SIXTH FRAMEWORK PROGRAMME

Project no. 30848

PreCarBi

Materials, Process and CAE tools developments for Pre-impregnated Carbon Binder yarn preform composites

Instrument: **STREP Specific Targeted Research Project**

Thematic priority **4 – Aeronautics and Space**

Project PreCarBi Deliverable D1.4.2
Report on Dissemination and Exploitation Activities

D1.4.2

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V1

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PU	Public	
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	CO

Report Authorization Status

	Name	Organisation Short Name, Department, Function	Date	Signature	Comments
Authors	Frank Weiland	EUR, EDVLI, project engineer	22.10.2009		based on inputs from all partners
	Florian Dorn	EUR, EDVLI, project engineer	26.10.2009		
Approvals	Christian Weimer	EUR, EDVLI, department manager	28.10.2009		
Authorizations	Wolfram Koletzko	EUR, ETFV, Program Manager R&T	30.10.2009		

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Cover Page and Summary

Main Report = The whole report including cover page and summary with details, but no annexes or appendices

Annexes = All annexed separate documents

Content

Summary

Table 2 in chapter 2 summarizes the dissemination activities which have been undertaken or which are planned. The individual dissemination activities of each partner are summarized in the sub-chapters following this overview table.

Table 3 in chapter 3 gives an overview of the exploitation plans followed by detailed exploitation aspects of each partner in sub-chapters.

1.1 Participant Table

Participant	Organisation short name	Organisation code
1	University of Cranfield	UCR
2	Airbus Germany	ADE
3	Airbus Spain	AES
4	Eurocopter	EUR
5	ESI	ESI
6	FACC	FAC
7	SICOMP	SIC
8	SIGMATEX	SIG
9	TOHO TENAX	TTE
10	University of Latvia	IPM
11	Huntsman	HUN
12	University of Patras	UPA

Table 1: Participants

2 Dissemination Activities

2.1 Overview Table

	(Planned) Dates	Type and Title* of (potential) dissemination activities	Type of Audience**	Countries addressed	Size of audience	Partner potentially involved
1.	Twice a year	Internal company presentation: Regular internal project presentations	Airbus Internal staff	Airbus countries (F, DE, ES and UK)	100-200	2 (ADE)
2.	Every 6 months	Presentation to Material, Design & Manufacturing Engineers	Industry	SP	Ca. 10	3 (AES)
3.	Nov 08	SAMPE/BCS Annual Students' Seminar "Binder coated carbon fibre tow activation techniques"	Research/Industrial	UK	100	1 (UCR)
4.	May 08	Presentation at Cranfield Multi-Strand Conference "A simplified discrete finite element modelling approach for non-crimped fabric composites"	Research/Industrial	UK	100	1 (UCR)
5.	Jun 08	Presentation at ECCM 13 "A simplified discrete finite element model for non-crimp fabric composites"	Research/Industrial	EU	400	1 (UCR) 5 (ESI)
6.	Jun 08	Presentation at ECCM 13 "Investigation of perform manufacturing techniques using novel binder coated carbon fibre tows"	Research/Industrial	EU	400	1 (UCR)

7.	July 09	Presentation at ICCM 17 "Development of high toughness epoxy resins for liquid composite moulding"	Research/Industrial	Global	~1000	1 (UCR) 11 (HUN) 7 (SIC) 5 (ESI)
8.	Dec 09	Journal paper in preparation "Material model parameter identification using the Markov Chain Monte Carlo technique"	Research	Global	~1000	1 (UCR) 5 (ESI)
9.	Dec 09	Journal paper in preparation "Multi objective drape-mechanical performance optimisation"	Research	Global	~1000	1 (UCR) 4 (EUR)
10.	Dec 09	Journal paper in preparation "Modelling the mechanical response of bindered preforms"	Research	Global	~1000	1 (UCR)
11.	Dec 09	Journal paper in preparation "Processing of binder coated carbon fibre tow composites"	Research	Global	~1000	1 (UCR)
12.	Dec 09	Journal paper in preparation "Shear behaviour of binder coated carbon fibre tow preforms"	Research	Global	~1000	1 (UCR)
13.	Dec 09	PhD Thesis "Mechanical Performance of Binder Yarn Composites"	Research	UK	~1000	1 (UCR)
14.	Dec 09	PhD Thesis "Processing and performance of composite reinforcement preforms using binder coated carbon fibre tows"	Research	UK	~1000	1 (UCR)

15.	Jun 10	Presentation at ECCM 14: ""Development of an automated tow placement system for preforming binder coated carbon fibre tows"	Research/Industrial	EU	~400	1 (UCR)
16.	2-5.06.2008	Conference (13th European Conference on Composite Materials)	Research	Worldwide	500	10 (IPM)
17.	Oct-Dec 2009	Research paper	Composite Industry & research	Worldwide	Large	10 (IPM)
18.	7-10 June 2010	Presentation of failure criteria for textile composites at ECCM14	Conference	Hungary	500	7 (SIC)
19.	2010 and following years	Conference, exhibition and publication of Binder Yarn and possible Downstream Products	Industry, General Public	EU, USA, J among others	Wide spread	9 (TTE)
20.	2010 and following years	Conference, exhibition and publication of Process Window, Post-Processing and Mechanical Properties of Binder Yarn	Industry, General Public	EU, USA, J among others	Wide spread	9 (TTE)
21.	April 2009 – December 2009	Conference/Poster	Composite Industry & research	European	Large	1 (UCR) 3 (AES) 4 (EUR) 5 (ESI) 6 (FAC)
22.	April 2009 – December 2009	Publications (1-2)	Composite Industry & research	Worldwide	Large	1 (UCR) 3 (AES) 4 (EUR) 5 (ESI) 6 (FAC)
23.	July 2009	Conference Paper and Presentation: "Manufacture of a Rotor Blade Pitch Horn Using Novel Binder Yarn Fabrics"	Composite Industry & research	Worldwide	Large	4 (EUR) 1 (UCR) 5 (ESI) 12 (UPA)

Table 2: Overview of Dissemination Activities

* Press release (press/radio/TV), Media briefing, Conference, Exhibition, Publications, Project web-site, Posters, Flyers, Direct e-mailing, Film/video

** General public, Higher education, Research, Industry (sector x)

2.2 Major Dissemination Activities ADE:

Internal company presentation: Regular internal presentations of project results to Airbus internal staff twice a year.

Technical paper presentation: No

Hardware exhibition: None

2.3 Major Dissemination Activities AES

Internal company presentation: Presentations to Material, Design & Manufacturing Engineers every 6 months

Technical paper presentation: none

Hardware exhibition: none

Other: Dissemination within relevant Airbus R&T Clusters.

2.4 Major Dissemination Activities UCR

Internal company presentation: none

Technical paper presentation: Journal and conference papers on a variety of topics including stress modelling using the simplified tow based model, optimisation and stochastic modelling, forming modelling and optimisation

Hardware exhibition: none

Other*:* none

2.5 Major Dissemination Activities ESI

Internal company presentation: none

Technical paper presentation: ECCM 13 and ICCM 17

Hardware exhibition: none

Other: PRECARBI activities were advertised in the ESI Group Journal (ESI TALK, Issue n°37)

A specific page was dedicated to PRECARBI project on ESI Group corporate site http://www.esi-group.com/corporate/alliances/projects/precarbi/precarbi/?searchterm=precarbi

2.6 Major Dissemination Activities HUN

Internal company presentation: none

Technical paper presentation: The developments of toughened resins which took place in the frame of PreCarBi were presented at the International Conference on Composite Materials (ICCM17) in Edinburgh. This is one of the most important conferences in the field of composite materials (www.**iccm17**.org).

Hardware exhibition: none

Other: none

2.7 Major Dissemination Activities IPM

Internal company presentation: internal seminars twice per year

Technical paper presentation:

Presentation and conference paper at 13th European Conference on Composite Materials, June 2-5, 2008 Stockholm, Sweden.

Full title of presentation: Vitauts Tamužs, Sergejs Tarasovs, Uldis Vilks and Inese Rumkovska “Development of test methods for adhesion measurements of flexible elastic materials”, 13th European Conference on Composite Materials, June 2-5, 2008 Stockholm, Sweden.

Hardware exhibition: none

Other: none

2.8 Major Dissemination Activities SICOMP

Internal company presentation: none

Technical paper presentation: E. Marklund and L.E. Asp*: "Multiscale methodology for matrix failure prediction in non-crimp fabric composites", ECCM 14.

Hardware exhibition: none

Other: none

2.9 Major Dissemination Activities TTE

Internal company presentation: Quarterly Report within TTE, every 3 months

Technical paper presentation: Technical Symposium for Customer, December 2007: “Binder Yarn Developments”

Hardware exhibition: Technical Symposium for Customer, December 2007

Other: Technical Presentation to selected customers and potential partners, since 2007 and on-going

2.10 Major Dissemination Activities UPA

Internal company presentation: none

Technical paper presentation: Presentations on Conferences on Composite Materials

Hardware exhibition: none

Other: Publications in scientific journals

2.11 Major Dissemination Activities EUR

Internal company presentation:

Regular internal presentations of project results to Eurocopter internal staff once every 2 months.

Technical paper presentation with partners:

F. Weiland, C. Weimer, C. V. Katsiropoulos, S. G. Pantelakis, M. Asareh, D. D. R.Cartié, A. R. Mills, A. A. Skordos, L. Dufort, P. De Luca, A. K. Pickett:

"Manufacture of a Rotor Blade Pitch Horn Using Binder Yarn Fabrics"; ICCM-17 Conference, July 2009

Hardware Exhibition: Internal exhibitions of demonstrators

2.12 Major Dissemination Activities FACC

Internal company presentation:
Internal presentations to board of directors, design and structures

Technical paper presentation:
none

Hardware exhibition: none

Other: none

3 Exploitation Activities

3.1 Overview Table

Exploit-able Know-ledge Nr	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use	Patents or other IPR protect-tion / Confident iality	Owner (partner Nº Name) & Other Partner(s) potentially involved in exploitation
1.	Automated fibre placement of dry fibre/binder yarn	Airplane	After 2010	No/ Confidential	Airbus
2.	Manufacture of highly integrated RTM Fittings	Airplane	After 2010	No/ Confidential	Airbus Operations S.L.
3.	Design of complex RTM tooling	Airplane	After 2010	No/ Confidential	Airbus Operations S.L.
4.	Preform robustness model (PAM-CRASH)	Aerospace	3-5 years	N/A	UCR ESI
5.	Software Code: Multi-objective drape optimisation methodology	Aerospace, Automotive	3-5 years	N/A	UCR ESI
6.	Software Code: Markov Chain Monte Carlo for damage parameter identification	Aerospace	>5 years	N/A	UCR
7.	Software: PAM-QUIKFORM (approximate mapping analysis of binder yarn composites)	Advanced Composites Industry	2010	na	ESI Group
8.	Software: PAM-FORM (accurate FE draping simulation of binder yarn composites)	Advanced Composites Industry	2010	na	ESI Group
9.	Software: PAM-RTM (FE infusion simulation of Binder yarn preforms)	Advanced Composites Industry	2010	na	ESI Group
10.	Software: PAM-Crash – Visual composites: Impact and stress analysis of binder yarn composites	Advanced Composites Industry	2010	na	ESI Group

11.	Toughening of 1-component epoxy resin systems/ Toughened resin systems for high-end applications	Aerospace composites	> 1 year	none	HUN
12.	Failure criteria textile composites	Aircraft structures Aero engines Automotive	4 years	-	SICOMP
13.	Process simulation tool	Aircraft structures Aero engines Automotive	4 years	-	SICOMP
14.	Idea of Binder Yarn	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Patent	TTE
15.	Basic products (carbon fiber, preparation, binder system, etc.) and Production technique (composition and formulation of preparation, preparation application, drying, winding, QM, etc.)	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Confi-dential	TTE
16.	Process Window of Binder Yarn	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Patent	TTE
17.	Properties of Binder Yarn (mechanical, physical, chemical) Properties of Binder Yarn to be analysed	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Patent	TTE
18.	Possible post-production Methods of Binder Yarn	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Patent	TTE
19.	Downstream-Products made of Binder Yarn	All sectors which use carbon fibers today, e.g. aerospace, automotive, industry among others	2010	Patent	TTE
20.	Pitch case in new design	Helicopter / helicopter rotor blades	After 2009	Yes / confident ial	EUR
21.	Pitch case in new manufacturing method	Helicopter / helicopter rotor blades	After 2009	Yes / confident ial	EUR

22.	Draping simulation and optimisation tools	Helicopter	After 2009	n.a.	EUR, ESI, UCR
23.	NCF Material with stitch	Aerospace, Automotive, Infrastructure, Industrial, Marine.	Material technology ready now, but dependent up on fibre commercialisation	NDA / confidentiality agreements	**Sigmatex, TTE (for Aero, FACC,EUR, Airbus Spain)**
24.	NCF Material without stitch	Aerospace, Automotive, Infrastructure, Industrial, Marine.	Process would need 12 months to commercialize, low cost. Dependent up on fibre commercialisation	NDA / confidentiality agreements	**Sigmatex and TTE**
25.	NCF Material without stitch	Aerospace, Automotive, Infrastructure, Industrial, Marine.	Process would need 12 – 24 months to commercialize with high investment. Dependent up on fibre commercialisation	NDA / confidentiality agreements	Sigmatex
26.	Woven material	Aerospace, Automotive, Infrastructure, Industrial, Marine	Material technology ready now, but dependent up on fibre commercialisation	NDA / confidentiality agreements	Sigmatex, TTE (for Aero, EUR, Airbus Spain)
27.	3 D woven profiles / preforms	Aerospace, Automotive.	3D woven profiles are qualified on an aero platform but for new item would take 3 -4 years, but dependent up on fibre commercialisation	NDA / confidentiality agreements	Sigmatex, TTE (for Aero, EUR, Airbus Spain)
28.	Pressure formed preforms	Aerospace, Automotive, Infrastructure, Industrial, Marine	Process would need 2 -3years to commercialize with high investment. Dependent up on fibre commercialisation	NDA / confidentiality agreements	Sigmatex and TTE
29.	Manufacturing of cylindrical duct structures using binder yarn applied sub-preforms	Aerospace	After 2009	NDA / confidentiality agreements	FACC

Table 3: Overview Exploitation Activities

3.2 Exploitable Results ADE

Exploitable knowledge N°1:

Exploitable result:
Automated fiber placement of dry fibre/binder yarns.

Partner(s) potentially involved in the exploitation:
none

Potential exploitation of the results:
Preform manufacturing for complex component geometry

Technical and economic market considerations:
Cost savings due to reduced manufacturing efforts

Potential obstacles which might prove to be barriers to commercialisation:
Binder yarn maturity /material cost

Non-commercial use or impact, relating e.g. to the development of new standards or policies:
No

Further additional research and development work, including need for further collaboration:
Not yet known

Intellectual Property Rights protection measures:
No

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
None

Other potential impact from the exploitation of the result (socio-economic impact):
None

3.3 Exploitable Results AES

Exploitable knowledge Nº2:

Exploitable result:
Manufacture of highly integrated RTM Fittings

Partner(s) potentially involved in the exploitation:
Airbus Operations S.L.

Potential exploitation of the results:
Manufacturing of Fittings for Horizontal Tail plane application

Technical and economic market considerations:
Cost saving due to new lean design and associated reduced manufacturing efforts

Potential obstacles, which might prove to be barriers to commercialisation:
Not yet known

Non-commercial use or impact, relating e.g. to the development of new standards or policies:
None

Further additional research and development work, including need for further collaboration: Not yet known

Intellectual Property Rights protection measures:
None

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
None

Other potential impact from the exploitation of the result (socio-economic impact):
None

Exploitable knowledge Nº 3:

Exploitable result:
Design of complex RTM tooling

Partner(s) potentially involved in the exploitation:
Airbus Operations S.L.

Potential exploitation of the results:
Manufacturing of complex RTM parts

Technical and economic market considerations:
Cost saving due to new lean design and associated reduced manufacturing efforts

Potential obstacles, which might prove to be barriers to commercialisation:
High tooling costs

Non-commercial use or impact, relating e.g. to the development of new standards or policies:
None

Further additional research and development work, including need for further collaboration: None

Intellectual Property Rights protection measures:
None

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
None

Other potential impact from the exploitation of the result (socio-economic impact):
None

3.4 Exploitable Results UCR

Exploitable knowledge N°4:

Exploitable result:
A modelling methodology for the mechanical and damage behaviour was developed based on use of PAM-CRASH.

Partner(s) potentially involved in the exploitation: UCR, ESI

Potential exploitation of the results: The methodology can be implemented as a separate material model within PAM-CRASH.

Technical and economic market considerations: This addresses a potential market need that will become relevant once the use of preforms with binder expands and the potential damage of them during handling, storage and transportation becomes an issue.

Potential obstacles which might prove to be barriers to commercialisation: Limited use of the bindered performs could limit the applicability of the modelling methodology. Also, the extensive experimental campaign required for the characterisation of the materials can hinder the application of the methodology.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: N/A

Further additional research and development work, including need for further collaboration: No additional development work is necessary; implementation requires additional effort on the software engineering side of the work.

Intellectual Property Rights protection measures: Consortium agreement

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
None

Other potential impact from the exploitation of the result (socio-economic impact):
Limitation of scarp materials

Exploitable knowledge N°5:

Exploitable result: A method for the multi-objective optimisation of draping was developed and implemented.

Partner(s) potentially involved in the exploitation: UCR, ESI

Potential exploitation of the results: The method can be implemented as a routine of existing optimisation packages.

Technical and economic market considerations: Application of the methodology will lead to novel process designs for draping than can use fully the design flexibility offered by composite materials.

Potential obstacles which might prove to be barriers to commercialisation: Complexity of the technique can act as a barrier for adoption by designers in the aerospace and automotive industries.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: N/A

Further additional research and development work, including need for further collaboration: No additional development work is necessary; implementation requires additional effort on the software engineering side of the work.

Intellectual Property Rights protection measures: Consortium agreement

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): None

Other potential impact from the exploitation of the result (socio-economic impact): None

Exploitable knowledge N°6:

Exploitable result: A methodology for the automated identification of damage parameters and their stochastic properties using Markov Chain Monte Carlo was developed and implemented.

Partner(s) potentially involved in the exploitation: UCR, ESI

Potential exploitation of the results: The technique developed can be implemented as a software routine in a stochastic simulation package.

Technical and economic market considerations: This development addresses the long term need for robust estimation of stochastic properties of composite materials; this will become more relevant as the use of composite materials expands with their variability becoming a frontline issue.

Potential obstacles which might prove to be barriers to commercialisation: The relevance of the technology depends on the adoption of the concepts of stochastic simulation by the composites community; alternatives to this such as extensive experimental testing and high safety factors are costly but dominant options within the community.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: N/A

Further additional research and development work, including need for further collaboration: No additional development work is necessary; implementation requires additional effort on the software engineering side of the work.

Intellectual Property Rights protection measures: Consortium agreement

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): None

Other potential impact from the exploitation of the result (socio-economic impact): None

3.5 Exploitable Results ESI

Exploitable knowledge N°7-10:

Exploitable result:

The exploitable result are new PAM-QUIKFORM software functionalities,

- Possibility to use a curve to define the draping direction with a constant ply angle,
- Possibility to drape the part with a defined order,
- Possibility to export the flat pattern curve in IGES format
- Validation of new genetic algorithm for fibre optimisation (in collaboration with Eurocopter)

The exploitable result for PAM-RTM software functionalities

- New infusion material data collected for Binder Yarn composites (with partner SICOMP)
- Validation simulation of 3 demonstrator parts (with Airbus, FACC and Eurocopter)

The exploitable result are new PAM-CRASH/Visual composites software functionalities:

- New data on material characterisation – preform analysis (with partners IPM and Cranfield)
- Validated simulation of preform impact (with Cranfield and IPM)

Partner(s) potentially involved in the exploitation: The exploitation will require the active participation of the industrial partners - Airbus Spain, Airbus Germany, Eurocopter and FACC. It is anticipated that these partners will continue to apply the new binder yarn technologies and simulation methods to their future industrial parts. ESI Group and the industrial partners will initiate discussions on the software application following the end of the project.

Potential exploitation of the results: Advanced Composites industry, especially aeronautics; However, it is felt that the materials and methods developed in PreCarBi can be applied to other manufacturing industries and especially the Automotive sector.

Technical and economic market considerations: ESI Group will commercialise these functionalities in Europe. In Germany and Austria these responsibilities will be taken by ESI GmbH.

Potential obstacles which might prove to be barriers to commercialisation: An essential requirement is that Toho Tenax does fully commercialize the new Binder Yarn materials. In the present economic climate that may be difficult, but it is confidently felt that the materials will be exploited and commercially developed in the longer term (estimated 1-4 years).

Non-commercial use or impact, relating e.g. to the development of new standards or policies: The work on preform robustness (WP4 and 5) is new and represents an important new field. It is felt that more work will be needed in this area and that, in the longer term, test standards will need to be developed. The work done here (and published) represents a useful start and contribution to this field.

Further additional research and development work, including need for further collaboration:

- Further work on binder yarns materials characterisation (mechanical properties, infusion properties, draping properties) are required especially for the latest type 4 BY or possibly future generations of the materials.
- Preform robustness: test standards and validated simulation methods

Intellectual Property Rights protection measures: NA

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): EUROCOPTER GmbH (within the project), TENSYL (F)

Other potential impact from the exploitation of the result (socio-economic impact): NA

3.6 Exploitable Results HUN

Exploitable knowledge N°11:

Exploitable result: Toughened resin systems for high-end applications

Partner(s) potentially involved in the exploitation: HUN

Potential exploitation of the results: Qualification and Commercialisation of resin systems

Technical and economic market considerations: In the frame of the PreCarBi meeting 1-component resin systems were developed since this is the state-of-the-art for the aerospace industry nowadays. It seems that there is a big interest to move towards 2-component systems that show advantages of room temperature transportation and storage. Therefore it should be considered to use the formulating routes developed in PreCarBi for 2-component toughened systems

Potential obstacles which might prove to be barriers to commercialisation: the properties (e.g. Compression after impact) of the resin systems should be further improved in order to be appealing enough for the aerospace end-users in order to start a qualification process. A qualification is needed in order to find easily the way to the market.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: The formulating routes developed in PreCarBi can be used in other technologies/products e.g. Adhesives.

Further additional research and development work, including need for further collaboration: The properties (e.g. Compression after impact) of the resin systems should be further improved in order to be appealing enough for the aerospace end-users.

Intellectual Property Rights protection measures: none

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): there were some contacts with aerospace manufacturers.

Other potential impact from the exploitation of the result (socio-economic impact): Toughened epoxy resins can eventually result in better performance composite parts and this as a final result could lead to reductions in weight and energy consumption.

3.7 Exploitable Results SICOMP

Exploitable knowledge N°12 and 13:

Exploitable result: User defined material models and subroutines

Partner(s) potentially involved in the exploitation: ESI

Potential exploitation of the results: Support to industry

Technical and economic market considerations: Not done yet

Potential obstacles which might prove to be barriers to commercialisation: Not known today

Non-commercial use or impact, relating e.g. to the development of new standards or policies: None

Further additional research and development work, including need for further collaboration: Failure criteria and process simulation tool needs further development work. Several project applications/proposals (both EU and domestic) are currently underway.

Intellectual Property Rights protection measures: None

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): None

Other potential impact from the exploitation of the result (socio-economic impact): If successful, the further development work on these models would ensure powerful simulation tools for composite designers.

3.8 Exploitable Results TTE

Exploitable knowledge N°14 to 19:

Exploitable results: See Table 3 on page 22

Partner(s) potentially involved in the exploitation: none

Potential exploitation of the results: See Table 3 on page 22

Technical and economic market considerations: Binder Yarn seems to be an innovative product which may overcome drawbacks of current carbon fiber reinforcements. Therefore, technical and economic potentials are promising.

Potential obstacles which might prove to be barriers to commercialisation:
All Carbon Fiber products need a material qualification from fixed production technology. The current demand of binder yarn is limited to development projects and thus the production yield of a pilot plant is suitable. Any bigger, commercial production site will produce more material than needed today. This being said, binder yarns for material qualification are currently only available from a pilot plant which will probably not meet future demand. Therefore, re-qualifications of industrial plants are likely.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Binder yarn provides a novel approach to composites. The post-processing and possible applications are not established. Therefore, any further results are hard to estimate.

Further additional research and development work, including need for further collaboration:

Since binder yarn promises new properties, such as tackiness upon demand, or robust preforms for post-processing, new testing standards have to be developed for quality management.

Intellectual Property Rights protection measures:

The basic idea of binder yarn based on suitable binder systems has been patented in 2005 (International Patent Number WO 2005/095080 A1). Further patent applications of the products are expected.

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Few selected end-use customers from variant industry sectors and potential partner are contacted to discuss business cases for the commercialisation of binder yarn and

downstream products. The comments are positive, but several details have to be fixed.

Other potential impact from the exploitation of the result (socio-economic impact):

Binder yarn and related technologies will strengthen the European production and development sites of Toho Tenax Group. Some new colleagues are employed, as well as new production techniques are installed.

3.9 Exploitable Results EUR

Exploitable knowledge N°20:

Exploitable result: Pitch case in new design

Partner(s) potentially involved in the exploitation: EUR

Potential exploitation of the results:

New design enables the application of (semi-) automated manufacturing technologies which may lead to substantial cost savings in production.

Technical and economic market considerations:

Cost savings by new design and related techniques

Potential obstacles which might prove to be barriers to commercialisation:

Load tests required for the qualification of the design have to be undertaken in order to validate the calculated stiffness and strength of the part.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: None

Further additional research and development work, including need for further collaboration: See "potential obstacles"

Intellectual Property Rights protection measures:

Patent for pitch lever attachment concept (design) is granted, further patents are planned

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Only internal exploitation is planned.

Other potential impact from the exploitation of the result (socio-economic impact):

None

Exploitable knowledge N°21:

Exploitable result: Pitch case in new manufacturing method

Partner(s) potentially involved in the exploitation: EUR

Potential exploitation of the results:
Application of (semi-) automated preforming technologies in production.

Technical and economic market considerations:
Cost savings by new manufacturing method and related techniques

Potential obstacles which might prove to be barriers to commercialisation:
Process robustness in serial production environment has to be proved.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: None

Further additional research and development work, including need for further collaboration: Not yet known

Intellectual Property Rights protection measures: Patent for pitch lever attachment concept (manufacturing method) is granted, further patents are planned

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
Only internal exploitation is planned.

Other potential impact from the exploitation of the result (socio-economic impact):
None

Exploitable knowledge N°22:

Exploitable result: Draping simulation and optimisation tools

Partner(s) potentially involved in the exploitation: ESI, UCR

Potential exploitation of the results:
Implementation of novel tools/functionalities for optimization of the draping strategies.
Improvement of Manufacturing Engineering

Technical and economic market considerations:

Reduction of lead time ("first-time-right") and enhancement of part performance through reduced maximum shear angles and respect of design constraints.

Potential obstacles which might prove to be barriers to commercialisation:
Mismatch between calculated values by simulation and measured values on the real part.

Other reinforcement materials (like non-crimped Fabric) are not taken yet into account.

Non-commercial use or impact, relating e.g. to the development of new standards or policies: None

Further additional research and development work, including need for further collaboration: Validation work has to be continued. Draping technologies have to be developed to put calculated draping strategies into effect. Draping behaviour of other reinforcement materials have to be implemented.

Intellectual Property Rights protection measures: n.a.

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
Commercial contacts with ESI have been established.

Other potential impact from the exploitation of the result (socio-economic impact):

None

3.10 Exploitable Results SIG

Exploitable knowledge N°23:

Manufacture of Multi-axial (NCF) materials with stitch

Exploitable result:

Knowledge gained to manufacture, in a commercial manor NCF materials from binder impregnated carbon using stitch media, having identified processing parameters required to produce material acceptable to meet Aerospace specifications such as AIMS 05 06 000 part 1.

Partner(s) potentially involved in the exploitation:

TTE, FACC, EUR, Airbus Spain.

Potential exploitation of the results:

To get material qualified on an aerospace part utilizing its pre forming capabilities to reduce costs, Materials could be exploited in other markets, such as automotive, marine or industrial applications.

Technical and economic market considerations:

The fabric conversion method is technically mature, the fibre needs to be fully commercialized and production ready, also it needs to offer a benefit to the end users to give the incentive for it to be developed.

Potential obstacles which might prove to be barriers to commercialisation:

Production readiness of the binder fiber, alternative technologies (powder coating) offer more benefits at a lower cost.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:

Commercialization of the fibre

Intellectual Property Rights protection measures:

None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Demonstrators exhibited in Sigmatex show room were the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Other potential impact from the exploitation of the result (socio-economic impact):

Exploitable knowledge N°24:

Manufacture of Multi-axial (NCF) materials without stitch produced off line

Exploitable result:

Knowledge gained to manufacture, in a NCF materials from binder impregnated carbon using stitch media, then activating the binder yarn off line, followed by removal of the stitch yarn, having identified processing parameters required to produce material acceptable to meet Aerospace specifications such as AIMS 05 06 000 part 1.

Partner(s) potentially involved in the exploitation:

TTE, FACC, EUR, Airbus Spain.

Potential exploitation of the results:

To get material qualified on an aerospace part utilizing its pre forming capabilities to reduce costs, Materials could be exploited in other markets, such as automotive, marine or industrial applications.

Technical and economic market considerations:

The fabric conversion method is technically mature, the process to activate the fabric is available and can be subcontracted, and the auto method to remove the pillar stitch would need development. The fibre needs to be fully commercialized and production ready, also it needs to offer a benefit to the end users to give the incentive for it to be developed.

Potential obstacles which might prove to be barriers to commercialisation:

Production readiness of the binder fiber, alternative technologies (powder coating) offer more benefits at a lower cost. Would the stitchless material drape, handle satisfactorily in up line processes, with out excess fiber distortion.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:

Commercialization of the fibre, development of de-stitch process, development of the process to make performs from stitchless NCF.

Intellectual Property Rights protection measures:

None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Demonstrators exhibited in Sigmatex show room were the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Other potential impact from the exploitation of the result (socio-economic impact):

None

Exploitable knowledge N°25:

Manufacture of Multi-axial (NCF) materials without stitch produced on line

Exploitable result:

Knowledge gained to manufacture, in a NCF materials from binder impregnated carbon without using stitch media, activating the binder yarn on line, having identified processing parameters required to produce material acceptable to meet Aerospace specifications such as AIMS 05 06 000 part 1.

Partner(s) potentially involved in the exploitation:

TTE, FACC, EUR, Airbus Spain.

Potential exploitation of the results:

To get material qualified on an aerospace part utilizing its pre forming capabilities to reduce costs, Materials could be exploited in other markets, such as automotive, marine or industrial applications.

Technical and economic market considerations:

The fabric conversion method is technically possible, the process to activate the fabric would need to be finalized and sourced, installed on the NCF machine requiring sizable capital expenditure .The fibre needs to be fully commercialized and production ready, also it needs to offer a benefit to the end users to give the incentive for it to be developed.

Potential obstacles which might prove to be barriers to commercialisation:

Production readiness of the binder fiber, capital expenditure required and pay back, development of on line method, alternative technologies (powder coating) offer more benefits at a lower cost. Would the stitchless material drape, handle satisfactorily in up line processes, with out excess fiber distortion.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:

Commercialization of the fibre, development of online activation method, development of the process to make performs from stitchless NCF.

Intellectual Property Rights protection measures:

None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Demonstrators exhibited in Sigmatex show room where the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Other potential impact from the exploitation of the result (socio-economic impact):
None

Exploitable knowledge Nº: 26

Manufacture of woven materials using 100% binder or blends of.

Exploitable result:
Knowledge gained to manufacture, in a commercial manor woven materials from binder impregnated carbon, having identified processing parameters required to produce material acceptable to meet appropriate Aerospace specifications.

Partner(s) potentially involved in the exploitation:
TTE, FACC, EUR, Airbus Spain.

Potential exploitation of the results:
To get material qualified on an aerospace part utilizing its pre forming capabilities to reduce costs, Materials could be exploited in other markets, such as automotive, marine or industrial applications.

Technical and economic market considerations:
The fabric conversion method is technically mature, the fibre needs to be fully commercialized and production ready, also it needs to offer a benefit to the end users to give the incentive for it to be developed.

Potential obstacles which might prove to be barriers to commercialisation:
Production readiness of the binder fiber, alternative technologies (powder coating) offer more benefits at a lower cost.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:
Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:
Commercialization of the fibre

Intellectual Property Rights protection measures:
None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Demonstrators exhibited in Sigmatex show room were the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Other potential impact from the exploitation of the result (socio-economic impact):

None

Exploitable knowledge N°27:

3 D woven performs using binder yarn

Exploitable result:

During the project it became apparent that the binder yarn incorporated into a woven 3 D shape greatly helped the performing, hence infusion process.

Partner(s) potentially involved in the exploitation:

TTE, FACC, EUR, Airbus Spain. Airbus Germany

Potential exploitation of the results:

To get material qualified on an aerospace part utilizing its pre forming capabilities to reduce costs, Materials could be exploited in other markets, such as automotive, marine or industrial applications.

Technical and economic market considerations:

3 D woven structures are in their infancy as a perform solution with a lot of further work required to understand the intricacies of the structures and their failure modes , the fibre needs to be fully commercialized and production ready, for this technology there are no competing binder systems.

Potential obstacles which might prove to be barriers to commercialisation:

Production readiness of the binder fiber and 3D woven structures.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:

Commercialization of the fibre, understanding 3D woven structures.

Intellectual Property Rights protection measures:

None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):

Demonstrators exhibited in Sigmatex show room were the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Exploitable knowledge N°28:

Preforms from laminated layers of binder material buy vacuum pressure

Exploitable result:

During the project with TTE work was done looking at the possibility of high volume performing using vacuum pressure molding, could be developed to be done by stamping presses. Taking layers of binder fabrics and laminating through a laminating machine, cutting then pressing.

Partner(s) potentially involved in the exploitation:

TTE, FACC,

Potential exploitation of the results:

Method would lend it self to high volume automotive, industrial components. Possibly interior aircraft components.

Technical and economic market considerations:

Readiness of the forming process plus fibre, carbon fibre price v weight saving

Potential obstacles which might prove to be barriers to commercialisation:

Production readiness of the binder fiber and development of forming process to get acceptable tack times.

Non-commercial use or impact, relating e.g. to the development of new standards or policies:

Could potentially reduce impact on the environment by helping cut waste (material, transport, power) in the manufacture of the components.

Further additional research and development work, including need for further collaboration:

Commercialization of the fibre, understanding of forming process.

Intellectual Property Rights protection measures:

None disclosure agreements

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.):
Demonstrators exhibited in Sigmatex show room were the technology is promoted to potential customers, composite parts manufactures servicing a variety of industries.

Other potential impact from the exploitation of the result (socio-economic impact
None

3.11 Exploitable Result FACC

Exploitable knowledge N°29:

Exploitable result: Manufacturing of cylindrical duct structures using binder yarn applied sub-preforms.

Partner(s) potentially involved in the exploitation: FACC AG

Potential exploitation of the results: Manufacturing of sub-preforms

Technical and economic market considerations: Time and cost savings by an accelerated lay-up process by using BY containing sub-preforms.

Potential obstacles which might prove to be barriers to commercialisation: Availability and price of BY

Non-commercial use or impact, relating e.g. to the development of new standards or policies: none

Further additional research and development work, including need for further collaboration: not yet defined

Intellectual Property Rights protection measures: none

Commercial contacts already taken, demonstrations given to potential licensees and/or investors and any comments received (market requirements, potential etc.): none

Other potential impact from the exploitation of the result (socio-economic impact): none