

# **Composites Technology Roadmapping**

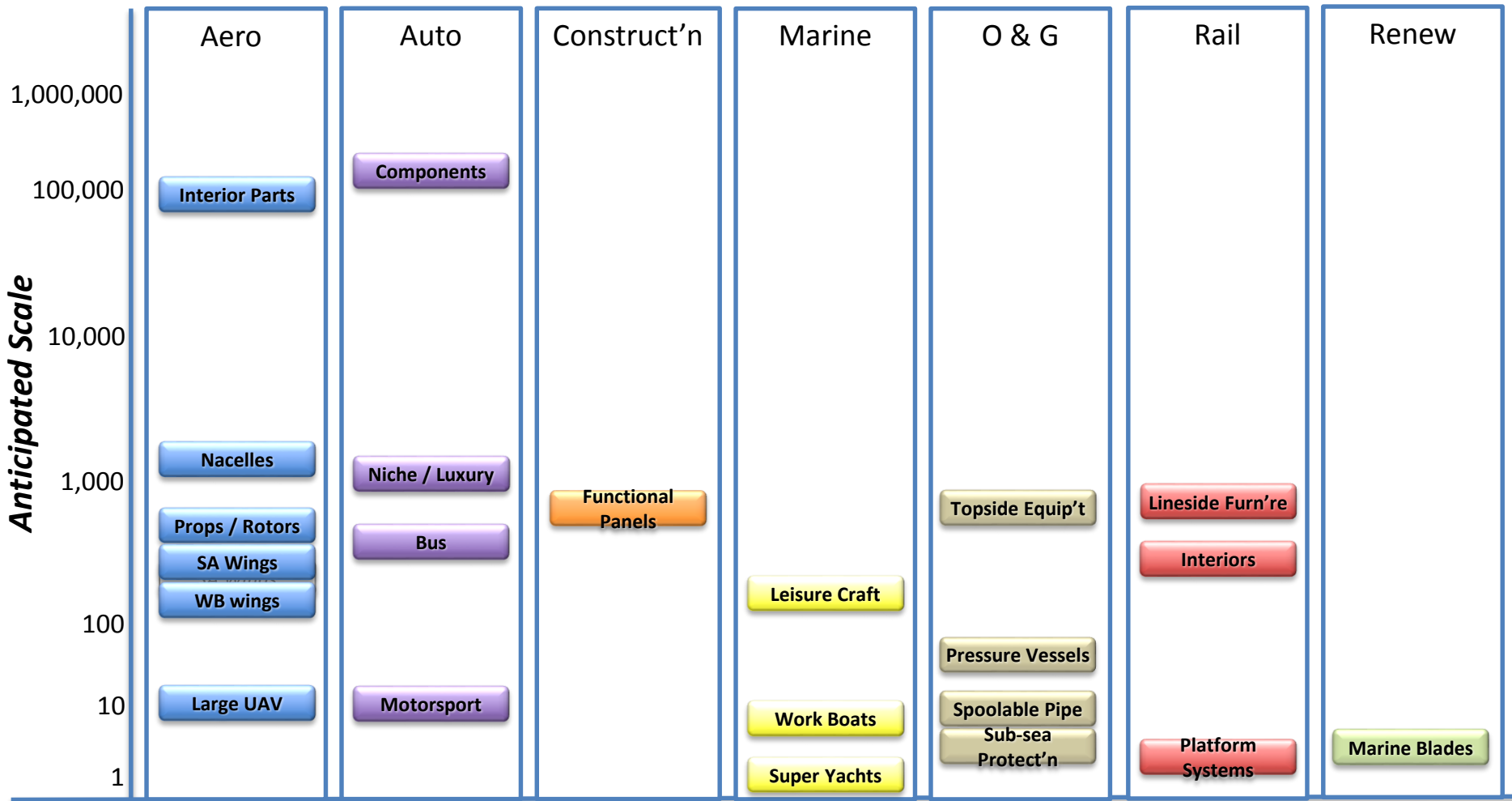
**Executive Summary of a Report to CLF Technology  
Working Group 2014**

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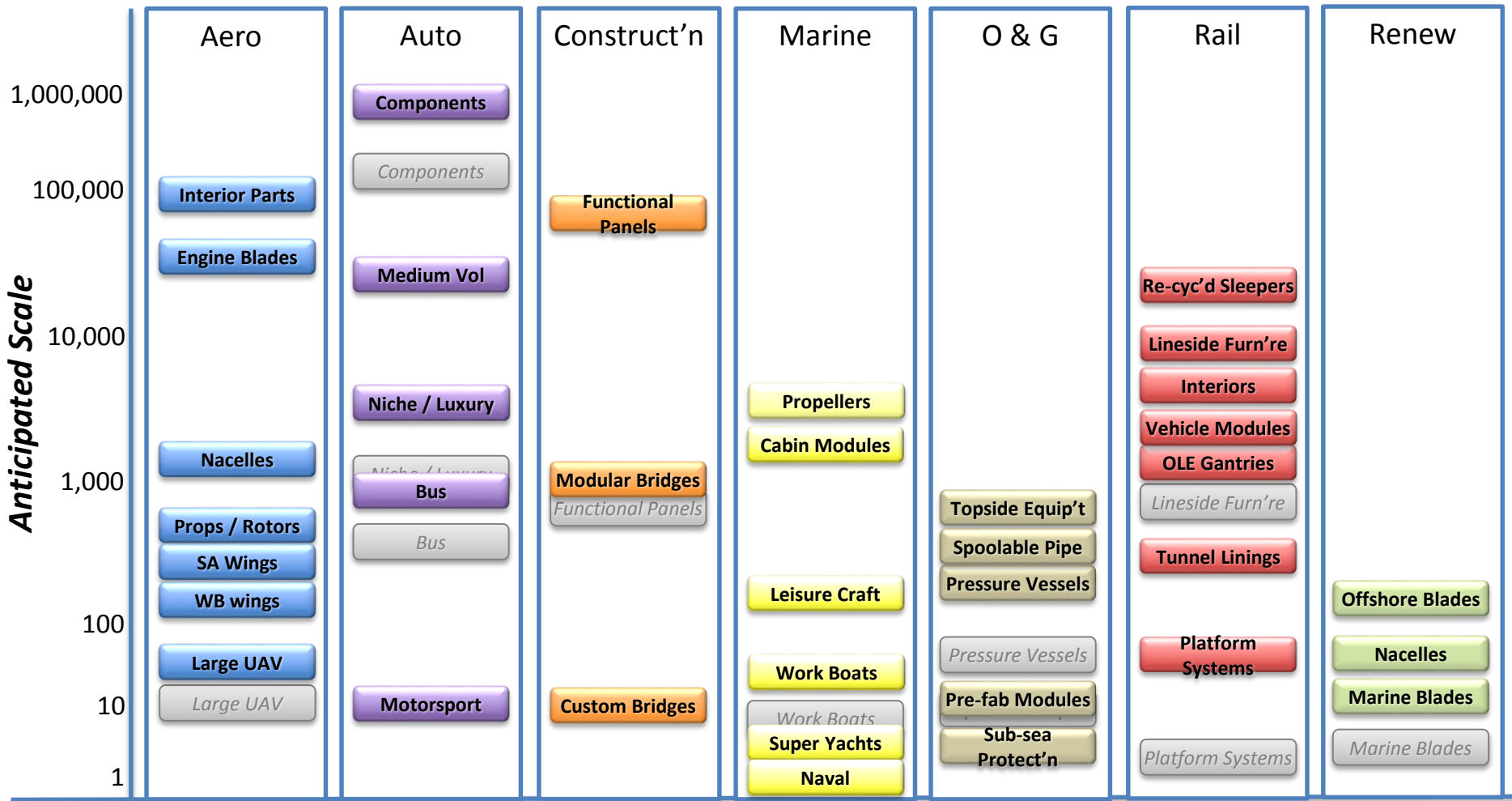
# Executive Summary

- 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 publically funded projects with composite content, worth £316m, of which £257m was funding, from 12 different sources.
- The Market Pull roadmapping identified that UK future manufacturing capability development required. The following two slides show examples of the requirements per sector and application by volume of parts firstly for current UK capability and then in the second slide for where the UK would like to be in 2025. The third slide splits these into groups requiring similar volumes and performance levels produces allowing the cross-sector manufacturing development required to be identified.

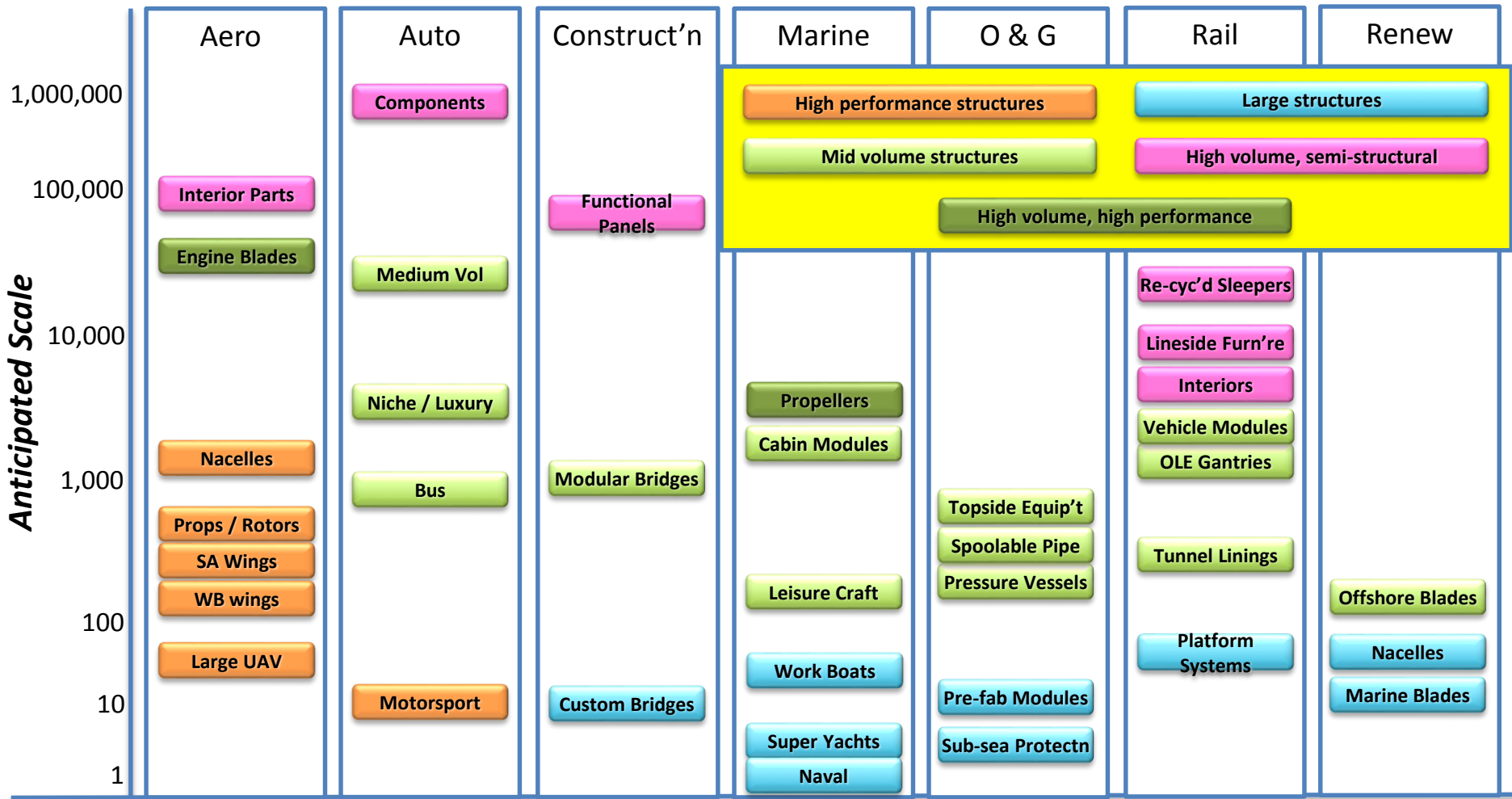
# Technology - Part volumes requirement – 2014



# Technology - Part forecast requirement – 2025



# Technology - UK 2025 – product categories



# Technology - Cross Sector Manufacturing Development

This gives five types of manufacturing capability that the UK should focus on:

	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.	Develop current basic capability.
<b>High volume, semi-structural</b>	High	Small	Semi-structural	Car components, aero and rail interiors	Design for manufacture	RTM, thermoplastics, stamping	Full automation	Develop current basic capability.
<b>High volume, high performance</b>	High	Small	Structural	Aero engine blades, marine propellers	Design for performance, design for manufacture		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, Tooling.				EIT, LSP, TSB
		Design			Design for performance, Design for dis/assembly, Design codes.				
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, RTM, Automated equipment, Automation systems.				TSB, EIT, AMSCI
		Design			Design for manufacture & performance.				
Technology				Joining, Technology transfer, Process simulation, Manufacturing simulation.					
High Volume, Semi-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:

Increase level of funding for cross-sector benefit	Materials/Chemistry	Design/Modelling	Manufacturing	Testing/Properties	Environmental	Smart/Functional
	3D reinforcements	Design for dis/assembly	Demonstrators	Data generation	Recycling - in process	Morphing
	Fibre development	Design for manufacture	Large structure assembly	Electrical conductivity/ lightning	Energy efficiency	SHM
	Coatings	Performance driven design	Repair	Fire		
	Resin development	Process simulation	Automated equipment	Large structure testing		
	Thermoplastics	Design	Automated systems	Long term testing		
		Modular design	Niche manufacturing	NDT		
		Manufacturing simulation	Tooling	SHM		
		Cost modelling	Coatings	Standards		
			Joining	Through thickness properties		
		Resin development				
Maintain funding	CMC	Product simulation	Cost reduction	Mechanical properties	Recycling - end of life	Smart
	Textiles	LCA	Manufacturing	Environmental testing	Environmental	
		Design codes		Durability	LCA	
		Software				
Sector Specific Need	Carbon fibre (auto)		High volume manufacturing (auto)		Update Green Guide to Composites	
	Link nano and biocomposite research to industry.		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 & 3D).  Resin development (e.g. cycle time, temp and fire).  Fibre development (reduce cost carbon).  Thermoplastics  Coatings  Apply nano.	Design for manufacture, assembly, manufacture, performance, modularisation  Design codes.  Process, manufacturing and product simulation.  Cost modelling.  LCA	Niche manufacture  Large scale demonstrators.  High volume manufacture.  Automation and assembly.  Joining.  Repair.  Cost reduction.  Tooling.  Coatings.	Materials/ properties database.  Optimise for sector requirements  Large scale testing.  Standards development  Fire.  High temperature.  Electrical conductivity.	Repair.  Through life properties (durability, environment etc.)  Damage monitoring (NDT, SHM).	Use of LCA.  Continue end of life recycling.  Increase in process recycling.  Green Guide.	Smart structures.  Morphing.  Integration of SHM.
Large Structures							
Mid Volume Structures							
High Volume, Semi-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, Semi-structural	Grand Challenge							
	Funding.							
High Volume, High Performance	Ongoing R&D							
Data Generation	Funding	Provision and upkeep of a database of material and mechanical properties.						
Materials development	Infrastructure	Facilities for resin formulation and fibre development.						

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The Market Pull roadmapping also identified requirements in other areas, which have been passed to relevant working groups:

	Common Requirements	Sector Specific Requirements
<b>Infrastructure</b>	Demonstrator production facilities, with access to process and manufacturing equipment.	
	Testing facilities – particularly large scale, live and fire.	
	Database of materials and mechanical properties.	
	Equipment to develop new fibres and resins.	
<b>Funding</b>	Feasibility studies for materials or process applicability.	Continued support for composites research from ATI (aero) and EIT (rail).
	Support to grow SMEs.	
	Manufacturing technology transfer across sectors.	A Grand Challenge would rapidly boost UK capability in high volume composite production techniques (auto).
	Funding of large structure demonstrators.	
	Funding of high volume manufacturing capability development.	
Processes to deliver rapid funding.		
<b>Standards</b>	Revision of standards and creation of design codes and guidelines to support entrance into new sectors.	
	Particular work needed on fire standards.	
	Development of life cycle and prediction models and standards.	
<b>Supply Chain</b>	SME support to grow to take advantage of market opportunities.	
	Need to understand international competition.	
	Elasticity – the supply chain needs to grow with opportunities.	
	Gaps:	
	Production of large components.	
	Design and product/process simulation for new sectors.	
	Provision of small volumes of material	
	Carbon fibre	
UK based pipe manufacture.		
Further study is required to identify and fill gaps.		
<b>Skills</b>	Skills shortage at all levels.	
	Lack of basic awareness of composites in most companies which is preventing specification of composites.	
	Specific requirement for; repair, design.	