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Abstract

This document describes some products which potentially used selected technologies to be transferred.

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LIST OF ABBREVIATIONS:

The following abbreviations are used in the document:

DL	Deliverable
P	Product
VBO	Vaccuum Bag Only
SMC	Sheet Molding Compound
PEEK	Poly ether ether ketone
PEI	Poly ether imide
PEKK	Poly ether ketone ketone
PSS	Poly styrene sulfonate

1. INTRODUCTION

The objective of the AEROCAR project is to promote the technological transfer between the Aeronautic and Automotive sectors. The project consortium is composed by four research centres; INEGI from the Norte region of Portugal and Rescoll from Aquitaine in France focused on the Aeronautic sector; CTAG from Galicia and Leartiker from the Basque Country, both located in Spain, focused on the Automotive sector. Therefore, the potential for technology transfer will be analysed and promoted with the industry of these regions. These highly technological sectors have their own well established technologies and procedures that have matured within each sector to meet their specific needs. Portugal will be analysed as a single region, since the regions have very little administrative support in Portugal and both sectors have their activities spread throughout the country.

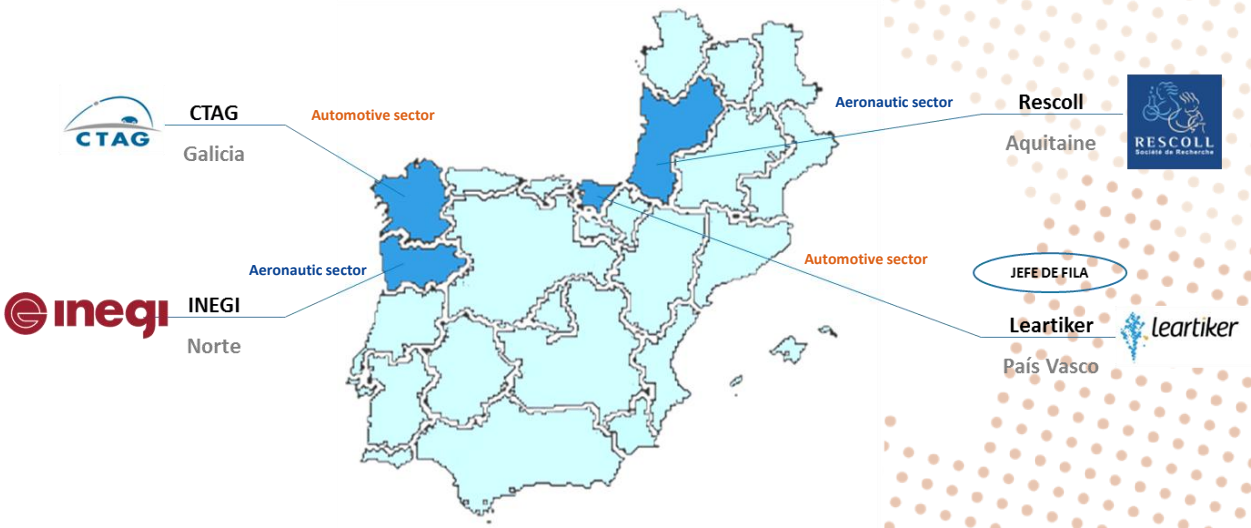

FIGURE 1 – REGIONAL SPECIFIC STUDIES TO BE ADDRESSED THROUGH AEROCAR

Nowadays, with the use of new materials and advanced manufacturing processes, these sectors have to adapt and embrace the new technologies available. To reduce the uncertainty associated with the adoption of every new technology, AEROCAR proposes the transference of technologies with higher maturity levels in the Automotive sector to the Aeronautic sector and vice-versa. The different needs of each sector narrows the set of technologies that may be transferable. Both sectors are of strategic importance in south-west Europe due to their high innovation potential and due to the creation of high added value employment. AEROCAR intends to strengthen the economical capacity of both sectors by improving their technological basis.

The present document corresponds to Deliverable 3.4.1 and Product 3.3 of the AEROCAR project and describes products where technologies selected to be transferred could be used.

2. METHODOLOGY

The adopted methodology to perform this study has three steps as is showed in FIGURE 2.

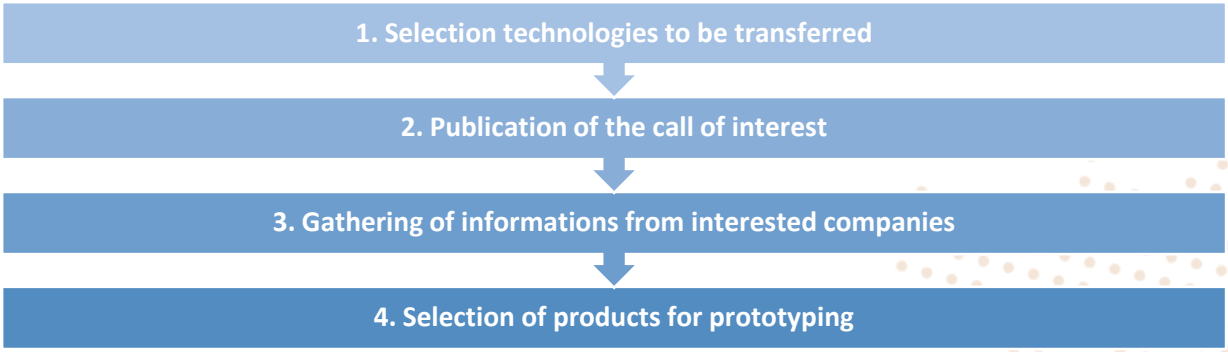

FIGURE 2 – ADOPTED METHODOLOGY

All partners followed the above steps to gather the evaluation of the technologies.

The main objective of this Deliverable 3.4.1 and Product 3.3 is to:

- Highlight several products needed by end-users from both aeronautic and automotive sectors.
- Select four products (two per sector) for proptotyping;

2.1. IDENTIFICATION OF TECHNOLOGIES PRESENTING THE HIGHEST POTENTIAL TO BE TRANSFERRED

Previous deliverable[1] and product[2] have permitted to evaluate technologies and materials used in automotive (or aeronautic) domains considering their potential utilization in the aeronautic (or automotive) domain, respectively. According to the evaluation of these technologies regarding technical criteria used in a specific domain (aeronautic or automotive) as well as their potential to be transferred, it was possible to define a short list of technologies for the further of AEROCAR's project.

[1] DL3.3.1 Selection of technologies and materials with an interest to be transferred
[2] P3.2 Selection of technologies and materials presenting transfer capacities

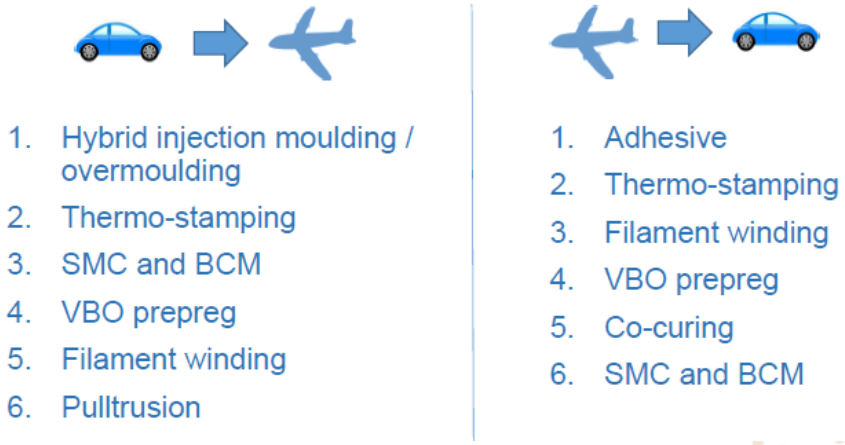

FIGURE 3 – SUMMARY OF THE SELECTED TECHNOLOGIES TO BE TRANSFERRED.

Figure 3 summarized the selected technologies to be transferred. It appears that most of them are dedicated to composite parts manufacturing and to bonding application. It is important to note that adhesive technology cover a wide range of application such as adhesive or functional coating like adhesion promoter coating.

2.2. PUBLICATION OF CALL OF INTEREST

The aim of AEROCAR's project consists to facilitate the transfer of technologies and materials between both aeronautic and automotive sectors. In order to provoke the curiosity of Companies which would be interested to collaborate to the project, a call of interest has been written and largely diffused through the AEROCAR's project's website (www.aerocar-sudoe.com) as well as the website of each partners. Figure 4 reports the call of interest diffused on the different previous mentioned media.

AEROCAR seeks companies interested in participating in the development of new prototypes

- Those who are interested should submit their ideas for the prototype before June 30.

The first two phases of the AEROCAR project come to an end with the publication of the first results of the project. A documentation compiles the studies carried out on technologies and aeronautical and automotive materials. This material is available on the project website www.aerocar-sudoe.com.

COLLABORATORS HUNTING

Currently, the AEROCAR project is finalizing the third phase, which will define the prototypes that will be manufactured during phase 4. During this fourth phase, Leartiker and CTAG will develop two aeronautical prototypes in which automotive materials and technologies will be used. Rescoll and Inegi will manufacture two other automotive prototypes with materials and technologies used in the aeronautical sector. To define these prototypes, the collaboration of different companies that provide real application cases that have an industrial impact for their development is necessary. The technologies that will be most valued when designing the prototypes are: *Hybrid injection moulding / overmoulding, Thermo-stamping, SMC or BMC, VBO prepreg, Filament winding, Adhesive, Filament winding and Co-curing*. They are all processes related to polymeric materials and combinations of these with other materials.

The development potential of both sectors, the degree of innovation / patentability of the submitted idea, the procured profit or advantage through technological transfer, technical / technological and economic viability, and finally, the necessary resources for the development of prototypes will all be assessed.

For this reason, we, in AEROCAR, call for an expression of interest: we are looking for partners who are interested in collaborating on the project. Companies that are interested in participating may contact the following Project Managers before June 30:

LEARTIKER: Aner Retolaza, aretolaza@leartiker.com

CTAG: Denise García, denise.garcia@ctag.com

INEGI: Susana Sousa, sousa@inegi.up.pt

RESCOLL: Thomas Stimpfling, thomas.stimpfling@rescoll.fr

FIGURE 4 – PICTURES OF THE CALL OF INTEREST AVAILABLE ON THE AEROCAR'S PROJECT'S WEBSITE (WWW.AEROCAR-SUDOE.COM)

3. RESULTS FROM CALL OF INTEREST

Unfortunately, the call of interest diffused in the frame of AEROCAR's project received only few answers. Nevertheless, it was possible to highlight different technologies and products for the transfer from one sector to the other. Highlighted technologies and products are presented below:

Technologies	Hybrid injection moulding Thermo-stamping Thermo-forming Injection moulding SMC	Adhesive Functional coating Thermo-stamping VBO prepreg
Application parts	Actuator body Intercostal girder	Suspension system Automotive seats

TABLE 1 – SUMMARY OF HIGHLIGHTED TECHNOLOGIES ACCORDING TO THE RESPONSE FROM CALL OF INTEREST.

The description of the different application parts are presented in the further of this report.

3.1. AIRCRAFT PRODUCTS USING AUTOMOTIVE TECHNOLOGIES

3.1.1. Actuator body for an aeronautic part

Actuators in aircraft play a vital role for flight and control; often their operation ensures the safety of the aircraft and every passenger on board. There are used in landing gear and flaps. Generally, these type of parts are constituted by metallic parts due to their strong mechanical resistance. The interest of aeronautic companies consists to substitute metallic parts, which are prone to corrosion leading to a loss of properties. An additional interest will consist to reach a lightweight structure in order to reduce the fuel consumption. Due to their high mechanical properties, composites materials appears to be the best candidates for such applications, especially when they are manufactured by using injection moulding process. This process is largely used in automotive application and presents several advantages such as significant cost reduction, strong production rate and greater design freedom. Moreover, the final parts present an elevated quality, without the need of post-processing, and thermoplastics are recyclable and the whole process is resource and energy-efficient.

The fact of using high temperature thermoplastic polymers (like PEEK, PEI, PEKK, PSS etc.) reinforced with synthetic fibres (e.g. carbon fibres) as base materials allows to meet the demanding technical requirements requested by the aeronautic sector. The most remarkable properties of these sort of polymers is its low friction coefficient, high resistance to abrasion, high chemical and hydrolysis

resistance, elevated dimensional stability even in high temperature conditions (over 400°C) and during a significant period of time. Showing these properties, they are suitable candidates to replace heavy metal components since they show lower weight even if compared with aluminium or titanium. The lightweight property is an advantage considering the consumption of fuel in aricrafts and the subsequent production of greenhouse gas emissions (GHG) that are pollutant for the environment.

To improve even more the final mechanical performance of the component to be conceived as prototype demonstrator in GT4, it is forecasted to develop inserts to be used as localized reinforcements to reinforce critical areas, reduce thicknesses or avoid the need of a significant number of ribs. For this purpose, an insert from unidirectional fibre tapes configured with a thermoplastic polymer will be manufactured using a new process comprising a compression moulding step, thus promoting a good adhesion and compatibility with the base thermoplastic matrix. This insert will be then over-moulded in an injection moulding machine adapted to work with high temperature polymers, using a combined process of injection-compression moulding (ICM). Through this methodology, the fluid fraction of thermoplastic flows until the nozzle and gets submitted to sequential processes of compression/de-compression, helping to completely and uniformly fill the mould cavity despite the insert, thus reducing residual stresses, deformation, internal material degradation and dimensional instabilities.

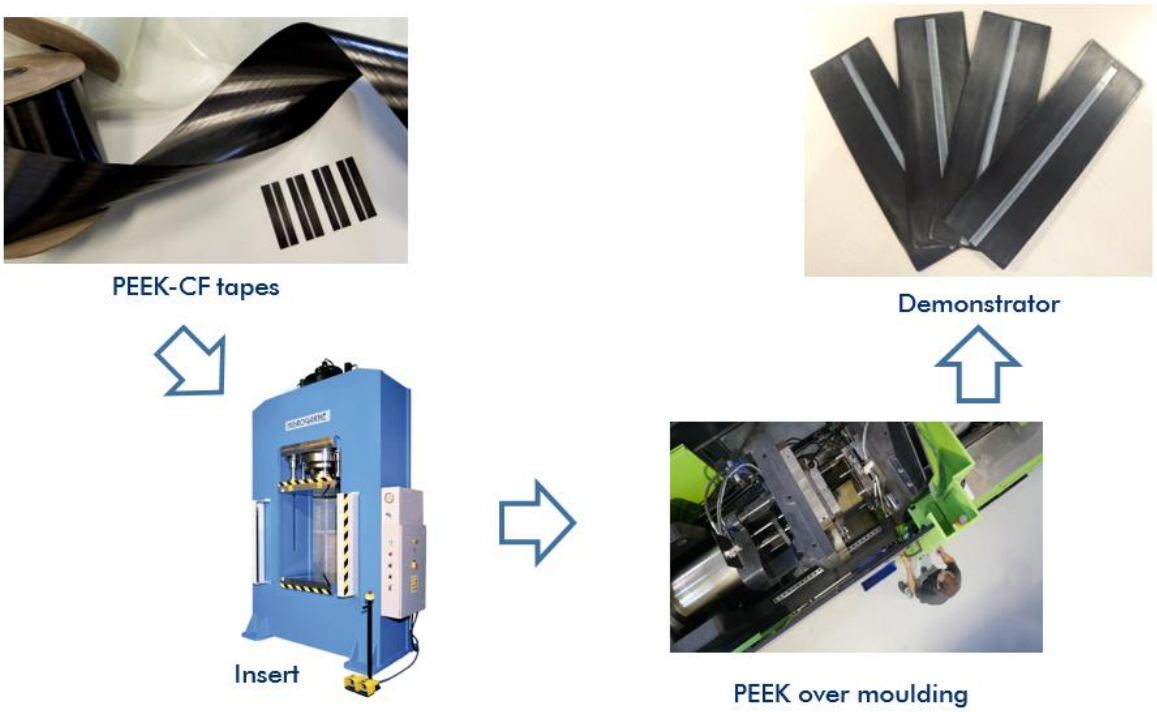

FIGURE 5 – SCHEME OF THE PROCEDSS CONCEIVED FOR THE PILOT EXPERIENCE IN GT4.

3.1.2. INTERCOSTAL GIRDER OF THE NON-PRESSURIZED FUSELAGE OF AIRCRAFT

Intercostal girder is a structural part that presents suitable rigidity to keep the shape of the fuselage and static resistance against ground and flight loads. Such components could be manufactured by thermoforming, over injection moulding, SMC or hybrid technologies that combines them, using different thermoplastic composites reinforced with short, long or continuous glass or carbon fibers. These wide ranges of possibilities to select technologies and materials allows a versatility of manufacturing processes. The feasibility of the final application of the component has been assessed as well. One of the most important manufacturers of aeronautic parts in this field will be involved in the project.

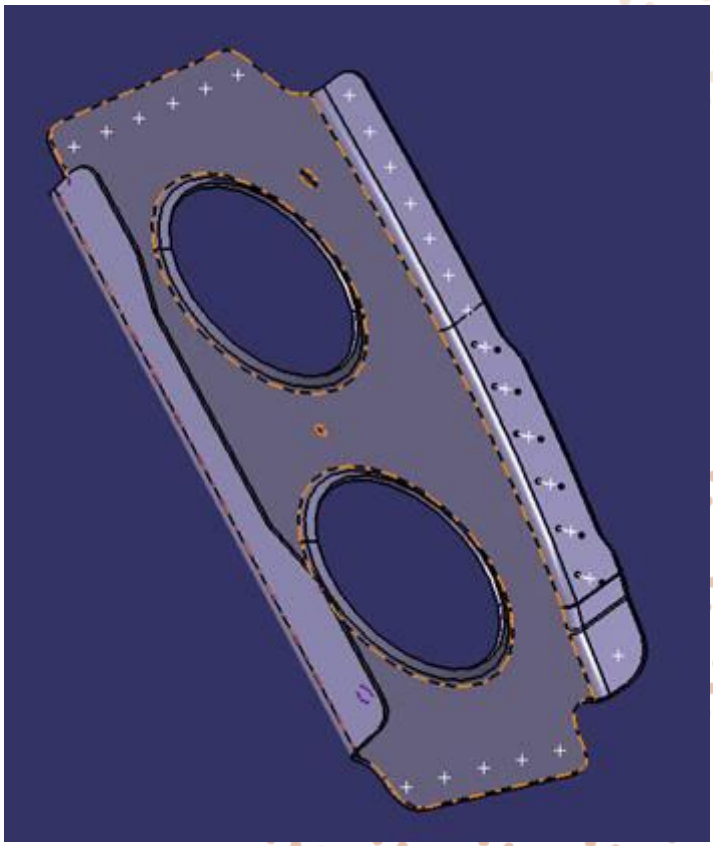

FIGURE 6 – SCHE OF AN INTERCOSTAL GIRDER OF THE NON-PRESSURIZED FUSELAGE OF A COMMERCIAL PASSANGER ARICRAFT.

3.2. AUTOMOTIVE COMPONENTS USING AERONAUTIC TECHNOLOGIES

3.2.1. SUSPENSION SYSTEM FOR AUTOMOTIVE

Different materials such as steel and rubber usually constitute suspension systems used in automotive domain in order to provide mechanical resistance as well as vibration absorption. Nevertheless, in order to reduce the weight of vehicles, metallic parts tends to be replaced by composite materials. For such kind of components, the gain in mass could be between 10 and 60 % according to the type suspension system and thus the fuel consumption could be decrease as well.

FIGURE 7 – EXAMPLES OF SUSPENSION SYSTEM USED IN AUTOMOTIVE APPLICATION.

Elastomer parts are usually bonded to metallic substrate by using covercoat/adhesive process such as described in the Figure 8.

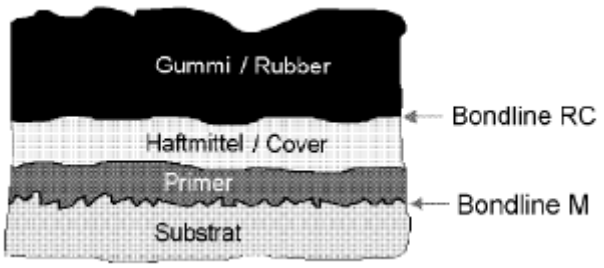

FIGURE 8 – BONDING SYSTEM USED FOR BONDING ASSEMBLY OF RUBBER SYSTEM TO A SUBSTRATE.

As mentioned previously, the replacement of metallic part by composite leads to a lightweight system but it could induced some trouble in term of adhesion. Indeed, composite presents usually a small surface energy inducing a weak of adhesion properties. Aeronautic domain already uses some adhesion

promoter primer in order to improve adhesion properties for composite materials, and especially for Polyamide composite. Such transfer could therefore improve bonding properties in term of adhesion and resistance to fluids.

3.2.2. STRUCTURAL PART OF CAR'S SEAT

Car's seat could be described as the assembly of several structural component such as armrest, backrest with lumbar support, head rest as well as seat base and track. Due to the frequent use of this part and the long life of vehicle, most of car seats are made from inexpensive but durable material in order to withstand prolonged use. Figure 9 represents a picture of an automotive seat frame. Generally speaking, structural part of car seat are constituted by assembling different metallic components thus providing strong durability and high mechanical resistance. Nevertheless, metallic parts are prone to corrosion and have to be protected by using additional post treatment. In parallel, the future trends in automotive tends to produce lightweight vehicle in order to reduce the fuel consumption. Metallic parts could be replaced by composites components presenting lightweight, strong mechanical resistance as well as resistance toward corrosion. Such composite component, using thermoplastic material, could be manufactured by using several technologies and more specially by using thermoforming with over moulding process. Such technology is already used in aeronautic domain to produce composite component presenting above-mentioned properties.

FIGURE 9 – PICTURE OF AN AUTOMOTIVE SEAT FRAME.

4. CONCLUSION

The aim of AEROCAR project consists to transfer technologies / materials used in automotive domains to aeronautic industries and vice versa. After highlighting different technologies presenting the highest capacities to be transferred, a call of interest has been published and diffused through different ways. Unfortunately, only few answers have been gathered by each partners. Take account these responses from interested Companies, four products have been defined in order to transfer technologies from aeronautic to automotive and vise et versa. These products are:

- Actuators bodies in aicrafts,
- Intercostal girder for aircraft,
- Suspension system for automotive,
- Structural part of automotive seat.