

# **Composites Technology Roadmapping**

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# EXECUTIVE SUMMARY

# Executive Summary

- Following on from the recommendations of the 'UK Composites 2013' report, Market Pull and Technology Push roadmapping were performed across the UK composites sector. The results of these were combined and analysed and recommendations made for Technology, Infrastructure, Supply Chain, Skills and Standards development and the suggested routes for support of this.
- The Technology Push roadmapping identified 212 research projects worth £316m with composite content, of which £257m was funding, from 12 different sources.
- The Market Pull roadmapping identified that UK future manufacturing capability development needed to focus on five areas:

	Volume production	Size of part	Performance level	Example applications	Design requirements	Example processes	Automation	Development required
<b>High Performance Structures</b>	Low	Large	High performance	Aerospace wing, motorsport tub	Design for performance and optimum use of composites (not black metal)	AFP, ATL, prepreg, OOA, Joining	Process automation for quality	Retain world leading status.
<b>Large structures</b>	Low	Large	Structural	Custom bridges, work boats, subsea protection	Design for performance, design for dis/assembly	LRI, Pultrusion, joining	No	Develop current capability.
<b>Mid volume structures</b>	Mid	Mid	Structural	Car, bus, modular bridges, cabin	Design for manufacture & performance	Pultrusion, LRI, filament winding	Semi-automated.	Introduce capability.
<b>High vol, non-structural</b>	High	Small	Non-structural	Car components, aero and rail interiors	Design for manufacture	RTM, stamping thermoplastics,	Full automation.	Develop current basic capability.
<b>High vol, high performance</b>	High	Small	Structural	Aero engine blades	Design for performance, design for manufacture	AFP	Full automation.	Develop current capability.

# Executive Summary

- The series of support mechanisms outlined below were recommended to support manufacturing development.

Theme	Type of Support		2014	2015	2016	2017	2018	2019	Funding
High Performance Structures	Demonstrator	Manufacturing		AFP, ATL, prepreg, OOA, Automated equipment, Automation systems, CFRP.					ATI, LSP
		Design		Design for performance and optimum use of composites (not black metal).					
		Technology		Joining, Process simulation, Manufacturing simulation.					
Large Structures	Infrastructure		Create facility for large scale prototype/demonstrator development & testing.						BIS, LEP
	Demonstrator/s	Manufacturing			LRI, Pultrusion.				EIT, LSP,
		Design			Design for performance, Design for dis/assembly, Design codes.				TSB
Technology				Joining, SHM, Fire, Large structure assembly, Large structure testing.					
Mid Volume Structures	Feasibility studies			Design/ material/ process suitability.					TSB
	Collaborative R&D	Manufacturing			Pultrusion, LRI, Filament winding, Automated equipment, Automation systems.				TSB, EIT, AMSCI
		Design			Design for manufacture & performance.				
Technology				Joining, Technology transfer, Process simulation, Manufacturing simulation.					
High Volume, Non-structural	Grand Challenge	Manufacturing		RTM, thermoplastics, stamping, Automated equipment, Automation systems.					TSB
		Design		Design for manufacture.					
		Technology		Process simulation, Manufacturing simulation, Textiles.					
	Funding.	Rapid funding	Facilitate quick development of prototypes to access market opportunities.						TSB, LSP,
High Volume, High Performance	Ongoing R&D		AFP, Automated equipment, Automation systems, CFRP.						ATI

# Executive Summary

- Comparison of the Technology Push and Market Pull work identified the following technology development requirements:

	Materials/Chemistry	Design/Modelling	Manufacturing	Testing/Properties	Environmental	Smart/ Functional
Increase level of funding for cross-sector benefit	Textiles	Design for dis/assembly	Demonstrators	Data generation	Recycling - in process	SHM
		Design for manufacture	Large structure assembly	Standards	Energy efficiency	
		Performance driven design	Repair	Large structure testing	Water efficiency	
		Process simulation	Automated equipment	NDT		
		Design	Automated systems			
		Design codes	Niche manufacturing			
		Modular design	Tooling			
		Manufacturing simulation				
	Product simulation					
Maintain level of funding for cross-sector benefit	Resin development	Modelling	Joining	Mechanical properties	Recycling - end of life	Smart
	Thermoplastics	Cost modelling	Manufacturing	Fire	Environmental	
	CMC	Legislation/regulations	Cost reduction	Through thickness properties	LCA	
	Fibre development	Software	AFP	Durability	Biofibres	
	MMC	Risk management		Long term testing	Bioresin	
	Nano			Creep		
				Electrical conductivity/ lightning		
				Environmental testing		
			High temperature			
			Optimisation			
Sector Specific Need	Carbon fibre (auto)		High volume manufacturing (auto)		Update Green Guide to Composites	
			RTM (auto)			
			Stamping (auto)			

# Executive Summary

This allowed cross cutting technology requirements to be laid over the manufacturing support required.

Theme	Materials	Design	Manufacture	Testing	Through-Life	Environment	Smart
High Performance Structures	Textiles (e.g. for automation & properties).  Resin development (e.g. cycle time, temp and fire).  Fibre development (reduce cost carbon).  Thermoplastics  SMC & MMC.  Apply nano.	Design for manufacture, assembly, manufacture, performance, modularisation  Design codes.  Process, manufacturing and product simulation.  Cost and risk modelling.	Large scale demonstrators including automation and assembly.  Joining.  Niche manufacture for quality and large scale one-offs.  High volume manufacture.  Tooling.	Materials/ properties database.  Optimise for sector requirements  Large scale testing.  Standards development  Fire.  High temperature.	Repair.  Through life properties (durability, creep, environment etc.)  Damage monitoring (NDT, SHM).	Use of LCA.  Continue end of life recycling.  Increase in process for cost reduction and environment.  Biofibre and bioresin.  Green Guide.	Smart structures.  Application of nano.  Integration of SHM.
Large Structures							
Mid Volume Structures							
High Volume, Non-structural							
High Volume, High Performance							

# Executive Summary

Identification of the technology requirement allowed addition of two projects to the manufacturing support already identified. The other technologies identified should be supported within the manufacturing projects established, but where this does not happen, R&D collaborative calls should be created in those technologies.

Theme	Type of Support	2014	2015	2016	2017	2018	2019	Funding
High Performance Structures	Demonstrator							
Large Structures	Infrastructure							
	Demonstrator/s							
Mid Volume Structures	Feasibility studies							
	Collaborative R&D							
High Volume, Non-structural	Grand Challenge							
	Funding.							
High Volume, High Performance	Ongoing R&D							
<b>Data Generation</b>	<b>Funding</b>	Provision and upkeep of a database of material and mechanical properties.						
<b>Materials development</b>	<b>Infrastructure</b>	Facilities for resin formulation and fibre development.						