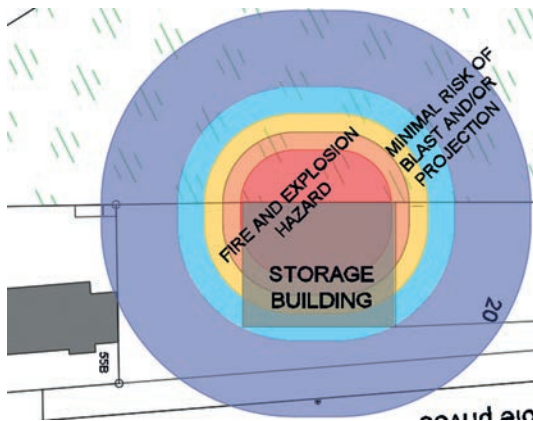
**Pauline GRENOUILLON**

Academic supervisor : Aïcha FONTE

Industrial supervisors : Laurent LELIEVRE/David COTRET

## OBJECTIVE/MOTIVATION

Our client would like to increase its storage capacity of explosive products for fireworks and blank firing bullets to 100 kg of active material. In order to obtain authorization, it is necessary to respect the regulations, especially those imposed by both the Environmental Code and the Internal Security Code. The objective is to ensure the storage is in accordance with the regulatory texts while respecting the legal deadlines. My mission



Map of pyrotechnic effect zones

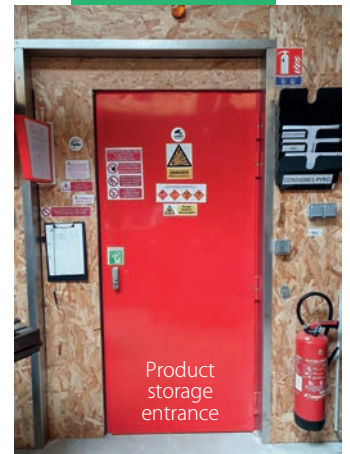
was to oversee the compliance of the installation to secure and legalize it. Successfully passing these legal requirements as well as increasing storage space are important steps that will enable our client to deliver the volume of customer demand, to be flexible with a wide variety of products, and to simplify logistics by centralizing storage in one place. This project will increase competitiveness and reactivity.

## RESULTS

After thorough analysis of regulatory texts, I established action plans, asked for quotes, gave useful information to the building manager so that he could begin the different renovation tasks. I used Microsoft Excel spreadsheets to handle the numerous tasks. To build the file, I created the operating instructions, the visual management and the traceability standards. I also checked the update of the site plans in CAD\*, calculated the radii of the pyrotechnic effect zones and I placed them on the site plan. Thanks to these results, we have noticed that there is no explosion hazard to neighboring land. The installation was audited by the "DREAL" \*\* on certain major checkpoints and then by a control office charged with inspecting the entire installation. All the protective elements and the requested documents were present and compliant. The deadlines and budget were respected. Our client can now develop his business in a secure and legal way.

**KEYWORDS :** regulatory audit, pyrotechnics, visual management, supplier sourcing, \*Computer Aided Design.

\*\* Regional Directorate for the Environment, Planning and Housing (DREAL = Direction Régionale de l'Environnement, de l'Aménagement et du Logement)



DERNIERS DELAIS (RETRO-PLANNING)		Semaine																				
		Jours																				
		L	M	T	J	V	S	L	M	T	J	V	S	L	M	T	J	V	S	D		
		DATE																				
		31	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
TACHES	Avancement à titre indicatif (en %)	NOM																				
Plans	100,0																					
Préciser les tâches concernant les éléments à intégrer dans les plans	100																					
Plan général à jour des stockages	100																					
Elaborer des risques / Indiquer les localisations et les limites des zones d'effets pyrotechniques	100																					
En plus des zones de danger, il faut indiquer la nature des risques	100																					
Plans des locaux facilitant l'entretien des services d'entretien et de sécurité	100																					
Plan des armoires électriques	100																					
Vérifier la correspondance des plans avec le réel et le respect des prescriptions	100																					
Documentation	100,0																					
Créer l'affichage sécurité	100																					
Créer les consignes de sécurité	100																					
Créer le classeur produits	100																					
Rédiger les consignes d'exploitation	100																					
Créer inventaire produits	100																					
Créer fiches entrée-sortie produits	100																					
Documenter les caractéristiques de résistance au feu du local	100																					
Créer étiquetage produits	100																					
Créer registre foude (carnet de bord compris dans l'ETF)	100																					
Rassemblez le dossier général	100																					

Retroplanning before control

Contact : grenouillonpauline@gmail.com

# Decrease the production scrap

## Industrial engineering



B. KIOTA

**Benjamin Kiota**

Academic supervisor : Benoît Le Roux  
Industrial supervisor : Maxime Aussant



Company/institution : MSL Circuits

### OBJECTIVE/MOTIVATION



In 2020, MSL Circuits decided to hire a full time junior engineer to work on production scrap issues. I was looking for a company to support me during my three-year studies at Polytech Orléans and they gave me my chance.

I used my first months to understand the multicauses problem and the way MSL Circuits was working on them. I suggested they improve the response time when a quality problem appears (JIDOKA), in order to improve the company's knowledge of its problem and minimize the consequences. With a better reaction system I proposed to equip the operators with better tools so they can take better decisions. My last contribution, was to participate to the creation of prediction models to prevent more quality problems from occurring.

### RESULTS

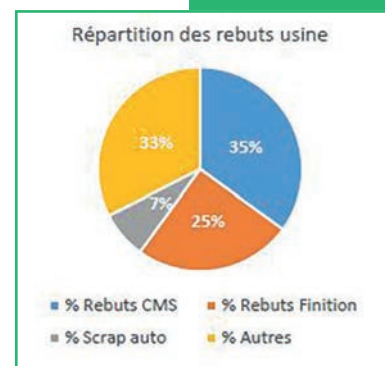
The general difficulties I had to overcome were linked to the people resistance having to deal with new tools, new approaches.

Thankfully, even the most resistant person changes if the factual results are convincing. In the beginning of 2023, I will spend 2 months with some volunteer operators to test the new way of working and we

are hoping that the result will be about 30% better of other lines.

I will write a paper with all the results, the weaknesses, the strengths and the future perspectives to encourage MSL Circuits to spread the tools on the other lines if they want to decrease the rejects on the production line.

**KEYWORDS :** scrap, production, data analysis, indicator, data science.



Problèmes identifiés	Aspects du problème	Solutions proposées	Gain potentiel
Manque de réactivité lors d'un événement rebut	Pas d'indicateur de performance relatif à l'objectif / pas de Jidoka possible	[MESURER] Création d'un indicateur (IKR)	Le maintien du niveau qualité demandé = 376 040€
	Beaucoup de supports d'information relatifs aux rejets (LS)	[VOIR] Créer un support synthétique (TRS, DISPO, IKR, FPI, Config machine têtes, feeders, buses, Alerte Mount Rate, Alerte Rejets cpts)	
	Mode de réaction confus ou inexistant	[COMPRENDRE] Définir des outils d'orientation et de caractérisation (OAD)	

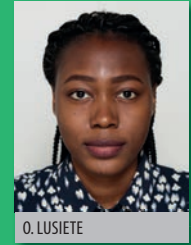
Tableau récapitulatif Causes / Solutions / Coûts

Contact : benjamin.kiota@etu.univ-orleans.fr



# Paint sealant reduction project

## Production engineering



O. LUSIETE

**Olive LUSIETE TUTONDA**

Academic supervisor : Paul BEAUVALLET

Industrial supervisor : Victor FORGERIT



Company/institution : RENAULT SAS

### OBJECTIVE/MOTIVATION

The project that I was given was the reduction of the length of paint sealants on Renault vehicles. The paint sealant is one of the products used on the cars and plays several roles especially on watertightness of the vehicle.

This project is a challenge, but no numerical target was set (for example reduction of 10 meters on small cars like Clio 5 and 15 meters on big car live Espace 5) because each car has a different size. Nevertheless, the aim is to put the quantity of paint sealants at the right level while guaranteeing the same level of quality to customers.

The genesis of this project was the results of a competitive analysis called Benchmark. It turned out that some competitors put less paint sealants in their vehicles than we did , so we were maybe over cautious regarding quality for this product.

This project was carried out in two phases. The first phase was to reduce the quantity of paint sealants on cars in production and the second phase on cars under development.

This project involves considerably positive changes in our current manufacturing process. By removing paint sealant, we gain in :

- ▶ Product used : both in terms of cost (in euros) and product mass (in kilograms),
- ▶ Cycle time : both in terms of operator availability and robot availability.

The rough ideas are:

- ▶ Price : 8 cents of euros per meter deleted
- ▶ Mass : about 60 grams per meter removed

### RESULTS

#### First phase of the project

In terms of volume : 18 cars were analyzed, more than 540 POS (Process Operation Sheets: a POS shows exactly where the product is applied as well as the quantity used) were opened because 1 car has at least 30 POS of paint sealants, more than 4,000 paint sealant beads were analyzed because 1 car represents at least 230 paint sealant beads.

The result of the bead-by-bead analysis on the 18 cars in production was conclusive. We removed between 0.5 m and 17 m of paint sealants and saved between 0.04 and 1.36 euros per car. Considering the millions of cars produced, this represents a considerable cost.

#### Second phase of the project

Two car models under development were chosen to carry out this paint sealant reduction project. They were chosen because the validation cost is nothing ; because they are projects under development, they must go through a testing phase before mass production.

Initially, the first car chosen for this project was designed with 120.4 m of paint sealant. This optimization allowed to save about 10 meters, which corresponds to a reduction of 0.8 € / vehicle. After this project, the paint sealant length is therefore reduced from 120.4 m to 110.69 m.

As for the second car, it was initially designed with 114.7 m. After study, we have also gained about 10 meters, which corresponds to a saving of about 0.8 € / vehicle. After this project, the new length is 104.9 m.

**KEYWORDS :** reduction, challenge, cost, watertightness, quality.

Contact : olive.lusiete-tutonda@etu.univ-orleans.fr

# Achieve a very precise cut of the leather

Production engineering

**MAGHO Rivan**

Academic supervisor : Estelle COURTIAL

Industrial supervisor : Léa COURTOT

Company/institution : Maroquinerie de Saint-Antoine

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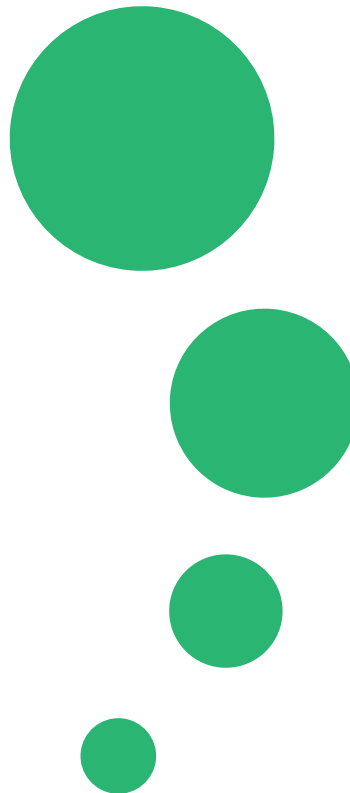
## OBJECTIVE/MOTIVATION

Hermes, based in the Paris area, is looking to determine the best cutting technology between waterjet and laser to meet its specific needs. The requirement is to achieve a very precise cut of the leather, with a tolerance of  $\pm 0.1$  mm, on very thin leathers with very complex shapes, especially for marquetry. They are also working on the cost effectiveness of outsourcing versus in-house production and are trying to determine when a machine purchase becomes cost-effective.

## RESULTS

We compared the two existing cutting technologies on different types of leather. The laser cutting is very precise but damages the leather. Indeed the laser burns the thin leather pieces. The water cutting principle is based on a waterjet at high pressure. The results were satisfying for large pieces but unsatisfying for short pieces. The latter were shorter than expected. The water cutting could be a cost effective solution for large pieces, but it is not suitable for cutting small pieces of leather. In both cases, it is very time consuming. This comparative study pointed out the drawbacks of these two technologies which were abandoned since they didn't meet Hermes' expectations.

**KEYWORDS** : processes, quality, cutting, continuous improvement.



Contact : rivan.magho@etu.univ-orleans.fr

# Creation of a digital and autonomous tool to drive the assembly department

Production engineering



E. ROQUES



Company/institution : John Deere

**Elie ROQUES**

Academic supervisor : Philippe GRILLOT  
Industrial supervisor : Sonia RAVET

## OBJECTIVE/MOTIVATION

The objective of this project was to provide a more efficient alternative to a large Excel file where key production indicators and figures were centralized. This file was filled every day by the supervisors, who had to obtain information on various databases, which was time consuming. In a year during which engine production was increasing, it was essential to free them from that non-value-added task in order to increase their presence on production shopfloor to support their teams.

The challenge was therefore to delete this Excel file and create an alternative that displays the indicators autonomously and automatically.

I developed a tool on Microsoft PowerBI. It is a Business Intelligence software that allows to connect several databases and calculate indicators which are updated daily.

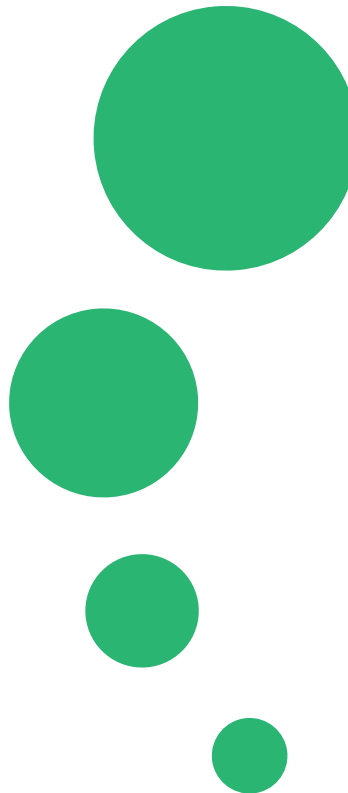
## RESULTS

At the end of this project, 95% of the indicators in the Excel file were calculated automatically and reliably in PowerBI. However, the remaining 5% prevented us from reaching our initial goal, i.e. suppressing the Excel file. In order to take advantage of the work done, the Excel file has been modified to only enter the remaining 5% of information. Completing this file today takes the supervisors 2 minutes per day, which corresponds to a reduction of almost 90% of the initial non-value-added time.

This tool is used for: Briefings (= meeting between the supervisor and his team, at the beginning of the shifts); Daily assembly review; Weekly operational review (Executive Committee and Supervisors) and monthly report (general production communication). It allows the interpretation

of the indicators and the results at different scales and serves as a support for meetings and communications.

**KEYWORDS :** powerBI, powerApps, KPI (Key Production Indicators), digitalization, continuous improvement.



Contact : [elieroques@outlook.fr](mailto:elieroques@outlook.fr)



# Relocation of a storage area

Production engineering

**Youness SLIMANI**

Academic supervisor : Chantal PROUST  
Industrial supervisor : Jean-Sébastien SCHUBERT

## OBJECTIVE/MOTIVATION

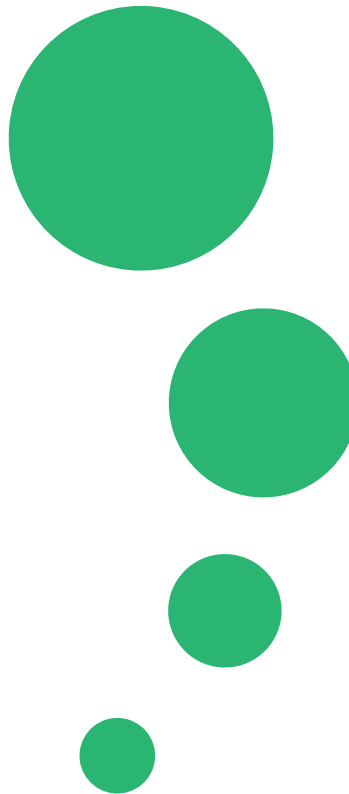
As a student in Polytech Orléans, more especially in Production Management, I am majoring a 3-year internship in Brandt Saint-Jean-de-la-Ruelle, one of the French leader's household appliances. During this second year of internship, I had to relocate the storage area of the inductor sector. The inductor sector is dedicated to the production of inductors. Indeed, this area required a reorganization in order to meet the constantly changing production needs, the needs from the different users of this area, also to improve the security and optimize the occupied space. To follow an organized plan that would allow me to define milestones in order to move forward and not get lost in the progress of the stages, I defined a forecast schedule that I have broken down into several distinct phases: Project Definition, Studies, Implementation and collect feedback for continuous improvement.

## RESULTS

Through the PDCA (plan, do check, act) tool, I managed to run a lot of actions to improve this area. I had to design the area in my computer with a scale to have a view over a lot of possibilities. At the end of my period into the company I was able to present the new storage area which permit to the logistics department the insertion and evacuation of pallets more easily, allow operators to find rows materials more easily and more ergonomically (reduce reduction of unnecessary travel), improve the waste management and finally allow to the general department to evacuate the copper bucket (production waste) for return to the supplier. When I returned in my company, I could collect feedback

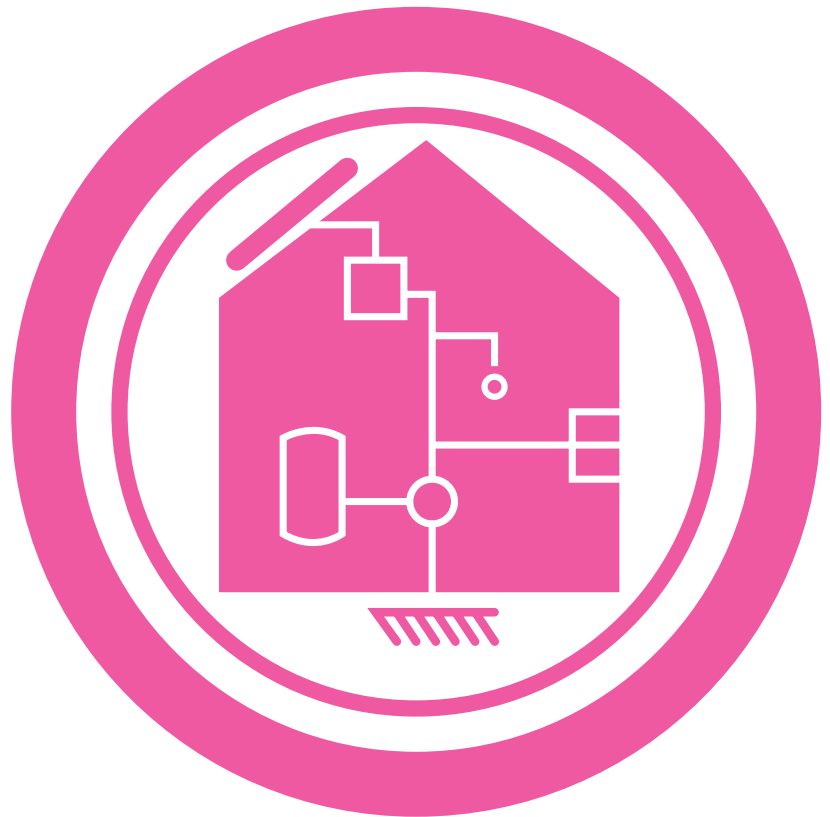
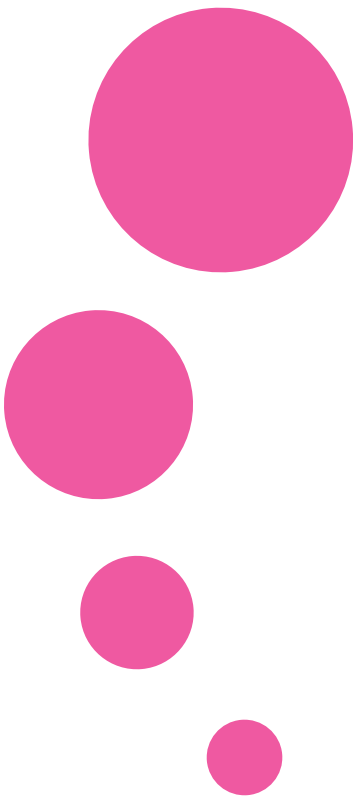
from the various users mentioned above, most of them are satisfied because this redesign has allowed their daily use.

**KEYWORDS :** continuous improvement, production, storage.



Contact : [youness.slimani@etu.univ-orleans.fr](mailto:youness.slimani@etu.univ-orleans.fr)

# Smart **building**



# Electricity supply of a methanation unit, Lugère, Loiret

Smart building



Company/institution : SPIE Industry

**Nicolas BARATEAU**

Academic supervisor : Guy Lamarque

Industrial supervisor : Loïc Desprez

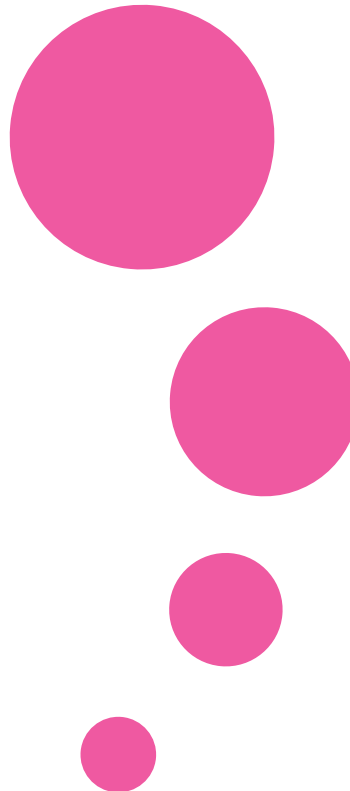
## OBJECTIVE/MOTIVATION

The purpose of this bio-gas power plant is to valorise the organic wastes from the local agriculture while producing bio-methane for the local gas grid and bio fertilizer for the local agriculture. The Saint- Jean de Braye SPIE Industry agency was in charge of providing the power supply to this gas plant by installing an 800 kVA transforming station as well as the VDI (Voice Data Image) system, the monitoring system and the security system. As a SPIE apprentice, I oversaw the follow-up of the project by attending the site meeting, managing the team, and taking care of the material supply, which was very informative.

## RESULTS

The carrying out of this project lasted for over one year, the unit was put in operation in December 2022. It will produce twenty-two gigawatts per hour per year and will supply around two thousand households. The liquid and solid digestates resulting from the anaerobic digestion will be spread in fields, thus providing all the nutrients essential to plant growth. While the methanation process produces CO<sub>2</sub> too, the owner of the site plans to install a CO<sub>2</sub> recovery system to get the CO<sub>2</sub> from the carbon filters and valorise it by selling it to industries that could use it such as the pharmaceutical industry or for water treatment.

**KEYWORDS :** methanation, biofertilizer, power supply.



Contact : [nicolas.barateau@etu.univ-orleans](mailto:nicolas.barateau@etu.univ-orleans)



# Renewal of a High Voltage A line (20kV)

Smart building



Company/institution : SPIE Citynetworks

**Mathis BASSINET**

Academic supervisor : Jean-Marc ROUSSEL  
Industrial supervisor : Marc-antoine SAUNIER

high voltage cable

## OBJECTIVE/MOTIVATION



overall site plan

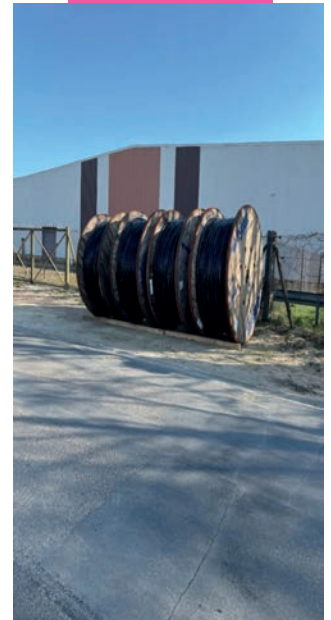
My project consists in renewing 2 High Voltage A lines on the small town of Saint Douillard on 1.2km to improve the life span. The operations vary from the opening of the road with a mechanical digger (trenches) to the connection of the cables in the transformer stations.

My primary responsibilities included managing all the administrative parts but also overseeing and coordinating the interactions between all the stakeholders involved in this project, acting as a liaison between ENEDIS (The customer), other companies, our field teams, the municipality, local residents and others. It was crucial for me to consistently monitor the financial aspects of the project, including the initial budget, the workers' on-site hours, supplies purchased and billing, the different equipment rentals in order to optimize the costs and thus increase the overall success of the project.

## RESULTS

The project began in early March 2022 and was completed in March 2023. The final result met expectations despite several disruptions caused by external factors. For example, we had scheduled intervention dates for each phase of the project and requested them as part of traffic plan, but the municipality did not respect our request, resulting in a loss of productivity. Another notable issue was the passage of a cable under a railway bridge. The ground was occupied by other entities such as orange or a gas transport pipeline, which made it difficult to pass our large diameter cable, but a solution was found relatively quickly. In the end, the client was very pleased with the work that was carried out and encouraged us to continue with this excellent project management.

**KEYWORDS :** electricity, management, public works, urban equipment.

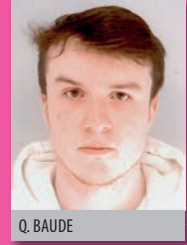


Meanused

Contact : [mathis.bassinet@gmail.com](mailto:mathis.bassinet@gmail.com)

# Creation of an indicator calculation tool

Smart building



**Quentin BAUDE**

Academic supervisor : Raphaël CANALS  
Industrial supervisor : Alicia RICHARD

Company/institution : Groupe SCOPELEC

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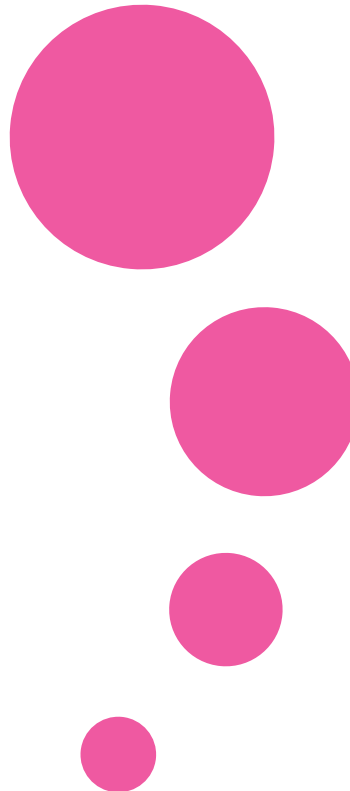
## OBJECTIVE/MOTIVATION

As an engineer apprentice for Scopelec, I was working in the performance department. The company had a huge new contract with Orange. As we won the contract for the Centre-Val de Loire area, it was necessary to understand and distinguish the differences between the old and the new contract. So, new indicators measured by Orange were introduced and evaluated by their team in weekly reviews and if we didn't reach our objectives, we would face penalties. Those indicators, also known as key performance indicators (KPIs), were completely new for a lot of departments, so we needed to understand them, then find a way to calculate them and finally create a file usable by everyone in order to maintain the objectives set by Orange.

## RESULTS

The result is an Excel® table that can be used by any employee of the concerned department in order to calculate our KPIs on a weekly basis. This allows employees to take action to improve the KPIs if they do not manage to meet the objectives. The Excel® table is linked to another file that automatically takes our performance into account to update the file. A modus operandi was also created in order to make it easier to use the table. With this file, every KPI has reached the result which had been expected by Orange since its introduction.

**KEYWORDS :** performance, pilotage.



Contact : [quentin.baude@etu.univ-orleans.fr](mailto:quentin.baude@etu.univ-orleans.fr)

# Deployment of video surveillance equipment on 19 municipalities

Smart building

**Louis Bonavita**

Academic supervisor : Guy Lamarque  
Industrial supervisor : Patrice ChereI

Company/institution : Eiffage Energie Systèmes

## OBJECTIVE/MOTIVATION

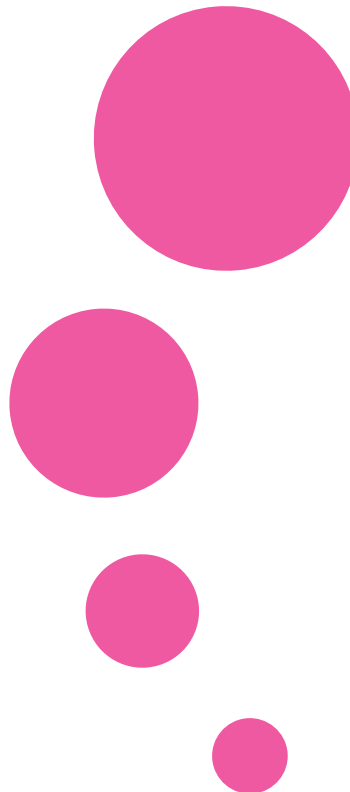
My project will focus on the deployment of cameras, transmission equipment, electrical connections for power supplies, and civil engineering work for a federation of 19 municipalities. This present project also includes the deployment of equipment for urban monitoring centers located in the headquarters of the federation. As well as the installation of active equipment (switches, routers, servers, operating stations), the installation of operating software and image analysis algorithms, the configurations and commissioning of the entire video surveillance system. A preliminary visit is necessary to study the feasibility of the project and radio transmission with the type of support, electricity needs, and verification of radio transmission. Finally, this project also includes user training, the installation of panels for citizen information, and a maintenance contract. For confidentiality and territorial security reasons, I am not authorized to disclose the names of the municipalities involved in my project.

## RESULTS

This year has been an enriching year for me. Indeed, I was able to learn more about the field of video protection and increase my knowledge in this area. I was able to develop many skills, such as rigor and organization. I am now able to conduct studies in various fields. What motivates me in public works is being able to concretely follow the progress and results of my work. I also appreciate the diversity of the job due to the different cases that one may be likely to handle. This allows me to stay motivated and gain more and more experience. I hope to continue working in this field in the coming years and have more projects of this scale. However, I am disappointed that I will not be able

to attend the implementation phase and follow the constructions teams throughout the project.

**KEYWORDS :** video, radio, power supply.

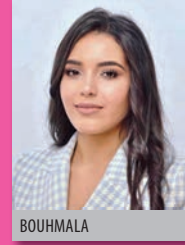


Contact : [louis.bonavita@etu.univ-orleans.fr](mailto:louis.bonavita@etu.univ-orleans.fr)



# Restructuring of school life center and the high school forum

Smart building



BOUHMALA

Bouhmala



Company/institution : Centre Val Loire

## OBJECTIVE/ MOTIVATION

During my studies at Polytech Orleans, I studied in the Smart Building specialty and worked as an apprentice at the Centre-Val de Loire Regional Council. I lead operations concerning high schools in the Loiret: restructuring, construction, renovation, fire security systems, etc.

My missions were to take on a project manager's responsibilities in connection with the different actors of the project, that is companies such as CT, CSPS, MOE... but also the internal services of the regional council according to the project and its files. I used to organize coordination meetings and drawing schedules for each project to ensure its progression. My job was also to carry out the technical and financial preparation of every operation.

One of my projects this year is the restructuring of the school life center and high school forum of a high school in Montargis. The main objectives of this project are to improve the reception and working conditions of the school life center and the forum through better functionality, modularity and reversibility improving the energy performance of the buildings at the same time.



## RESULTS

These 3 years of apprenticeship have been very rich in teaching, from a technical but also human point of view. I arrived at the Centre-Val de Loire Regional Council with few knowledges in the technical, administrative and financial fields. I found

a motivating teamwork atmosphere which allowed me to optimize my way of working since project organization and meeting deadlines.

Today, this project was delivered to users on time. This is the result of good organization and collaborative work with the various trades, regional council internal services and users involved in this operation. Thanks to this project, I was able to gain autonomy to maintain efficiency in the management of the project and to ensure that I meet the needs of users.

Finally, I am gratified to have chosen this apprenticeship. The experience I gained will undoubtedly be beneficial to me in my future work and career.

**KEYWORDS :** smart building, construction, contracting authority, management .

# Ecological transition of Vendôme Territories

Smart building

**Thomas CLEMENT**

Academic supervisor : Titaina GIBERT

Industrial supervisor : Jonathan JOUANNY

Company/institution : Agglomeration Community of Vendôme Territories

## OBJECTIVE/MOTIVATION

Due to global warming, the government decided to reduce the energy consumption of buildings with the Tertiary Decree. This decree consists in reducing the energy consumption of tertiary buildings of more than 1000m<sup>2</sup> with 3 key dates : by 40% in 2030, 50% in 2040 and 60% in 2050.

The objectives of the project were to identify the buildings affected by this decree, to recover the electricity and gas consumption from 2010 to 2019, to propose a reference year for each of these buildings, to collaborate with a private company called AVOB to collect the remote readings from the various meters, to propose ways of improving the buildings, either through insulation, by using Building Management Systems (BMS) or by using renewable energy.

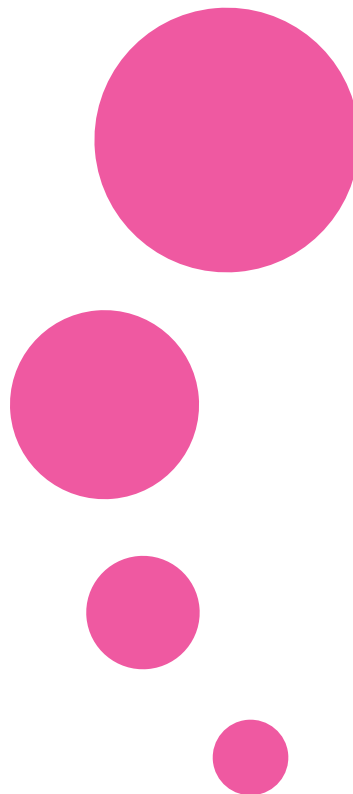
The final objective is to enter these tertiary buildings into the ADEME platform called OPERAT, and automate the new consumption data thanks to AVOB .

## RESULTS

I started by retrieving the plans of all the buildings in the federation of municipalities to calculate their surface area and check if they were part of the decree or not, then I called all the energy providers to retrieve consumption data with details when possible. Once I had all the consumption data, I was able to calculate the reference years for each one and then entered them into the OPERAT platform. In parallel, I collaborated with AVOB to give them access to our energy meter readings so that they could track consumption in real-time and automatically insert it into OPERAT in the future. I created consumption files so as to identify the 5 most energy-consuming buildings. Lastly, I chose

one of the most energy-intensive buildings to study in order to give suggestions for improvement with the goal of reducing energy consumption by 40%.

**KEYWORDS :** ecology, engineering, collaboration, internship, tertiary decree.



Contact : [thomas.clement1@etu.univ-orleans.fr](mailto:thomas.clement1@etu.univ-orleans.fr)

# Organize and supervise BMS projects

Smart building



T. DE LA TEYSSONNIÈRE

**Théophile de La Teyssonnière**

Academic supervisor : Emmanuel Beuruay  
Industrial supervisors : José Ojea/Sébastien Meyer

Company/institution : Schneider Electric

## OBJECTIVE/MOTIVATION

During my apprenticeship, I worked on two positions: the first was as a project manager, as such, my role was to organize and supervise BMS projects, which involves finding solutions to technical, relational, and also financial issues. The other was a sales position, which involved following customers closely and proposing solutions that meet their needs.

The aim of this project was to reconnect with customers with whom we had lost regular contact. The primary objective was to centralize all the customer information in our possession. The second step was to make contact by phone. If an appointment was scheduled, we would make a sales visit, thus aiming to create a trusting and personal relationship with the customer. Finally, the salesperson should maintain the link created previously by proposing technical improvements and evolutions.

## RESULTS

The building sector is a key area in the fight against greenhouse gas emissions and energy consumption in France. Buildings account for around 40% of energy consumption and 25% of greenhouse gas emissions. It is therefore crucial to take measures to reduce these figures. Schneider offers tailored and flexible solutions for each building to save energy. This project also aims to

raise awareness of the issue among companies. Following the creation of a database, we have gathered more than 250 companies. The project started in 2021 and the telephone contact phase is still ongoing, ending in mid-2023. We are already receiving positive feedbacks from some customers who are interested in our solutions and are willing to visit us to find out more about our offers.

**KEYWORDS :** building management system (BMS), performance, optimization, digital, energy.

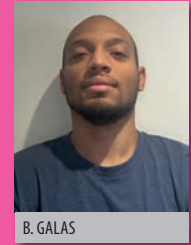


Contact : [delateyssonniere.theophane@gmail.com](mailto:delateyssonniere.theophane@gmail.com)



# A new operating room in an outpatient surgery unit for a Paris hospital

Civil engineering



B. GALAS

**GALAS Benoît**

Academic supervisor : Sophie Rager

Industrial supervisor : Sylvain Notin

**GETINGE** ✱

Company/institution : GETINGE

## OBJECTIVE/MOTIVATION

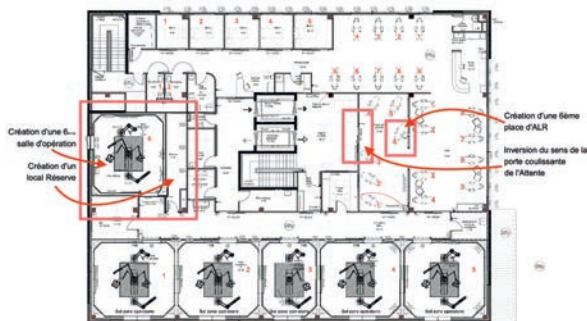
To meet the increased demand for short surgical operations, a Parisian hospital called on our services to create a sixth operating room for their outpatient surgery unit. We had to create an operating theater on the site of a reserve. This work requires us to intervene on all trades: HVAC, electricity, multimedia connections, plumbing, concrete. These tasks were carried out taking care not to interrupt the activity of the building. My role in this project was to assist the works manager. I took care

of the following aspects : project follow-up, planning and supervision of execution works, transmission of information to the client and subcontractors, participation in site meetings, ordering materials from suppliers, participation in reserve surveys. The major constraints were the control of the budget and planning, same colors and architecture as the existing blocks, and keeping the site always clean.

## RESULTS

The works started in November 2021 and ended in February 2022. We took a slight delay due to the shortage of raw materials caused by the covid-19. This caused delays in delivery that had to be managed as well as possible so as not to slow down the work. Despite this, we were able to deliver a functional room ready to be used. We have our own biomedical equipment produced by our factories in this operating room. There is an operating table, a screen embedded in the wall, an anesthetist arm, a surgeon arm and the operating lights. The success of this project has allowed us to establish a relationship of trust with the client and to continue to work with them in the future. GETINGE is not just a biomedical equipment sales company but contains various types of jobs, like the works unit.

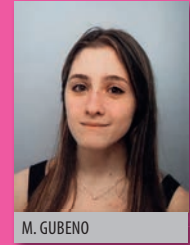
**KEYWORDS :** hospital, project, HVAC.



Contact : benoit.galas@etu.univ-orleans.fr

# EcoStruxure Automation Expert software validation

Smart building



M. GUBENO

**Manon GUBENO**

Academic supervisor : Sylvie TREUILLET  
Industrial supervisor : Nicolas NORMAND



Company/institution : Schneider Electric France

Validation  
laboratory of  
Schneider Electric

## OBJECTIVE/MOTIVATION

The objective of my 5A project is to contribute to the validation of the EcoStruxure Automation Expert software proposed by the company Schneider Electric and the PLCs in which the solutions of this software are deployed. This software, in constant development, requires a team of testers available to validate its features and new functionalities. My project this year was to participate in this validation. To do so, I had the responsibility to develop a software application allowing to manage the shutdowns and restarts of the tested PLCs, to monitor their behavior after each restart. It is a large-scale project because it requires the complete development of this application, from the design to the Human-Machine Interface, to the communication details between the application and each PLC and the implementation of the monitoring of the PLC behaviors.

## RESULTS

This software application has required a lot of work and time to set up. It still needs several improvements, especially concerning programmed shutdowns at fixed times or restart

scenarios. I encountered a lot of difficulties, especially on the management of the communication between the software and the different controllers in our laboratory, that required me to delve into the literature and to ask for help around me, not being completely familiar with these technical specificities. Yet, after a lot of work, I managed to establish communication channels that allowed me to send my cut-off requests and to retrieve the states of the different controllers. I was able to set up a screen, designed by myself, accessible to everyone so that testers could have a hand in the shutdowns of their controllers and perform their tests. Today, this application is used by everyone and also allows us to save energy by switching off all our machines every evening so that they are not left on all night.

**KEYWORDS** : PLCs, validation, software, shutdown tests, HMI.



Contact : manongubeno@hotmail.fr

# Design and implementation executive

## Smart building



Company/institution : SCHNEIDER ELECTRIC FRANCE

**Maxence LEROY**

Academic supervisor : Emmanuel BEURUAY  
Industrial supervisor : Keeran BALENDRAN

### OBJECTIVE/MOTIVATION

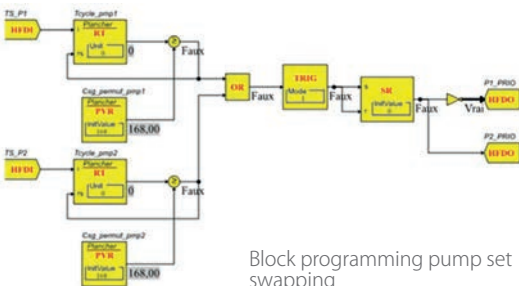
As part of my studies, I was able to do my work experience at Schneider Electric France in Paris. My role within this company has evolved over time. When I arrived, I was recruited as a BMS (Building Management System) technician, where I had to produce specifications, functional analyses, programming and graphic views of the project, before going to put them into service directly on site. Afterwards, my job evolved and I became a contract management (maintenance) and quotation creation assistant for the different sites and clients. In this role, I had to draw up maintenance contracts (new or renewal) for our sites, draw up the quotation and deal with the customer relations part. I was also in charge of answering emails and phone calls for equipment or on-site interventions that I had to schedule, and plan the technician.

### RESULTS

During these different years and carrying out different tasks, my skills have greatly improved as well as my autonomy. I had to face many problems in the technical part as well as when I was in contact with customers. These are two totally

different jobs with a different workload. I had to learn to manage several things at the same time, while remaining professional, efficient and quick in my answers. Thanks to these two different roles, I have developed a lot of skills in two different subsidiaries around the world of BMS. Moreover, having been a technician before being in customer relations helped me a lot when I had to answer a customer or when I was making my estimates because I already had an idea of the equipment and the time needed to carry out the intervention, which allowed me to rarely make mistakes in my estimates proposed to the customers and thus appear more serious and competent.

**KEYWORDS :** BMS, supervision, graphical views, programming.

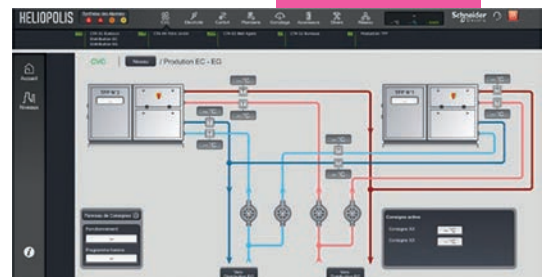


Block programming pump set swapping

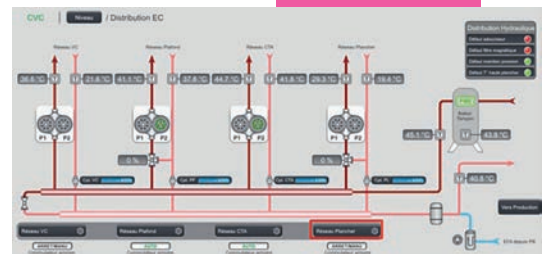
Radiant ceiling



Hot and cold water production



Heat water distribution



Contact : maxence.leroy45@gmail.com



# PV panels and the technical sheets of the lamps installed according

Smart building

**Mouhirah TOMBOTAM**

Academic supervisor : M. LAMARQUE

Industrial supervisor : M. LEGUET

Company/institution : Spie CityNetworks (Saint Jean De Braye)

## OBJECTIVE/MOTIVATION

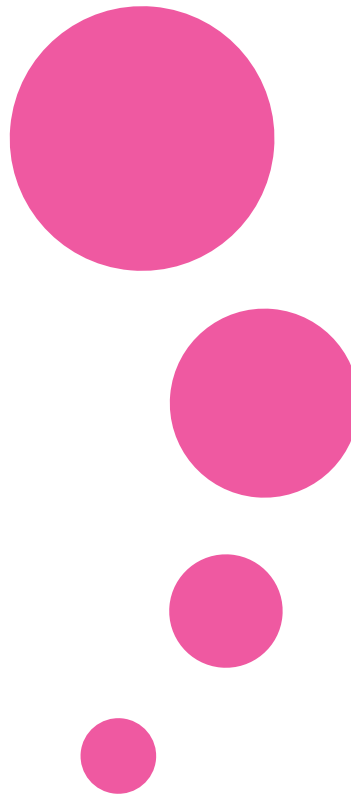
For my last year of engineering school at Polytech Orléans, specializing in Smart Building, I was able to join SPIE CityNetworks in Saint-Jean de Braye, it is one of the European leaders in multi-technical communication and energy services. SPIE in Saint-Jean de Braye specializes in Smart City services, such as public lighting, urban video protection, and charging stations. The company will soon be opening a PV program. What I immediately liked about them were the various projects that I would be entrusted with, both on the technical side as a Smart City apprentice, as well as on the commercial side and finally the communication side with the local municipalities. These projects allowed me to increase my knowledge and skills in Smart City. What I also liked was their organization and the humanity of my boss and my colleagues, which made the atmosphere very pleasant and increased productivity.

## RESULTS

The following are the projects that I carried out for several periods. I worked on projects on the commercial part, assisting the business manager and making customers' estimates. I wrote a technical report for a customer by integrating concepts that I learnt during my training on the PV panels, and the technical sheets of the lamps installed according to the project. For the communication part, I did research on a current topic that could impact the budget of towns and made a presentation on it. To accomplish these tasks, I had to do research, make a synthesis and communicate. For the technical part (lighting, charging station), I used my skills

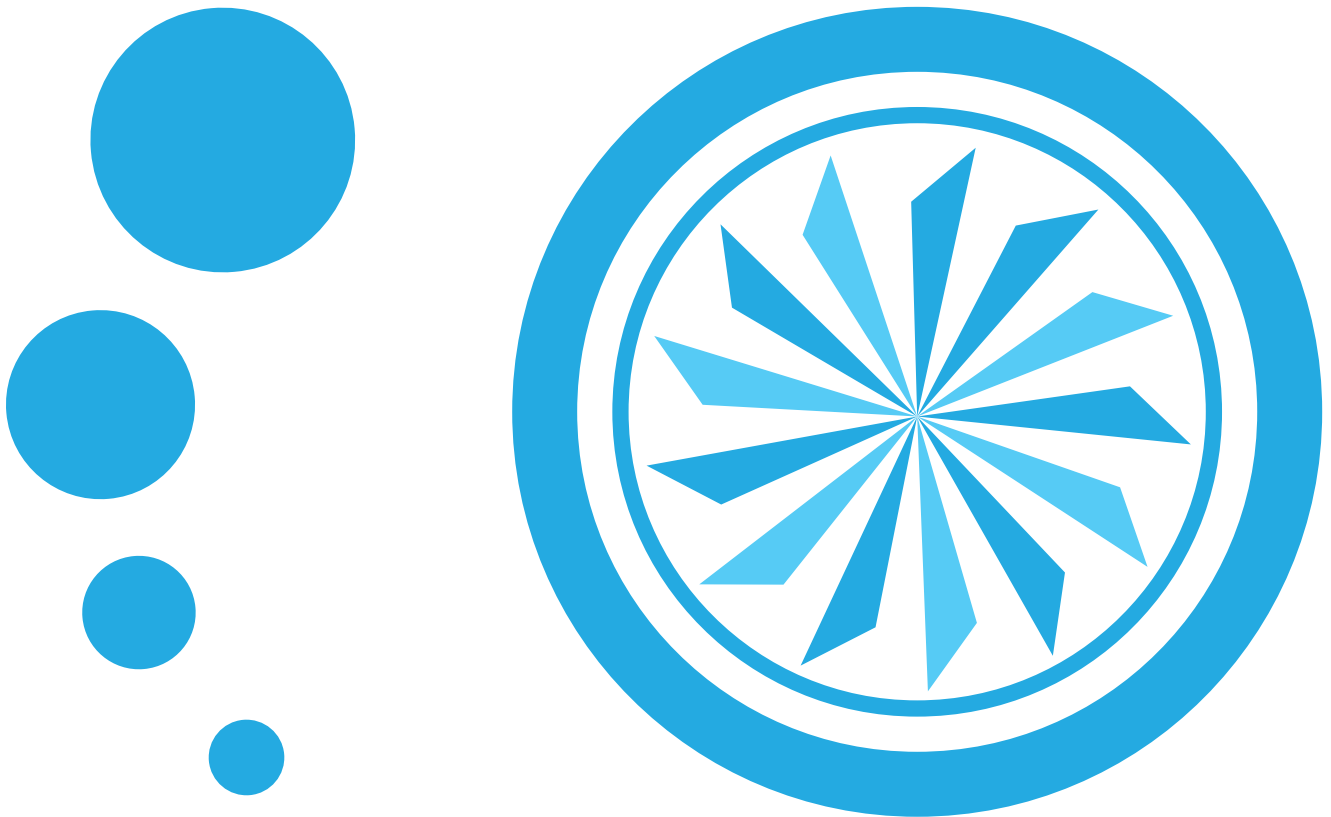
to find solutions according to the specifications and the technical skills that I acquired in DUT and at Polytech as well as in my former company, especially on lighting.

**KEYWORDS :** Photovoltaic.



Contact : [mouhirah.tombo-tam@etu.univ-orleans.fr](mailto:mouhirah.tombo-tam@etu.univ-orleans.fr)

# Technologies for **energy, aerospace and engine**



# Autoconsumption : optimization by criteria, performance and environmental impacts

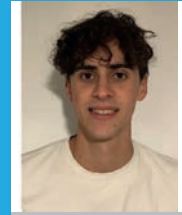
Energetics

**DUVAL Thomas/LAURENT Axel**

Academic supervisors : HESPEL Camille/CAILLOL Christian  
Industrial supervisor : BAILLEAU Didier



Company/institution : MayENR



T. DUVAL



A. LAURENT

## OBJECTIVE/MOTIVATION

The start-up MayENR, an engineering and design office specialising in energy transition provided to Polytech Orleans a new project. Nowadays, MayENR has noticed a development and an incentive for collective self-consumption. In this context, the main objective of the project is to design an energy optimization algorithm by controlling several energy consumers on the case of a collective self-consumption. This algorithm would be based on three different criteria such as economic (reduce the electricity bill), energy independence (favour self-consumption) and environmental impact (reduce CO2 emissions). The client will be able to choose between a mix of these 3 criteria, according to a hierarchy or a distribution desired by the client.

created for different sites (factory, municipal swimming pool, individual house) which are optimised by a single given criterion. In the figures joined, without optimisation, the hot water tank only works when we have programmed it, i.e., between 21:00 and 7:00. With the "economic" optimisation, the hot water tank consumption takes place when the electricity price is at its lowest. Then, it ran during PV production. The control of different appliances in the same time is possible thanks to a priority rule between these consumers.

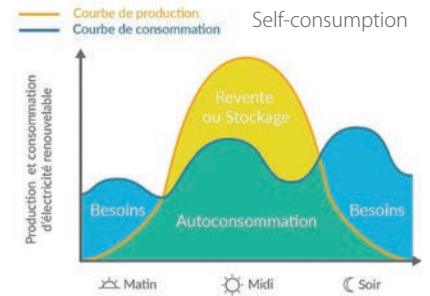
**KEYWORDS :** optimization, self-consumption, photovoltaics, production, control

## RESULTS

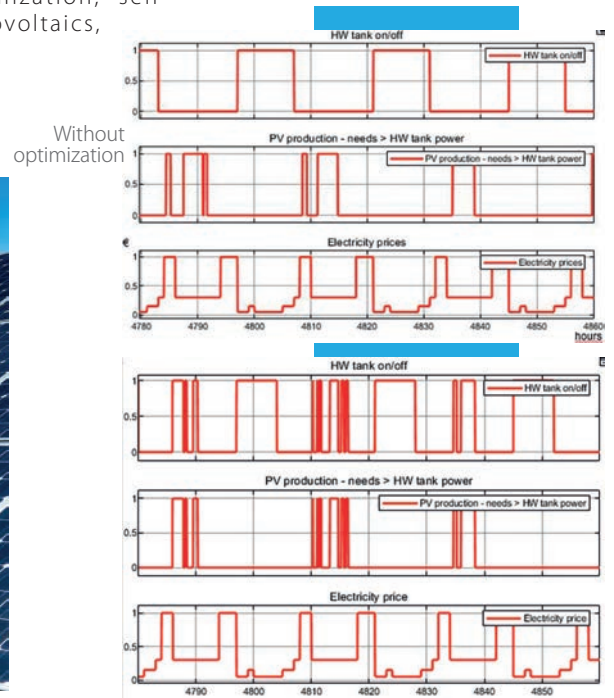
Based on research, several algorithms have been



Photovoltaic panels



Self-consumption



With optimization

Contact : [thomas.duval2@etu.univ-orleans.fr](mailto:thomas.duval2@etu.univ-orleans.fr)/[axel.laurent@etu.univ-orleans.fr](mailto:axel.laurent@etu.univ-orleans.fr)



# Vented bowl optimization

## Mechanical engineering



Company/institution : Kemica Coatings

### OBJECTIVE/MOTIVATION

The company KEMICA coatings aims to validate a new concept of rotating nozzle allowing to spray resin as a protective coating on floors or walls. The objective of our project is to carry out a CFD simulation on the fluent software of the flow of the resin particles and the air jet upstream of the nozzle to the wall. After selection of the resin/air interaction model and validation on test cases, the distribution of the resin on a pseudo wall was simulated as a function of the nozzle rotation speed. Finally, the nozzle sizing laws were defined.

The main objective of our project is to model the particles-laden flow of resin and air. In order to accomplish this, we must conduct a thorough literature review on this type of flow to select the appropriate model. Once selected, we will validate the simulation on simple academic problems before moving on to the more complex problem of the vented bowl. Another objective of our project is to optimize the airflow by improving the design of the blades. This will enable us to create a machinable final design of the bowl. Our motivation for this project stems from the fact that we recognized the need to learn extensively about the flow type we are dealing with. As a new concept to us, we had to delve deep into the subject matter to extract what is important and to gain a comprehensive understanding of our work.

### RESULTS

As our main objective was to model how the resin impacts the wall, we have made several simulations in order to see the repartition of the resin on the surface. As expected, the concentration of the painting can be compared to a gaussian function. So that the resin is highly concentrated at one

**Pierre Michelet/Theo Roland**  
Academic supervisors : Mme Hespel/M. Passaggia  
Industrial supervisor : M. Baret

point and when you move away from this point the concentration decreases exponentially. As the bowl is supposed to rotate, we have made different simulations with different swirl velocity. The results show that the higher the swirl velocity, the further the resin is from the axis of rotation, but it keeps the gaussian tendency with a lower maximum. In addition to the swirl velocity, we induced an angle on the air flow to see how it changes the behavior of the resin.

**KEYWORDS :** CFD, particles, multiphase, painting.



P. MICHELET



T. ROLAND

Caption

Contact : pierre.michelet1@etu.univ-orleans.fr/theo.roland@etu.univ-orleans.fr

# Energy transition of the headquarters of the company AXEREAAL

Environment engineering

**Hemme Suzie/Houvenaghel Cassandre**

Academic supervisor : Jean-Michel Favié

Industrial supervisor : Antonio Teixeira



S. HEMME



C. HOUVENAGHEL



Company/institution : AXEREAAL

2<sup>nd</sup> place  
17<sup>th</sup> annual final year projects forum

## OBJECTIVE/MOTIVATION

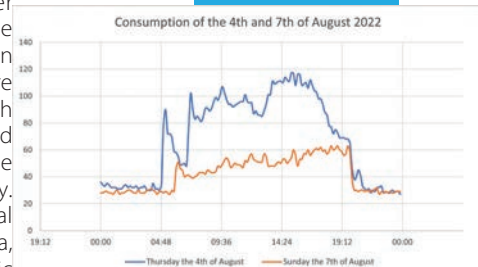
AXEREAAL is a leading agricultural and food processing cooperative group which includes 11000 farming members in France and around the world. With today's environmental context, AXEREAAL wishes to lower its impact on the planet and be more responsible and sustainable. Our main purpose is to advocate for a solution improving the energy transition of the company's premises. To this end, we have studied the headquarters' power needs and consumption habits. We have considered a lot of energy transition solutions and especially for producing green energy on site. We have measured the site's production potential and dimensioned several energy production strategies as well as financial schemes over 30 years. The goal is to give options to the company in order to move towards energy self-sufficiency while lowering its environmental footprint and improving their image.

## RESULTS

First, we gave a critical analysis on an energy transition solution proposed by an engineering office for AXEREAAL's plant in Chateauroux.

Afterwards, while studying the HQ's power needs, we designed an automated tool for the company to appreciate its power consumption and improve their consumption habits. The latter instrument provides graphs of the consumed power over any period. Then we estimated with statistics the share of energy used by each consumer such as heating or lighting and concluded that an optimal solution would be mixing thermal and electric energy. After analyzing the production potential on site based on meteorological data, we chose to dimension a photovoltaic plant over the parking lot whereas we suggested that the company conduct a deeper study of the wind power potential on the roof. Moreover, we proposed a weak-depth geothermal solution to benefit from the ground heating power and lower the heating and refreshing power needs.

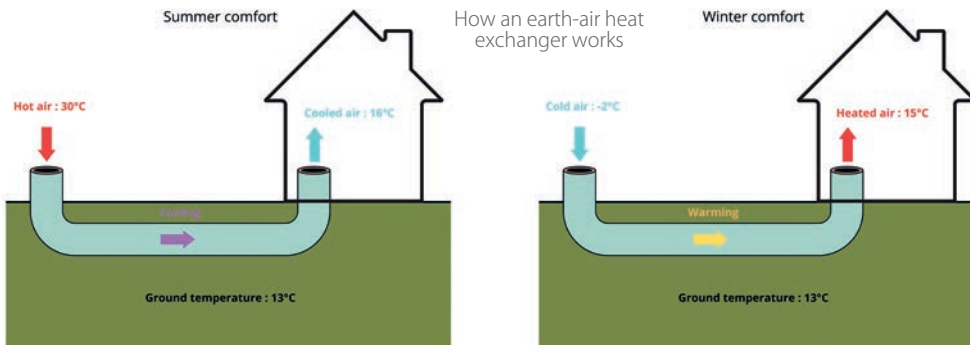
**KEYWORDS :** power needs, self-consumption, energetic mix, power-saving.



Electrical consumptions of the premises in 2021



3D modelling of a photovoltaic plant over the parking lot



AXEREAAL's headquarters premises

Contact : [suzie.hemme@etu.univ-orleans.fr](mailto:suzie.hemme@etu.univ-orleans.fr)/[cassandre.houvenaghel@etu.univ-orleans.fr](mailto:cassandre.houvenaghel@etu.univ-orleans.fr)

# PAPEE-3 Thrust Vector Control (TVC) of a small-scale airbreathing vehicle

Aerospace engineering



**Quentin DE SEVERAC/Aubin SAINT-SUPERY/  
Muhammad MD NAZAM/Abdelrahman ABOURAYAN**  
Academic supervisors : Alain CHARLET/Guillaume COLIN/Anwar SHANWAN  
Industrial supervisor : Marc BOUCHEZ

Company/institution : MBDA



cm14-gas-turbine

## RESULTS

Firstly, we designed a vehicle based on the generic subsonic missile sketched by E. L. FLEEMAN (Georgia Tech, USA), adapting it to the dimensions and performance of our turbojet. The scale reduction allowed us to keep the aerodynamic characteristics in order to have a prototype able to fly.

Concerning the TVC system, the whole engine is articulated within the vehicle, with two electric jacks that position the motor in all directions. Thus, the vehicle equipped with the engine and the TVC system were designed on 3DEXPERIENCE software. In addition, a small prototype of the system was 3D-printed. In parallel to the design, we modelled the dynamic behaviour of the vehicle in two dimensions with some hypotheses, using SIMULINK. Then, we verified our model with the help of scientific works on flight mechanics. Finally, we proposed a control solution to manage the altitude.

This TVC work paves the way for a possible follow-on next year, called PAPEE-4, to test on ground and to model in more details the designed system.

**KEYWORDS :** automatic control, modelling, propulsion, mechanic, aerodynamic.

## OBJECTIVE/ MOTIVATION

MBDA is studying different modes of airbreathing propulsion. It is thus interested in the mini turbojet Armfield CM14 owned by Polytech Orléans, and a multiyear student project called PAPEE ("Propulsion aérobie petite échelle évolutive") was proposed 3 years ago by the European missiles company MBDA. As part of this project, this year, our task was to design a vehicle able to fly and to host the mini turbojet and to control its thrust angle. This study aims to find a solution for a dynamic control of the thrust vector, i.e. the direction of exhaust gas ejection from the turbojet engine to steer the vehicle. Thus, this work aims to achieve two main tasks: designing a vehicle with its TVC system, and establish a dynamic vehicle model on Matlab Simulink, to create and test the TVC control solution before its implementation on the prototype. For the TVC system design, we studied two architectures: the first one with an articulated nozzle, and the other with a complete articulation of the turbojet.

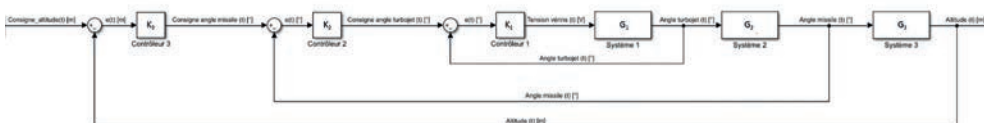


Schéma Block PAPEE3

Contact : [quentin.de-severac@etu.univ-orleans.fr](mailto:quentin.de-severac@etu.univ-orleans.fr)/  
[aubin.saint-supery@etu.univ-orleans.fr](mailto:aubin.saint-supery@etu.univ-orleans.fr)/  
[mo.nazam@etu.univ-orleans.fr](mailto:mo.nazam@etu.univ-orleans.fr)/  
[abdelrahman.abourayan@etu.univ-orleans.fr](mailto:abdelrahman.abourayan@etu.univ-orleans.fr)



Q. DE SEVERAC



A. SAINT-SUPERY



M. MD NAZAM



A. ABOURAYAN

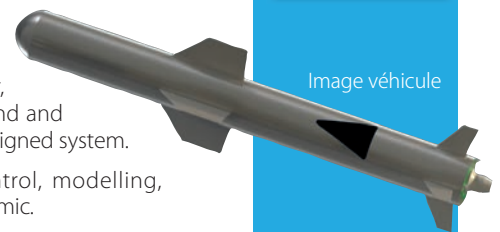
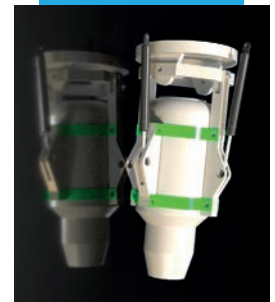


Image véhicule

Image TVC



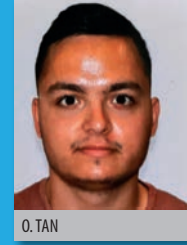


# Development of a Micro-Factory in battery manufacturing for the retrofit of thermal vehicles

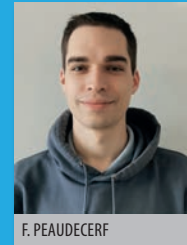
Industrial engineering

**Osman TAN/Florent PEAUDERCERF**

Academic supervisors : Alain CHARLET/Jean-Michel FAVIE  
Industrial supervisors : Aymeric LIBEAU/Benjamin MATRAS



O. TAN



F. PEAUDERCERF



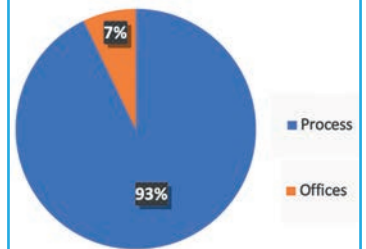
Company/institution : Transition-One



## RESULTS

In this project, we worked on different standards for implanting a modular and movable micro-factory such as battery storage and building regulation. To evaluate the needs of the process equipment, we did a lot of hypotheses to search the power of all the devices. We focused on offices, and we used the consumptions of the equipment to search the needed surface area for installing solar panels to replace the power needed to run the micro-factory. For the office's needs, we found an autonomous electricity production, and, in the process, which consumes a lot of energy, it depends on the layout of the micro-factory. Process equipment will be in containers of 40 feet in a warehouse. For each line of production and assembly, we have determined the resources required in energy and space where the robots, conveyors, cameras, and sensors will be used.

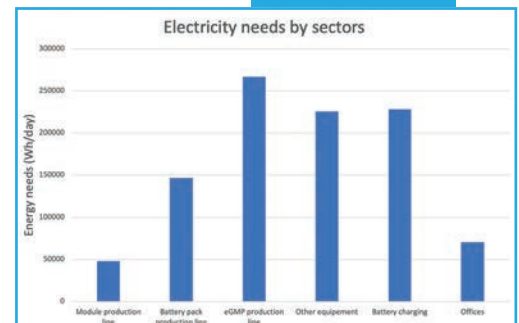
## Electricity Consumption



## OBJECTIVE/ MOTIVATION

Our project tackles the development of micro-factories in France. We are working with the company Transition-One, founded in 2018 by Aymeric Libeau. Transition-One is known for the conversion of vehicles from thermal to electric. Currently, the company is in a stage of R&D, and they will be targeting different brands in the future such as Renault and Fiat. The strategy is to sell vehicles with a range of approximately 100 km which can be charged in four hours with a domestic charging system. In our project, the goal is to think how to build an eco-friendly micro-factory which produces its own electricity and can be installed easily, quickly, modular and where we can assemble the modules with the cells, the batteries, and the electric engine. After those steps, all the components are sent to a collaborating garage to be fit into a vehicle and respect all the certifications.

**KEYWORDS :** electric vehicle, industrial process, renewable energy.



Contact : [Osman.tan@etu.univ-orleans.fr](mailto:Osman.tan@etu.univ-orleans.fr)/[florent.peaudercerf@etu.univ-orleans.fr](mailto:florent.peaudercerf@etu.univ-orleans.fr)

# Retrofit of piston diesel/gasoline engines to run on hydrogen

Energetics



Company/institution : Design Tech Centre

**Hidrio/Sayag**

Academic supervisor : Fabrice Foucher  
Industrial supervisor : Eric Torres

**Selected participant**  
17<sup>th</sup> annual final year projects forum



A. HIDRIO



B. SAYAG

## OBJECTIVE/MOTIVATION

The objective of this project is to outline the steps required to retrofit gasoline and diesel engines to run on hydrogen instead. This conversion is in response to the ban on the sale of new petrol and diesel cars in Europe by 2035. The project includes several tasks such as studying hydrogen production, comparing traditional fuels like gasoline with hydrogen, analyzing the retrofit process, examining various scenarios based on the age of the vehicle, conducting a life cycle assessment of the engine, and studying the costs and impact on maintenance of such a retrofit. By completing this project, it will be possible to understand the feasibility of converting gasoline and diesel engines to run on hydrogen and the associated benefits and challenges. This will ultimately contribute to the development of a sustainable transportation system that reduces carbon emissions and supports a cleaner environment.

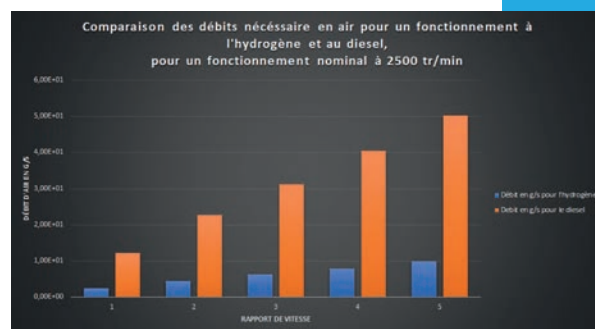
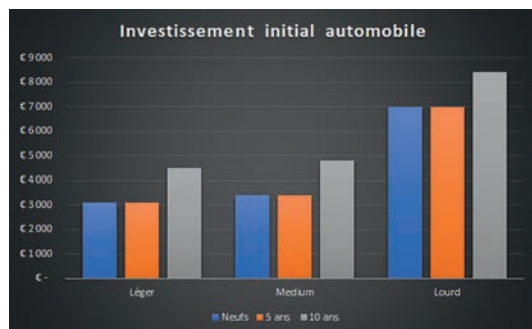
traditional fuels with hydrogen. The retrofit process for converting gasoline and diesel engines to run on hydrogen was analyzed, and various scenarios based on the vehicle's age and environmental regulations were examined. A life cycle assessment of the engine was conducted, and the costs and impact on maintenance of retrofitting engines to run on hydrogen were studied. It was found that retrofitting engines to run on hydrogen is feasible, although there are challenges, such as the high cost of hydrogen production and storage and the potential for corrosion in the engine. The year of vehicle production is a significant factor in determining the feasibility of retrofitting. Further research and development will be necessary to fully realize the potential of this technology.

**KEYWORDS :** retrofit, hydrogen, engine.

## RESULTS

Several studies and research were completed in the project, including the study of hydrogen production methods and a comparison of

	E-hydrogen (electrolysis)	Steam reforming	Natural gas field*	Coal gasification
<b>Energetic efficiency</b>	20%	23%	130% (EROI)**	19%
<b>Cost</b>	+++	-	--	-
<b>GHG</b>	-	++	--	+



Contact : alexia.hidrio@etu.univ-orleans.fr/benjamin.sayag@etu.univ-orleans.fr

# Qualification of a black globe temperature measurement device

Energetics

**Magnus Nshimiyimana/Agathe Masclaux**

Academic supervisor : Christian CAILLOL

Industrial supervisor : Laurence DURIVault-REYMOND

## OBJECTIVE/MOTIVATION

Current climate conditions predict an increase in the frequency and intensity of extreme weather events. This increase in temperature will make the phenomenon of "heat stress" more common, that is heat above what humans can tolerate and thus vulnerability and risks for workers, but also an increase in "urban heat islands".

To estimate heat stress the Wet Bulb Globe Temperature (WBGT) index is calculated. It will depend on temperature, humidity, air movement and radiation, which will allow the assessment of risks to workers. However, we found that when the WBGT was measured using the black globe, there was a time lag of up to several minutes between the displayed temperature and the actual temperature of the area.

The objective of this project is to model the temperature response of the black globe to a variable environment. To do this, we will attempt to create a 0D model of our black globe using Matlab.

## RESULTS

To do this, we listed the different thermal constraints that could influence this value: solar radiation, external air, the temperature of the ball, the temperature of the interior area, as well as the probe measuring the temperature. Our goal being to determine the temperature of the probe, we posed different differential equations (for the temperature of the sphere, of the interior area, and of the probe) which have an impact on the others. In order to solve these equations, we used a matlab function (Ode45) which works in our case.

The interactions between the different systems are described by energy equations in various parts of the globe.

**KEYWORDS :** heat transfers, thermometer, wet bulb globe temperature, matlab, urban heat islands.



Contact : [magnus.nshimiyimana@etu.univ-orleans.fr](mailto:magnus.nshimiyimana@etu.univ-orleans.fr)/[agathe.masclaux@etu.univ-orleans.fr](mailto:agathe.masclaux@etu.univ-orleans.fr)



# Contribution of road texture to vehicle fuel consumption

Energetics



Company/institution : Colas Core Center

**Arnaud BONTEMPS/Rémy GIRAULT**

Academic supervisor : Pascal HIGELIN  
Industrial supervisor : Emmanuel LOISON

**Selected participant**  
**17<sup>th</sup> annual final year projects forum**

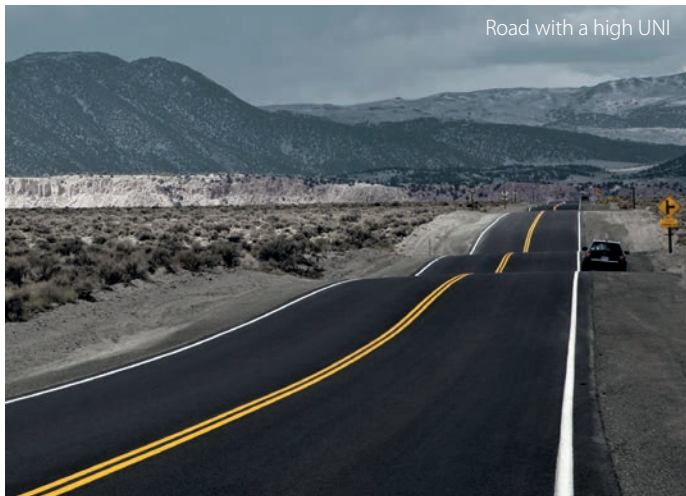


A. BONTEMPS,



R. GIRAULT

## OBJECTIVE/MOTIVATION



Road with a high UNI

Energy consumption is nowadays one of the first criteria for research or continuous improvement. This criterion is present in any other areas, such as road mobility. We see many innovations in new vehicles to reduce emissions and save natural resources. But we can also contribute to reduce these emissions by improving the roads on which these vehicles run, especially during the infrastructure construction phase by choosing alternative techniques and materials, in order to limit the rolling resistance of vehicles, and to reduce the energy expenditure of users. In this project, we studied the contribution of road surfaces to vehicle fuel consumption. This was done to determine if the cost of searching for a pavement with lower rolling resistance would be profitable for the road companies.

## RESULTS

For this project, we started by researching the literature on the different forces that apply to a vehicle and see the impact of the road's characteristics on it. After having found numerous studies on the subject, the second objective was to determine the road parameter that has the most impact on the rolling resistance through an experimental test. The choice of the Coast down, consisting in dropping the car at a constant speed and studying the deceleration was retained, and we set up the test procedure with the list of materials, the steps to be carried out, the acquisition of data and the values which can modify the results. This allowed us to define the contribution of the UNI (wave of the road), and the texture of this one.

**KEYWORDS :** road, rolling resistance, consumption, energetics transition.

Speed sensor for the Coast Down



Contact : [arnaud.bontemps@etu.univ-orleans.fr](mailto:arnaud.bontemps@etu.univ-orleans.fr)/[remy.girault@etu.univ-orleans.fr](mailto:remy.girault@etu.univ-orleans.fr)

Coast down procedure

# Optimization of a portable hydrogen-powered charging station

Energetics



Company/institution : CPA 30/BA 123

**Loïs Masson/Chloé Castera**

Academic supervisors : Guillaume Colin/Christine Rousselle  
Industrial supervisor : Commando parachutiste de l'air n° 30



L. MASSON



C. CASTERA

## OBJECTIVE/MOTIVATION

During missions the army use different devices such as radios, drones or laptops that need to be charged. Therefore, they have to bring many batteries with them which add weight to their equipment. In this context, they need a discreet and easy-to-carry charging station to recharge their devices. The unit purchased a first prototype a few years ago. It uses a hydrogen fuel cell. Hydrogen is generated by a chemical reaction between water and a hydrolysing powder. However, the energy produced is too low to recharge the equipment quickly. The main objective of the project is therefore to improve the power output of the system without losing its ease of use during an operation.

Loïs and Chloé using the prototype



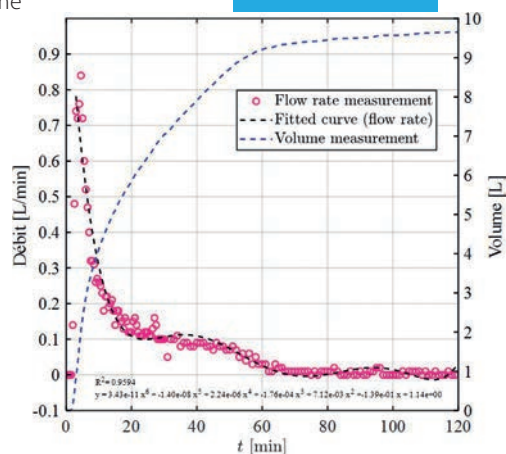
## RESULTS

Numerous tests were carried out on the current prototype to understand it and determine the limiting factor. The composition of the powder, the amount of hydrogen produced in the reaction and the fuel cell's capacity were the three main areas of work. After X-ray diffraction and fluoroscopy, the powder was found to be a mixture of 97% aluminium (Al), 2% quicklime (CaO, calcium oxide) and 1% impurities.

By following this equation:  $\text{Al}(s) + 3\text{H}_2\text{O}(l) \rightarrow \text{Al}(\text{OH})_3(s) + 3/2 \text{H}_2$ , it is possible to generate 0.65L of hydrogen per gram of powder. As for the fuel cell, it can generate 25 W with a hydrogen flow rate of 0.3 litre per minute.

Knowing these characteristics, it was possible to propose some improvements. For example, since hydrogen production is non-linear (see Figure 1), adding a hydrogen buffer tank and a flow controller could increase the amount of hydrogen absorbed by the fuel cell.

**KEYWORDS :** hydrogen, energy production, portable solution, electricity, chemistry.



hydrogen production and flowrate in function of time, for 1 bag of hydrolysing powder

Contact : [chloe.castera@etu.univ-orleans.fr](mailto:chloe.castera@etu.univ-orleans.fr)/[lois.masson@etu.univ-orleans.fr](mailto:lois.masson@etu.univ-orleans.fr)

# Optimization of heat consumption on air compressors

Energetics



B. BRICHET



V. CHABOUSSOU

**BRICHET Baptiste/CHABOUSSOU Vincent**

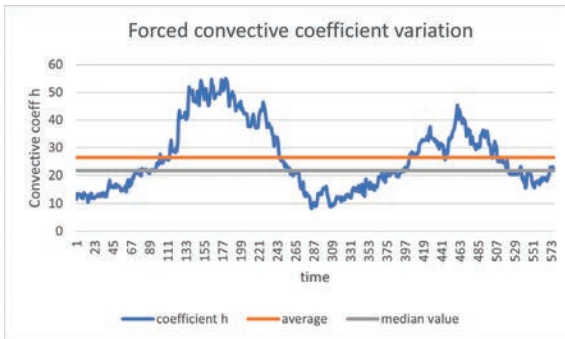
Academic supervisors : GBREQUIGNY Pierre/MAZELLIER Nicolas

Industrial supervisor : RIFFAUD Philippe



Company/institution : BORGWARNER

## OBJECTIVE/MOTIVATION



Evolution of the heat transfer coefficient in forced convection

In order to reduce its energy consumption, BorgWarner (an important automotive equipment manufacturer), located in Blois, would like to optimise the heating network on its site. The site is heated by boilers but also by heat recovery from 5 air compressors.

This waste heat allows the company to reduce its gas consumption and therefore its CO2 emissions as well as its energy bill. Indeed, the compressor calories can either be recovered through the hot water network to heat the offices and part of the workshop or to be evacuated to the outside via air coolers.

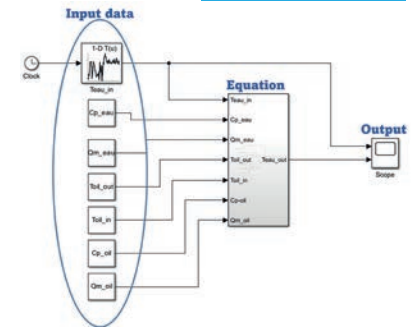
However, the recovery of heat from the compressors is not optimal, as BorgWarner would like. The aim would be to optimise the management of the network to extract as much energy as possible from the compressors.

## RESULTS

We first carried out an analysis of the system data to study the consumption and operation of the

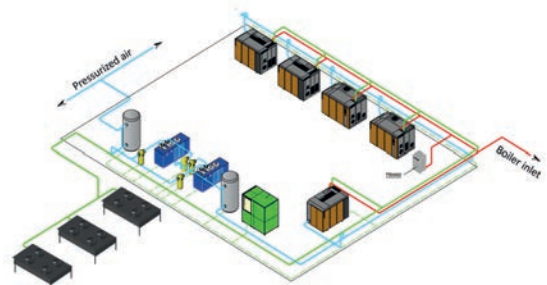
compressors. This study was made to identify the indicators to be checked to prevent problems on the compressor exchangers and identify on which range of time to focus our studies. This step was essential to start modelling the system, especially air cooler and heat exchanger, and to study the various parameters. We found that exchangers as it is seemed to be working optimally whereas air coolers have a limited use in cooling water. Indeed, they seem to have a rather low efficiency since the water temperature follows more the variations of the outside temperature even if the air coolers are running. Moreover, the oil temperature set point at the exchanger outlet seems to limit energy recovery through partial closure of the three-way valves.

**KEYWORDS :** heat recovery, waste heat, consumption reduction.



Heat exchanger Matlab model

Schematic diagram of the heat and compressed air network



$$mC_{p_{air}}\Delta T_{air} = m_{eau}C_{p_{eau}}(T_{eau_{entree}} - T_{eau_{sortie}}) = \lambda h_{NS}(T_{paroi} - T_{air}) + (1 - \lambda)h_{FS}(T_{paroi} - T_{air})$$

Natural convection
Forced convection

Heat equation in the exchanger that governs the system

Contact : [baptiste.brichet@etu.univ-orleans.fr](mailto:baptiste.brichet@etu.univ-orleans.fr)/[vincent.chaboussou@etu.univ-orleans.fr](mailto:vincent.chaboussou@etu.univ-orleans.fr)



# Design of a multi-energy station in CVL

Energetics



J. KOBA



S. OUAZIZ



Company/institution : GRDF

**Joseph KOBA/Sabrina OUAZIZ**

Academic supervisors : Camille HESPEL/Olfa MERCHEGUI  
Industrial supervisor : Karine RAMAYE

**Selected participant**  
**17<sup>th</sup> annual final year projects forum**

## OBJECTIVE/MOTIVATION



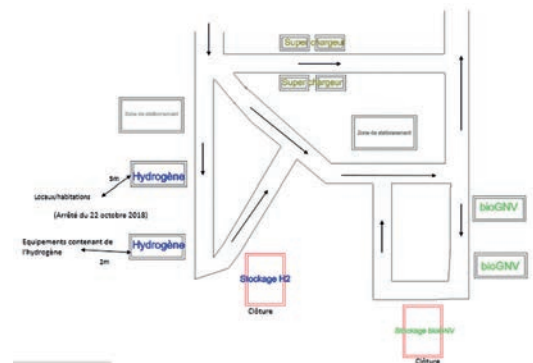
The current environmental emergency has motivated the creation of this project. Indeed, many laws have been passed to implement the energy transition, we can cite the energy transition law of August 17, 2015. In order to meet this demand, it is imperative to reduce the rate of greenhouse gas emissions. The transport sector, more specifically trucks or LCVs, emits a good number of GHGs. It

is therefore necessary that these freight vehicles only run on biofuels (bio2 or bioGNV) or electric motors. Our project is therefore to conceptualise green multi-energy service stations to refuel these bio-trucks running on biofuel or electric motors. This study will be based on the Centre Val de Loire region in order to achieve the projections set out in terms of the number of bioH2 or bioGNV tracks and supercharger charging points.

## RESULTS

In order to achieve this project, we will present all expected results. The first result, is the plan of the "ideal" station. This plan will show the different safety distances according to the associated regulations, the distribution areas, the storage areas, the vehicle traffic areas, etc. On this model, we will indicate the location chosen according to the flow of trucks and the fuel production areas in the vicinity. The second result is a report containing all the data necessary for the establishment of this station (regulations, costs, aids, storage, suppliers, sizing, etc.). And the last one will be an table where the customer will see a typical day of this station and he will have all the necessary data for the good progress of the day (number of trucks by fuels, necessary stockae, operating costs, cost price...).

**KEYWORDS :** service station, multi-energie, biohydrogène, bioGNV, superchargers.



Contact : [kouao.koba@etu.univ-orleans.fr](mailto:kouao.koba@etu.univ-orleans.fr)/[sabrina.ouaziz@etu.univ-orleans.fr](mailto:sabrina.ouaziz@etu.univ-orleans.fr)

# Design of a heavy-duty vehicle retrofit unit : Diesel to Methane

Energetics



Company/institution : GRDF

**Alexis DELMER/Mehdi GUIGNOLLE**

Academic supervisors : Alain Charlet/Pascal Higelin

Industrial supervisor : Karine Ramaye



A. DELMER,



M. GUIGNOLLE

## OBJECTIVE/MOTIVATION



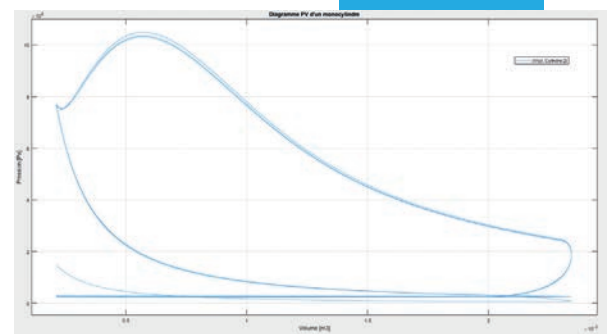
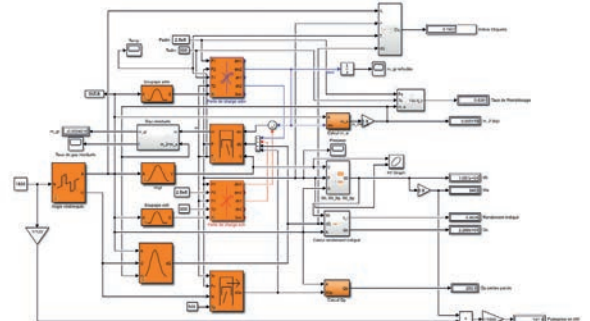
In a context where the regulations on hydrocarbon combustion are getting more stringent, it is important to look at other energy sources such as biogas. With the increase in the production of biogas, GRDF wishes to promote this fuel and its use in existing technologies. It is therefore necessary to evaluate the adaptability of the systems to assess the feasibility of a change of carburation. The objective for GRDF is to increase their knowledge in the field of motorization. The goals of this project are to understand and to measure the benefits of retrofitting heavy duty vehicles. Our study can then be used to guide decisions in favour of retrofitting diesel engines whether with biomethane or not.



## RESULTS

Three different retrofit technologies have been identified and studied throughout the project: dual fuel with a pilot injection of diesel/biodiesel with gas and methane as the main fuel; dual fuel using a single injector for both diesel and methane; and finally, a more important retrofit technology where injector of the initial engine would be replaced by a spark plug. The cylinder heads as well as the internal engine geometry would also have to be changed for this engine to work. We compared their pros and cons and produced a simulation with MATLAB Simulink of an engine running on pure methane to quantify the performances, and operating conditions of such an engine.

**KEYWORDS :** motorization, retrofit, heavy-duty vehicles, biofuels, biomethane.



Contact : alexis.delmer@etu.univ-orleans.fr/mehdi.guignolle@etu.univ-orleans.fr

# Study of technologies and solutions for the production and consumption of renewable hydrogen

Energetics



Company/institution : Eurowatt

**Benjamin Cauquot/Arthur Munsch**

Academic supervisors : Christine Rousselle/Azeddine Kourta Industrial  
Industrial supervisors : Vincent Swaenepoel/Jérémy Biacabe



B. CAUQUOT,



A. MUNSCHY

## OBJECTIVE/MOTIVATION



Stellantis PEUGEOT e-EXPERT fuel cell truck, Hyvolution forum

Green hydrogen produced by electrolysis through zero-carbon electricity (renewable energies, nuclear energy) is considered as one of the main levers for transport, power, and industry decarbonation by both replacing fossil fuels with a decarbonized energy vector in the long term and by enabling the share of renewable energy production to be increased. Many companies today study the economic and environmental benefits of investing in the development of hydrogen infrastructure. Eurowatt is an independent French producer of renewable energy implanted both in France and abroad. Offering turnkey solutions for solar and wind projects, the company is now aiming to expand its expertise in hydrogen production, distribution and uses. The objective of this project is to deliver a report on the existing hydrogen production processes and distribution systems, the state of the art of the French and international

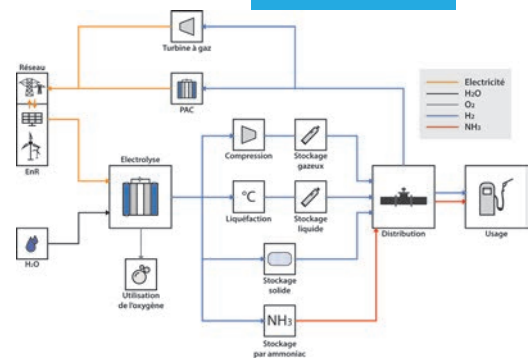
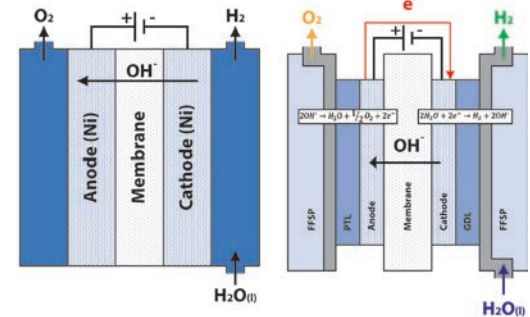
hydrogen infrastructure as well as already existing solutions for hydrogen uses.

## RESULTS

The technologies related to the production, distribution and end-use of renewable hydrogen are numerous, some are mature, and some are still in development. The study of these technologies has led to the development of an ergonomic Excel file presenting in a visual way the research made. The study of the production technologies includes an exhaustive description of each equipment necessary for hydrogen production (electrolyzers, coolers, compressors, storage units), listing the different existing technologies as well as a benchmark of some equipment. A state of the art of hydrogen distribution solutions has been carried out, evoking the possible solutions (on-site consumption, transportation (ships, trucks, injection into natural gas pipelines) by pointing out their advantages and disadvantages. The main use cases for mobility have also been discussed, evoking the advantages and disadvantages and an example of an existing application for each use.

**KEYWORDS :** hydrogen, renewable energy, production, distribution, applications.

AEM (Anion Exchange Membrane) electrolyzer



Hydrogen production, distribution and use

Contact : [beniamin.cauquot@etu.univ-orleans.fr](mailto:beniamin.cauquot@etu.univ-orleans.fr)/[arthur.munsch@etu.univ-orleans.fr](mailto:arthur.munsch@etu.univ-orleans.fr)



# Gelled fuel for air-breathing propulsion

Aerospace engineering



Company/institution : MBDA

**Fatima El Carmouhi/Maxence Badonnel**

Academic supervisor : Christine Rousselle

Industrial supervisor : Florian Chantre



F. EL CARMOUHI



M. BADONNEL

## OBJECTIVE/MOTIVATION



gelled gasoline process

The project is being carried out for MBDA missile systems, an industrial company in the defense and aerospace field. Fuel optimization is one of the main challenge in aerospace industry (and particularly liquid fuels), to increase range and performances of flying systems. But the transport and storage of this fuel remains complicated. Indeed, ensure fuel stability and decrease risks of leakage, it is worth considering alternative fuel configurations like gelled fuels. This is the core of our subject: the study of the relevance of gelled fuels, applied to air-breathing propulsion. With the growing demand for efficient and safe fuels in aerospace propulsion systems, gelled fuels are closely examined in recent years. Indeed, due to their unique structure, gelled fuels offer the advantages of both solid and liquid fuels. This type of fuel behaves like a solid when stationary and can flow and atomize like a liquid under shear stress.

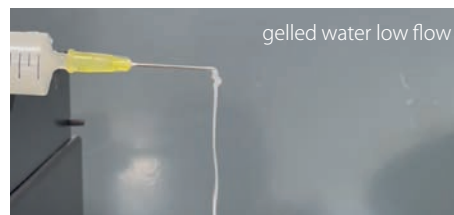
## RESULTS

The results of the project are articulated under 4 different axes :

- ▶ a bibliographic report of the research carried out and the results obtained
- ▶ the study of the rheological model of gelled fuels
- ▶ the study of the behavior of gelled fuels
- ▶ the study of the fuel injection system in an academic combustion chamber

In addition, and to better understand the behavior of gelled fuels, we set up and then carried out some experiments using a gelling agent: the Carbopol 940. We carried out several samples of gelled water and gelled diesel depending on the concentration of gelling agent. These samples were thus inserted and pushed into a syringe pump system to simulate the injection of fuel into the combustion chamber. We noted that the higher the injection rate, the more possible it is to overcome the shear stresses and thus allow the gel to flow more liquid.

**KEYWORDS :** propulsion, gelled-fuel, kerosene.



gelled water low flow



gelled water high flow



gasoline and carbopol940



Experiments

Contact : fatima.el-carmouhi@etu.univ-orleans.fr/maxence.badonnel@etu.univ-orleans.fr

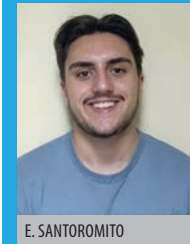
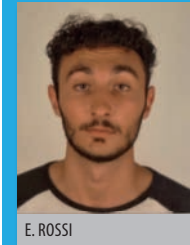
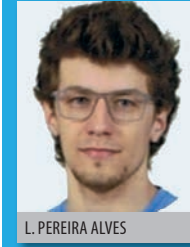
# Numerical simulation of a Waverider during an atmospheric reentry

Aerospace engineering

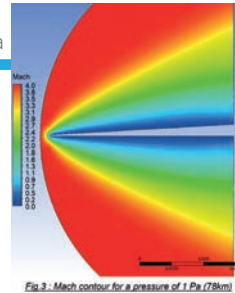


Company/institution : ICARE – UPR3021 CNRS

**Luís Pereira Alves/Enzo Rossi/Enzo Santoromito**  
 Academic supervisors : Ivan Fedioun/Nicolas Mazellier  
 Industrial supervisor : Viviana Lago



Mach countour 1Pa



## OBJECTIVE/MOTIVATION

The goal of this project is to provide wall boundary conditions (BCs) for the Navier-Stokes (N-S) equations that account for partially rarefied flow regimes as observed during the atmospheric reentry of a Waverider.

Indeed, as the pressure decreases with increasing altitude, the flow becomes rarefied, which means that above 50km, N-S equations using standard no-slip wall BCs are no longer valid because they don't account for the molecular aspect of flows, whereas Boltzmann (B) equations do. However, B-equations are only valid above 80km. Consequently, between 50 and 80km of altitude, neither no-slip N-S nor B equations are perfectly valid. The main difference between N-S and Boltzmann, is that Boltzmann induces a non-zero slip velocity. To approximate Boltzmann behavior, we have to modify the classical no-slip BC in N-S with a non-zero slip velocity, extending that way the N-S upper validity limit.

We all chose this subject because it deals with aerodynamics/aerospace engineering, and to deepen our high-altitude knowledge, previously studied in our courses.

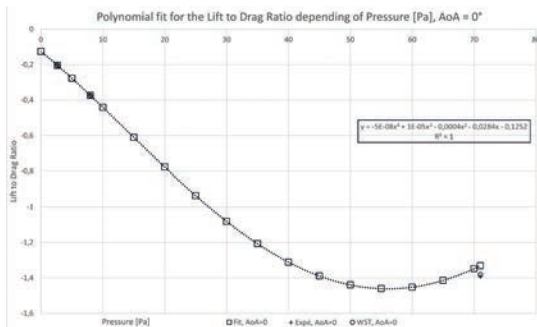
## RESULTS

Numerical simulations were done using the CFD software Ansys Fluent.

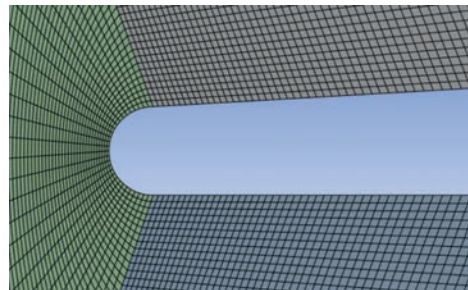
It is impossible to set a slip velocity directly into Fluent, so we rather change the related wall shear stress component. To confirm this hypothesis, several flat plane (Blasius solution) simulations were conducted, because Blasius gives semi-analytic expressions which allow us to easily compare our numerical results to the theory. The method was then implemented for the Waverider's simulations.

During this phase, an optimization of the Waverider's mesh and computational domain in 2D was simultaneously performed, allowing to obtain coherent Mach number, pressure and temperature distributions. The thickening of the boundary layer with increasing altitude was clearly observed, matching experimental data. Finally, the 3D Waverider's geometry and mesh are in progress.

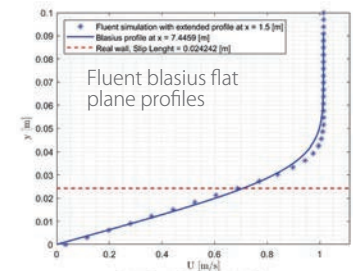
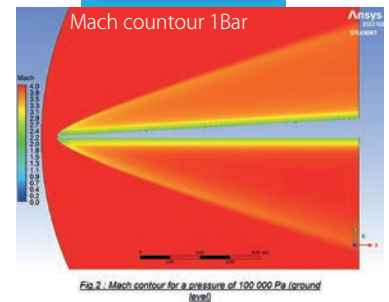
**KEYWORDS :** waverider, atmospheric reentry, numerical simulations (CFD), shock waves, rarefied medium.



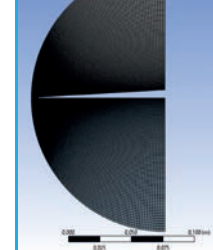
Lift drag pressure polynomial fit



2D structured mesh



2D computational domain



Contact : [luis.pereira-alves@etu.univ-orleans.fr](mailto:luis.pereira-alves@etu.univ-orleans.fr)/[enzo.rossi@etu.univ-orleans.fr](mailto:enzo.rossi@etu.univ-orleans.fr)/[enzo.santoromito@etu.univ-orleans.fr](mailto:enzo.santoromito@etu.univ-orleans.fr)

# Study and characterization of a parachute for artillery ammunition

Aerospace engineering



**Inès VERMEIRE/Maxence PEPIN/Benjamin LASCOR**  
 Academic supervisors : Pierre-Yves PASSAGGIA/Nicolas MAZELLIER  
 Industrial supervisor : Nathan GRANGE

Company/institution : Nexter Arrowtech

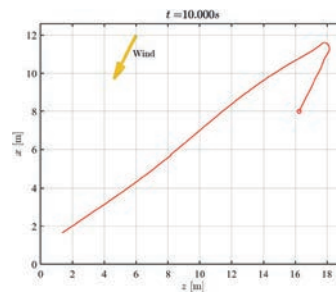
## OBJECTIVE/MOTIVATION

Artillery projectiles propelled through the air require a braking device to ensure that the payload is landed at the desired location and speed. These devices are in most cases parachutes, but their dynamics in real operating conditions are very complex. It is therefore quite difficult to predict with high accuracy the landing zone. This issue is tackled in the project n° 22 "Study and characterization of a parachute for artillery ammunition". Our aim is to provide a model to predict trajectories and speed descent with respect to the time as a function of certain inlet conditions (parachute tensions, mass of the payload). To do this, we will solve a two-body problem in 3D using the Fundamental Principle of Dynamics. In addition, we need to estimate a drag coefficient with simulations via Fluent.

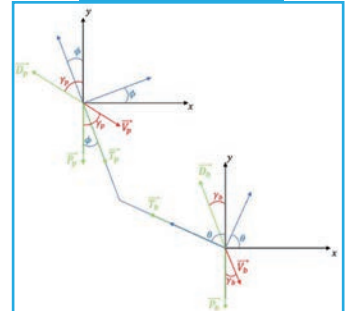
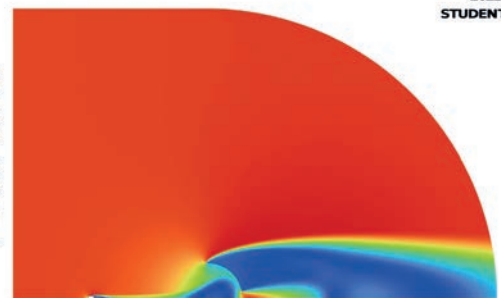
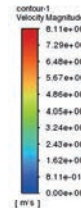
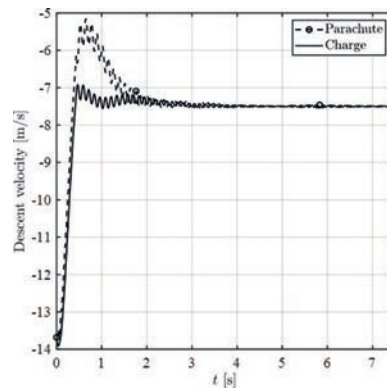
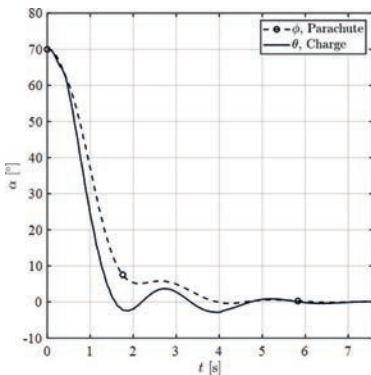
## RESULTS

In order to achieve our goal, we decided to start with a simple problem and gradually increase in complexity. We therefore solved a 2D one-body problem, considering the parachute and the useful charge as a single compact body. Then we solved a

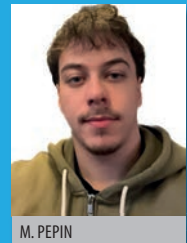
two-body 2D problem. Indeed, the parachute and the payload have movements relative to each other. We extended this problem to 3D by considering the weather conditions. The motion of the payload and the parachute is then governed by 3 equations of position and 4 equations of angles for each body. In addition, we have modelled the opening of the parachute by a homothety of its surface. We notice that our system stabilizes itself and we can predict a trajectory and descent speeds according to the net conditions provided by NEXTER. Finally, thanks to the simulation, we can estimate the drag coefficient of the parachute and the payload.



**KEYWORDS :**  
 parachute,  
 payload,  
 descent  
 speed, PFD,  
 trajectory.



I. VERMEIRE



M. PEPIN



B. LASCOR

Contact : [ines.vermeire@etu.univ-orleans.fr](mailto:ines.vermeire@etu.univ-orleans.fr)/[maxence.pepin@etu.univ-orleans.fr](mailto:maxence.pepin@etu.univ-orleans.fr)/[benjamin.lascor@etu.univ-orleans.fr](mailto:benjamin.lascor@etu.univ-orleans.fr)

Ansys  
 2022 R2  
 STUDENT



# Optimization of the suction performance of a fluid suction system by numerical simulation

Energetics

**Alexis DELAVAUT/Murielle MABERI GRODET**

Academic supervisor : Ivan FEDJOUN

Industrial supervisors : Xavier DIEUDONNE/Léna MENIRI



A. DELAVAUT



M. MABERI

## OBJECTIVE/MOTIVATION

This project was initiated by a company specialising in the production of a fluid suction system for medical application, with the main objective of increasing the suction function of their devices.

To this end, the company launched an experimental campaign that showed an increase in the suction capacity of their system when a certain amount of air was present in the suction line. In these conditions, the flow inside the suction line goes from a single-phase flow to a two-phase flow.

To determine the optimal configuration that maximises the suction capacity of body fluids, our methodology first involved identifying and studying the physical phenomena implied.

Subsequently, numerical simulations of the two-phase flow using the VOF approach were performed. In this way, recommendations for the design of an optimised device were obtained.

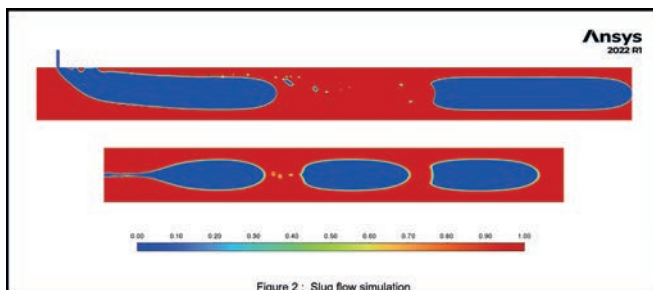
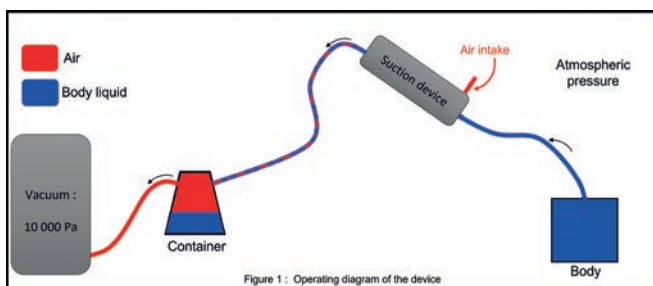
## RESULTS

Initially, a thorough bibliography was carried out on the different two-phase flow regimes. This step allowed to identify several flow regimes such as bubbling, a stratified or annular regime that can be associated with the phenomenon to be characterized. The experimental campaigns allowed us to identify the "slug flow" regime as the dominant one. Thus, our numerical studies focused on the VOF modelling of a slug flow in a microchannel.

At the same time, simple analytical models of two-phase Poiseuille flows were developed on simplified geometries of the endoscope to validate with experimental data provided by the company the laminar and VOF results obtained with Ansys Fluent.

At the end, an optimal range of gas fraction to be injected was found depending on the physical parameters of the body fluid drawn in such as viscosity and surface tension that operate on this non-linear phenomenon.

**KEYWORDS:** slug flow, gas-liquid flow, numerical simulation, VOF method, optimization.



Implementing the simulation

Contact : [alexis.delavault@etu.univ-orleans.fr](mailto:alexis.delavault@etu.univ-orleans.fr)/[murielle.maberi-grodet@etu.univ-orleans.fr](mailto:murielle.maberi-grodet@etu.univ-orleans.fr)

# Characterization of a detachment on a ramp and its control with a sweeping jet

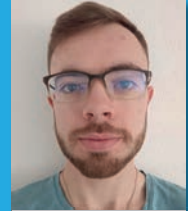
Aerospace engineering



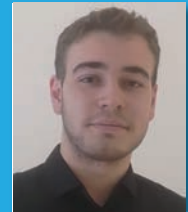
Company/institution : GDR 2502, Dassault

**Loïc GUILLEMOT/Tony MARTINEZ**

Academic supervisor : A. KOURTA



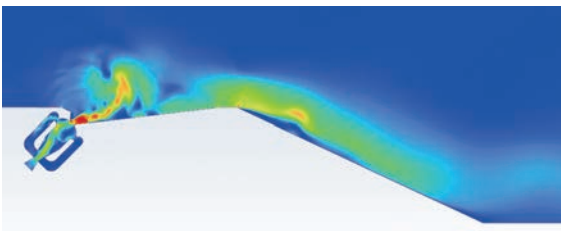
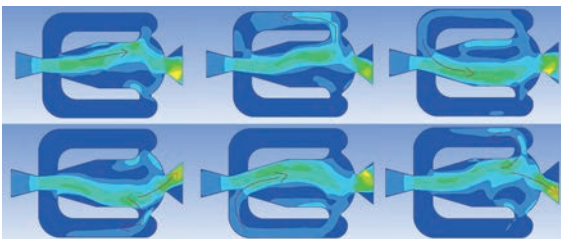
L. GUILLEMOT



T. MARTINEZ

## OBJECTIVE/MOTIVATION

The research team of the GDR 2502 is specialized in the field of aerodynamics, with the main objective to study the separation of flows in order to improve the efficiency, safety and energy consumption of aerodynamic vehicles. The PRISME laboratory and the industrial partner Dassault are collaborating on this project. Our research consists in examining the flow over a backward-facing ramp when it is perturbed by a fluidic actuator. The actuator is a sweeping jet, which offers several advantages, including a constant inlet pressure, no moving components, and a relatively high oscillation frequency. This project encompasses two different studies: an analysis of the actuator itself and its various characteristics, and the analysis of the flow on a backward-facing ramp, with and without the jet but in particular how the position and tilt of the actuator affects the recirculation bubble.



## RESULTS

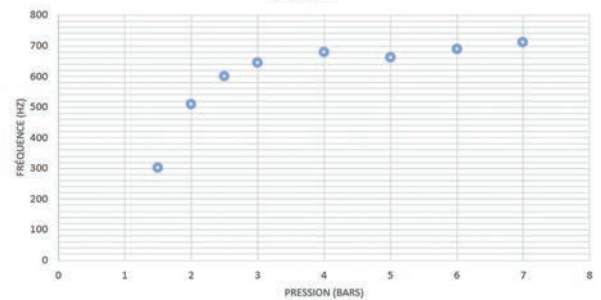
This project is divided into two main parts:

actuator study and flow analysis. We utilized the student version of the Fluent® software to conduct two simulations - one at the actuator scale and the other at the ramp scale. The actuator simulations were performed at varying inlet pressures to identify the ideal jet sweep rate. To optimize the jet's characteristics,

we explored the optimal angle, position, and frequency to decrease the recirculation area. Additionally, we conducted simulations of the ramp without an actuator to analyze the behavior of the recirculation zone under different parameters such as input speed and ramp geometry. We therefore linked the jet and the ramp in the last simulations to check the impact of the jet on the recirculation bubble. We averaged the post-ramp velocities over time by checking the Q criterion. This will allow us to model the average recirculation bubble for each simulation.

**KEYWORDS** : control, flow, sweeping jet, detachment.

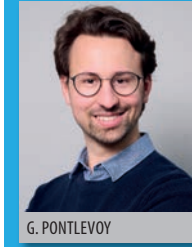
Fréquence de sortie de jet en fonction de la pression d'entrée



Contact : [loic.guillemot@etu.univ-orleans.fr](mailto:loic.guillemot@etu.univ-orleans.fr)/[tony.martinez@etu.univ-orleans.fr](mailto:tony.martinez@etu.univ-orleans.fr)

# Optimization of a Dual-Bell Nozzle for Rocket Engines

Aerospace engineering,



G. PONTLEVOY

**PONTLEVOY Gaëtan**

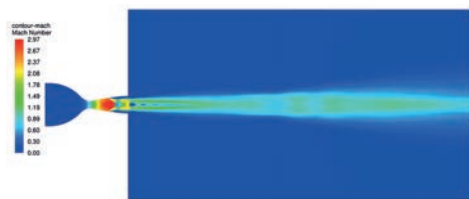
Academic supervisor : KOURTA Azeddine

Industrial supervisor : LEGROS Brian

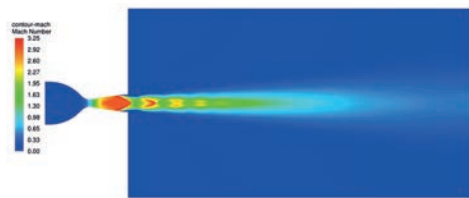


Company/institution : ICARE - PRISME

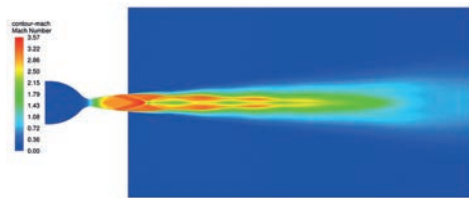
## OBJECTIVE/MOTIVATION



k-omega SST, NPR=7, First Mode



k-omega SST, NPR=14, Second Mode



k-omega SST, NPR=50, Adapted Nozzle

The project, initiated by the Icare laboratory, aims to study dual-bell nozzles (DBN) to understand their operation and their ability to operate at two different pressure regimes. Single nozzles are optimized for a specific pressure range, while dual-bell nozzles can operate at both high and low pressure, improving the overall rocket efficiency. Moreover, the similar design to conventional nozzles and the reliability

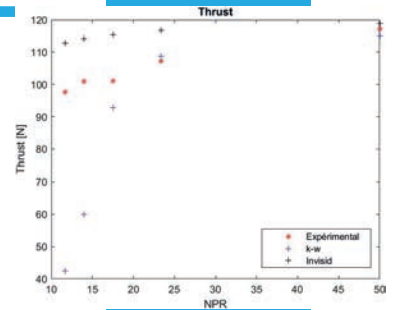
that comes with the DBN concept make them a potential candidate of the next generation of launcher's nozzle.

The study will begin by examining a simple nozzle to understand its operation and create corresponding profile codes. Next, the operation of the double-bell nozzle will be studied using these codes to simulate external pressure changes. A secondary radial injection will be added to improve the transition between the two operating regimes. The dual-bell nozzle efficiency will be measured by performing experiments in the supersonic wind tunnel at the Icare laboratory and will be compared with the numerical results.

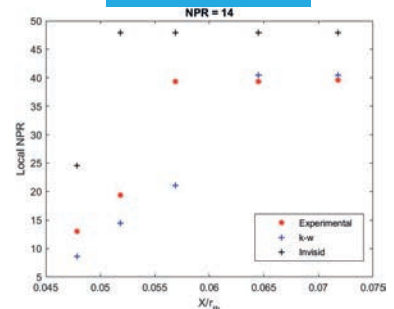
## RESULTS

Firstly, a bibliography was compiled to understand the operation and behaviour of a dual-bell nozzle. This allowed us to identify the two operating regimes (high and low altitude). In the second step, we studied the behaviour of this nozzle using a 1D code. This allowed us to highlight the great disparities between pure theory and experiment. Following this, we used an axisymmetric 2D geometry, with an inviscid model and a turbulent model (k- $\omega$  SST). These different numerical calculations allowed us to see the errors between the calculations and the experiment, to see the limits of the prediction and to theorise a pressure ratio leading to the switch between the two operating regimes. In the end, the 2D turbulent model for the dual bell nozzle gives results that are fairly consistent with reality, but a little too overestimated.

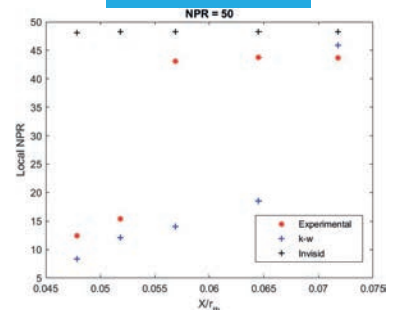
**KEYWORDS :** dual-Bell nozzle, numerical simulation, gas flow.



Comparative Thrust



Comparative Pressure Ratio for NPR=14



Comparative Pressure Ratio for NPR=50

Contact : [gaetan.pontlevoiy@etu.univ-orleans.fr](mailto:gaetan.pontlevoiy@etu.univ-orleans.fr)



# Study of combustion's stability in condensing boilers

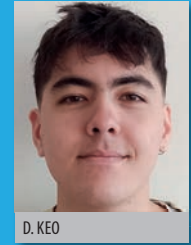
Energetics

**Keo Dylan/Mazoyer Maxime**

Academic supervisors : Caillol Christian/Higelin Pascal  
Industrial supervisor : Pagoto Marcos



Company/institution : Vaillant group



D. KEO



M. MAZOYER

## OBJECTIVE/MOTIVATION

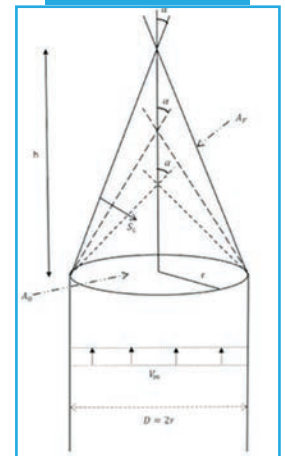
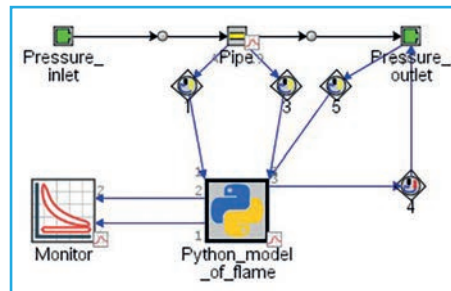


For a new project, the company discovered that one of their boilers has trouble functioning efficiently due to some perturbations in the combustion chamber. These perturbations come from pressure variations upstream and downstream of the flame which will induce variations on the flow rate of the mixture before the combustion. Then the flame properties will be modified and so will the efficiency. All these interactions are related with each other making this phenomenon a self-sustained one. The other topic of this project is linked to the environmental policy of the company, in fact, they want to use biogas or hydrogen to reduce the CO<sub>2</sub> emission. Considering all these constraints, our task is to create a numerical model to analyse the flame stability and the pressure phenomena and then add the effects of the use of biogas or hydrogen.

## RESULTS

Since the beginning of our project, we achieved several tasks such as the comprehension of the former students' work and the creation of a model based on the code program they did last year. The software the company wants us to use is GT power, so we had to translate the MATLAB program into python language which is understandable by GT power. The Python code works well, and the results are alike the MATLAB ones. We made a first GT-power model to reuse the Python code and results are again alike the MATLAB ones so the implementation of the MATLAB code on GT-power is done. Then we introduced a new formula for the dynamics of the combustion chamber and interactions between each flames. Finally, we had to take in account the effects of the composition of the fuel on the phenomena.

**KEYWORDS :** boiler, combustion, instabilities, GT-Power Model, Python.



Contact : dylan.keo @etu.univ-orleans.fr/maxime.mazoyer@etu.univ-orleans.fr

# Optimization of a cast iron cast

Energetics

**Rose NANA Tchana/Bastien Carriere/Moussa Thiam**

Academic supervisors : Ivan Fedioun/Pierre Brequigny  
Industrial supervisor : Olivier Collot



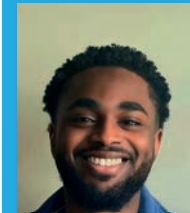
Company/institution : Atlantic



R. NANA



C. CARRIERE



M. THIAM

## OBJECTIVE/ MOTIVATION

Our project proposed by the Atlantic Group, a company specialising in the design of innovative equipment for domestic heating concerns the optimisation of the cast iron heating element of an electric radiator.

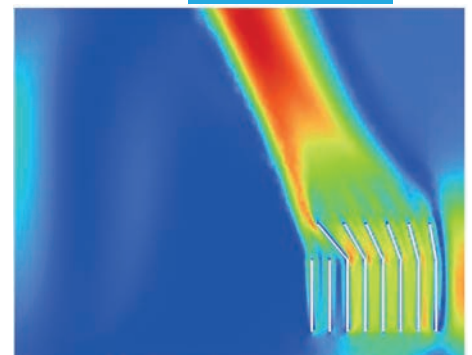
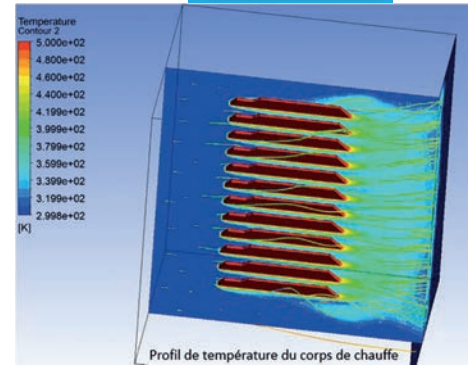
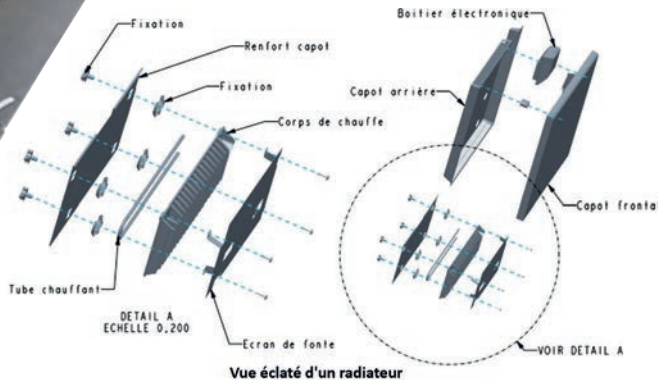
The radiator's heating element is the component that spreads heat into the surrounding area. It comprises of a cast iron block with a resistance set inside. The goal of our project is to maximize the amount of heat produced for a given amount of electricity while optimizing the heating element by evenly redistributing the heat produced by the resistor.

To carry out the project, it is essential to understand the operation of electric radiators and the various empirical laws related to the heating element. Then, we will use the proposed components and our expertise to validate the current model with the software ANSYS. This will allow us to optimise the shape of our heater and improve the heat flow through.

## RESULTS

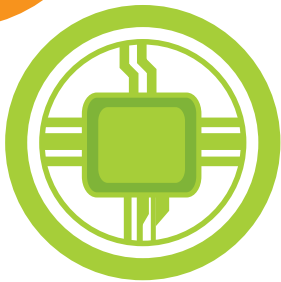
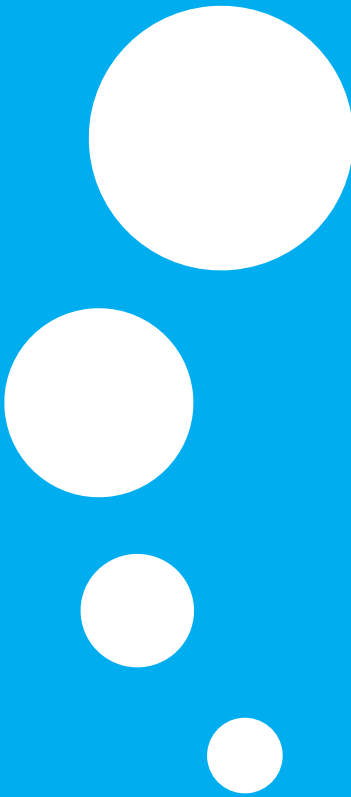
At the end of the project, we performed a first simulation on the fins distributed on the heat body to validate the existing model provided by the industrial. This allowed us to make an initial estimation of several parameters such as the velocity and the temperature fields. Then, we constructed different optimization models. The solutions we have chosen match our customer's needs as best as possible. In fact, as a first step, we decided to adjust the length and slope of the fins to better distribute the heat flow. They are placed on the side of the block to prevent overheating the electronics of the radiator, and we also realized a 15% weight reduction compared to the existing model.

**KEYWORDS :**  
energy, thermic, fluent, electric radiator.



Modèle d'optimisation 2D

Contact : [bastien.carriere@etu.univ-orleans.fr](mailto:bastien.carriere@etu.univ-orleans.fr)/  
[moussa.thiam@etu.univ-orleans.fr](mailto:moussa.thiam@etu.univ-orleans.fr)/  
[rose.nana-tchana@etu.univ-orleans.fr](mailto:rose.nana-tchana@etu.univ-orleans.fr)



**IoT**  
internet of things





# Unpublished projects

The details of the project completed by these students have not been authorized for publication by the company/institution.

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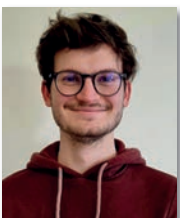
**Lamia KRIKBA**  
Civil engineering  
lamia.krikba@etu.univ-orleans.fr



**Fakher Eddine SENOUCI**  
Civil engineering  
fakher-eddine.senouci@etu.univ-orleans.fr



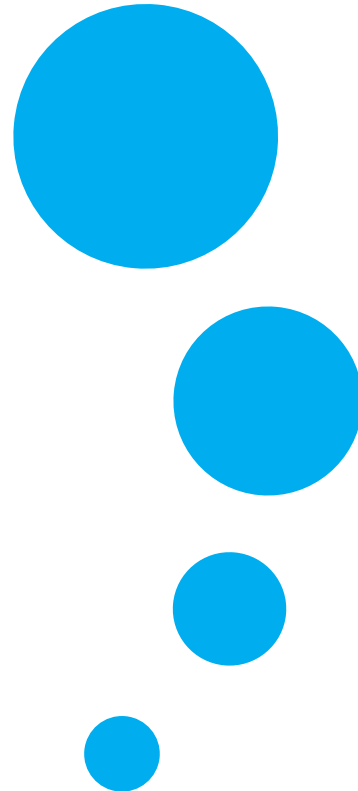
**Bastien MARQUET**  
Production management  
bastien.marquet@etu.univ-orleans.fr



**Thibaut LEMOTHEUX**  
Technologies for Energy,  
Aerospace and Engine  
thibaut.lemotheux@etu.univ-orleans.fr



**Arthur SAUVAGE**  
Technologies for Energy,  
Aerospace and Motoring sciences  
arthur.sauvage@etu.univ-orleans.fr



Technologies for Energy,  
Aerospace and Motoring sciences

**Nicolas LAGRANGE**  
nicolas.lagrange@etu.univ-orleans.fr

**Théo LERAY**  
theo.leray@etu.univ-orleans.fr

**Hugo TOISON**  
hugo.toison@etu.univ-orleans.fr

# The final year projects forum

Each year, students who are completing their final year of studies at Polytech Orléans compete to participate in the Final Year Projects Forum. Students may present their projects individually or in groups, after which a selection is made by each department head of those projects which will compete before a jury of knowledgeable professionals from businesses and institutions in the wider community. During the Forum, each student or group of students presents their project over the course of an entire day, beginning with a general assembly during which a brief oral description and PowerPoint® presentation is made. This is followed by in-depth discussions with each jury member at individual stands constructed by the students, where they are able to give a more detailed explanation of their work. The jury selects and makes an award to each of the five best projects of the Forum, and also presents the Innovation Award and the High Schoolers' Choice Award.

The Final Year Projects Forum promotes the relationship between the school, its students and the business community, and allows students to make direct contact with those companies who might wish to recruit graduates in their field.

**SAVE  
THE DATE**  
**MARDI 7 MARS**

**17<sup>e</sup> FORUM  
DES PROJETS D'ENTREPRISES  
DE FIN D'ÉTUDES**

**POLYTECH<sup>®</sup>  
ORLÉANS**  
Ecole d'ingénieurs de l'université d'Orléans

# Our remarkable equipment

## Wind Tunnel

The Lucien Malavard wind tunnel of the PRISME laboratory is used by Polytech Orléans students for aerodynamic systems studies typical of the automobile, aeronautics and environmental industries. Those who specialise in these fields have the opportunity to do their practical work and projects in this exceptional environment.

## Clean Room

A class 10 000 clean room of 100 m<sup>2</sup> is in service at the GREMI laboratory of Polytech Orléans. Students working in the Engineering Physics and Embedded Systems specialty carry out their practical work study projects in micro/nano-technologies and plasma processes in this facility.

## Material Mechanics Hall

Experimental devices in the Material Mechanics Hall of the PRISME laboratory are used by our engineering students during their projects to determine the mechanical behavior of innovative materials. This equipment may also be used to test materials such as woven composite reinforcements for aerospace and medical applications (biaxial tensile benches, benches to test shear, bending, wear and shaping) and materials in extreme conditions, such as ceramics for high temperatures with

applications in new energies (mechanical test furnace for traction, compression, bending, and creep, under controlled atmospheres (nitrogen, argon, air) from ambient temperature up to 1 600°C).

## Engine Test Benches

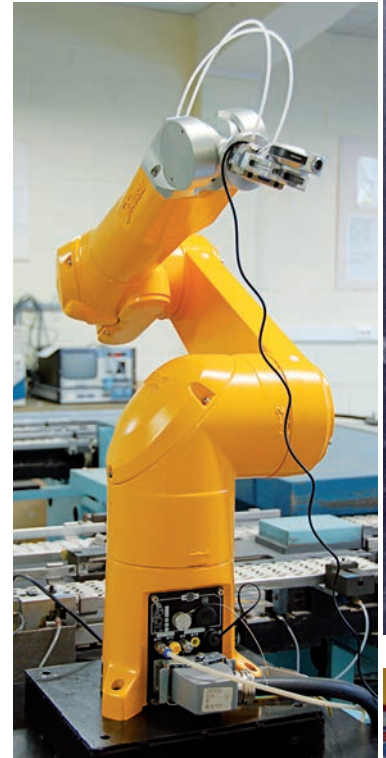
The engine test benches of the PRISME laboratory are used by Polytech engineering students and by students of the international Master's degree "Automotive Engineering for Sustainable Mobility" for projects and practical work in the fields of combustion, energy efficiency, pollutant formation and engine control.

## Computer science labs and WIFI network

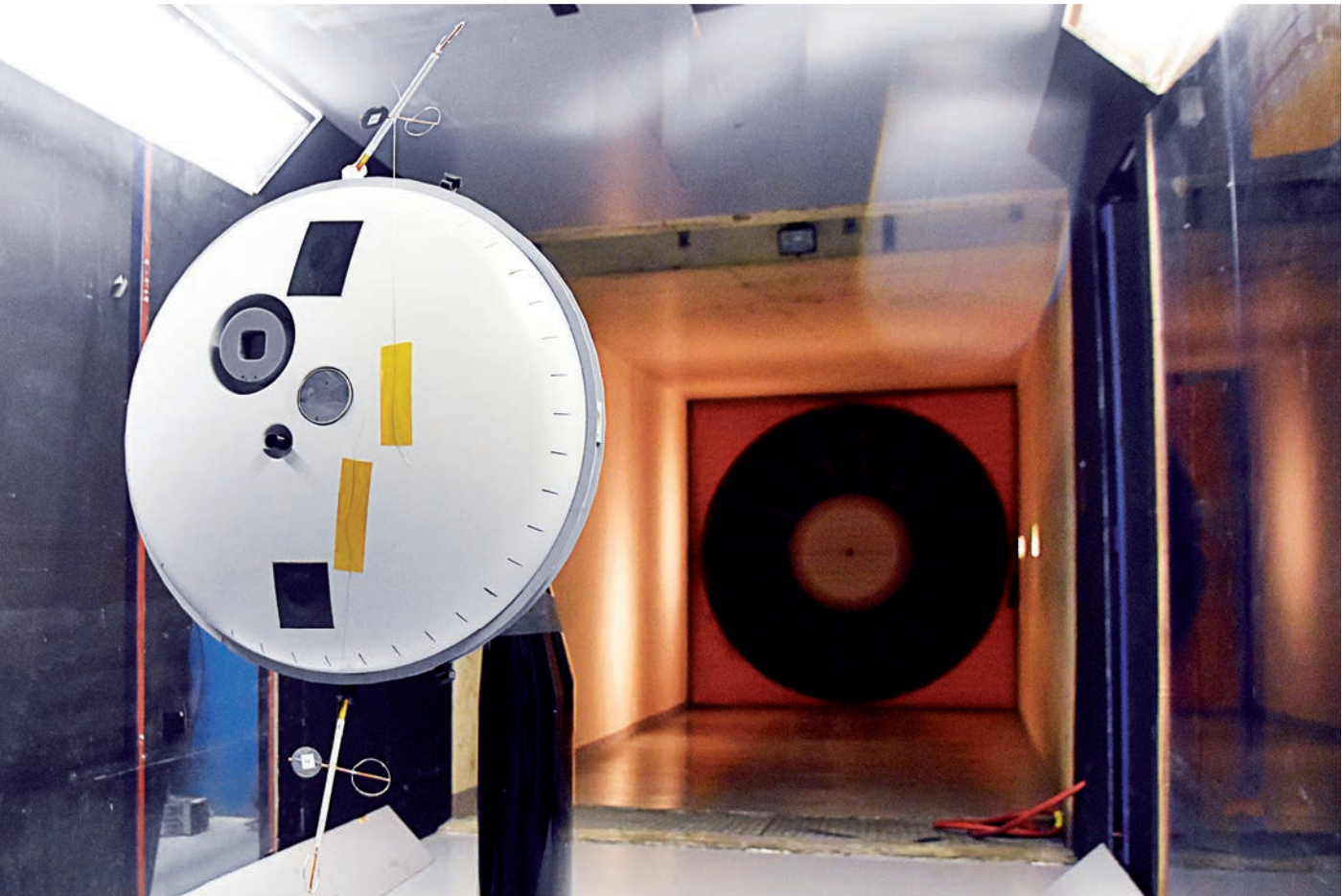
Polytech Orléans provides twelve self-service computer science labs with 300 computers and all necessary software for the use of its engineering students for lessons, projects, and personal work. WIFI access points are available in Polytech facilities and on campus for internet connection using laptop or tablet computers and smartphones.

## Robots

Polytech Orléans has both industrial and domestic robots for use as part of the robotics coursework.













# Index of students



## A

ABDUL SHAMAD	
Camille.....	14
ABENZA Alexandre.....	112
ABOURAYAN	
Abdelrahman.....	139
AFFITCHIN Eric.....	60
AITMAHMOUD Walid.....	18
ANGONIN Hugo.....	25
ARNOULD Nicolas.....	101
AUDIO-RETAILLEAU	
Léna.....	40
AUSSERT Charles.....	23

## B

 BADONNEL Maxence.....	149
 BAHY GNONLE.....	22
BARATEAU Nicolas.....	124
BARBIER Louis.....	62
BASSINET Mathis.....	125
BAUDE Quentin.....	126
BEN SALAH Wael.....	113
BEN-MOUMEN Badr.....	12
 BERESSI Théo.....	56
BERNARD Léa.....	27
BERTON Xavier.....	26
BOITTIN Valentin.....	97
BONAVITA Louis.....	127
 BONTEMPS Arnaud.....	143
 BOPP Alice.....	28
 BORGES Lucas.....	94
BOUARFA Reda.....	101
BOUCHARD Robin.....	53
BOUHMALA.....	128
BOURGEOIS Alexandre.....	23
BOUKHAL Ayman.....	12
BRETONNIERE	
Valentine.....	101
BRICHET Baptiste.....	145
BROEKS Flavien.....	106
BROSSARD Pierre.....	114
BRUNET Béatrice.....	66

## C

CALMON Elise.....	29
CARRIERE Bastien.....	156
CASTERA Chloé.....	144
CAUQUOT Benjamin.....	148
CENICO Flavie.....	85
CHABOUSSOU Vincent.....	145
CHAPEL Julien.....	58
CHARTIER Baptiste.....	15
CHAUVET Léo.....	50
CHEVREUL Laure.....	30
CHONIER Guillaume.....	48
 CHRETIEN Emma.....	24
CLEMENT Thomas.....	129
 COTTET Clément.....	99
COUDIERE Thomas.....	25

## D

DA SILVA FERREIRA	
Mélani.....	67
DAVIN Nina.....	17
DE LA TEYSSONNIÈRE	
Théophile.....	130
DE MASSOL Georges.....	52
DE SEVERAC Quentin.....	139
DE SOUZA Joao.....	104
DELAVALT Alexis.....	152
DELMER Alexis.....	147
DI PERI Thomas.....	52
DIABY Cheick.....	53
DJIEUTIEU Mégane.....	31
DUCHESNE Maxime.....	115
DUVAL Thomas.....	136

## E



EL CARMOUHI Fatima.....	149
EI HAISSOUF Imane.....	103
EL BOURACHDI	
Ghizlane.....	32
EL GOSS Mehdi.....	33
EL MACHOUDI	

Mohamed.....	55
ELGHASSAL Othmane.....	18

## F


FAUPIN Charline.....	68
FAURE Guillaume.....	116
FEDDAL Madiha.....	65
FERREIRA TORCATO	
Alexandre.....	16
FIACK Louis.....	69
 FORËT Arthur.....	102

## G

GAISONN Léonie.....	86
GALAS Benoît.....	131
GIANNETTI Laura.....	54
 GIRAULT Rémy.....	143
GOIRAND Clara.....	65
GOUAMI Anis.....	70
GREARD Paul.....	26
GREGOIRE	
Mathieu.....	97
GRENOUILLON	
Pauline.....	117
GRELIER Ludivine.....	71
GUBENO Manon.....	132
 GUERIN Juliette.....	21
GUEYE Fatoumata.....	34
GUIET Sarah.....	72
GUIGNOLLE	
Mehdi.....	147
GUILLEMOT Loïc.....	153

## H


HAMMACHE Yasmine.....	53
HELM Baguilou.....	17
 HEMME Suzie.....	138
HENIN Camille.....	14
HERINGER Benoit.....	35
 HIDRIO Alexia.....	141
 HOUTIN Samantha.....	24

 HOUVENAGHEL Cassandre ..... 138 HUMBERT Louis ..... 106
---



**J**

JEAN Ilona ..... 73
JEHANNO Nathan ..... 51
JUBIN Shivani ..... 36
JUILLARD Coline ..... 74


**K**

KAMAL Ilyas ..... 108
KAMDEM Manuela ..... 13
KEO Dylan ..... 155
KHALLAF Abdullah Gamal ..... 13
KIOTA Benjamin ..... 118
 KOBA Joseph ..... 146
KONGYRBAYEVA Aigerim ..... 59
KOUADIO Asse ..... 103


**L**

LACHAUSÉE Alexandre ..... 100
LAFFICHE Lin ..... 100
LAPORTE Iléana ..... 75
LASCOR Benjamin ..... 151
LAURENT Axel ..... 136
LE GUENNEC Alan ..... 37
 LEGRAND Nicolas ..... 94
LEROUX Adele ..... 76
LEROY Maxence ..... 133
 LHERMITE Pierre-André ..... 56
LISAI Chiara ..... 77
LIU Xuancen ..... 65
LUSIETE TUTONDA Olive ..... 119

**M**

MABERI-GRODET Murielle ..... 152
MAGHO Rivan ..... 120
MANGIN Amandine ..... 50
MANIFET Charlotte ..... 87
MARMANDE Leo ..... 58
MARTINEZ Tony ..... 153
MASCLAUX Agathe ..... 142
MASSON Loïs ..... 144
MAURIN Etienne ..... 19
MAZOYER Maxime ..... 155
MD NAZAM Muhammad ..... 139
 METROT Raphael ..... 98
MICHELET Pierre ..... 137
MORIVAL Lisa ..... 78
MOSSMANN Valentin ..... 20
MOUTAOUEKKIL Zineb ..... 38
MUNSCHY Arthur ..... 148

**N**

NANA-TCHANA Rose ..... 156
NDOBI Isaline ..... 50
NGUESSAN Justin ..... 60
NGUYEN Kimhoa ..... 79
NICOLEAU Jules ..... 88
NIMAL Mathilde ..... 80
NSHIMYIMANA Magnus ..... 142
 NTOUTOUME AYI Paul ..... 22

**O**

OGER Marion ..... 26
 OUAZIZ Sabine ..... 146

**P**


 PAJON Romain ..... 61
---

PATINOTE Arthur ..... 48
PEAUDECERF Florent ..... 140
 PENEL Valentine ..... 21
PEPIN Maxence ..... 151
PEREIRA ALVES Luís ..... 150
PERRETTE Kevin ..... 16
PHILIPPE Maxence ..... 50
PIEDEFER Tom ..... 54
 PIK Arthur ..... 99
PINAUD Chloé ..... 89
PLACIDE Maëva ..... 104
 PONCET Simon ..... 102
PONTLEVOY Gaetan ..... 154
PRÉAUCHAT Marine ..... 104
PRESTI Florestan ..... 96

**Q**

QUÉRÉ Antoine ..... 90
------------------------

**R**



RALALA Tahina ..... 54
RANDEYNES Augustin ..... 25
RANDRIANASOLO Rovatiana ..... 15
RAOUL Kevin ..... 95
REBAI Sabrina ..... 39
ROLAND Theo ..... 137
ROQUES Elie ..... 121
ROSSI Enzo ..... 150
ROSSIBOURCET Alice ..... 105
ROUX Julia ..... 81
 ROY Adrien ..... 94
RUSTOM Wadih ..... 41

**S**

SAGA Cedric ..... 42
----------------------



# Index of students

SAINT-SUPERY Aubin .....139  
 SAKHO Ndeye .....82  
 SALESSE Léa .....103  
 SANTOROMITO Enzo .....150  
 SAUZE Guillaume .....96  
 SAYAG Benjamin .....141  
 SCHOONBAERT  
 Baptiste .....50  
 SEBBAR Ibrahim .....98  
 SEBTI Mohamed .....95  
 SERVIER Emma .....83  
 SLIMANI Youness .....122  
 SOHOU Karyn .....43  
 SOLER Baptiste .....57  
 SOMMIER Etienne .....52  
 SOURI Taha .....44

## T

TAN Osman .....140  
 THAUVIN Bastien .....91  
 THERRY Tom .....98  
 THIAM Moussa .....156  
  THION Lesly .....61  
 TOMBOTAM  
 Mouhirah .....134  
 TRAORE Aboubacar .....45

## V

VATEL Cédric .....19  
 VERMEIRE Inès .....151

## W

WANG Shizhen .....50  
 WEBER Sylvain .....20

## X

  XU Wenze .....61

## Y

YAMEOGO Wendlassida  
 Jean-Etienne .....46  
 YOUSSEF Ahmad .....47

## Z

ZAHID Yahia .....84  
 ZHANG Yu .....65

### Final year projects forum awards



# Index of participating companies & institutions

## A

Agglomération Community of Vendôme Territoires.....	129
Antea Group.....	12 13
Amphenol Antenna Solutions.....	24
ASP.....	117
Atlantic.....	156
Atos.....	61
Axereal.....	39 138
Axess.....	44
Axess Vision Technology.....	58
Aximum.....	32

## B

Base aérienne 123 Orléans Bricy.....	97 99 101
BC.n.....	34
Blédina.....	72
Boiron laboratories.....	80
BorgWarner.....	145
Bouygues Bâtiment Grand Ouest.....	31

## C

CAOM Bâtiment IDF.....	35
Centre Val de Loire.....	128
Clares Immobilier.....	28
Colas.....	30 40 46 143
Conseil Départemental du Loiret.....	14
Cosmetic Valley.....	64
CPA 30/BA 123.....	144
Cresitt Industry.....	59

## D

Darcy Lab.....	22
Delpharm.....	70
Design Tech Centre.....	141
Duffay.....	85

## E

EGIS Centre Ouest.....	47
Eiffage.....	33 36 127
Elaiapharm Lundbeck.....	76
Eurowatt.....	148

## F

Framatom Intercontrôle.....	112
France Loire.....	43

## G

GDR 2502, Dassault.....	153
Getinge.....	79 131
GRDF.....	146 147
Guerlain.....	68
Groupe SCOPELEC.....	126

## I

IBK Ingénierie.....	37
Icare.....	150 154

## J

John Deere.....	113 121
-----------------	---------

## K

Kemica Coatings.....	94 137
Keyhive.....	52

## L

La Bouledogue.....	88
Laphal Industries.....	75
Les Crudettes.....	115
Lilly.....	82
L'Oréal.....	66 67 77 83
Louis Vuitton.....	74

## M

Maquet SAS.....	50
Maroquinerie de St-Antoine.....	120
MayENR.....	136
MBDA.....	139 149
MSL Circuits.....	118

## N

Nexter Arrowtech.....	151
Novartis Pharma.....	69
Novo Nordisk.....	51 65

## O

OBM Construction.....	41
Orange.....	55
Orléans Métropole.....	23
Oxylum.....	29

## P

Polytech Orléans.....	15 17 20 26 48 56 57 60 62 102 108
-----------------------	------------------------------------

## R

Relais électrique du Loiret.....	95 96
Renault SAS.....	119

## S

Safran.....	104 114
Sanofi.....	84
Savencia fromage & dairy.....	87
Schneider Electric.....	130 132 133
SIT.....	86
SNCF.....	38
Sodebo.....	73
Sogea.....	27 42
Sologne Ingénierie.....	21
SPIE.....	124 125 134

## T

Transvalor.....	103
Transition-one.....	140

## U

University of Orléans : R&D Expertise and Transfer Unit CETRAHE.....	16 18
--	-------

## V

Vaillant Group.....	155
VAISALA.....	53
Vetoquinol.....	81

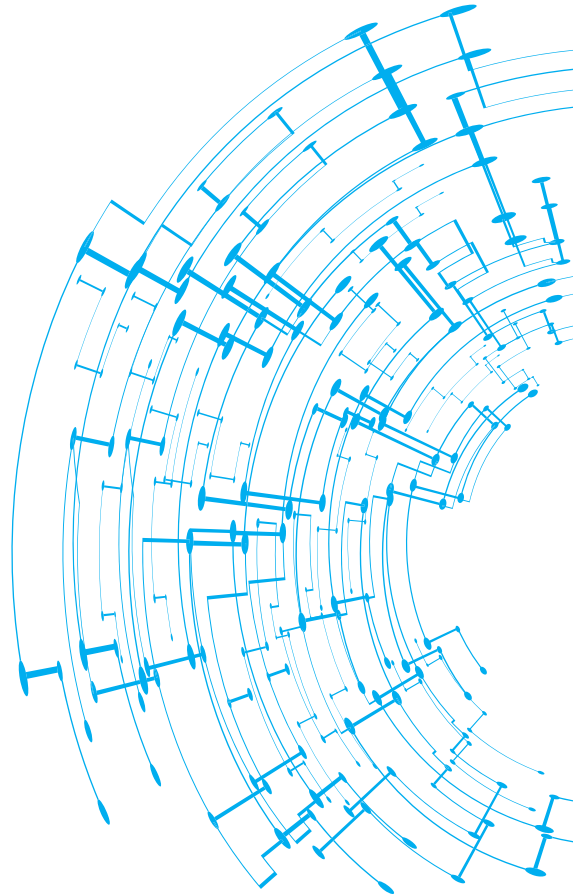
## Z

Zéfal.....	106
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**POLYTECH ORLÉANS**

School of Engineering of the University of Orléans  
8 rue Léonard de Vinci  
45072 Orléans cedex 2 | FRANCE

