



ROTOPOL 2024

A study of different manufacturing processes for rotomolding tools

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University of Caxias do Sul - Brazil

AGENDA

- Brief presentation - Introducing Myself
- Research Project Scenario
- Research Project in development

INTRODUCING MYSELF

- Where I come from in Brazil – Place and University
- Why am I here
- What are my expectation: Learn, Networking, Contacts

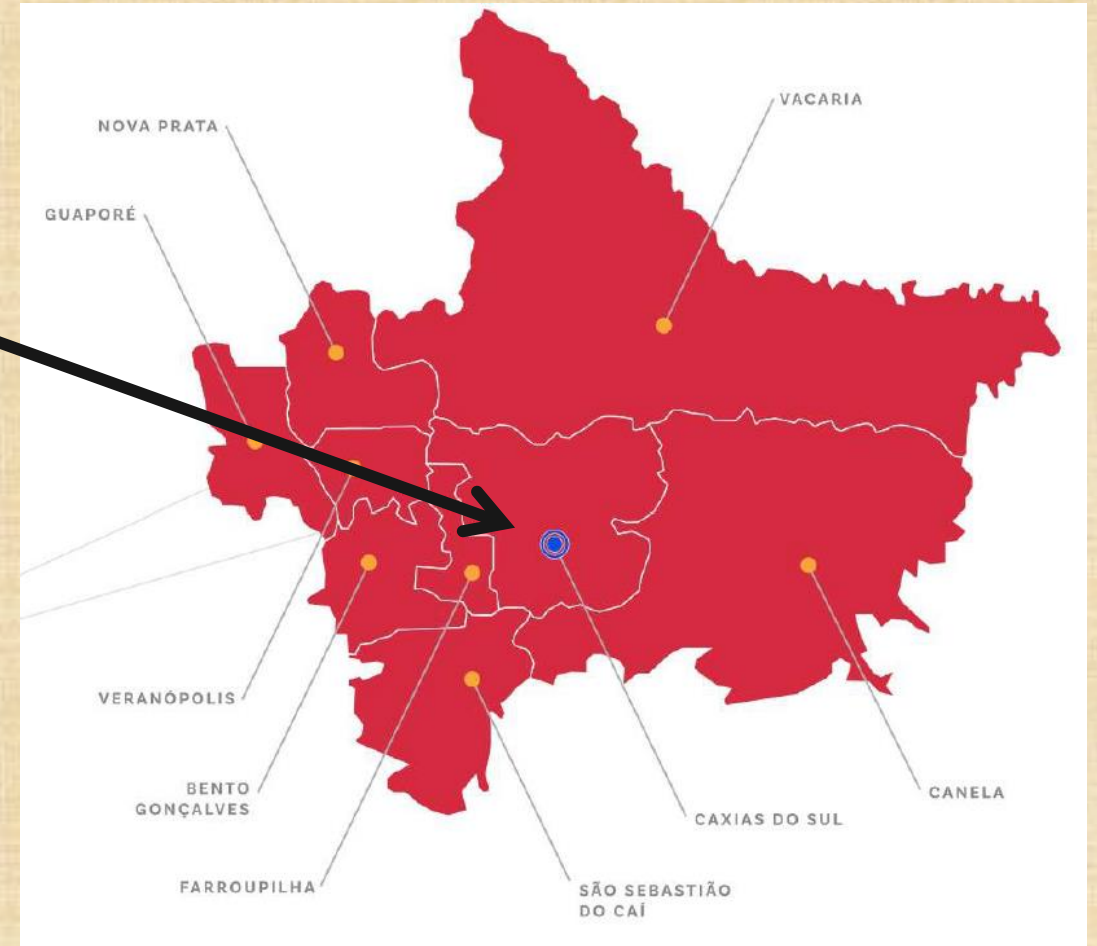
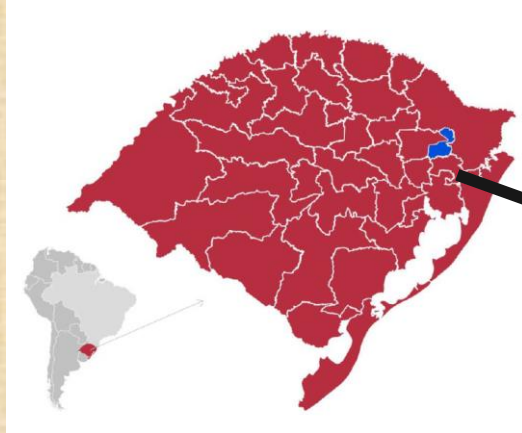
INTRODUCING MYSELF – WHERE I COME FROM



- ✓ *Rio Grande do Sul – extreme South of Brazil – mountainous touristic region on Brazil*
- ✓ *Rio Grande do Sul State borders Uruguay and Argentina*
- ✓ *Caxias do Sul region is an industrial development cluster with high national recognition. Some of the main business:*
 - *Truck trailers / Implements*
 - *Buses*
 - *Mould makers*
 - *Clothing*
 - *Cutlery*
 - *IT and Automation companies*
 - *Furniture*
 - *Wine*
 - *etc.*

Yes, unfortunately, this is the place that has been affected by the strong rains

INTRODUCING MYSELF – UNIVERSITY OF CAXIAS DO SUL



UCS BY THE NUMBERS

DEGREE PROGRAMS

091 UNDERGRADUATE	198 GRADUATE
072 ATTENDANCE PROGRAMS	160 LATO SENSU
019 ONLINE PROGRAMS (EAD)	038 STRICTO SENSU (MESTRADO E DOUTORADO)

University of Caxias do Sul is a Multi Campi University – 9 campus

INTRODUCING MYSELF – UNIVERSITY OF CAXIAS DO SUL



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SCIENCES & ENGINEERING CENTER



114 professors

60 technical staff

21 research labs

35 teaching labs

20 undergraduate programs

7 graduate programs

1740 undergraduate students

110 graduate students

SCIENCES & ENGINEERING CENTER

Undergraduate Programs

Analysis and Systems Development - A.A.S.

Automotive Engineering - B.Sc.

Chemical Engineering - B.Sc.

Chemistry - B.Ed.

Civil Engineering - B.Sc.

Computer Engineering - B.Sc.

Computer Networks - A.A.S.

Computer Science - B.Sc.

Control and Automation Engineering - B.Sc.

Digital Creation - B.Sc.

Digital Games - A.A.S.

Electrical Engineering - B.Sc.

Embedded Systems - A.A.S.

Environmental Engineering - B.Sc.

Materials Science Engineering - B.Sc.

Mathematics - B.Ed.

Mechanical Engineering - B.Sc.

Physics - B.Ed.

Production Engineering - B.Sc.

Software Engineering - B.Sc.

SCIENCES & ENGINEERING CENTER

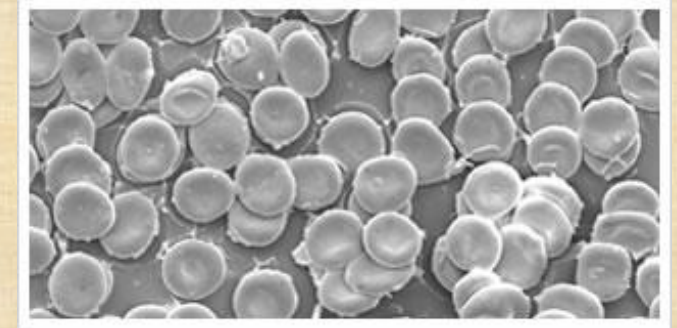
Graduate Programs



Engineering and Environmental Sciences - M.Sc.



Process Engineering and Technologies - M.Sc. and Ph.D.



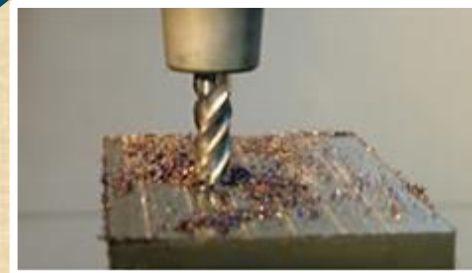
Materials Science - M.Sc. and Ph.D.



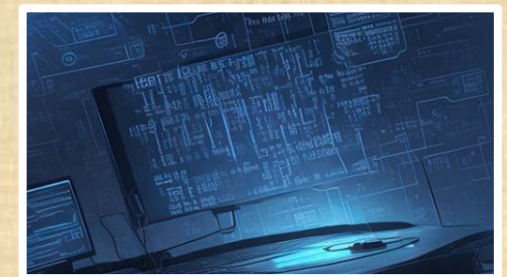
Mathematics and Science Education - M.Sc.



Production Engineering - M.Sc.



Mechanical Engineering - M.Sc.



Computer Science - M.Sc.

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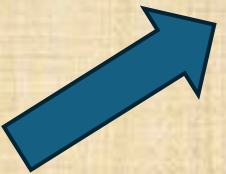
RESEARCH PROJECT SCENARIO

- ✓ National Program for **Green Mobility and Innovation – Mover**;
- ✓ It is a federal government initiative that aims for boosting modernization and sustainability in the areas of mobility and logistics in Brazil;
- ✓ The main goal is to improve the competitiveness of specific sectors in the national automotive chain on the global levels;
- ✓ The resources come from taxes incentive of the automotive industry;



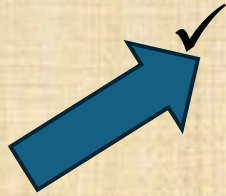
RESEARCH PROJECT SCENARIO

Mover involves 3 priority programs

- 
- ✓ **Brazilian Tooling Program** - aims to overcome the challenges faced by tooling shops with low productivity and technological lag. The focus is to capacitate the automotive product tooling chain, aiming to achieve global competitiveness levels. (~ 50 millions Euros)
 - ✓ **Biofuels, Safety and Vehicle Propulsion Program** – focus on electrification of the vehicle powertrain for high energy efficiency, use of biofuels to generate energy and the innovation of safety systems to preserve the integrity of passengers. (~55 millions Euros)
 - ✓ **Priority Vehicle Connectivity Program** – focus on new business models and training people to overcome the challenges of integrated mobility, decarbonization and data security. (~ 15 millions Euros)

RESEARCH PROJECT SCENARIO

Brazilian Tooling Program Fronts



- ✓ **RD&I Projects** - Tooling Design and Manufacturing Processes: proposes improvements in the various phases of the tooling production life cycle in search of increased durability, reparability, productivity and applications in innovative materials and processes
- ✓ **Human Resources Training** – formation courses aimed at the tooling sector
- ✓ **Entrepreneurship Front** - contributing to the construction of an increasingly innovative and technological culture in the tooling sector
- ✓ **Innovation Front** - a platform capable of connecting the tooling industry and solution providers, mainly in the theme of Industry 4.0.

RESEARCH PROJECT SCENARIO

- ✓ **Our research group is participating in the following projects**
 - ✓ High Pressure Die Cast (HPDC) – Aluminum Injection Moulding
 - ✓ Low-cost monitoring for injection molds (tryouts)
 - ✓ injection molds for low volume production
 - ✓ **Rotational molding tooling:**
 - ✓ It was demanded by the manufacturers of machinery and equipment for agricultural industry
 - ✓ Motivation – COVID19 pandemia – high dependence of imported tanks (fuel tanks) – the prices of the freight has increased expressively
 - ✓ Understanding the internal (Brazilian) supply chain in the field of rotomolding tanks – technology and costs

RESEARCH PROJECT PARTNERS

Universities



Companies



RESEARCH PROJECT PARTNERS

Manufacturers of machinery and equipment for agricultural industry

- ✓ AGCO (Global Company - Canoas Plant –RS)
- ✓ AGRALE (Caxias do Sul Company)

OEM´s, Mold Makers and Design offices

- ✓ XALINGO SA – OEM
- ✓ Massochini Tecnologia em Moldes e Plásticos – Mold Maker - Machining
 - ✓ VOA Indústria – Mold Maker – Steel Sheets forming and welding
 - ✓ ICON SA – Mold Maker - Machining
 - ✓ Dirk Henning – Product Designer
- ✓ Modelação Feuser – Aluminum Foundry (Casting)

RESEARCH PROJECT

The project's mission is to contribute to the development of technologies aimed at raising the level of technological maturity and efficiency of the Brazilian tooling chain, more specifically in the theme of molds for the production of rotomolded tanks.

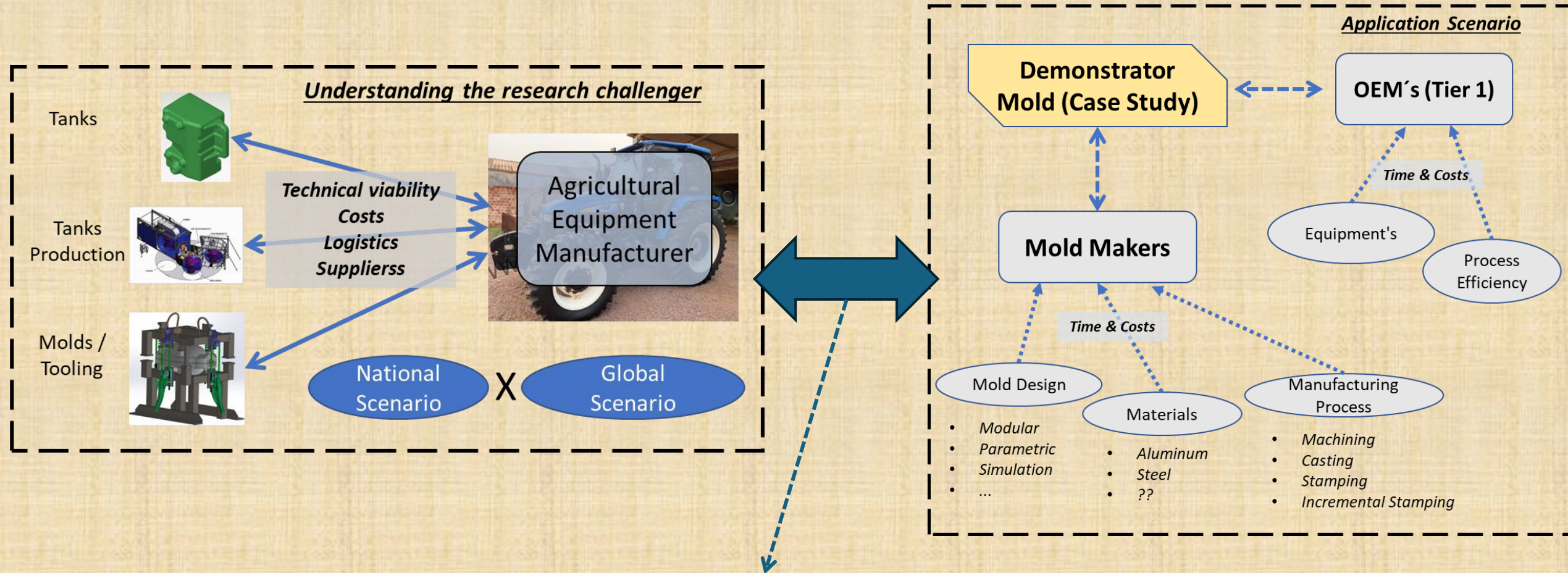
Main Goal - propose a systematic study to evaluate the production of tooling for the manufacture of tank-type polymeric parts

RESEARCH PROJECT

Some of the goals and contributions expected:

- a) Understand the *national and international scenarios* in the production of tanks for applications in products in the automotive and agribusiness sectors;
- b) Identify *technological gaps* between existing research and technologies in Brazil and in leading countries producing these types of products;
- c) *Add technical knowledge* to manufacturers of molds for rotational molding;
- d) *Disseminate knowledge, skills, good practices and technologies* in successful use in companies outside Brazil to national companies;
- e) Identify the *main technological challenges* involved in the production process of these types of products, considering the design and manufacturing of molds;
- f) Bringing *academia and companies together* in the search for solutions for the national market.

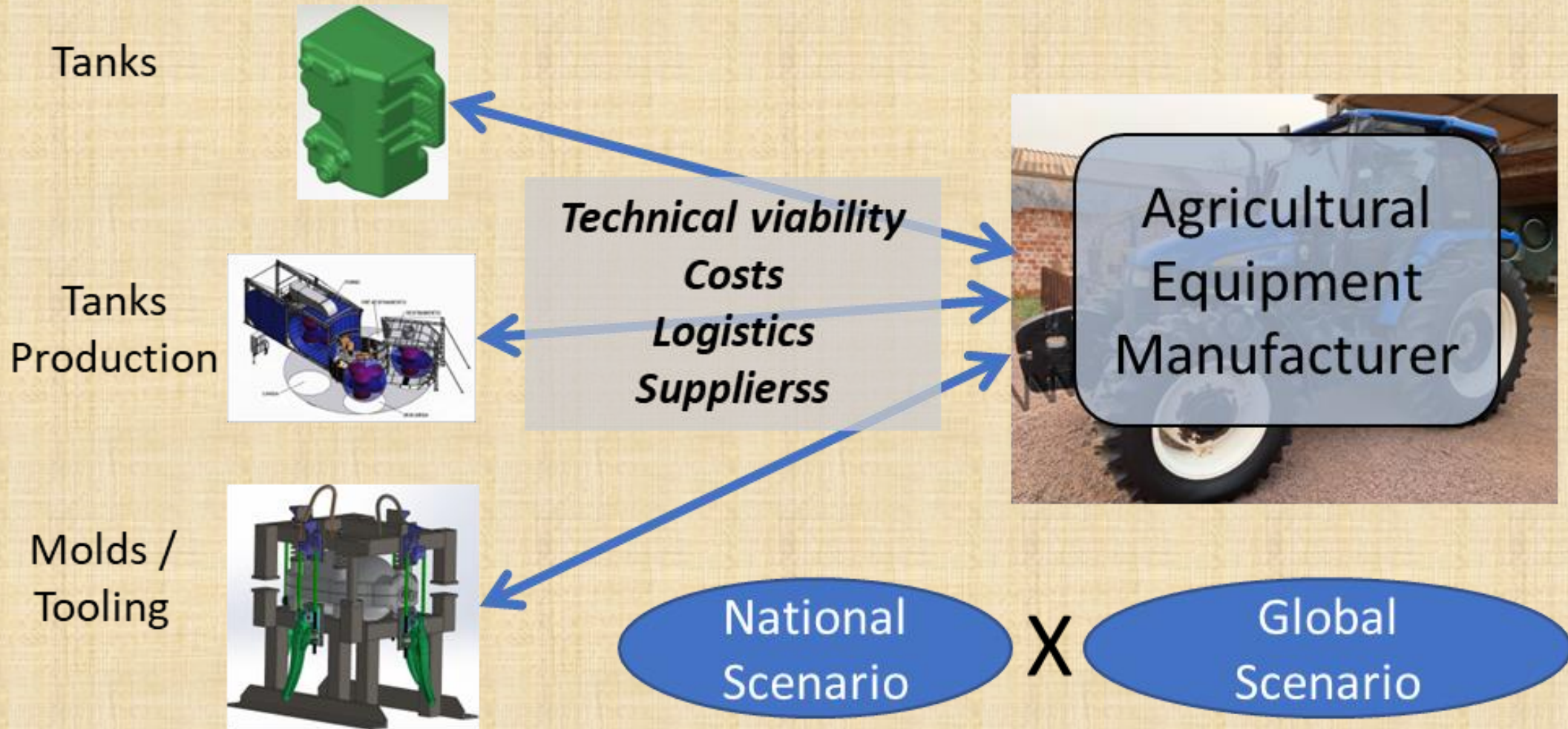
RESEARCH DESIGN AND APPROACH



Information Exchange

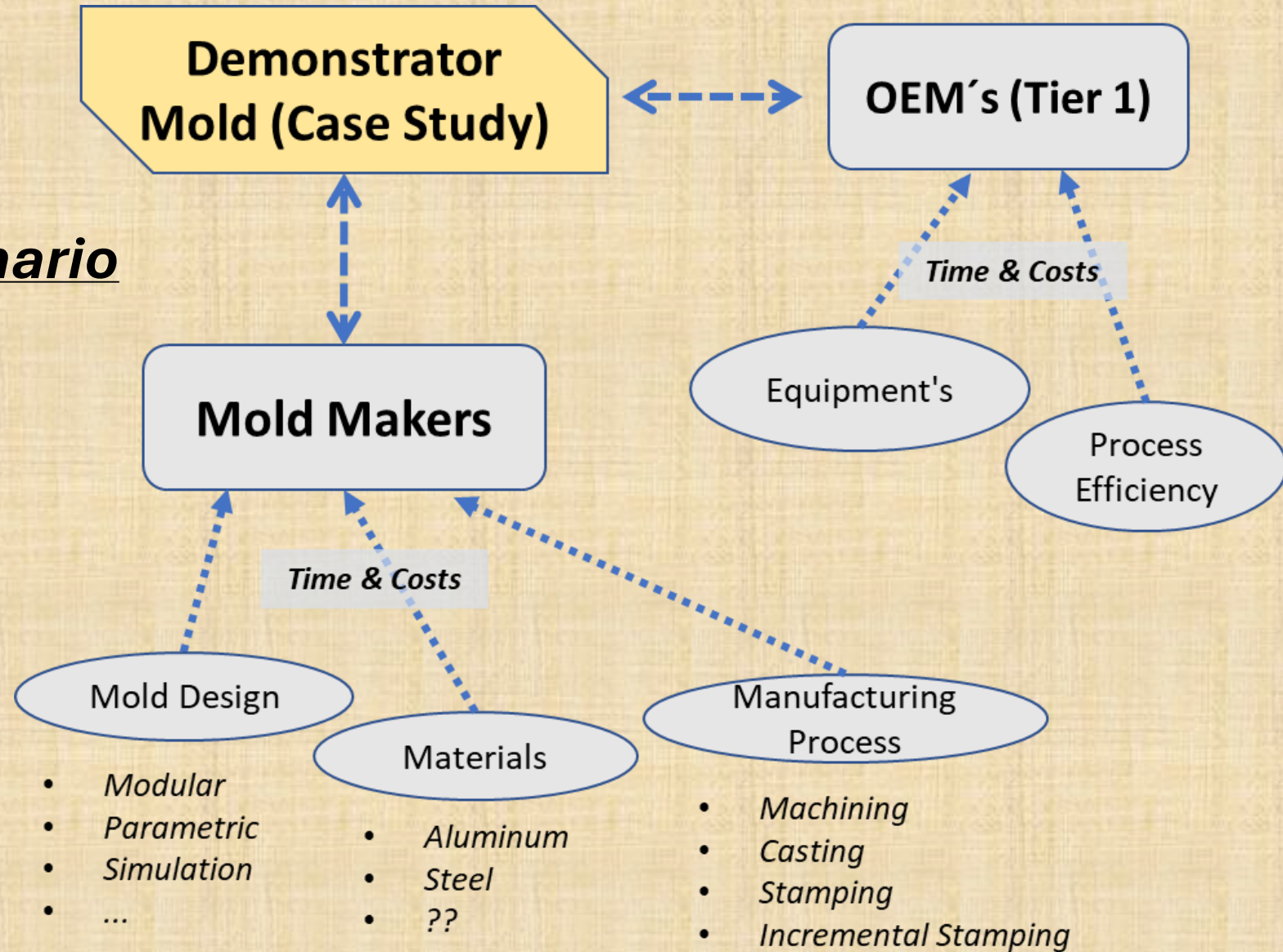
RESEARCH DESIGN AND APPROACH

Understanding the research challenger

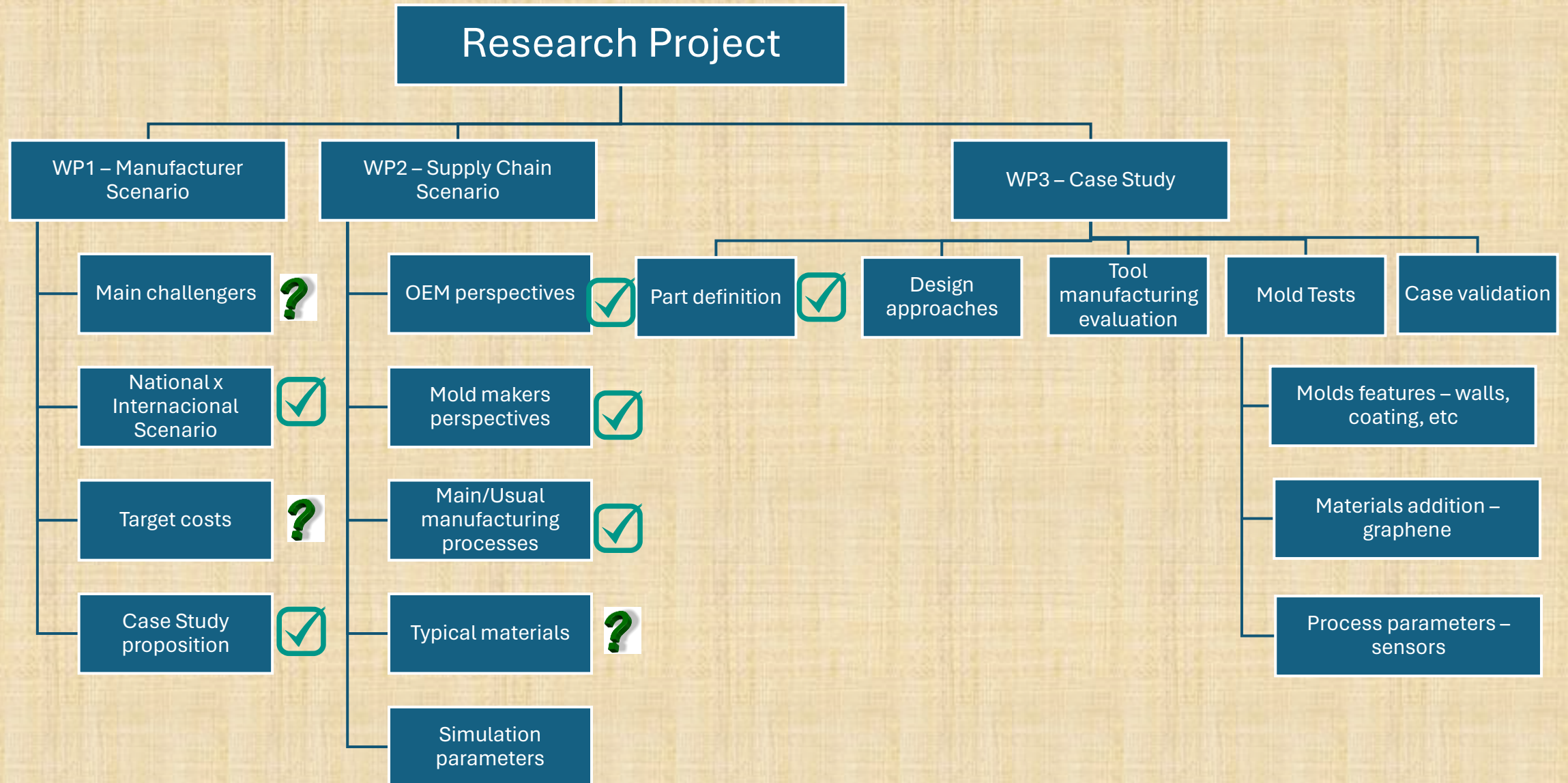


RESEARCH DESIGN AND APPROACH

Application Scenario

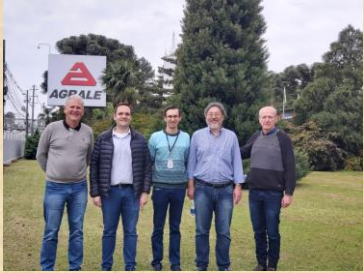


RESEARCH PROJECT



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RESEARCH PROJECT NATIONAL AND INTERNATIONAL SURVEY



RESEARCH PROJECT

NATIONAL AND INTERNATIONAL SURVEY

- ✓ Literature survey on Rotomolding Process
 - ✓ Process principals
 - ✓ Process parameters
 - ✓ Materials – Polymers conventionally used;
 - ✓ Rotomolding machines
 - ✓ Types of tools (molds)
 - ✓ Tools materials and manufacturing routes;
 - ✓ Main applications and market (partial vision so far) ;

Polyethylene
Polypropylene
Nylon
Polycarbonate

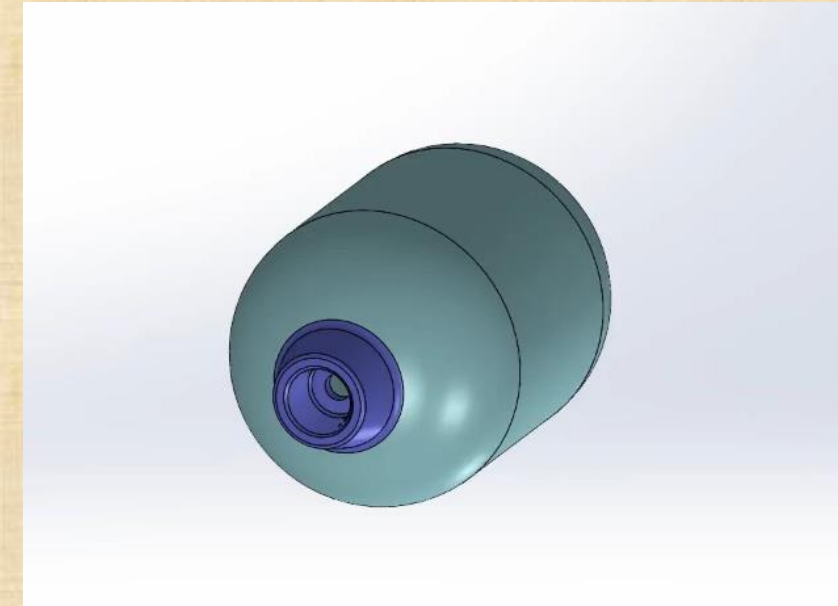
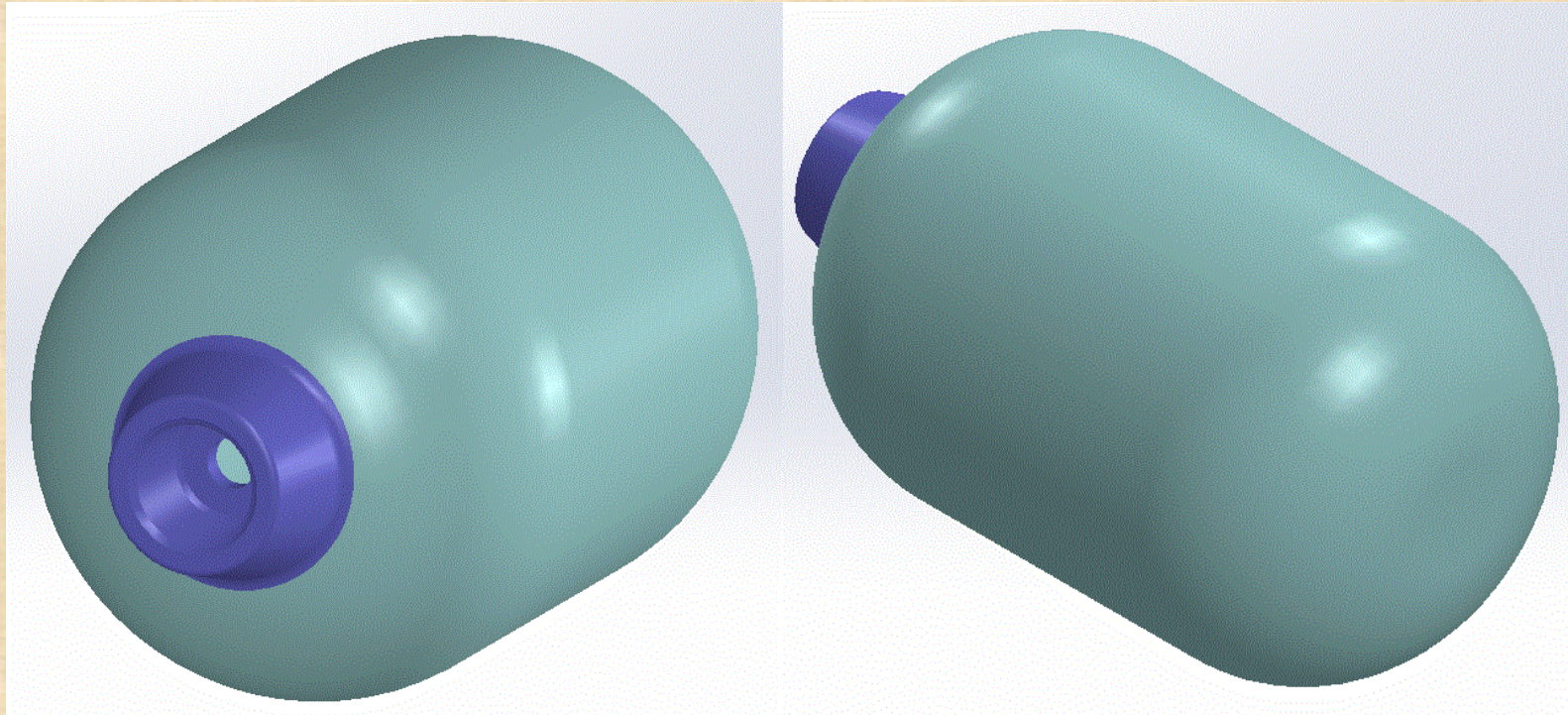
RESEARCH PROJECT

PARTS DEFINITIONS

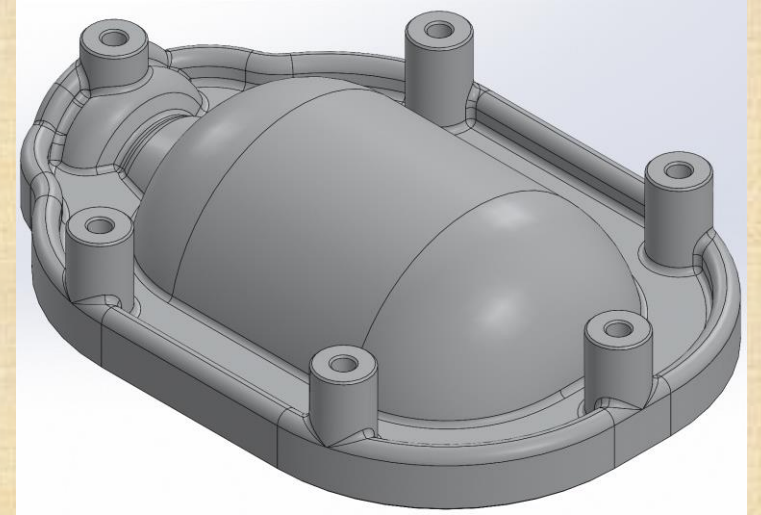
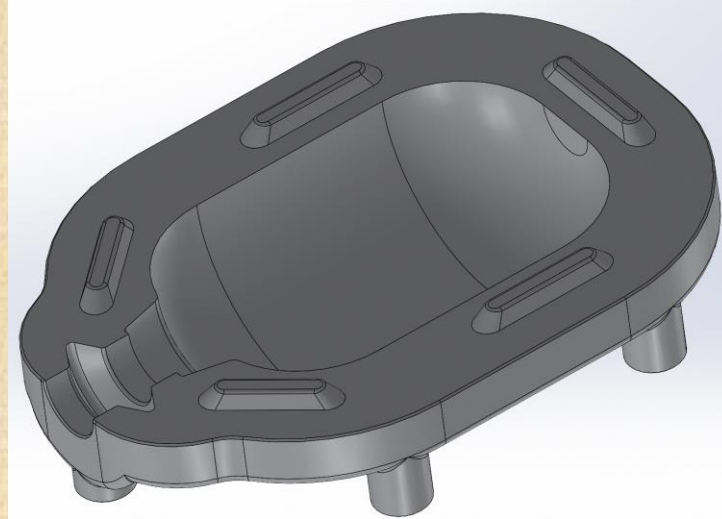
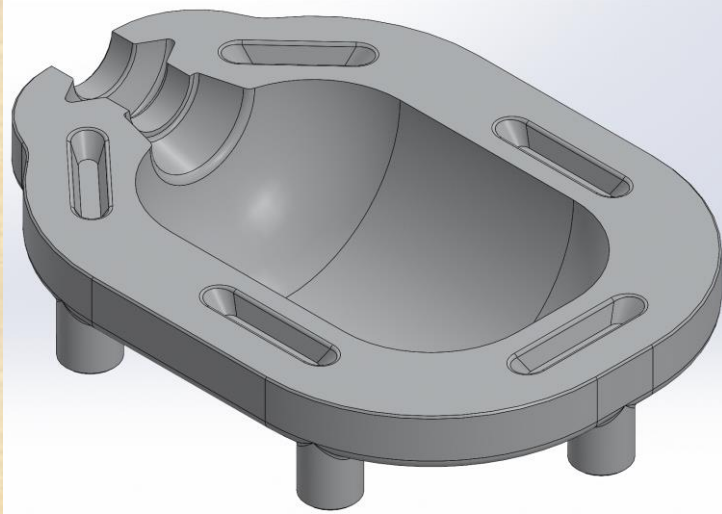
Three different parts:

- ✓ An experimental part – Pressure Vessel (laboratory)
 - ✓ *Mold material testing*
 - ✓ *Polymer material testing (composites)*
 - ✓ *Process parameters*
 - ✓ *Manufacturing process routes and costs*
- ✓ Small Fuel Tank (Agrale)
- ✓ Medium size Fuel Tank (AGCO)

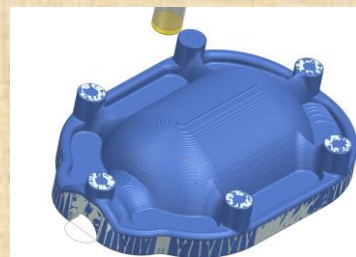
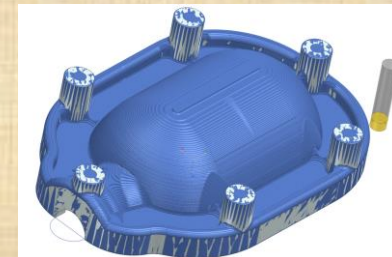
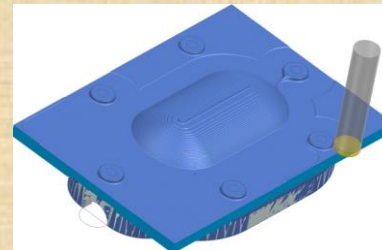
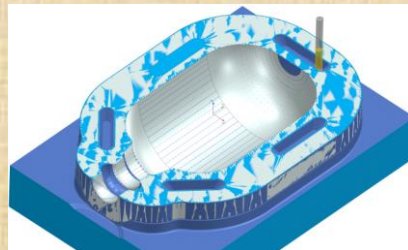
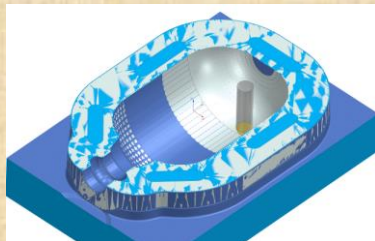
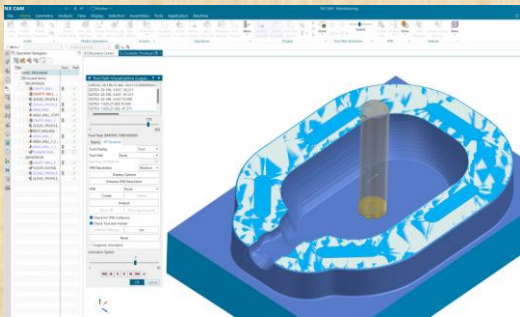
STUDY CASE 01 - PRESSURE VESSEL (PV)



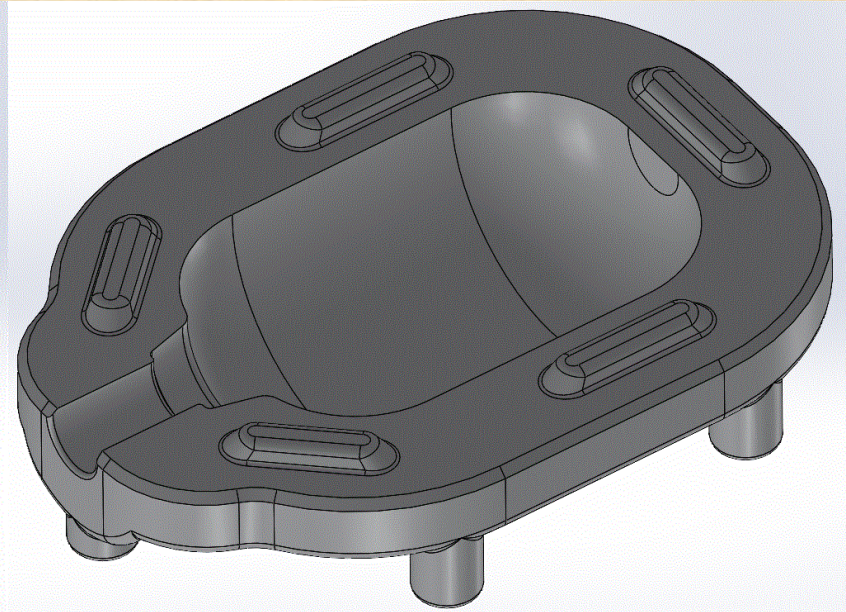
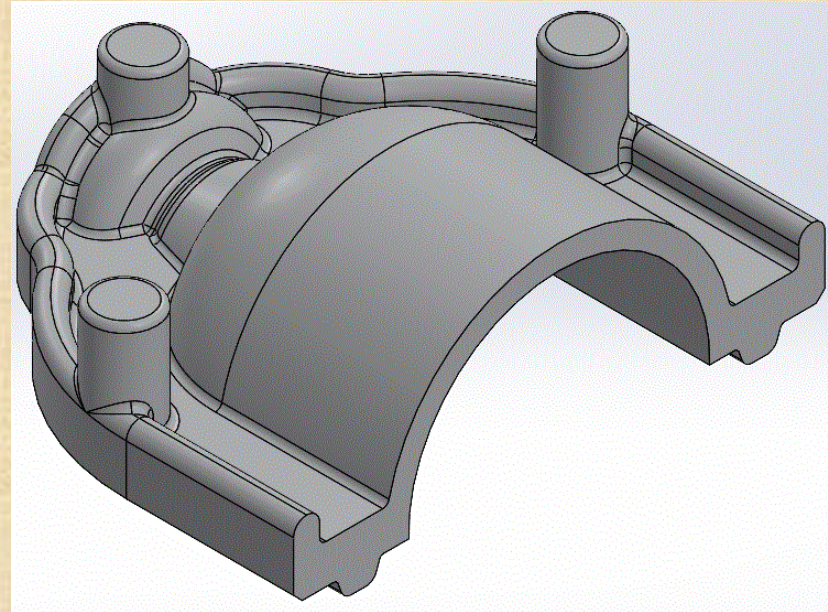
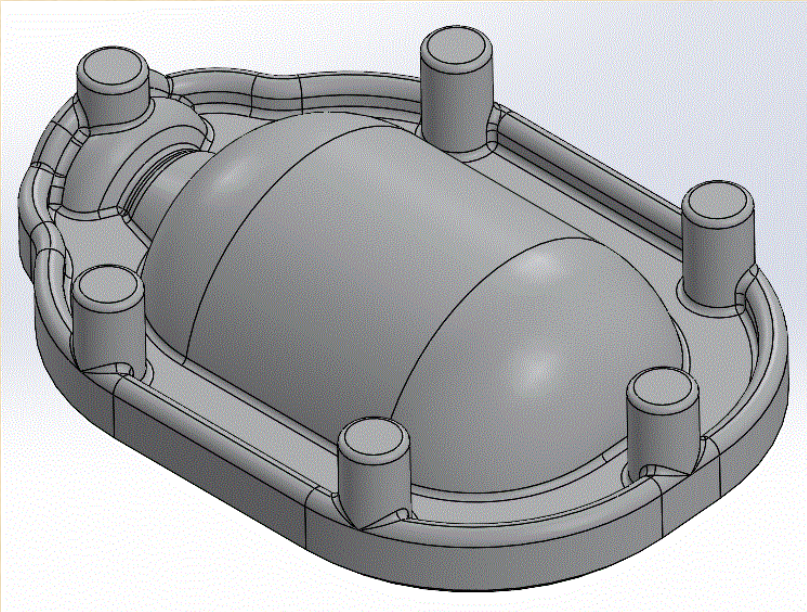
STUDY CASE 01 – PV Machined



5083 aluminum alloy

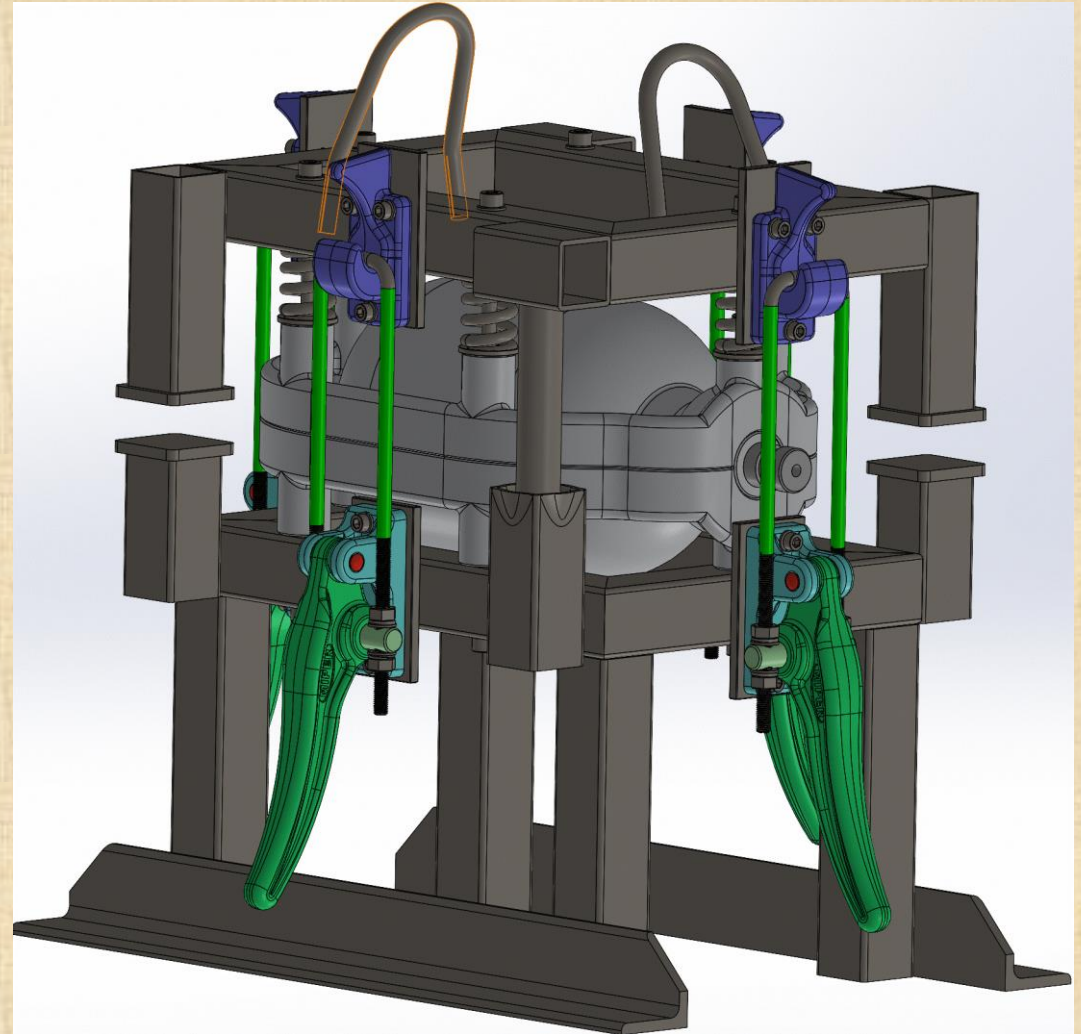
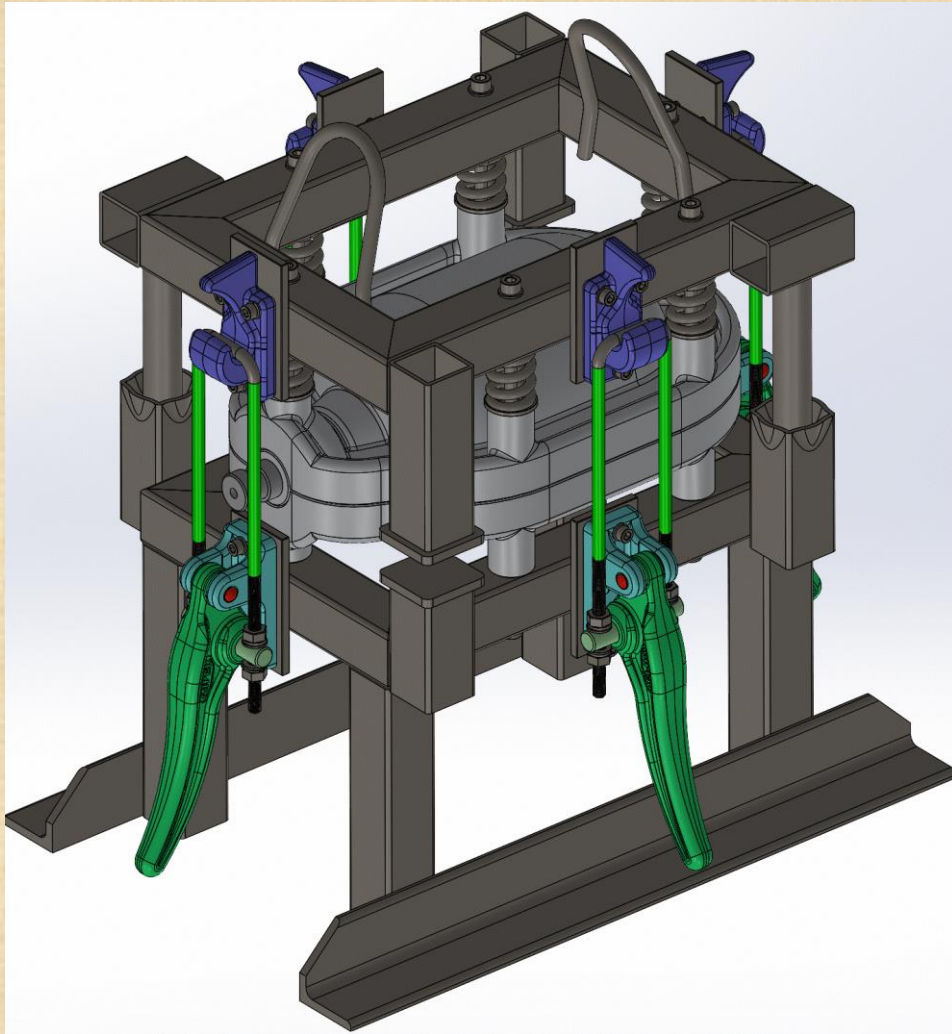


STUDY CASE 01 – PV Casted



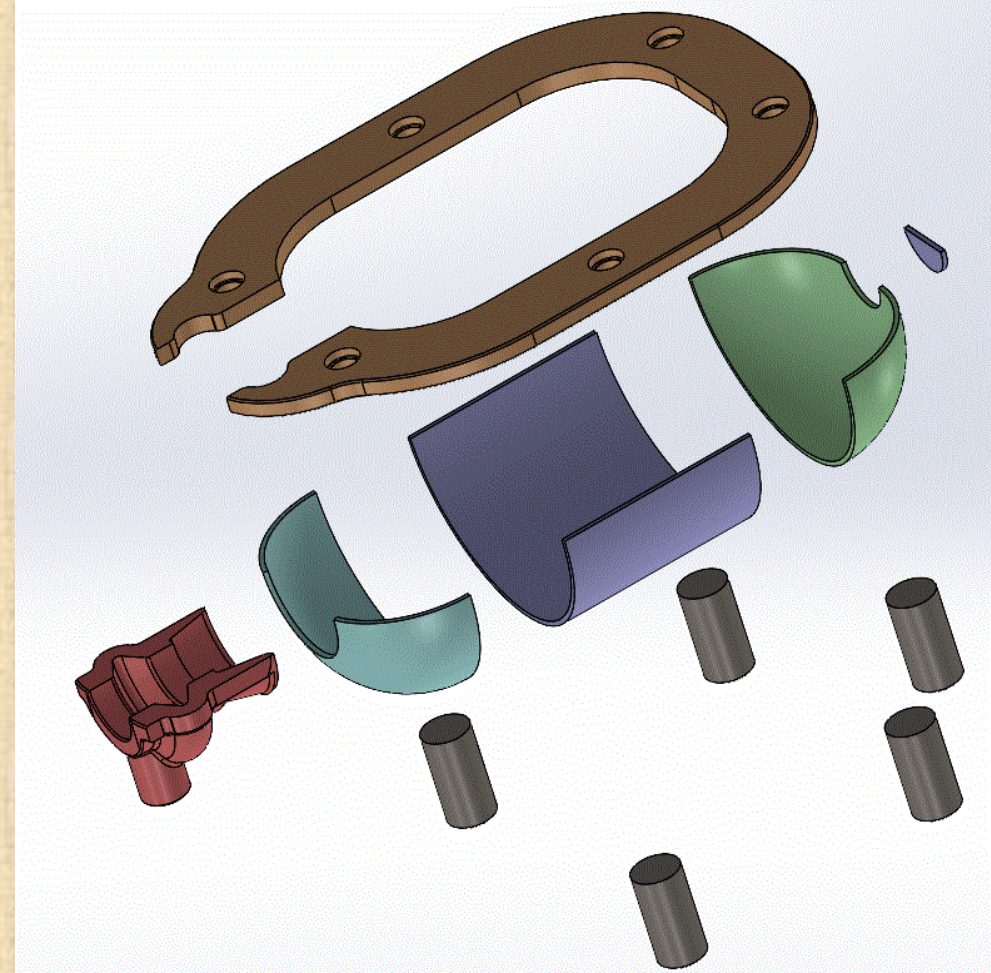
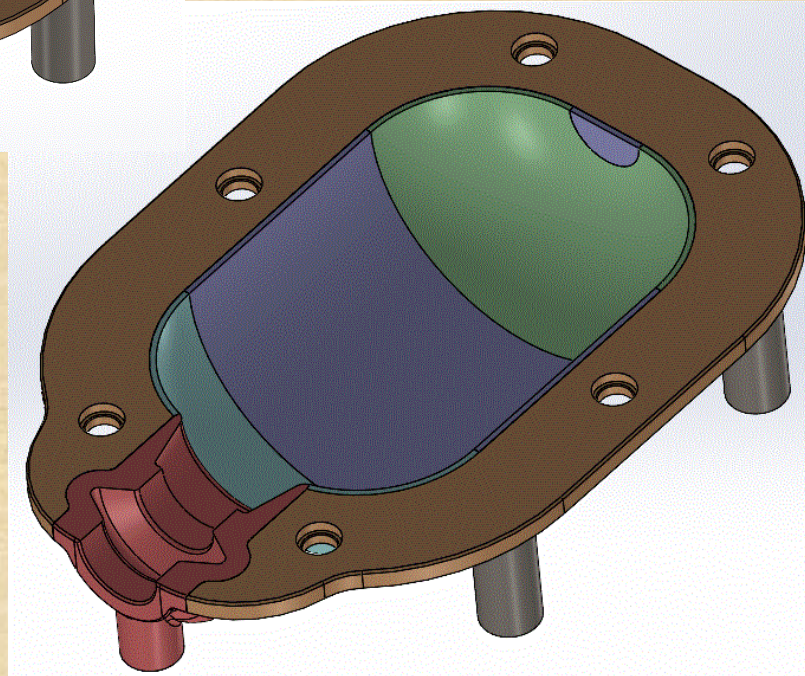
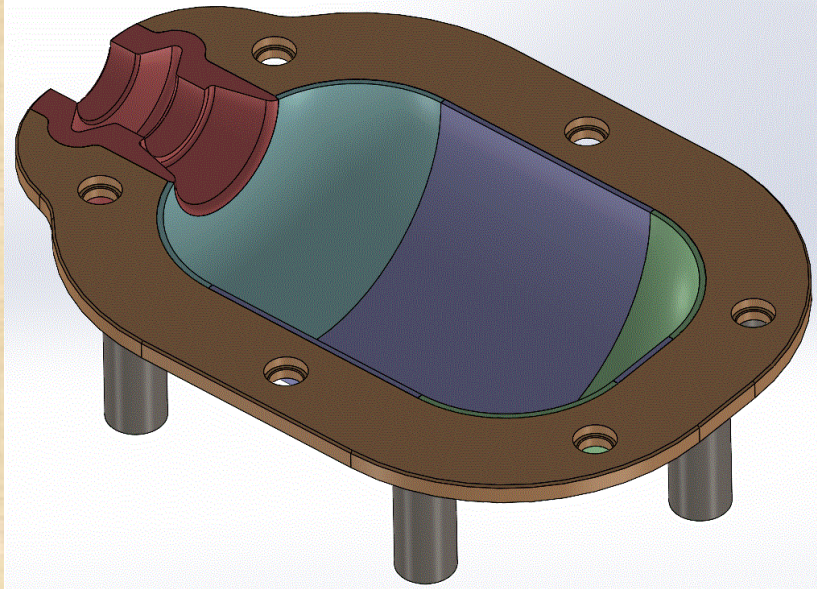
SAE 329 aluminum alloy

STUDY CASE 01 – PV – Mold Frame



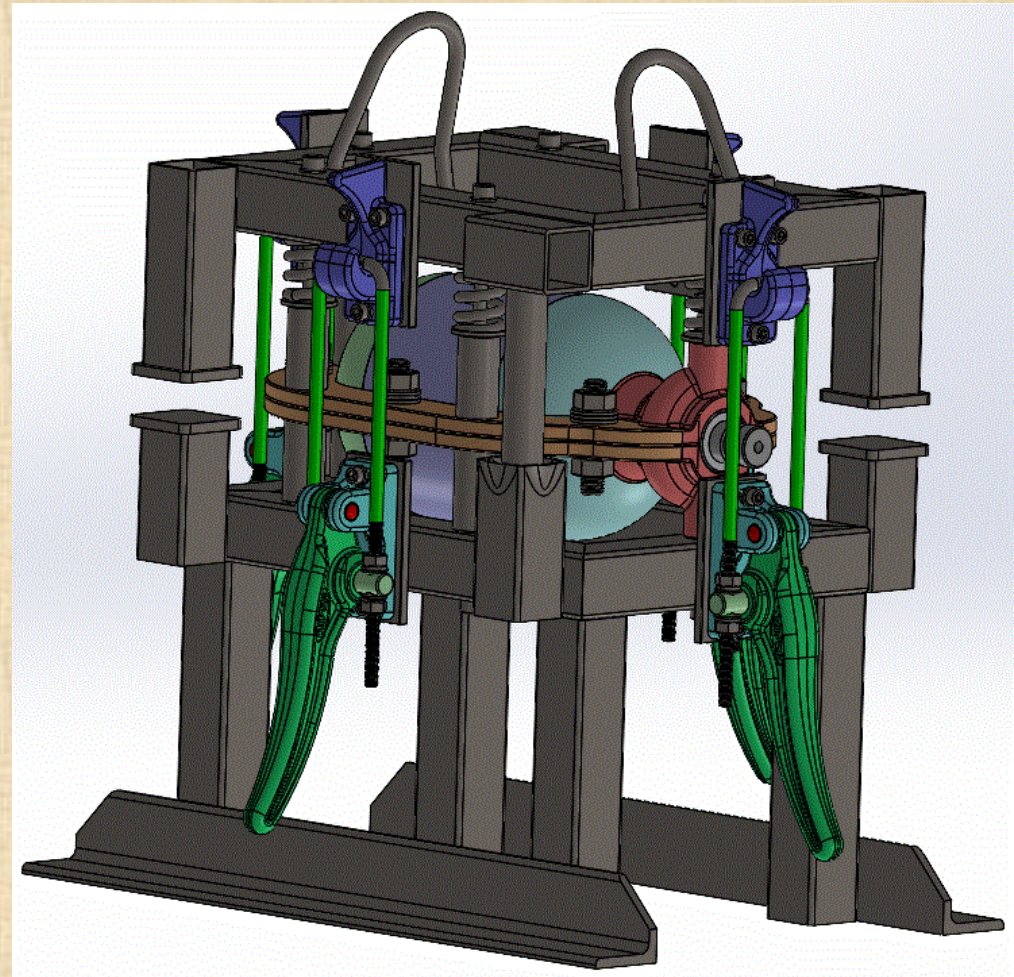
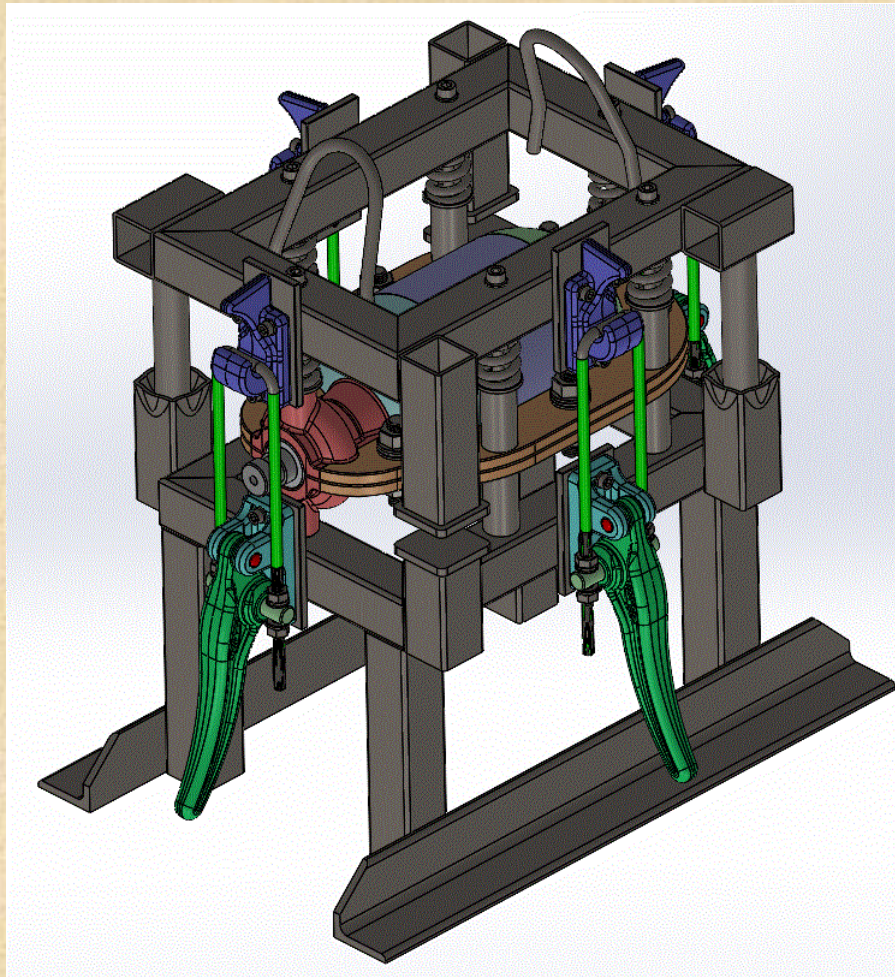
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STUDY CASE 01 – PV Metal Sheet



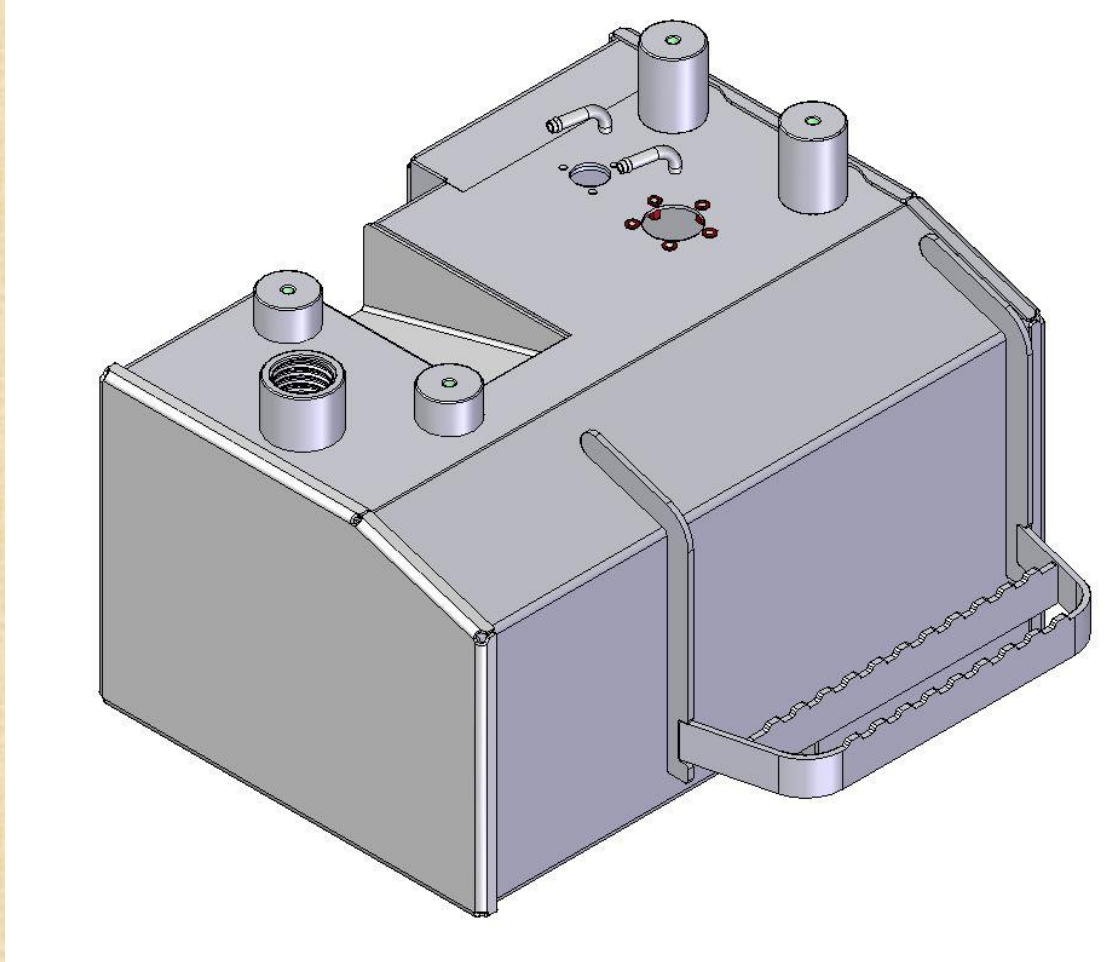
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STUDY CASE 01 – PV Mold Frame Metal Sheet

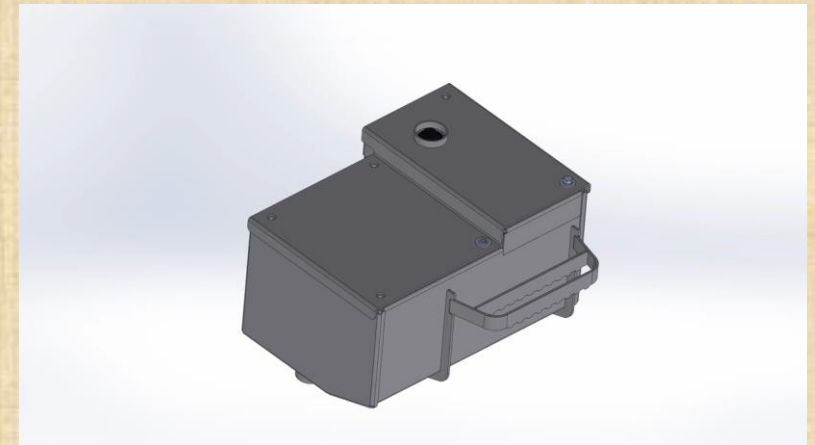


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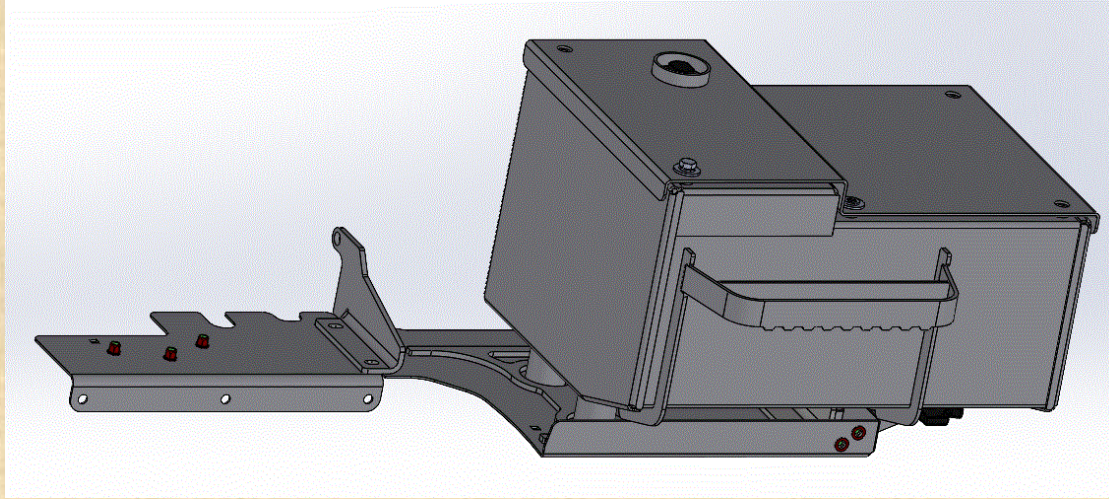
STUDY CASE 02 – FUEL TANK SUBSTITUTION



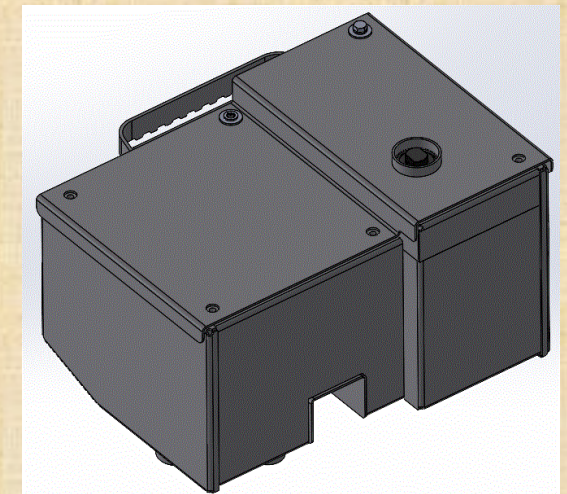
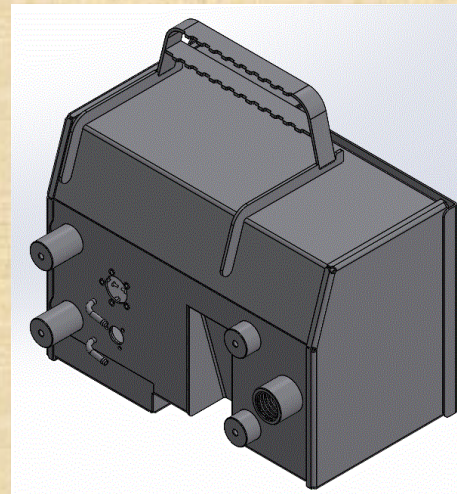
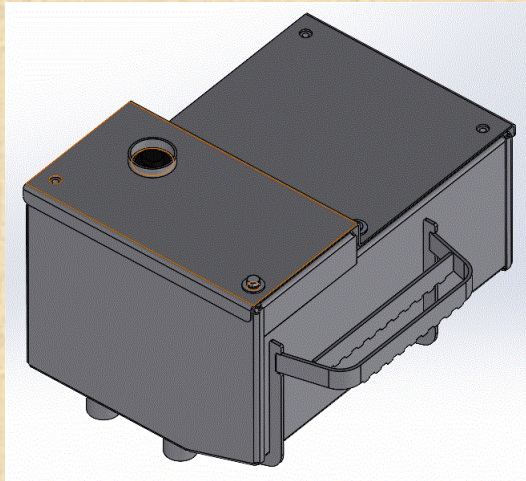
Original Tank - Metal



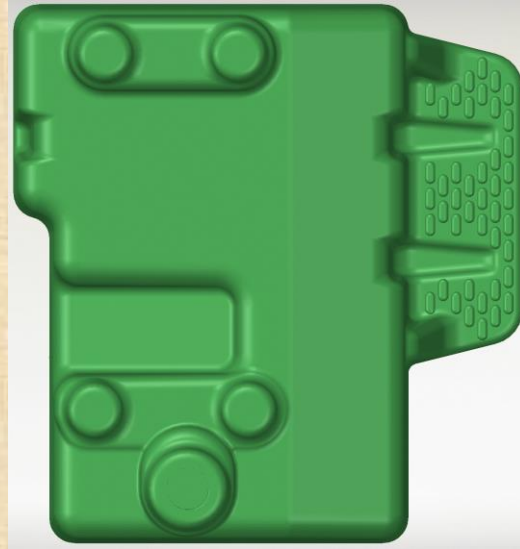
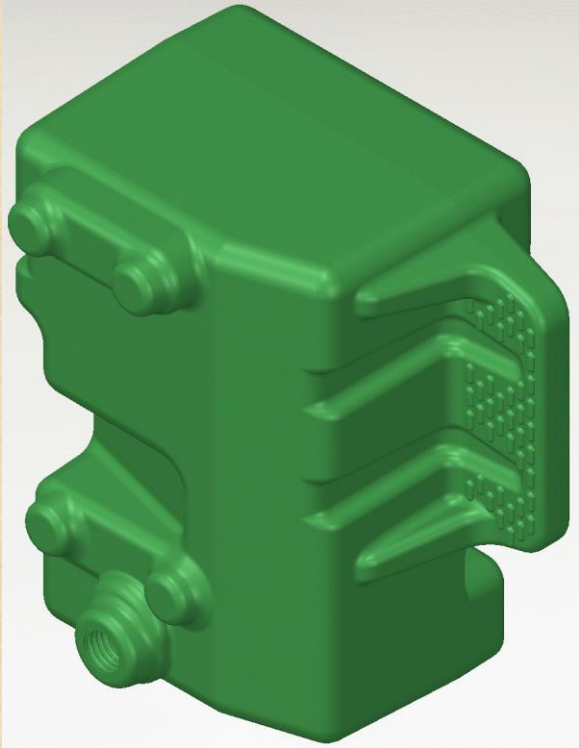
STUDY CASE 02 – FUEL TANK SUBSTITUTION



- *Study of the tank functionality*
- *Keeping the key features – Interchangeability:*
 - *support and fixing points*



STUDY CASE 02 – FUEL TANK SUBSTITUTION



- *Initial proposal – in development*



FINAL COMMENTS

- Project is on its initial stages – we have lots to catch on
- From the visits: different approaches of technologies and manufacturing Processes;
- Mold material – it seems there is a common sense
- Different levels of solutions: basic (rustic) to advanced
- High variety of products: size, geometry, quantity – a challenger for defining process parameters x productivity
- Next steps:
 - getting some experimental results and
 - searching for cooperation with Universities and Companies

ACKNOWLEDGEMENT

MOVER Program (ROTA2030 – FUNDEP)

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Questions?

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