



Northwest Automotive Innovation Strategy

2009

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Executive Summary

The innovation strategy presented is aimed at the automotive cluster and identifies a number of themes and actions that will complement strengthen and intensify the existing regional innovation activities.

The North West automotive sector has been at the forefront of incremental process innovation. Many of the larger companies in the North West are recognised as best practice examples of Lean Manufacturing and this type of incremental process innovation as a result of interventions arising from the recommendations of the original Automotive Innovation Growth Team (AIGT) has been delivered by the NAA and widely taken up by the automotive suppliers.

The AIGT also played a part in the development of a government sponsored Foresight Vehicle Programme. This programme led to the development of a Technology Road Map in 2004 which identified the technical priorities for technologies in five thematic areas including Engine and Power Train, Hybrid Electric and Alternatively Powered Vehicles, Advanced Sensors, Software and Telematics, Advanced structures and Materials and Design and Manufacturing processes.

Collaborative research and development projects addressing these themes have been undertaken. Funding for this programme ended in 2006 and the Technology Strategy Board (TSB) formed around the same time is now delivering government funded collaborative research, technology and development programmes aimed at key industry sectors.

Climate change and reduction of greenhouse gas emissions have become major drivers for product and process innovation. As a result innovation systems for low carbon technologies are receiving a higher degree of intervention from government sources than other technologies. Such intervention takes the form of technology push or in market pull or both. For example, Low Carbon Vehicle (LCV) is a key innovation platform within the TSB programme and programmes in this area are facilitating the development of new low carbon technologies, products and systems which have the potential to disrupt the traditional vehicle supply chains (Technology Push). The Department of Transport through its Low Carbon Vehicle Procurement programme is aiming to accelerate the market entry of innovative low carbon products (Market Pull). These programmes are encouraging more radical product and process innovations

The Innovation Strategy presented therefore recognises that in addition to continuing activities aimed at incremental innovation, support for radical innovation is also required.

However in this difficult and tense economic situation there is an understandable reluctance for vehicle manufacturers to invest in new product and process innovation. Intervention support by government, government agencies and regional stakeholders is therefore needed to ensure that the North West automotive sector remains competitive when the market returns to normality.

The Innovation Strategy is structured around seven underpinning strategic themes. For each theme a number of proposed actions to support their delivery are proposed. Consideration has been given to:

- The global trends and drivers affecting the automotive industry,
- Relevant Foresight Vehicle Technologies specifically those aligned with the Low Carbon Vehicle agenda
- The present situation in the cluster relating to practices and activities known to encourage and support innovation.

Extensive consultation has taken place with key stakeholders including automotive companies, Higher Education Institutes, North West Development Agency staff and other cluster organisations within the region. The strategy has taken cognisance of developments in CENEX, the Centre of Excellence for Low Carbon and Fuel Cell Technologies and related developments in Low Carbon Vehicles sponsored by the Department for Transport and the Technology Strategy Board. Supporting research from a number of sources including the Innovation White Paper¹, Regional Innovation Strategy, the initial findings from the new Automotive Innovation

¹ Innovation Nation, published March 2008

Growth Team expert groups on Technology and Low Carbon Product Development and Technology and Low Carbon Infrastructure have informed the strategy. The overall vision for the cluster set out in the Automotive Cluster Strategy 2009-2019 is to have “A globally competitive cluster with world-class standards of excellence in Manufacturing, Engineering, Supply Chain Management, Innovation and Workforce Skills”.

The Innovation Strategy is a key pillar of this Cluster strategy. A network meeting comprising a cross section of key regional stakeholders consulted during the evidence gathering phase has been held to review the strategic themes and gather further input.

The objectives of the Innovation Strategy are to:

- Provide support to industry to increase product, process and service innovation
- Position the cluster at the forefront of technology innovation and on the shortlist for new investment
- Increase collaborative R&D between industry and research organisations
- Aim for international excellence in technology and innovation to ensure that the region is seen as a preferred location for inward investment
- Grow and sustain the cluster

The strategic themes recommended address the weaknesses and constraints observed in the assessment of key practices and activities that drive and support innovation.

ASSESSMENT OF CURRENT CLUSTER INNOVATION CHARACTERISTICS

An assessment of the characteristics and key practices that drive and support innovation within the cluster was derived from the primary and secondary research. The assessment is as follows:

- **Innovation Culture** – The Innovation Culture that exists within the larger automotive companies has driven Lean Manufacturing, an incremental innovation process, to world class standards. Products from these companies are characterised by strong innovative design features. In other companies such as Scorpion Electro Systems, Torotrak and Clean Air Power, good examples of product innovation can be found. There are also excellent examples of leading edge research in Foresight Vehicle technologies taking place within some of the region’s universities. However there is a need to increase the capacity and capability to innovate within the wider cluster.
- **R&D Intensity** – There has been a relatively low level of Automotive Sector engagement with funded Research Technology and Development (RTD) programmes such as the Foresight Vehicle Programme², and the TSB programmes, regional programmes such as Grants for R&D and the European Framework 7 programmes etc. This is thought to be due to lack of awareness of such programmes, complexity of administrative processes to participate in such programmes and their apparent relevance and applicability, etc
- **Skills** – A recent mapping study of the cluster highlighted a skills deficit at graduate engineer and technician level – as the pace of Low Carbon Vehicle technology quickens it is envisaged that different skills will be needed to support these developments
- **Finance** – The credit crunch is affecting the ability of companies to invest, resource and participate in large scale RTD projects
- **Technical Capability** – There is a strong capability in Foresight Vehicle technologies such as (Materials, Electrical Engineering, Electronic, Design and Manufacturing) within some of the region’s Universities. There is also a critical mass of companies working on Low Carbon Vehicle activities but increased effort is required to intensify both the level of activity and bandwidth of capability to position the region nationally and internationally.

² The Foresight Vehicle is now administered by SMMT

- **Communications Internal** - The business to business and business to HEI communication of technology capabilities and technology needs is weak.
- **Communications External** – Despite its position as the second most significant region for automotive manufacture in the UK, knowledge of the technology strength and capability of the Northwest automotive sector is relatively low at a national level and the cluster appears less well connected and influential in shaping agendas with government bodies such as BERR, DIUS and DfT and their respective innovation partners such as AIGT2, TSB and Cenex
- **Inter Industry Linkage** – There is an apparent gap in the inter industry linkage between the automotive cluster, environmental technology, chemical and aerospace clusters and the wider road transport sector. The latter sector is important as it is likely to feature in 'green procurement' initiatives.
- **University/College Interaction** - Collaboration between companies and regional universities is weaker in comparison to other comparable UK automotive regions. The research indicates that Loughborough, Warwick, Cranfield and Birmingham universities enjoy major collaborative public/private funded projects with the automotive sector.
- **Technology** - Good examples of advanced technology exist in companies and in HEIs. The region is host to the only volume producing Truck Company in the UK and also a major Bus Company. However there is an apparent disconnect between the technology roadmaps and technology themes that are being identified by bodies such as TSB and AIGT2. The focus of these groups is currently car centric. Unlike other UK regions, little is taking place in the way of Public Sector sponsored Low Carbon Vehicle Demonstrator projects.
- **New Products** – The processes to support small business and enterprise to pull through automotive and automotive related products from invention, product development to commercialisation are weak and fragmented. There is a need to form better connections between funding sources and early stage development and at the later stages to intensify the activities and routes to market for Low Carbon Vehicle products, components and systems for commercial vehicles, buses and niche vehicles
- **New Processes** – Manufacturing and related manufacturing processes are covered in the NAA Supply Chain Development Strategy. Greater emphasis within the cluster is required on sustainable manufacturing processes to reduce carbon footprint and material waste. To support the enterprise innovation process a more joined up support process for the (Concept- Commercialisation) stage delivered by experts with vehicle knowledge is required
- **New Markets** – Greater focussed activity is required to support export and inward investment activities through greater promotion and marketing of the region's automotive manufacturing capabilities and regional strengths in foresight technology.
- **ICT** – The region has a number of ICT assets which are underexploited by the automotive sector. For example the Daresbury Science and Innovation supercomputing and high performance and distributed computing & data services with capability in complex computational fluid dynamics.
- **Customers** - Supplier development programmes delivered by the NAA have made good progress on facilitating incremental process innovation with benefits in cost, quality and delivery. Programmes aimed at customer led collaborative product and service innovation are required.
- **Suppliers** – Developments in Low carbon vehicles have the potential to disrupt traditional supply chains. Action is required to identify and scope supply chain required for Low Carbon Vehicles e.g. electric motors, batteries, power electronics, energy storage, control software and identify capability and gaps within existing vehicle supply chains. There may also be potential for new supply chains for electric vehicle charging infrastructure

Based on this assessment and supporting background research the following strategic themes (ST) and supporting actions are proposed:

- ST1 Promote and develop the regional technology capability particularly around Vehicle Foresight Technologies.**
- 1.1 Promote the HEI capabilities in key Foresight Vehicle Technologies inter cluster and outside of region to policymakers, influencers and stakeholders
 - 1.2 Identify, develop and monitor advances in key Foresight Vehicle Technologies appropriate to the North West region e.g. Low carbon Vehicles, Materials and Design and Manufacturing Processes
 - 1.3 Encourage industry and HEI ownership of the strategic theme
- ST2 Develop an Innovation Support process to lead companies through the key innovation stages by**
- 2.1 Setting up robust system to capture pipeline of innovation concepts and ideas
 - 2.2 Effective proof of concept evaluation TRL1-TRL3³
 - 2.3 Access to funding and finance (private and public sector)
 - 2.4 Supporting and monitoring progress through TRL1-TRL4
 - 2.5 Developing routes to market
- ST3 Enhance the business to business and business to HEI innovation collaboration by**
- 3.1 Developing a process to facilitate innovation collaboration
 - 3.2 Supporting industry led, collaborative innovations which address key innovation platforms
 - 3.3 Supporting innovation projects which lead to economic impact and longer term sustainability
- ST4 Increase the level of regional activity in collaborative research and development by**
- 4.1 Establishing a regional cluster innovation network
 - 4.2 Synchronising network meetings with scheduled R&D competition programme calls
 - 4.3 Forming innovation special interest groups
- ST5 Establish regional 'test bed' for Low Carbon Technology Development**
- 5.1 Scope facilities and evaluate market demand for facility for Low Carbon Technology development
- ST6 Improving Innovation Culture by**
- 6.1 Improving leadership and unlocking potential in small companies
 - 6.2 Developing innovation skills
 - 6.3 Identify appropriate innovation benchmarks for the cluster
- ST7 Progressing Delivery of the Strategy by**
- 7.1 Establishing a regional automotive innovation growth team
 - 7.2 Align regional Innovation areas and direction with AIGT2 and TSB developments

³ Technology Readiness Level is a term that is now being commonly used to measure and characterise the level of maturity of technology from level 1 Concept through to Level 8 Commercialisation

The strategy supports the 2009-2019 Automotive Cluster Strategy and will be delivered through the proposed 3 year action plan which is presented in Appendix 2.

1. Purpose of the Strategy

The automotive sector in the Northwest has been identified as a key internationally competitive sector for the region. Innovation is critical to long-term economic growth. Innovation in the sector thus far has been focussed on incremental process innovation. However this incremental innovation alone is not adequate to ensure sustained growth and competitiveness of the sector. Sustained growth can occur only with the continuous introduction of new products, processes and services arising from radical innovation. The strategy seeks to identify themes and priorities to support and intensify the innovation activities in the sector.

1.1 Key Objectives

The key objectives of the strategy are to:

- Provide support to industry to increase product, process and service innovation
- Position the cluster at the forefront of technology innovation and on the shortlist for new investment
- Increase collaborative R&D between industry and research organisations
- Aim for international excellence in technology and innovation to ensure that the region is seen as a preferred location for inward investment
- Grow and sustain the cluster

1.2 Links to Regional Manufacturing and Economic Strategies

The strategy for the automotive sector is aligned with the regional manufacturing strategy and regional economic strategy. More specifically the strategy seeks to,

- Help businesses to increase their capacity and capability to innovate
- Improve the interaction between businesses and the science/HEI base
- Help companies respond to global opportunities and risks
- Support companies to use resources efficiently and respond to climate change
- Develop a highly skilled workforce at all levels
- Improve the image of manufacturing
- Ensure that places, spaces and infrastructure are fit for the purpose of manufacturing.

1.3 Measures of Success

The key measures of success of the strategy are:

- Continued investment into the regionally based global automotive companies by their parent companies.
- Increase in GVA of the cluster.
- Increased regional participation in collaborative RTD programmes

- Increased collaboration business to business and business to HEI i.e. Engagement of companies and universities with technology development initiatives relevant to the design, development and manufacture of future vehicles
- Increased business expenditure on research and development
- Increased level of employee skills relevant to the current and future needs of the companies in the cluster.
- New inward investment into the region.

1.4 The Northwest Automotive Cluster

Economic Profile

The core of the Northwest automotive cluster directly generates some **£6bn** of the total UK automotive manufacture economy which relates to approximately 13% of the UK total, placing it as the second most significant region for automotive manufacture. If the related industries e.g. logistics and transport, general engineering and service industries which form part of the cluster are included then this figure increases to circa **£9bn**.

During the period 2002 to 2007 there has been an estimated overall increase in turnover of circa 38% following an investment of some **£2bn** in the region's major vehicle manufacturing facilities by their owners. Turnover was forecast to increase over the next 5 years by a further 24% particularly in the regions volume car manufacturers, with the already committed further investment in the General Motors manufacturing facility at Ellesmere Port and the potential for further investment at the Jaguar/Land Rover facility, subject to future business decisions by Tata Motors. This growth is now subject to review because of the current recession and the longer term impact this might have which is uncertain at the moment.

Employment in the core of the Northwest automotive cluster is currently estimated to be approximately 23,000 and was expected to remain around this level for the next 5 years as companies seek to increase sales whilst maintaining headcount. This has been recently affected by the downturn in the market which is leading to significant redundancies in the short term. If the related industries in the cluster e.g. transport and logistics, general engineering, sub-contract engineering and service industries are included then this figure increases to circa 40,000.

Annual output from the region in 2007 was approximately 220,000 cars and 20,000 trucks which are supplemented by truck bodies and trailers, specialist vehicles and automotive components. This was expected to rise during the next 5 years by approximately 30% mainly with the increased volumes at the General Motors Manufacturing EP facility and potential increased volumes at the Jaguar Land Rover facility. Currently output in the region is expected to drop dramatically in 2009 due to the current economic climate.

More recently the reverse takeover of East Lancs Coachworks by Optare and the decision to re-locate its manufacturing base to a new larger facility in Blackburn will lead to increased output and the need for new locally based suppliers.

Size and Scope

The strength of the sector in the Northwest lies in it's diversity, ranging from volume car manufacturers, including prestige and niche car manufacturers to truck and specialist vehicle manufacturers. Figure (1) illustrates the structure and scope of the automotive cluster in the

Northwest based on the industry classification system. The main strength in the region is the presence of the five vehicle manufacturers who account for approximately 80% of the total turnover and approximately 50% of the total employment in the core of the cluster.

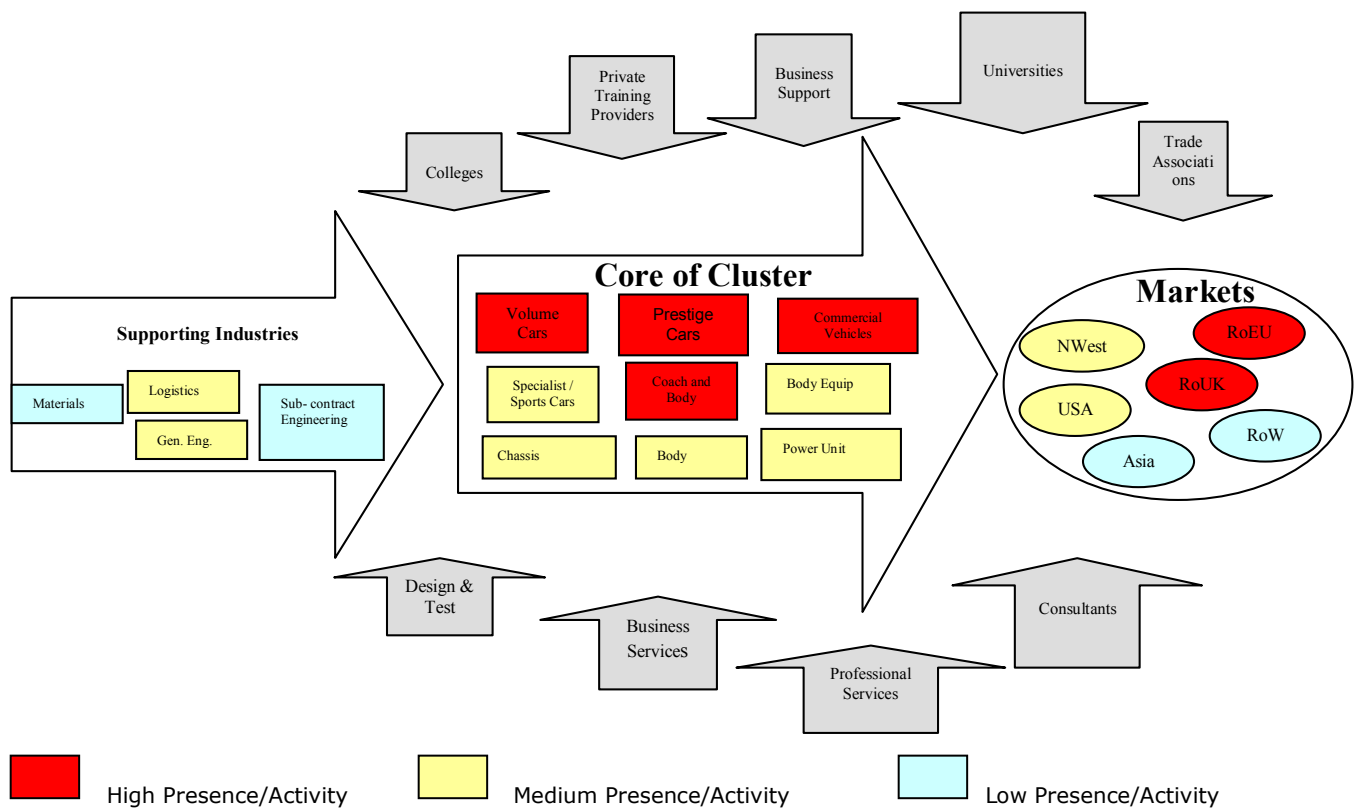


Figure (1) Structure of the Northwest Automotive Cluster

The cluster is characterised by the following sub-sectors:

- Volume car manufacturers (>100,000 units p.a.)
- Prestige cars
- Commercial vehicles
- Specialist and low volume vehicles
- Coach, trailer and body builders
- Body shell and trim
- Power unit and drive train
- Chassis equipment and systems
- Body equipment and systems

These sub-sectors are supported by related and supporting industries such as logistics and transport logistics, sub-contract engineering services, general engineering, design and test.

2. Policy Context

2.1 Background

The primary context for this strategy is the Automotive Cluster Strategy 2009-2019 and the Northwest Manufacturing Strategy and the actions identified within these strategies. Other national strategies on Innovation (1) and Manufacturing (2), (3) and (4) Northwest Regional Policy on Innovation (5). Other policy documents and studies to inform policy have been consulted and references to these documents will be presented in later sections of this report.

2.2 New Automotive Innovation and Growth Team (NAIGT)

Innovation initiatives for the UK Automotive sector over the last six years have been based on the findings and report (6) of the original Automotive Innovation and Growth Team Report. The recommendations from this report gave rise to a number of government supported interventions such as the National Supply Chain Groups Programme; the Low Carbon Vehicle Partnership; the Automotive Academy (now part of the National Skills Academy for Manufacturing); two technology centres of excellence – Cenex for Low carbon and Fuel Cells Technologies and innovITS for Intelligent Transport Systems and Services and the Foresight Vehicle Programme a government funded collaborative Research and Development programme to support technology developments in key foresight technology areas. A Foresight Vehicle Technology Roadmap (7) which informed the technology and research directions for future road vehicles was produced by the Society of Motor Manufacturers and Traders (SMMT). With the exception of those that continue to play a role as Knowledge Transfer Networks such as Cenex and innovITS the other programmes proposed by the AIGT are mainly complete and the SMMT Knowledge Transfer network for the automotive industry promoted via the Foresight Vehicle web site <http://www.foresightvehicle.org.uk/> . Dedicated funding for Foresight Vehicle research and development activities ended circa 2006.

The Department for Business, Enterprise and Regulatory Reform (BERR) has commissioned a new AIGT (NAIGT) to facilitate a collective view from the UK automotive sector on the innovation and growth challenges it faces in the period to 2025. An industry-led Steering Group (chaired by Richard Parry- Jones CBE) has responsibility for gathering evidence and recommendations from a number of expert groups working in the areas of:

- Supply Chain Development, Technology
- Low Carbon Product Development
- Technology and Low Carbon Infrastructure
- Business Environment and Key Performance Indicators.

The final report of the NAIGT is due around March/April 2009 with government response to recommendations by May 2009.

Early indications are that there is a need to

- retain both vehicle manufacture and maximise added value and future supply chain activity in the UK,
- increase supplier competencies particularly at tier 2 and 3 levels in the supply chain,
- strengthen the internationalisation of UK based suppliers
- have a better framework for industry-university collaboration

- review ways to exploit the strength of the UK niche vehicle sector

At an interim stakeholder meeting 5th February 2009 the emerging findings from the expert groups were presented.

The ***Competitiveness of the UK Automotive Sector & Key Performance Indicators*** group are proposing that the following Innovation Measures are used to track innovation at the product and process level.

Market-related measures

- Percentage of sales accounted for by new products. Note: This is the most commonly used measure for innovation, alongside the number of patents. The data is available through official statistics, also available across countries. However there is a need for it to be adjusted for lifecycle of the respective product.

Carbon-related measures

- Carbon emissions in production, by unit produced.
- Well-to-wheel energy balance (more comprehensive than tailpipe)

R&D related measures

- Growth rate of R&D expenditure, UK overall.
- R&D expense in the UK against other countries
- R&D expenditure as % of total sales
- Number of patents submitted, although it is acknowledged that patents are a poor proxy of innovation

Innovation capability- related measures

- Skills, number of engineers graduating in the UK
- Interaction with Higher Education Institutions, in terms of £ spent on collaborative research between firms and universities

The expert group responsible for addressing ***A Supportive Business Environment*** proposed the following.

Strengthen certainty and credibility

- Create a permanent Industry/Government forum "National Automotive Council" to manage the evolution of future automotive policy and provide business with certainty and credible governance to ensure focus, implementation and sustainability of the NAIGT's recommendations.
- Provide long term 2025 framework
- BERR to deliver further joining up across Whitehall and Agencies

Improve UK investment offer

- Simplify and maximize incentives and funding for upgrading and developing existing (and new) manufacturing locations (consistent with EU rules)
- Examine scope for carbon footprint reduction incentives and possible links to EIB funding
- Focused public procurement within EU rules to promote uptake of UK developed/made product

Widen collaboration

- Provide forums and influence other IGT/RDA-driven investments to promote cross sector collaborations(e.g. aerospace, renewables, defence) and stronger business-university collaboration around science and technology development as part of integrated UK industrial and science policy
- Expand role of Universities as cluster and cross-sectoral knowledge integrators

Promote positive automotive industry image

- Through SMMT, use Automotive Policy/NAIGT recommendations to promote a positive image for the industry and attract future talent from interventions in schools and higher education

Get the monetary and fiscal message right

- Credit Systems -lessons from current situation and temporary bank/credit actions to inform longer term if needed
- Ensure alignment of fiscal measures and policy objectives understood –continue to ensure that UK systems (e.g. VED or congestion charges) are technology neutral and promote interests of UK industry as well as other goals (revenue, carbon reduction etc.)

Protect flexible labour markets

- Continue to protect and enhance existing labour-market flexibility, including temporary working arrangements

Expand and deepen skills provision

- Further develop sector skills (SEMTA) offerings to fully meet industry needs at apprentice, NVQ 2-4, management and leadership skills and HE automotive qualifications (e.g. degrees in automotive related topics)
- Promote retention of key skills in UK (including UK trained overseas nationals)

The **Competitive Supply Chain** group recommended

- A continuous national strategic supply chain development programme is established
- Industry and Government should review ways to increase supplier competencies
- A joined up strategy should be developed through the creation of a “UK Automotive Sourcing Council”
- A single framework for industry-university collaboration should be introduced

The expert group on **Low Carbon and Technology** proposed the following:

Create a leadership Team

- Continue NAIGT beyond April to develop future automotive strategy in the UK
- With ownership of underpinning documents
- Bring clarity to the disparate array of stakeholders currently in the low carbon transport arena

- Developing and managing the transition to Low Carbon
- The delivery of NAIGT recommendations

Establish Test Bed UK

- To create a formal partnership mechanism between regulators, industry and consumers
- Assist OEM's, technology driven SME's and research establishments demonstrate their expertise in LCV to UK
- Provide a compelling reason for 1st and 2nd tier suppliers to be in the UK
- Promote UK plc to a wider worldwide audience

Release and maintain roadmaps and research agendas to focus spend and collaboration

Establish Government funding mechanism to support product development and industrialisation phase of R&D

Evaluate new test procedures based on Well to Wheel methodology and energy focused rather than current Tank to Wheel

These recommendations from the groups will be reviewed by the NAIGT top level groups and presented to Government for a response. This process is expected to complete by May 2009.

Recognition of the interim developments has been taken into consideration in the development of the strategy.

3. Map of Players Influencing Automotive Innovation

3.1 National Level

At a national level a number of government departments and agencies influence innovation in the automotive sector. These include DBERR (Department of Business Enterprise and Regulatory Reform), DIUS (Department of Industry Universities and Skills) and DfT (Department for Transport). Other organisations and bodies such as TSB and Cenex support delivery of government policy. At a European level the European Union determines the overall European policies and frameworks.

There have also been studies commissioned by government departments such as the King Review which examined the vehicle and fuel technologies which could help decarbonise road transport, particularly cars, over the next 25 years. Other groups such as Knowledge Transfer Networks have been set up to appraise departments of emerging technologies and technology development. The use of expert industry bodies such as the NAIGT discussed in the previous section is also a mechanism used to inform policy making.

Some of the known programmes associated with the national and European bodies that help influence and support innovation in the cluster are shown in Figure 2.

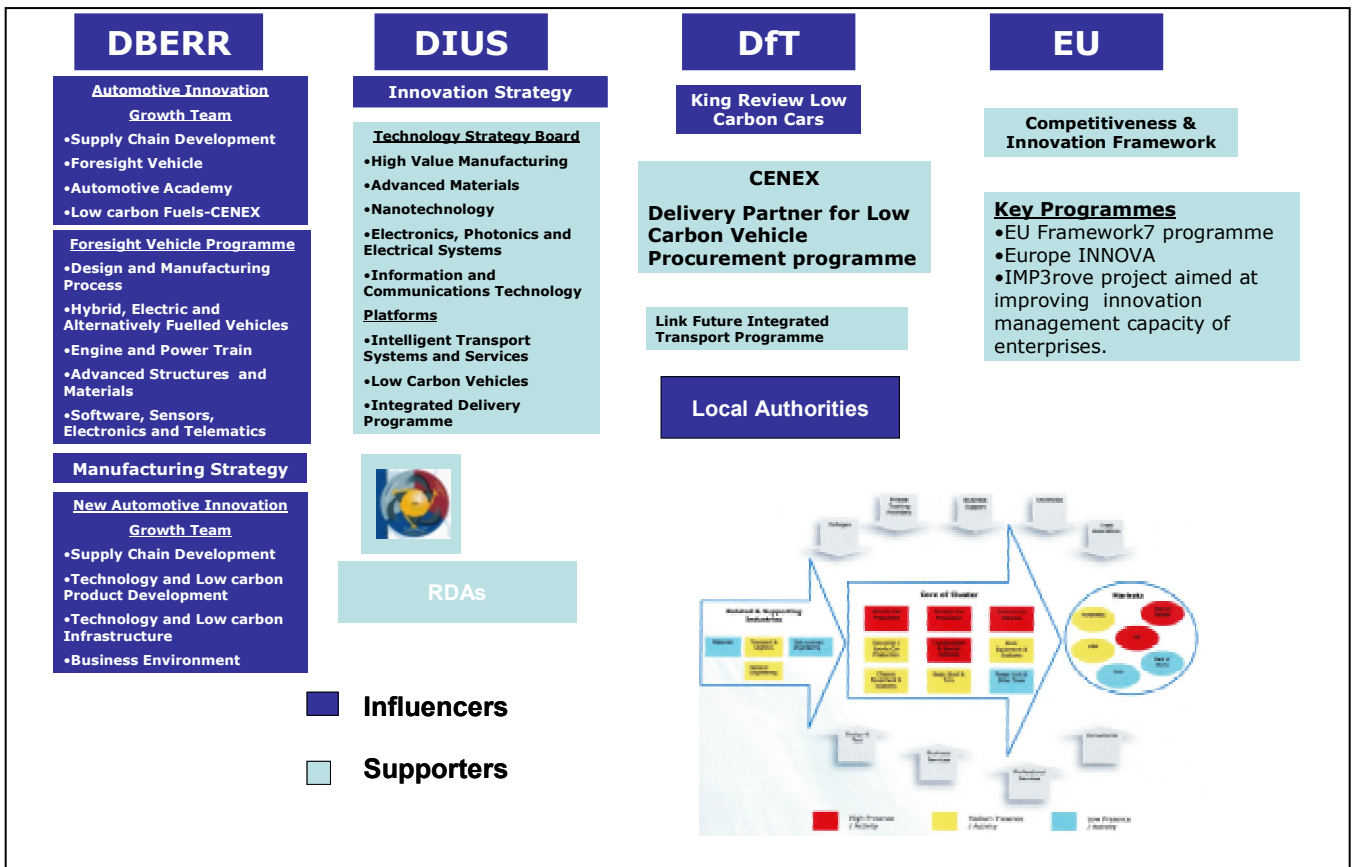


Figure 2 Map of Players and Programmes Influencing Automotive Innovation at National Level.

Output in the form of strategies, policy documents, support programmes and reports is formidable and often only known to those who have been involved in their production.

Our primary research indicates that many of the large companies in the region's automotive cluster are often unaware of what interventions and programmes are being

proposed, recommended and also lack understanding and knowledge of the themes, scope and objectives of innovation support programmes.

3.2 Regional Level

At a regional level the players influencing innovation in the automotive cluster include the Northwest Development Agency, the Science Council, cluster bodies, the region's universities, Business Link and the Learning and Skills Council.

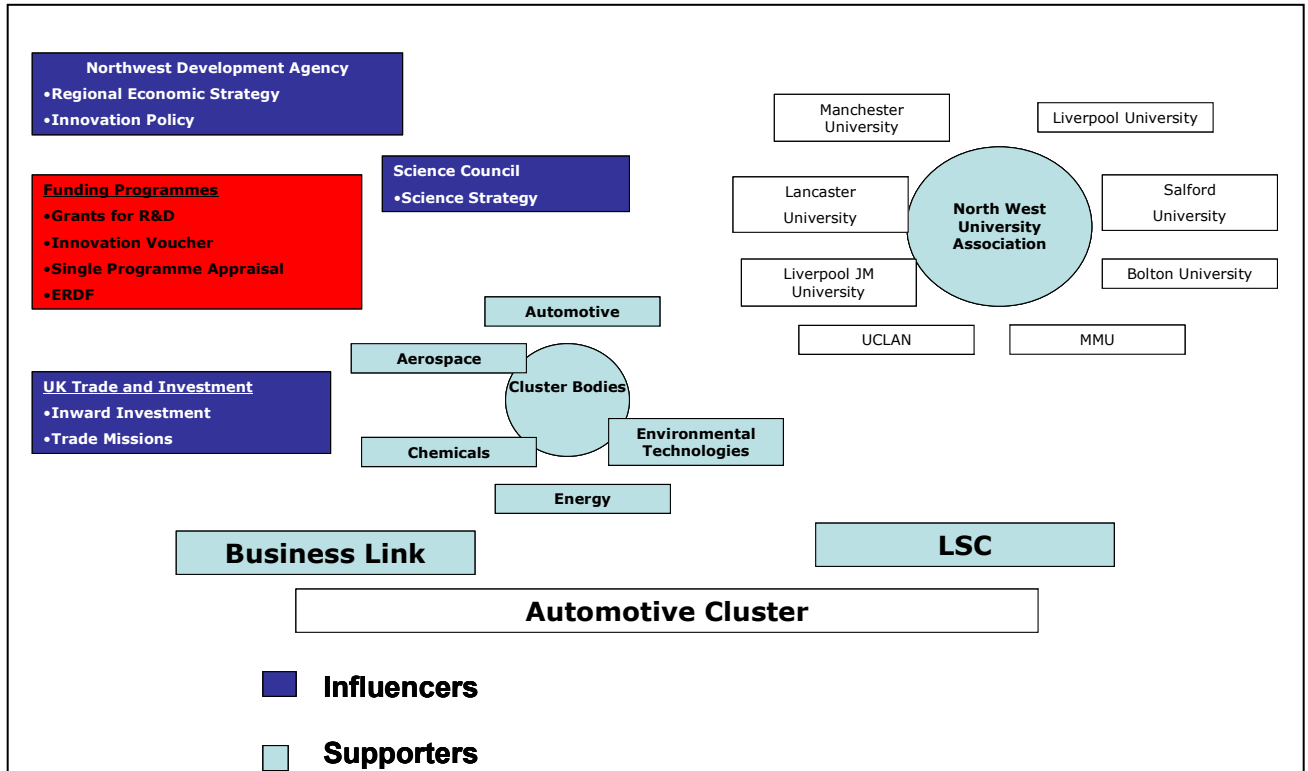


Figure 2 Map of Players and Programmes Influencing Automotive Innovation at Regional Level

The above map does not include prospective Investors and Venture capital organisations which also play a key role in the support of early stage funding and commercialisation of product and process innovations. Company Product development and research departments are included within the automotive cluster.

The knowledge of the national innovation programmes by the clusters in the region is patchy and although there is regional presence on some of the national bodies that have been mentioned e.g. NAIIGT. The communication of developments taking place on such programmes is at best modest and often too late to allow participation by the companies. Our primary research with smaller enterprises indicates that advice and technical support to evaluate potential inventions, information on sources of funding for proof of concept and early stage development is weak.

4. Foresight Vehicle Technologies

The Foresight Vehicle Technology roadmap produced in 2002 and updated in 2004 identified the technology and research directions for future road vehicles. The roadmap and technologies identified remain broadly relevant to the automotive sector today and the roadmap provides a valuable resource for encouraging innovation and a useful framework for supporting collaboration, decision making and action within the road transport sector.

A number of technology themes have been identified and these include:

Engine and Powertrain (EPT)

The Engine and Powertrain (EPT) technology theme includes the following vehicle functions and systems:

- On-vehicle fuel filling systems and fuel types.
- Conversion of energy in fuel to useful mechanical power.
- Transmission of power to wheel hub.
- Associated and auxiliary systems such as air flows, after treatment, lubrication systems, generators, alternators and climate control.

Hybrid, Electric and Alternatively Fuelled Vehicles (HEAFV)

This technology theme includes the following vehicle systems and functions:

- Application of new and alternative fuel types, such as hydrogen, LPG, CNG, LNG, bio-diesel and bio-ethanol/methanol.
- Conversion of energy in conventional and alternative fuels to useful mechanical power.
- Electrical motors for vehicle propulsion, storage systems, hybrids and fuel cells for converting fuels directly to electrical energy.

Advanced Software, Sensors, Electronics and Telematics (ASSET)

The ASSET technology theme includes the following vehicle functions and systems:

- Onboard systems for road travel, vehicle and driver assistance (including electronics and sensors),
- Information/communications and control, and high voltage electrics to support future engine systems.
- Interfaces with the road traffic specific infrastructure.

The Advanced Structures and Materials (FASMAT)

FASMAT includes the following vehicle functions and systems:

- Supporting structure (body) which is an integral part of many other systems and features of the vehicle, such as style, glazing, heating and airflow systems.
- Structural components, including suspension, hard and soft trim.

Design and Manufacturing Processes (DMaP)

This technology theme is broad, covering the full life cycle of road vehicles, with strong links to the other technology themes:

- Design, engineering, prototyping, manufacturing, assembly, use and recycling/regeneration.
- Other business processes, including supply chain management, marketing, logistics, distribution and retail.

The Foresight Vehicle Programme was a government supported R&D initiative which funded projects addressing Foresight Technology themes and officially ended 2004. Funding for collaborative R&D innovation resides mainly with the TSB and with the

exception of the Low Carbon Vehicle innovation platform, There is little direct correspondence between TSB themes and Foresight Vehicle themes.

5. Low Carbon Vehicle Programmes

The issues of Climate Change, Energy Security and Global Population Growth will put unprecedented pressure on the earth's natural resources. UK has committed to 60% cuts in CO2 emissions by 2050. Transport contributes c25% of UK CO2 emissions and is growing and of this, road transport accounts for c80%. This focus by national governments on reducing CO2 emissions will create opportunities for new product and process innovation and according to Ian Pearson *'There are rapidly expanding markets for low-carbon products and services the world market for environmental goods and services is projected to grow from \$548bn in 2004 to \$800bn by 2015⁴.*

Reference (8) points to the fact that road transport is the second largest emitter of carbon dioxide in the UK and is one of the few major sectors of the economy in which emissions are rising. It also highlights that a range of vehicle technologies and fuels exist which could lower the carbon footprint of road transport and suggests that developments in internal combustion engines and hybrid and electric vehicles are two major opportunity areas for UK manufacturers.

The UK government has put in place schemes to support R&D in Low Carbon Vehicle Technologies. These include:

5.1 TSB Low Carbon Vehicle Integrated Delivery Platform Initiatives

The programme launched in September 2008 is aimed at stimulating innovation throughout the entire supply chain from the science base through collaborative R&D to fleet users. Circa £100m of public sector co-funding has been secured from DfT, TSB, Engineering and Physical Sciences Research Councils (EPSRC) and a number of regional development agencies. The ambition is to grow this funding further over the coming five years to help focus the R&D activities to focus attention on innovative medium to longer term low carbon transport solutions.

The TSB Low Carbon Vehicle initiative is a competitive process which invites industry led bids against specific programme calls. A two stage process is used and the first stage takes the form of an Expression of Interest (EOI) by the lead partner of the collaborating consortium which is then independently evaluated and if successful the consortium is invited to develop a full blown proposal (Final Stage) which undergoes further independent evaluation. If successful at this stage, contracts between TSB and the collaborative consortium are formed.

The process can be rather daunting and is unlikely to be suited to smaller companies that don't have experience of constructing first and second stage bids. Even larger companies that do not have the in house expertise of competitive bid processes may be disappointed with the outcomes. Success is not guaranteed and there is a substantial requirement to demonstrate new innovation and significant potential for exploitation in the bid. Success rates vary depending upon the theme and number of applications. As this is the main channel for industry funded innovation, there are a high number of applications.

5.2 DfT Low Carbon Vehicle Procurement Programme

The theory of public procurement as a driver for technology innovation is that by stating its future needs the public sector can stimulate ideas and innovation and by forward committing to purchase, the public sector can enable ideas to become new products. Furthermore by acting as an early adopter, the public sector can accelerate the market entry of innovative products.

⁴ Ian Pearson, MP, Climate Change and Environment Minister (now Minister of State (Minister for Science and Innovation))

The public sector is also a major purchaser of vehicles. For example:

- Public sector fleet estimated as 100,000 heavy duty and 200,000 light duty vehicles (AEA Technology study, 2007)
- Around 13,000 new heavy duty and 75,000 new light duty vehicles procured by public sector organisations each year
- Main vehicle types are cars, small and large panel vans, mini-buses and refuse collection vehicles
- Public sector influences bus market mainly through contracting structures

Funding of £20m is available to support phase 1 with potential to increase to £50m if projects are successful. The first phase concentrates on cars and light vans, later stages may be focused on buses and trucks. The project is managed by CENEX who is the delivery partner. A number of potential suppliers of vehicles have been selected and strategic public sector partners and pilot local authorities have been identified. These include:

Initial Strategic Partners	Pilot Local Authorities
Government Car & Despatch Agency	Coventry
Royal Mail	Newcastle & Gateshead
HM Revenue and Customs	Liverpool
Environment Agency	Glasgow
Metropolitan Police	
Transport for London	

A number of providers of Low Carbon and all electric vans have been shortlisted. With the exception of involvement by Liverpool Council as one of the pilot local authorities involvement by Northwest companies is low because of the focus of this programme. As this programme moves to a second phase involving commercial vehicles and buses, the Northwest Automotive cluster needs to position itself as a prominent participant in the provision of appropriate vehicles.

6. Automotive Cluster Innovation Characteristics

The previous sections have highlighted the background secondary research that has been considered in the development of the strategy. In this section the information gathered to define the Northwest Automotive innovation characteristics and support the development of the Innovation strategy will be discussed.

Figure 3 shows the sources of information that have been used.

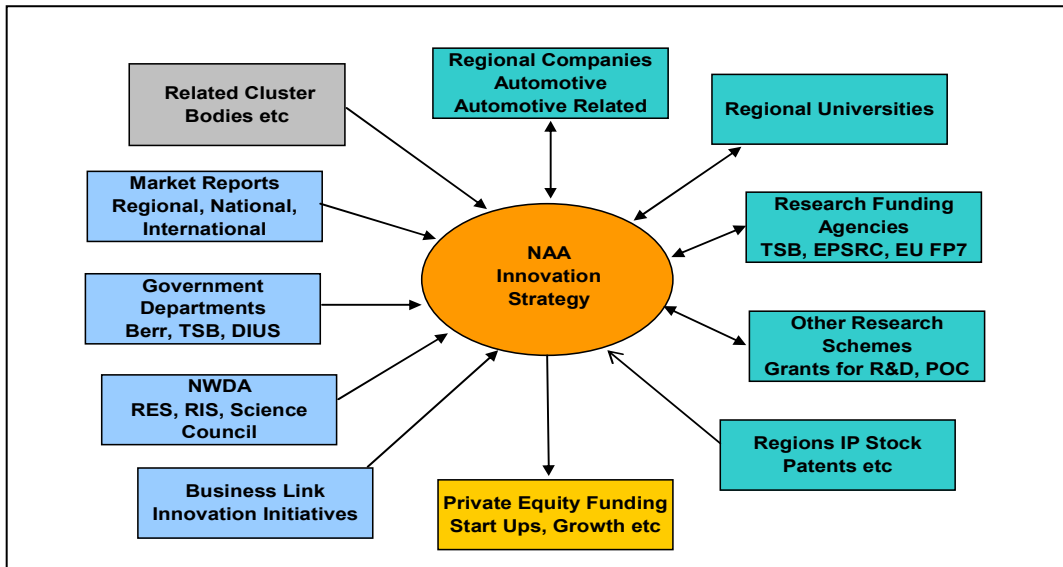


Figure 3 Sources of Information

Appendix 2 provides a list of the organisations consulted/researched during the information gathering stage. Information gathering took the form of 'one to one' meetings, group meetings and presentations, email correspondence and secondary research.

The output from this stage is presented in the following sections.

- Northwest Capability in Key Foresight Vehicle Technologies
- Low Carbon Vehicle Developments in the North West
- Innovation Support Infrastructure – Invention to Innovation
- Innovation Assessment and Findings

6.1 Northwest Capability in Foresight Vehicle Technologies

The Northwest regional capability in foresight vehicle technologies has been assessed using:

1. Data relating to the Northwest organisations participation in projects supported by the Foresight Vehicle (FV)
2. Information from meetings with organisations listed in Appendix 2 and secondary research.

Northwest Participation in Foresight Vehicle Programme

Analysis of Foresight Vehicle Programme data established the level of activity by Northwest organisations (companies and universities in this programme). The results of this analysis provided a starting point to establish innovation active universities and companies and also determine levels of FV thematic interest.

The data also provides a relative comparison of the North West with the other recognised automotive regions namely West Midlands (WM) and East Midlands (EM).

Figure 4 presents the number of supported projects by FV thematic area. The scope of each theme has been added for reference.

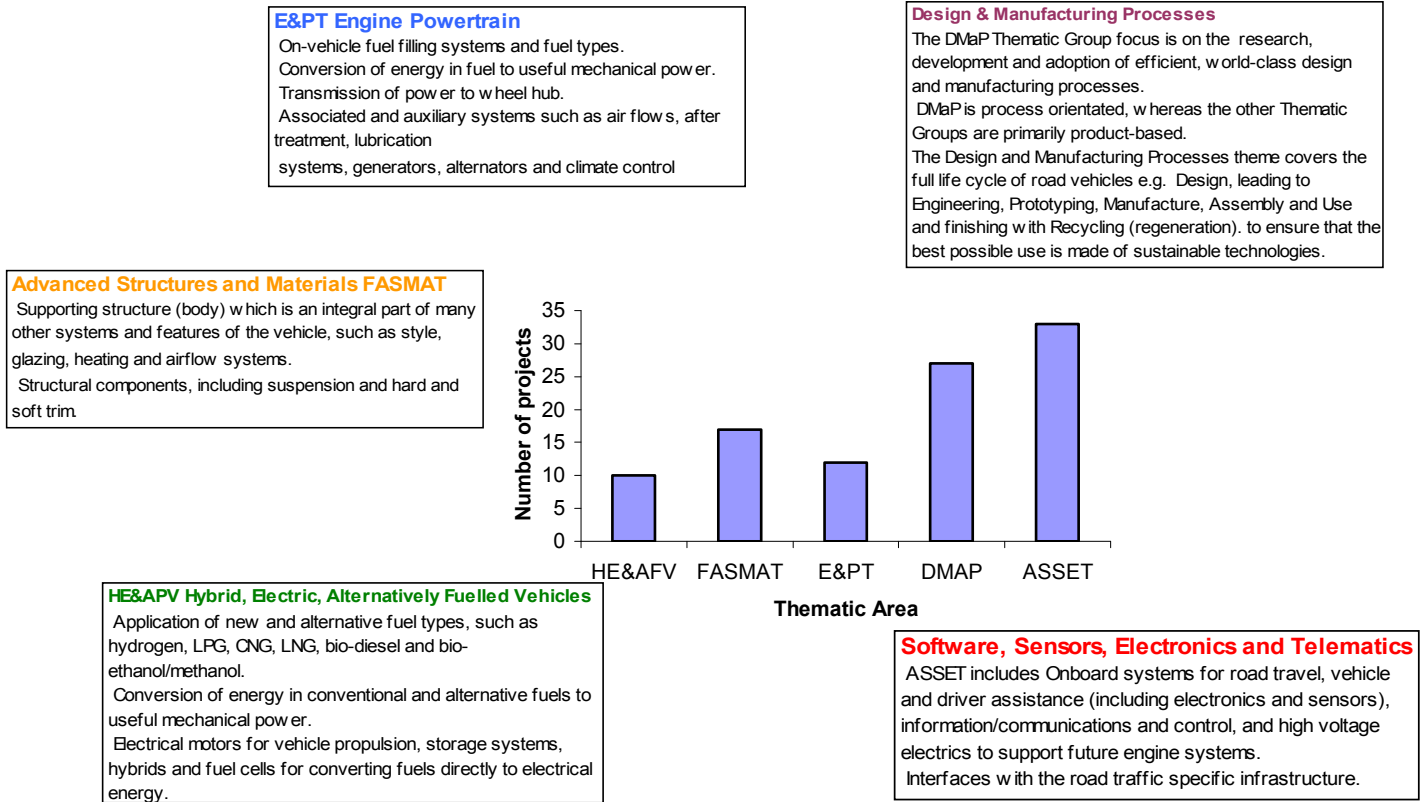


Figure 4 Supported Projects by FV Theme

Figure 5 shows a comparison of the Northwest FV activity with WM and EM.

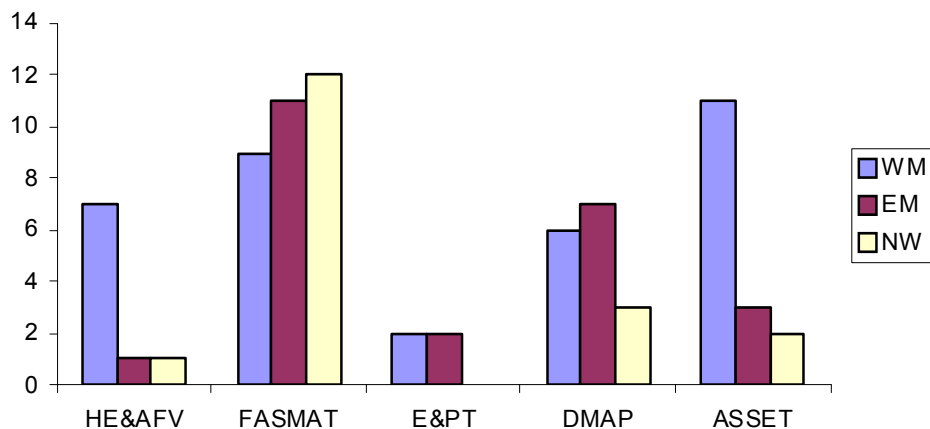


Figure 5 Comparison of FV Project Activity by Automotive Regions

The Foresight Vehicle programme has generated over 100 programmes since its launch. However this programme has now largely been superseded by the TSB initiatives and programmes which, with the exception of the Low Carbon Vehicle Platform, do not explicitly map directly to the foresight vehicle themes.

Although organisations in the Northwest region has been active in the Foresight Vehicle research programme, with the exception of the Advanced Structures and Materials (FASMAT) programme the level of activity in the other themes has been lower than other strong automotive regions in the UK such as East and West Midlands. As the Foresight Vehicle projects were in the main university led, this possibly also reflects the stronger connection between universities such as Warwick, Birmingham, Coventry and Loughborough and the respective automotive and automotive related players in their region. The data also reflects the location of the principal Tier1 suppliers of engines, engine technology, control systems, software and telematics.

It has proved difficult to compile comparable data for the Northwest region on the TSB supported programmes since:

- With the exception of Low Carbon Vehicles there is no explicit theme relating to vehicle foresight technologies
- Publicly available information on projects and project participants is incomplete (Commercial in-confidence reasons)

Northwest Capabilities in Foresight Vehicle Technologies

Despite the apparent low level of activity in the funded Foresight Vehicle Programme, there is considerable strength and capability within the region in Foresight Vehicle Technologies. Within the region's universities and the Daresbury Innovation Centre there is evidence of leading edge developments taking place in specific technologies such as materials, material processing, design, manufacturing and engineering analysis and electric vehicle technology. In the large vehicle manufacturing companies manufacturing assembly techniques and supporting manufacturing systems are world class. Examples of innovative products and services can be found in companies such as Oaktec, mi Tech, Clean Air Power and Torotrak. It is interesting to note that the latter two companies benefit from the excellent development testing facilities at mi Tech

Innovative products and innovation ideas are not just seen within the universities and larger sized companies. Small companies such as Scorpion, Original Equipment and Lodematic for example have highlighted interesting innovative products and ideas for new products. A small number of inventors and micro companies have approached NAA for advice and support with concepts and ideas. It is likely that as a more robust system for support and early stage funding is established, a stronger pipeline of such inventions will emerge.

The table below summarises some of the organisations working in the Foresight Vehicle Technology areas. This relates to past or current research, development engineering or as an integral part of the design and development activities. No attempt has been made to qualify the status of the developments. Furthermore it should be noted that this compilation is not exhaustive. Further development of this knowledge base by ongoing research and dialogue with the cluster is 'work in progress' by NAA and will support the development of the Vehicle of the Future web portal⁵. This project will be discussed in a later section and will continue to add additional and more comprehensive details on the capability of the cluster.

Engine & Powertrain	
Astra Vehicles Technologies	Astra designs and manufacturers custom exhaust system solutions for new commercial vehicles, manufacturers under licence the award winning Adastra TM diesel particulate filter system, which retrofits to older vehicles for the reduction of carbon particulate emissions.
Bentley Motors	Bentley Motors based in Crewe designs, engineers and manufactures a number of the world's most respected high performance cars. For example the Continental Super sports which is the fastest, most powerful Bentley ever with

⁵ www.nwfuturevehicle.com

	<p>630PS (621 bop) 0-60 mph in 3.7 seconds (0-100 km/h in 3.9 seconds) and a 204 mph (329 km/h) top speed.</p> <p>The Super sports is Bentley's first Flex Fuel performance car and is 110 kg lighter than the Continental GT Speed. Bentley Motors is an example of a company that is involved at the leading edge of all aspects of foresight vehicle technologies.</p>
Blue Flame Performance Engineering	<p>Blue Flame is one of the UK's leading brands for exhaust system technology. With over 25 years experience and a globally recognised brand Blue Flame provide high quality exhaust system solutions for a growing customer base across diverse industries. The company's facility in Skelmersdale is home to leading edge exhaust engineering, world class manufacturing and comprehensive test facilities</p>
Bosal UK	<p>Bosal UK Ltd is the UK subsidiary of the International Bosal Group. Specialising in the manufacture of exhaust systems, Bosal offers a comprehensive range of products to both O.E. and aftermarket clients including pipes, silencers, catalytic converters, mountings and accessories.</p>
Helical technology	<p>Helical Technology design and manufacture pneumatic and electronic actuators for turbochargers, and valve rotators for industrial and marine engines</p>
Juno Racing	<p>Juno Racing Limited design and race winning, innovative and beautifully engineered racing cars. The company was formed in 1999, by ex-Williams F1 designer Ewan Baldry with the sole objective of becoming the world's leading manufacturer of racing cars. To date, the company has concentrated on sports prototype racing cars and has built winning cars for a number of UK and European Championships. Having already established an enviable reputation as a designer and manufacturer of high quality cars, they continue to build upon their success moving, as the next step in their development, into International sports prototype racing.</p>
Kestrel Powertrains	<p>Kestrel Powertrains Ltd was formed in 2003 by Eur Ing Martin Smith with a view to developing a flywheel energy storage system for urban vehicles from buses to trucks, vans and taxis. There is a current project team in place to build, test and develop the Kestrel ECARE driveline for use in midi buses and delivery trucks. Kestrel is actively seeking a user consortium to participate in commercializing the ECARE driveline</p>
Libralato Engines	<p>Manchester based Libralato Engines is a CleanTech research and development company developing the Libralato engine. The engine is a breakthrough technology, an 'eco-engine' for the 21st century – exceptionally compact, powerful, efficient, clean and quiet.</p>
M-Sport	<p>M-Sport, the team chosen by Ford Motor Company to mastermind their assault on the FIA World Rally Championships since 1997, has been growing in size and stature since it was originally formed in 1979 under the name of Malcolm Wilson Motorsport. M-Sport is another example of a North West company that is active in a range of foresight vehicle technologies.</p>
Torotrak	<p>Torotrak is a world leader in full-toroidal traction-drive transmission technology and development of IVT (Infinitely Variable Transmission) and TCVT (Toroidal Continuously Variable Transmission)</p>
Bolton University	<p>Bolton University recruits around 200 students annually on automobile and transport related courses. Industrial links include: TRW, Jordan F1 and mi Technology Group. Research strengths include Automobile Design, Engines, Composite Materials and Manufacturing Systems.</p> <p>"Bolton's research in Engines & Powertrain is supported by strength in Finite Element Analysis, Predictive Modelling of Combustion (Flame-Retardant) and Powertrain & engine testing. The design studio is also equipped with industry standard engineering design and analysis software, including: ProEngineer Wildfire, SolidWorks, 3D Studio, ProMechanica, Ansys, Fluent, LSDyna, Abacus and Maya.</p>

Liverpool University	<p>The University of Liverpool Department of Engineering's research groups include the Advanced Manufacturing Research and Dynamics and Control. Relevant research areas include automotive engine and powertrain dynamometer testing and friction induced vibration and noise in car disc brakes. Industrial collaborators include Ford, TRW Automotive and MIRA.</p> <p>Liverpool's Engineering department has expertise in Laser Ignition for lower emissions in Internal Combustion Engines. The Department also has capabilities for Engine Emission Control and Heat and Power capabilities. Research has been conducted on Engine combustion management, Variable Valve Train, Valve actuation, Turbo Charging and Super Charging of downsized engines, Dual Clutch Transmissions, Kinetic/Thermal Energy Recovery, Combustion sensing (ion current sensing), Driveline modelling and control – driveline backlash/launch control. Idle speed control, Laser ignition and Robust Powertrain control.</p>
Daresbury Science and Innovation Campus	<p>"Daresbury Science and Innovation Campus is a new model based on open innovation has been in operation for over 3 years, Engineering Technology Centre houses a range of equipment needed to deliver the large scale engineering projects associated with the large facilities it runs. This ranges from CAD design capability to advanced prototyping facilities.</p>
Origo Industries	<p>Origo Industries is a research and development company based at Daresbury Science & Innovation Campus with core technologies in the automotive and energy sectors. Technologies include:</p> <ul style="list-style-type: none"> • Carbon capture through CO2 and regeneration via biocatalytic processes. • New combustion chambers leading to higher engine power to wheel capacity, lower fuel input and reduced emissions. • Hybrid energy recovery via macrosonic sound resonance technology. <p>Origo is looking for access to OEM vehicles for successful integration into existing factory line assembly.</p>
Oaktec	<p>Oaktec is an engineering research and development partnership that focuses on energy efficient vehicle design. Oaktec projects have included the construction and testing of prototypes of their own internal combustion engine concept and work with alternative fuels including bio-ethanol and propane and butane gas.</p>

Hybrid Electric and Alternatively Powered Vehicles	
Acal Energy Ltd	<p>ACAL Energy Ltd is the world's leading developer of low cost Proton Exchange Membrane (PEM) Fuel Cells, powered by ACAL Energy's proprietary platinum free cathode technology (FlowCath®), developing Fuel Cell systems, for a range of uses including stationary, residential and automotive applications requiring larger than 1 kW of power. Its radical innovative designs will deliver substantial cost savings and performance improvements that will accelerate the adoption of PEM Fuel Cell technologies in key markets.</p>
Leyland Trucks	<p>Leyland Trucks, one of Britain's leading manufacturing companies, is a wholly-owned subsidiary of PACCAR Inc. Since Leyland Trucks was acquired by PACCAR in 1998, it has become the group's established centre for light and medium truck design, development and manufacture. Leyland Trucks is currently working on a Hybrid vehicle project supported by TSB</p>
Oaktec	<p>Oaktec is an engineering research and development partnership that focuses on energy efficient vehicle design. Oaktec are developing new technologies that will further exploit the potential of hybrid systems combined with CVT transmission in race and rally conditions.</p>

Optare	Optare is one of the most respected names in the UK bus and coach industry offers a new double decker Rapta with optional Enova hybrid drive using Lithium ion battery technology – Completely interchangeable with a diesel bus
The University of Liverpool	The Engineering department has conducted research in Alternative fuels, flex-fuel, bio-fuels, Electric Vehicles, Batteries, Ultra-capacitors, Electric Energy Management and Storage, Hydrogen Electrolytic Cells and Catalysis. Liverpool has also participated in collaborative research for Hybrid Vehicles
The University of Manchester	The Power Conversion (PC) Group at Manchester's School of Electrical and Electronic Engineering offers strong research in Electrical Machines, Power Electronic Circuits and Systems Motor Drivers & Actuators, Superconducting Devices, Fuel Cell & Energy Storage Systems, Microgrids and Power Electronics Enabled Electrical Systems for Aircraft, Vehicles & Ships. This department produced a prototype of a fuel cell Taxi. The Group's funding portfolio includes the Rolls-Royce University Technology Centre in Electrical Systems for Extreme Environments

Software, Sensors, Electronics and Telematics	
Assembly Solutions	Assembly Solutions specialise in cable assemblies & wire harnesses, battery cables, braided cables, control boxes & panels as well as full vehicle harnesses
CC Electronics	CC Electronics Europe manufacture high technology Printed Circuit Boards on very short lead times.
Norcott Technologies Group	The Norcott Technologies Group is a supplier of electronic design, development and manufacturing services to companies in the automotive, communications and industrial market sectors. Norcott's design capabilities encompass technology research, system design, circuit design, FPGA, software, firmware and compliance engineering..
Original Equipment Ltd	"Original Equipment Limited design, prototype, test and manufacture bespoke instrumentation, PCBs (including full design, prototyping, component procurement and board population), looms and cable assemblies. Also low/medium volume manufacture and assembly electronic equipment including PCBs, bespoke instrumentation, looms and cable assemblies. Innovative automotive products include: <ul style="list-style-type: none"> • TrailerSafe – monitoring secure trailer connection on trucks • SliderSafe – ensuring correct use of fifthwheel sliders
Scorpion	Scorpion's automotive electronic products include vehicle security alarms, immobilisers, etc, cellular communications and bespoke products for OE and aftermarket customers
Simkins Technologies	Simkins Technologies trades under the brand name Simtek (UK) and offers design and production of small production runs and one-off bespoke electrical automotive systems for motorsport and specialist vehicles.
TRM Electronics	TRM Electronics research, develop and manufacture innovative automation products such as Motion Controllers, Servo Systems, Servo Amplifiers, Stepper Systems, Motor Control, Temperature Control and Small Machine Control Systems.
The University of Bolton	"Bolton's Build and Engineering Department capabilities in this area are Mechatronics, Intelligent Systems, Microcontrols, Instrumentation and measurement, Microelectronics, Robotics, Neural Networks and Micropower Generation (use of Vibration Energy for Energy Storage using RF-Microelectromechanical Systems – MEMS).
The University of Liverpool	Relevant technology includes research at The Centre for Intelligent Monitoring Systems (CIMS) which brings together the strengths of sensor technology, software and telemetry. The Solid State Electronics Group has two sub-divisions: one involved with the development of advanced Thin Film Transistors (TFT) and photovoltaic structures for high performance at low cost; a second involved with the development of high performance silicon structures and novel circuits for RF,

	<p>Micropower and 3G Neural Network applications.</p> <p>The Signal Processing and Communications Group core areas of theoretical developments are signal processing, machine learning, and modelling.</p>
The University of Manchester	<p>The design expertise, measurement and test facilities of the Microwave and Communication Systems Research Group at the University of Manchester provides a unique capability to deliver research and development in the areas of wireless communication, sensing and measurement systems over the frequency range 10KHz to 140GHz.</p> <p>The range of research activities is broad, encompassing instrumentation, transducer and sensor design, signal preconditioning, signal and information processing and interpretation in both machine and biological systems.</p> <p>The Microelectronics & Nanostructures (M&N) group research activities cover a range of topics concerned with the fundamental materials and physics issues surrounding advanced semiconductor devices, novel high speed electronic and optoelectronic devices, and advanced sensors and systems.</p>
The University of Lancaster	<p>Lancaster University was a project partner in DREAM (Design for Reliability for Electronics in Automotive Manufacture) which researched the main causes of failures in high voltage (42V) integrated electronic systems representative of chassis applications (e.g. steering/braking units) and optimise the packaging options to reduce potential failure modes to a minimum.</p>

Advanced Structures and Materials	
Bentley Motors	<p>Crewe Based authentic British motor company dedicated to the design, engineering and crafting of the world's most respected high performance cars. Bentley employs more than 4,000 people worldwide.</p>
Chemical Innovations Limited	<p>Chemical Innovations Limited (CIL) is a leading manufacturer of innovative, high-performance chemical products and is a key supplier to worldwide industry. CIL serve markets such as Automotive, Aerospace, Off-shore, Printing and the Tyre industry, and supply key products and innovative solutions including high-performance primers and bonding agents for rubber and polyurethanes, industrial tyre puncture-proofing systems and mould release agents.</p>
Chevron Racing Cars	<p>Chevron Racing Cars Ltd is a racing car vehicle and component manufacturer and specialise in the restoration of historic racing cars. The Chevron arquee was established in Salford in 1965 and is recognised worldwide as a successful racing car manufacturer & race team.</p>
CHK plc	<p>CHK Plc manufacture production fabrications for use in the commercial vehicle, materials handling and process equipment industries</p>
Fuataba Tenneco UK Ltd	<p>Futaba Tenneco UK Ltd is a leading Tier 1 supplier, specialising in the manufacture of pressed parts, welded assemblies and exhaust systems. With a broad range of stamping capabilities, ranging from 60T progression through to 2500T high speed transfer, combined with high levels of excellence within the tube manipulation and manual / robotic fabrication areas.</p>
Mitras Automotive (UK)	<p>Mitras Automotive (UK) specialise in the design and manufacture of value added engineered composite components for Automotive, Agricultural and Construction vehicles. Mitras has both compression and reaction injection moulding facilities, and offers a complete range of services from simple mouldings, to Class "A" painting and full system design and assembly.</p>
R.S.Clare & Co Ltd	<p>R.S.Clare & Co. Ltd. Design and manufacture special Automotive Greases for both high performance mechanical applications such as Drive Shafts, CV Joints, Steering and Suspension Systems, as well as for Vehicle Interiors, Switches, HVAC Modules, Door Mirrors, Locks and Latches, requiring compatibility with plastics and elastomers, and high levels of noise damping and tactile improvement.</p>
Saffil Automotive	<p>Saffil Automotive offer high quality products for any exhaust system, including durable support mats and highly insulating material based on Saffil Fibre.</p>

Sanko Gosei UK	Sanko Gosei UK specialises in the moulding and assembly of plastic moulded parts for complete systems or discrete component supply to the automotive industry.
Cartright Group	The Cartwright Group is one of the most efficient bodywork and trailer manufacturing plants in Europe providing solutions from design and manufacture of one off orders or high volume batches.
The University of Bolton	Research strengths include Automobile Design and Composite Materials. The Building and Engineering department has capabilities to provide Finite Element Analysis, Crashworthiness Analysis and the State-of-the-art design studio is also equipped with industry standard engineering design and analysis software, including: ProEngineer Wildfire, SolidWorks, 3D Studio, ProMechanica, Ansys, Fluent, LSDyna, Abacus and Maya. Crash test rigs are also available. Materials research is undertaken in the Centre of Materials for Research and Innovation (CMRI).
The University of Liverpool	Research in the Structural Materials and Mechanics Group is focusing on the manufacture, modelling, characterisation and testing of advanced materials and structures. Relevant research includes: <ul style="list-style-type: none"> • The dynamic response of novel energy-absorbing lattice structures • Microstructure optimisation in high-performance metals • Smart materials and structures • The blast response of metals and composite structures • The properties of lightweight metal foams produced using novel manufacturing techniques • The impact response of composites and lightweight structures and members
The University of Manchester	There is significant research activity in Metallic Materials within the School of Materials which encompasses all aspects of metals, alloys and metallic composites. This includes design, processing, forming, modelling, joining and performance. Modelling tools to predict and optimise the materials, for given applications are being developed. Light Alloys Towards Environmentally Sustainable Transport (LATEST) Portfolio Project is a project designed to target key enabling technologies that will expand the application of light alloys within the transport sector, delivering.
The Northwest Composites Centre	The Northwest Composites Centre was established by the Universities of Bolton, Lancaster, Liverpool and Manchester to create a centre of international scientific reputation to the benefit of industry. High strength composites have gained great acceptance in areas where their lightweight and exceptional strength outweigh cost issues.

Design and Manufacturing Process	
Bentley Motors	Crewe Based company dedicated to the design, engineering and manufacture the world's most respected high performance cars.
General Motors UK	General Motors Manufacturing Ellesmere Port produces the 5-door Vauxhall / Opel Astra and Astravan models.
Jaguar-Land Rover	Halewood Operations, located in Merseyside, builds the award winning Land Rover Freelander 2 and Jaguar X-TYPE models. The plant has a reputation for excellent manufacturing quality and is recognised throughout the industry as a centre of excellence for Lean Manufacturing.
Leyland Trucks	Leyland Trucks, one of Britain's leading manufacturing companies, is a wholly-owned subsidiary of PACCAR Inc. PACCAR is a global technology leader in design, manufacture and customer support of high-quality light, medium and heavy-duty trucks under the Kenworth, Peterbilt and DAF nameplates. Since Leyland Trucks was acquired by PACCAR in 1998, it has become the group's established centre for light and medium truck design, development and manufacture.
Optare	Optare is one of the most respected names in the UK bus and coach industry.

Lairdside Laser Engineering Centre (LLEC)	The LLEC bridges the gap between research concept and shop-floor production, allowing unrivalled access to expertise, equipment and training in the field of laser material processing. The Centre's ability to transfer processes from laboratory experiment to robust industrial method is an important resource for manufacturing industry.
Daresbury Science and Innovation Campus	The Computational Science & Engineering Department (CSED) at Daresbury SIC combines expertise in fluid flow modeling with the latest high-performance computing technology to enable the solution of complex fluid dynamic problems using leading edge Computational Fluid Dynamics.
Only the principle vehicle manufacturers and an examples of key advanced manufacturing and computational analysis resources have been listed. A significant number of component suppliers that have design, prototyping and or manufacturing responsibilities exist. In addition to the expertise within the region's universities in design and manufacturing, the region is also host to a small number of design and manufacturing service and support companies.	

The research and discussions with companies and universities relating to Foresight Vehicle Technologies has resulted in the following conclusions.

Conclusions

- Considerable strength exists within the Northwest region's HEIs on Foresight Vehicle technologies e.g. materials, materials processing, electric vehicle technologies and sensors and software. These capabilities are not explicitly promoted by the universities and are not widely recognised by the region's automotive and automotive related companies
- Participation by the industry sector in the foresight vehicle project and the TSB programmes by the North West region is lower than expected for the second most important automotive region in the UK. The knowledge and understanding of these programmes appears weak and there is also a concern that the themes in such programmes are 'car centric'
- Key automotive players such as Jaguar and General Motors are in the main assembly plants with R&D activities located outside of the region
- The region has a 'critical mass' of capability in Low carbon Vehicle technologies which will be discussed in a later section
- There are a number of 'pockets' of strong innovation, specialised technology providers and underexploited advanced technology facilities in the region
- Until recently the emphasis within many of the key companies has been on incremental innovation, specifically in product and process improvement. With the focus on climate change there is a greater interest in Low Carbon Products, Systems and technologies and collaboration, collaborative R&D and partnerships to share the risk of innovation in this area
- The Foresight Vehicle Technologies remain of relevance to the cluster and there are a large number of companies that could benefit from a more focussed and easier to access support programme
- The NAA should play a stronger role in promoting opportunities for increasing the participation of automotive and automotive related businesses and HEIs in Foresight Vehicle technologies.

6.2 Low Carbon Vehicle Developments

The Cenex Arup study (6) identified a number of regional Low Carbon Vehicle programmes underway or in preparation. These are programmes involving groups of stakeholders that include for example vehicle manufacturers, energy companies, local authorities and regional development agencies. The exact status regarding funding and progress of these programmes is not detailed. Some of these are just at the discussion stage.

These include:

- **Central London** - with involvement of motor industry, energy company and active sponsorship from the Local Authority
 - o Flagship urban centre
 - o Established recharging points
 - o PHEV Trials already underway (Toyota/EDF)
- **London (West)** - with involvement from Local Authority and limited involvement from energy company
 - o Pioneering boroughs including Richmond
 - o Urban location
- **West Midlands** - with active sponsorship motor industry, RDA and HEI base, involvement by local authority and limited involvement by energy company
 - o Technology cluster with urban component
 - o Group of interested stakeholders focused on Coventry and Warwick
 - o Local industry including TATA, JLR and Midlands Niche Vehicle Network
 - o Strong RDA support
- **Glasgow/Strathclyde** - with active sponsorship by energy company, involvement by Local Authority and Scottish Enterprise , limited involvement from vehicle industry and HEI base
 - o Technology cluster with urban component
 - o Group of interested stakeholders focused on Glasgow (City Council, Allied vehicles, SE plus Southern Scottish Energy
- **Newcastle** – with involvement from the motor industry, Local Authority and limited involvement by energy company, HEI and RDA
 - o Technology cluster with urban component
 - o Group of interested stakeholders including One North East, Smith Electric Vehicles City Council and Newcastle University

The organisations consulted in the Cenex-Arup study provided their views on potential routes to the take up of EVs and PHEVs and suggested approaches included:

- **High Level approaches**
 - o Motor industry led technology trial technology push
 - o Top down approach where policymakers drive deployment by regulatory push
 - o Interested communities provide a market pull to deployment
- **'Centre of Excellence' Proposition**
 - o Physical centre for dedicated research, development and design located at a higher education institute with a high level of competency in Low Carbon Vehicle Technologies within an area in which EV and PHEV laboratory and on road testing trials could be easily conducted
 - o Virtual network of industry (technology providers), Academia. business and fleet operators and sponsors RDAs and agencies including Cenex and the TSB .

At the recent New Automotive Innovation Growth Team stakeholder validation event 5 Feb 2009 some of the Low Carbon demonstrators were presented. This is shown in Figure 6.

'Test Bed UK' (Demonstration)

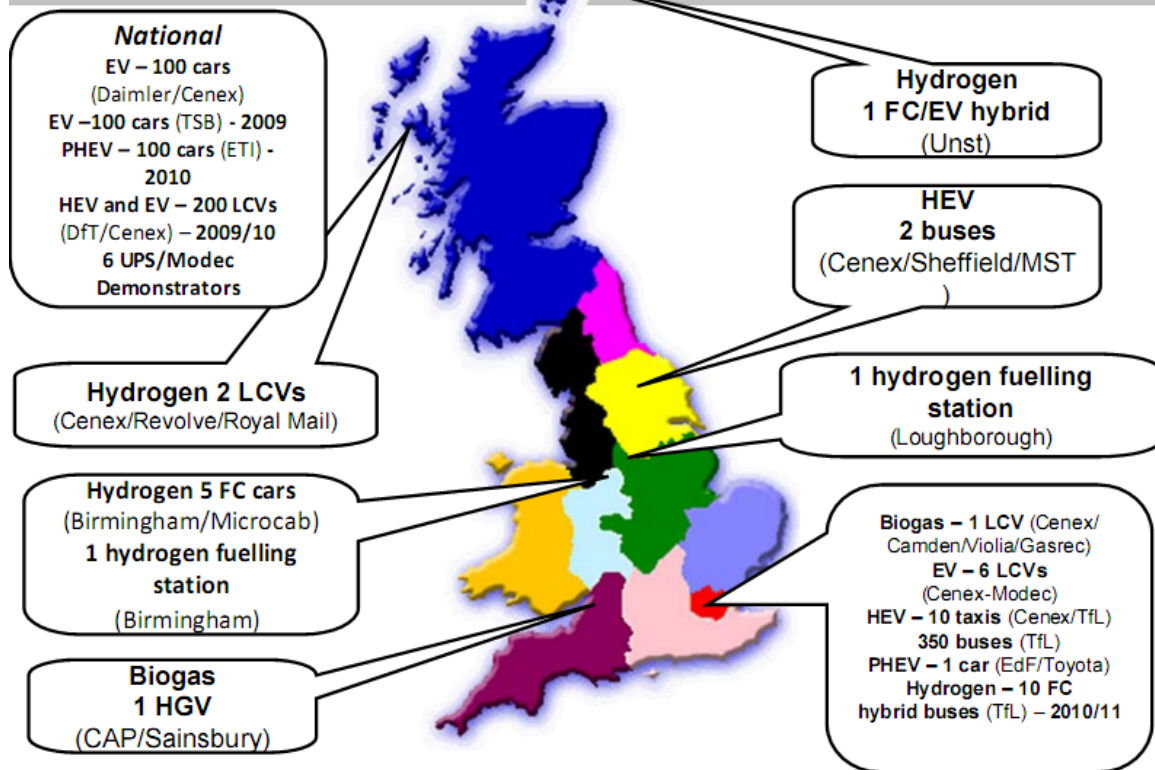


Figure 6 Test Bed UK Low Carbon Vehicle Developments⁶

Although there are a number of discrete Low Carbon Vehicle Developments taking place within a number of companies and the region's universities, there is little activity in the way of regional Low carbon Vehicle programmes or in major demonstrators such as those identified above.

It also would appear to be disconnected from the scoping and shaping of the technology themes relating to Low Carbon Vehicle Developments and there is little regional involvement with some of the expert groups on Low Carbon Technology and Infrastructure policy making. There is also a perception from players outside of the region that the North West is behind other UK regions in its Low carbon development activities. Some regional development agencies have stated their commitment to co-fund TSB Low Carbon activities and as indicated by the Arup Cenex report, other regional economic agencies are more proactive in facilitating or providing funds to initiate and catalyse regional pilot projects.

Low Carbon Vehicle Developments in the Region

A review of regional players in Low Carbon Vehicle technology was identified as part of the research. As part of the promotion of the Northwest at the Cenex Low Carbon Vehicle Event in October 2008 at Millbrook, the following Northwest companies and organisations participated:

- **Leyland Trucks** - Hybrid Vehicle development
- **Optare** - Hybrid Vehicle Development
- **Torotrak** – infinitely variable transmission

⁶ NAIGT Stakeholder Event 5th February 2009

- **Libralato Engines** - The engine is a breakthrough technology, 'eco-engine' exceptionally compact, powerful, efficient, clean and quiet and a potential range extender engine for hybrids
- **Acad Energy** - ACAL Energy Ltd is the world's leading developer of low cost Proton Exchange Membrane (PEM) Fuel Cells, powered by ACAL Energy's proprietary platinum free cathode technology (FlowCath®).
- **Clean Air Power** - has pioneered the move towards using natural gas to power vehicles by developing Dual-Fuel™ technologies that guarantee diesel engine performance, with significant cost savings and low carbon emissions.
- **Kestrel Engineering** - flywheel and an infinitely variable transmission (IVT)
- **Oaktec** - The Oaktec Honda Insight uses fuel efficient hybrid technology, which combines electric and internal combustion engines in a sporty package which is clean and green...and fast.
- **Manchester University** – School of Electrical and Electronic Engineering, Rolls Royce UTC, power electronics, electric motor drives, electromechanical systems

The research and discussions with companies on Low Carbon Vehicle developments has resulted in the following conclusions.

Conclusions

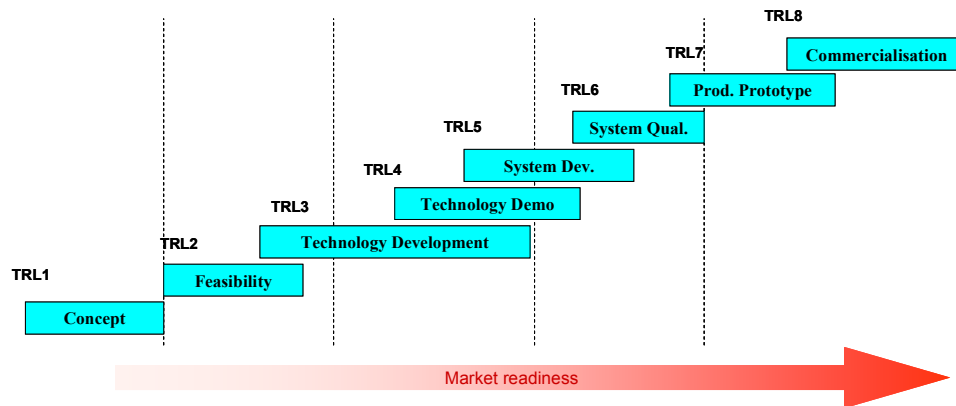
- **There is a developing core of Low Carbon Vehicle Technology expertise within the Northwest region**
- **The Northwest has an excellent reputation for research and development, design engineering and manufacturing. The development of Low Carbon Vehicle technologies provides an opportunity for the region to take a greater lead in the development and deployment of the new technologies required.**
- **Pilot and demonstration projects will be critical to address the questions and concerns of all stakeholders involved in Low Carbon Vehicle technologies and to provide an evidence base for the future wider roll out of vehicles**
- **The development of a low carbon vehicle 'Centre of Excellence' or regional 'TestBed' possibly centred on the expertise and experience that already exists would be a valuable physical asset to the region. This would also align with the UK TestBed network that is being discussed by the New Automotive Innovation Growth Team**
- **The development of a Low Carbon Vehicle Virtual Network would be beneficial. This recommendation would consolidate the existing knowledge and expertise in the Northwest region and enable knowledge sharing and transfer and assembly of bidding consortia for TSB, EU Framework7.**
- **The scope for regional pilot projects should be discussed with regional stakeholders e.g. automotive companies, utilities, transport executives public sector procurement, energy companies etc. These pilots could be co-funded by the regional agencies as an alternative to TSB and aimed at early commercial exploitation and scale up.**

6.3 Innovation Support Infrastructure – Invention to Innovation

The Support for Northwest Businesses leaflet published in December 2008 lists the services and public and private sector support available to individuals and businesses in the start up and expansion stages. These services are provided via Business link Northwest and cover for example:

- **Business Finance**
 - Small Loans for Business
 - Grant for Business Investment
 - Venture capital and Loan Funding
 - Northwest Business Angels
- **Advice for New and High Growth Businesses**
 - Start up
 - High Growth Coaching
- **Innovation and Efficiency**
 - Knowledge to Innovate
 - Grant for Research and Development
 - Innovation Vouchers
 - Knowledge Transfer Partnership

Most innovations pass along a ‘chain’ whereby they progress from the invention/concept to commercialisation. The use of the Technology Readiness level⁷ shown in Figure 7 is becoming more widely used by some companies and government agencies as a means of assessing the maturity of technology or invention.



TRL –Technology Readiness level

Figure 7 Technology Readiness Ladder

At each stage there can be a number of driving or inhibiting forces. The overall innovation performance depends on the scope and efficiency of each stage (Innovation Support Infrastructure).

TRL1-TRL2 (Concept to Feasibility)

These stages are often referred to as the invention, proof of concept and early stage development. The consultations with companies that have explored the use of the regional business support services in these stages have experienced disappointing results. This is not too surprising as high technology innovation, by its nature requires specialised technical knowledge and experience in routes to market and commercialisation. Individuals with the ability to support the validation of both technologies and markets are scarce.

⁷ Technology Readiness Levels in the National Aeronautics and Space Administration(NASA)
(Source: Mankins (1995), Technology Readiness Levels: A White Paper)

Business Angel investors and Venture Capital companies are often only interested when the initial concept has been validated and/or feasibility has been evaluated).

TRL3-TRL6 (Technology Development to System Qualification)

These stages are supported by collaborative R&D programmes such as the TSB. For a small company with little experience of collaborative research and even larger companies without in-house expertise, the application process can be complex and success is not guaranteed. Although the candidate innovation may be new to the company applying for support, often it lacks the innovation qualities required by the TSB criteria resulting in rejection of the application at the expression of interest stage. The overhead in preparing bids for small companies can be significant. Since bids have to be industry led unless there is already an existing relationship between the company and an appropriate university, the time between launch of the call and bid application can be too short.

Confidentiality of innovation application often precludes companies from using this particular channel for innovation developments.

The mi Technology group is a good example of an innovative technology service company. Mi Technology has a strong science and technology background supported by equally strong entrepreneurial skills. These have enabled mi Technology in addition to forming several start up companies to be pro-active in identifying and supporting projects at different TRL levels. mi Technology has as a result of this activity developed a logical structure to:

- connect creative inventor to investor
- manage creative thought process into a logical development programme
- connect programme to markets
- manage creative inventor with needs of disciplined corporate investor

and with appropriate investor support has created two new companies which have now progressed up the technology ladder with one at a stage of being linked to a global partner and with the prospect of flotation and the other bidding for significant contracts.

Discussions with mi Technology has confirmed our research that stages TRL1-TRL4 are critical in the innovation process and getting to TRL4 represents the highest risk for investors as the concept remains unproven to this point. Their independent research confirms that there is a gap in present support structures. mi Technology also identified the importance of a sustainable pipeline and portfolio of innovative project ideas and concepts.

The research and discussions with companies on the regional innovation support infrastructure have resulted in the following conclusions. These have been aligned with the stages in the Technology Readiness ladder.

Conclusions

- **At the TRL1-TRL3 levels there is a gap in the current business support infrastructure which is unlikely to be filled by generic services**
- **A technology mentoring and support process for automotive and automotive related applications for TRL1 – TRL3 stages is required**
- **There is an opportunity to build upon mi Technology's proven experience and investor contacts for collaboration to develop a pipeline and portfolio of product concepts and ideas that can be supported (technically and financially) and accelerated through the TRL1-TRL4 stages**
- **A pro-active service promoted via the NAA website is required to encourage and stimulate invention/innovation and secure a portfolio and pipeline of applications**
- **Connections to potential investors (Business Angels, Equity Investors, Venture Capital companies and mi Technology) at the early stage development are required**
- **At the TRL3-TRL6 stages there is a market failure with the present TSB innovation programme**

- **A regional funded collaborative R&D programme designed to 'kick-start' business to business and business to HEI collaborative R&D activities has potential to address the above market failure**
- **Establish a regional innovation collaboration network to facilitate networking and formation of collaborative networks to promote activity at the TRL3-8 levels**

6.4 Automotive Cluster Innovation Characteristics

In this section a summary of the evidence that has been gathered from the various sources is presented. The findings have been structured around characteristics commonly associated and used to assess innovation performance of companies.⁸ In this context the characteristics relate to the general automotive cluster, the underpinning processes and the activities taking place at a cluster or regional level. It should be recognised that many of these characteristics are related and not mutually exclusive.

The characteristics are as follows:

- Innovation Culture – The leadership, environment and support that exists to stimulate and encourage innovation
- R&D Intensity – The quality, status, investment level of relevant research taking place at a cluster or regional level
- Skills – Type, level and relevance of skills to support innovation in the cluster
- Finance – The availability and accessibility of finance and funding (Private and public sector) to support innovation
- Technical Capability – The technical strength and capability that exists within human resources of companies, HEIs, technical services and shared technical assets within the cluster
- Communications Internal – This relates to the level of communication, collaboration and mechanisms that exist inter cluster to lead, sponsor and support innovation
- Communications External – Relates to how the cluster and its members communicate and engage external bodies such as BERR, NAIGT2, CENEX, TSB other policy makers, influencers and collaborators to create and form innovation partnerships
- Inter Industry Linkage - Considers the extent of cross sectoral innovation activities taking place and recognises the range and diversity of science and technology solutions and collaborations
- University/College Interactions – Relevant and effective knowledge transfer and interactions between companies in the cluster and HEI and Colleges are important to support research collaborations and skills developments
- Technology - Relates to the level of supply and demand technology in the cluster. With the emphasis on low carbon vehicles, new technologies and approaches are required to ensure competitiveness and sustainability of the cluster
- New Products – This is a key output from innovation and relates to new products emerging at an enterprise level within the cluster
- New Processes – This is also a key output from innovation and can relate to new processes (manufacturing and or service) processes emerging at an enterprise level within the cluster. The processes could also be regarded as processes which support and encourage innovation
- New Markets – Market diversification or market entry are outputs resulting from innovation

⁸ Managing Innovation and New Technology, an initiative of the SPRINT Programme, an Innovation Programme forerunner

- ICT – Information and communications technology is often an enabler of innovation. In the automotive context this is often related to the extent of use of computer aided design and engineering analysis and tools or telematics applications
- Customers – Customers are beneficiaries of product, process and service innovation. Customers are also potential drivers of innovation providing market pull for new innovation
- Suppliers – This relates to companies in the cluster who are suppliers to other companies or downstream or upstream suppliers and are influencers or influenced by innovation developments taking place within the cluster

There now follows a brief summary of each of the above innovation characteristics of the cluster.

Innovation Culture

The majority of the large companies demonstrate high levels of innovation in their products and manufacturing processes. Many of these companies are considered to be regional and even UK Lean Manufacturing exemplars. Many of these companies have shared their experience of this form of incremental innovation with their suppliers and other companies in the region through the supplier development programmes administered by the NAA. There are other pockets of product innovation in the region, for example development of a hybrid racing car, continuously variable transmission and dual fuel system for trucks which has led to a pilot project involving a major retailer running a small number of Heavy Goods Vehicles powered by bio-methane from a landfill site. The region has considerable strength in its university base and there are several examples of innovative R&D projects in foresight vehicle technologies taking place.

Although there are a number of good examples of innovation, it is essential to broaden the base within the overall sector.

An earlier cluster mapping study identified the need to increase the capacity and capability to innovate.

R&D Intensity

This is a widely accepted indicator of innovation performance and is usually measured at a regional level by the Business Expenditure in Research and Development BERD and or business expenditure on collaborative R&D with the HEI base. The new AIGT has recommended a number of metrics for tracking R&D activity in the UK automotive sector.

For this study the basis of the assessment of R&D intensity relates to the analysis of participation by the automotive sector with funded RTD programmes such as Foresight Vehicle and TSB programmes. This suggests that although there are some good examples the level is relatively low considering that the Northwest is the second most important automotive region in the UK.

Skills

In a recent study the problem relating to the need for increasing high level skills at the technician and graduate engineering level was highlighted. The problem of attracting new engineering talent and skills into the sector is also recognised at a regional and national level.

With the growing interest in Low Carbon Vehicle technologies there is a need to ensure that appropriate skills are developed to support the new innovation, design, development and engineering skills required to keep the region competitive.

Finance

Innovation needs access to finance to support early stage product and process developments. At a later stage finance is required to support product commercialisation and market entry.

The credit crunch and the difficult economic environment are affecting companies' ability to participate in large scale projects and where new products and processes are required to support climate change a higher level of intervention support from

government departments is required. Greater levels and/or an improved structure for early stage finance and funding is required.

Technical Capability

There is a latent and underexploited strength and capability in Foresight Vehicle technologies (e.g. Materials (metallics and composites), Electrical and Electronics, Design and Manufacturing) in many of the region's universities.

The study has also identified a critical mass of companies working on LCV activities. Effort is required to increase the access to technical capability, increase relevant activity and support knowledge transfer.

Communications Internal

This characteristic relates to communications inter sector. Communications are essential for knowledge transfer, development of partnering and risk sharing.

The study has indicated that the overall knowledge of innovation requirements supply and demand in the region is weak. There is a need to enhance the business to business and business to HEI communications at a regional level.

Communications External

This characteristic relates to how the sector promotes and communicates its capability and position to the outside world – Policymakers, policy influencers, government partners, investors and inward investors. It also covers the communications from external innovation partners to the sector.

There is a lack of knowledge on the capability of the Northwest sector at a national level. Greater communication with national innovation partners such as AIGT2, CENEX, TSB, FP7 is required to build relationships and collaborative partnerships.

Inter Industry Linkage

Many industry sectors are reviewing their innovation processes. New technologies are often cross sectoral in their application and the requirements to deliver the Low Carbon economy are common across a number of sectors. There is therefore a greater need for effective inter industry linkages.

There is potential for greater cross cluster collaborations in areas such as reducing waste, emissions, energy and adoption of sustainable manufacturing principles. Greater collaboration with public sector procurement bodies and procurement initiatives in particular Sustainable Transport are required. Public sector procurement can play a role in stimulating market demand for new environmental technologies.

University College Interaction

Effective collaboration with regional universities is an essential determinant for innovation growth and sustainability across the sector. Like many regions the Northwest has introduced an Innovation Voucher scheme to stimulate interaction between regional businesses and the Northwest universities.

The collaboration between the sector and the regional universities appears less strong in comparison to other comparable automotive regions e.g. East and West Midlands with Loughborough and Warwick, Coventry and Birmingham respectively.

Technology

Technology has always featured as a distinctive contributor to the Northwest's economy. New technology developments and time to market are often a reflection of the efficiency and effectiveness of the regional and national innovation support infrastructure. Technology Readiness Level TRL is becoming a more popular means of assessing the technology assets of a company, university and region.

There are good examples of advanced technology within companies, HEIs and at an individual inventor level. The region is host to two key companies in the Truck and Bus market sectors, Leyland Trucks and Optare. However unlike other regions there is little taking place in the way of existing or planned Public Sector funded Low Carbon

Demonstrator products to help accelerate technology developments in these products. Furthermore the technology roadmaps and foresighting discussions on future Low Carbon Vehicles taking place at a national level appear to be 'car centric'.

New Products

Within the established large vehicle manufacturers plans for new products are being developed. With the exception of Leyland Trucks, Optare and Bentley the decisions and innovation relating to these new products are taking place outside of the region. In the move towards low carbon vehicles it is likely that traditional supply chains will be disrupted and new systems, components and services such as battery technologies, energy storage (flywheel, ultra-capacitors), energy management, power electronics, lightweight materials etc will be required.

The activities in Low Carbon Vehicles, products, components and systems aimed at commercial vehicles, buses and niche vehicles should be reviewed to support the development of future supply chains .

A more efficient and effective system to pull through new products at the concept and feasibility stage is required.

New Processes

Manufacturing processes are covered in the regional manufacturing strategy and at a sectoral level in the NAA Supply Chain Development Strategy and it is suggested that more focus should be given in these to sustainable manufacturing with specific emphasis on Reuse, Recycle and Remanufacture.

A new joined up process for supporting automotive and automotive related companies progress up the Technology Readiness ladder (Concept to Commercialisation is required.

New Markets

Recent events facilitated by NAA and UKTI have encouraged companies in the sector to explore opportunities for new markets e.g. India, Egypt.

During this study enquiries from UKTI relating to the region's capabilities in engine control systems and material light weighting from major global automotive players. This is indicative of the random inputs received and there is perhaps a need to be more pro-active in prospecting and dealing with such enquiries.

NAA should continue to facilitate and support appropriate UKTI export and Inward Investment initiatives.

More robust and pro-active promotion and marketing of the region's capabilities on vehicle foresight technologies is required.

ICT (Information and Communications Technologies)

ICT can play an important part of underpinning innovation and is often an important enabler of innovation in products and systems. The data gathering has identified key regional ICT assets such as the powerful computing facilities at the Daresbury Innovation Centre and is associated Computational Fluid Dynamics capabilities. Other facilities to provide CAD/CAM capability for SMEs exist within the region.

Ensure that the cluster is aware of and taking advantage of developments in ICT and able to access available regional computing assets and technology.

Customers

Innovation with customers of the automotive sector has largely taken the form of incremental innovation through supplier development programmes.

Future programmes delivered to the sector should in addition to incremental process innovation identify opportunities for partnering customer companies in product, process and service innovation.

Suppliers

A number of supplier development programmes have taken place and these are likely to continue as part of the NAA Supply Chain Development Strategy.

As developments in Low carbon Vehicles mature, the existing supply chains may be disrupted and this may create new opportunities for companies able to supply, for example, battery technologies, power electronics, energy management, driveline controls, control software etc. There is a need to identify and scope supply chain requirements for future vehicles and also the supply chain required to support electrification of vehicles and also alternative fuels infrastructure.

7. Strategic Themes

Based on the above assessment and supporting background research the following strategic themes (ST) are proposed:

ST1 Promote and develop the regional technology capability particularly around Foresight Vehicle Technologies.

- 1.1 Promote the HEI capabilities in key Foresight Vehicle Technologies inter cluster and outside of region to policymakers, influencers and stakeholders
- 1.2 Identify, develop and monitor advances in key Foresight Vehicle Technologies appropriate to the North West region e.g. Low carbon Vehicles, Materials and Design and Manufacturing processes
- 1.3 Encourage industry and HEI ownership of the strategic theme

ST2 Develop an Innovation Support process to lead companies through the key innovation stages by

- Setting up robust system to capture pipeline of innovation concepts and ideas
- Effective proof of concept evaluation TRL1-TRL3
- Access to funding and finance (Private and public sector),
- Supporting and monitoring progress through TRL1-TRL4
- Developing routes to market

ST3 Enhance the business to business and business to HEI innovation collaboration by

- 3.1 Developing a process to facilitate innovation collaboration
- 3.2 Supporting industry led, collaborative innovations which address key innovation platforms
- 3.3 Supporting innovation projects which lead to economic impact and longer term sustainability

ST4 Increase the level of regional activity in collaborative research and development by

- 4.4 Establishing a regional automotive cluster innovation network
- 4.5 Synchronising network meetings with imminent R&D competition programme calls
- 4.6 Forming innovation special interest groups

ST5 Scope regional 'test bed' for Low Carbon Technology Development

- 5.1 Scope facilities and evaluate market demand for facility for Low Carbon Technology development

ST6 Improving overall Innovation Culture in cluster by

- 6.1 Improving leadership and unlocking innovation potential in small companies
- 6.2 Developing innovation skills
- 6.3 Identifying appropriate innovation benchmarks for cluster

ST7 Progressing Delivery of the Strategy by

- 7.1 Establishing a regional automotive innovation growth team
- 7.2 Aligning regional Innovation areas and direction with AIGT2 and TSB developments

The strategy supports the 2009-2019 Automotive Cluster Strategy and will be delivered through the proposed 3 year action plan which is presented in Appendix 2. The activities required to deliver the strategy are presented in Table (1)

Table (1) Activities to Deliver the Strategy

Strategic Themes		Activities
ST1	<p>Promote and develop the regional technology capability particularly around Foresight Vehicle Technologies</p> <p>The3D website has been developed and can be viewed at www.nwfuturevehicle.com</p>	Launch the Future Vehicle 3D web-site. This is a unique three dimensional interactive presentation of the region's capabilities (HEI and companies) in Foresight Vehicle Technologies.
		Ensure input to the database by regional companies and universities and that content is regularly updated
		Review website visitor statistics
		Develop network/forum capabilities on website
ST2	<p>Develop an Innovation Support process to lead companies through the key innovation stages</p> <p>This process is predominantly aimed at TRL1-TRL4 and addresses a gap in the current support infrastructure. This process is also a pre-requisite for any subsequent commercial investment.</p>	Set up technology assessment/mentoring support process delivered by experts with vehicle expertise
		Promote service through NAA website
		Signpost to sources of funding e.g. Innovation vouchers, Grants for R&D, University Schemes etc
		Establish links to sources of funding public and private sector and set up meet the funder events
ST3	<p>Enhance the business to business and business to HEI innovation collaboration</p> <p>This process addresses market failure of TSB Scheme and is aimed at projects of smaller scale involving a minimum of two collaborators addressing the TRL3 to TRL6.</p>	Set up regional funded collaborative R&D programme designed to 'kick start' business to business and business to HEI collaborative R&D activities
		Evaluate industry led , collaborative partnership proposals addressing innovation platforms for funding support that deliver regional outcomes and metrics
		Monitor and report impact
ST4	<p>Increase the level of regional activity in collaborative research and development</p> <p>Aimed at increasing collaborative research and development activity by companies and HEIs in the region on appropriate themes.</p>	Establish regional innovation network
		Hold innovation network meetings at intervals appropriate to TSB Competition and Framework 7 Calls
		Set calendar of dates for network events
ST5	<p>Scope regional 'test bed' for Low Carbon Technology Development</p> <p>Concept built around a 'plug-n-play' facility where Low carbon Technology systems (hardware, software) can be developed and tested. Facility would also allow third party testing of supplier products. Concept fits with Test Bed UK approach being discussed by NAIGT.</p>	Scope facilities and market demand for facility for Low Carbon Vehicle Technology development.
		Develop investment proposal and business plan for regional funding
		Develop governance and operational structure
ST6	<p>Improving Innovation Culture</p> <p>Based upon assessment of individual company innovation needs. Workshop based delivery with management team with defined outcomes and measures. Potential to use</p>	Change management approach to unlock innovation potential in small companies
		Identify appropriate innovation metrics

	existing proven approach developed by Liverpool University	Develop funding justification
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ST7	Progressing Delivery of the Strategy Industry Led Leadership Teams can provide an overarching role for championing and influencing regional and national policy and funding. This Team would also take responsibility for implementing the proposed regional collaborative R&D programme.	Establish Automotive Sector Innovation Growth Team comprising representatives from NAA, Industry, Academia, NWDA, Regional Public Sector Procurement (Sustainable Transport) etc
		Set Terms of Reference and structure and meeting frequency
		Agree priority of strategy themes and actions monitor and support delivery of strategy

8. Measures of Success

The proposed Innovation Strategy will support the overall NAA strategy to achieve:

- Increased turnover and GVA in the cluster
- Increased output from the vehicle and component manufacturers
- Increased collaboration (amount and expenditure) between companies and universities with technology development initiatives relevant to the design, development and manufacture of future vehicles
- Develop Leading Edge demonstrator facilities supporting the Low carbon Vehicle agenda and the infrastructure required to support future vehicle developments
- Increase the intensity of activities from innovation to commercialisation (Volume and success)
- Increase the private sector funding for invention to innovation (Number of investors and value)
- Increased activity and participation in National collaborative R&D programmes such as TSB and European programmes such as FP7 (number and value)
- Support the region to create and sustain an environment and infrastructure, recognized as an area of world-class technology achievement
- Attract new talent and technology investment to the region
- Enhance regional automotive cluster profile to Inward Investors
- Increase the number of companies supported with projects with Northwest universities
- Increase number of employees supported with skills relevant to foresight vehicle technologies needs
- Increase number of publications in relevant press and other PR media

9. Implementation

Implementation of the Innovation Strategy will be progressed by the NAA and the proposed new Automotive Sector Innovation Leadership Council. ASILC.

8. References

Appendix 1 References

- (1) Innovation Nation, DIUS March 2008
- (2) Manufacturing new Challenges, New Opportunities, BERR-DIUS, September 2008
- (3) Five Dynamics of Change in Global Manufacturing, BERR Economics Paper 2, September 2008 supporting reference (2)
- (4) High Value manufacturing Key Technology Area 2008-2011 Technology Strategy Board September 2008
- (5) Northwest Regional Innovation Policy (Draft for Consultation), NWDA, March 2008
- (6) The Automotive Innovation Growth Team Report, May 2002
- (7) Foresight Vehicle Technology Roadmap , SMMT , 2004
- (8) Delivering the Low Carbon Economy- Business Opportunities for UK Manufacturers ,EEF in partnership with Deloitte, January 2008
- (5) The North West Automotive Industry Cluster Mapping Study, March 2002
- (6) Investigation into the Scope for the Transport Sector to Switch to electric Vehicles and Plug-In Hybrids CENEX, ARUP Report for BERR and DfT October 2008

Appendix 2 List of Organisations Consulted

Organisation	Principal Activities
<i>Leyland Trucks Ltd</i>	Design , Manufacture of commercial vehicles
<i>Optare Group Plc</i>	Design, Manufacture of buses
<i>Mi Technology Group</i>	Independent Testing, Development and Consultancy services to automotive manufacturers and suppliers
<i>Torotrak Plc</i>	The world leader in full-toroidal traction-drive transmission technology, focused on the development of IVT (Infinitely Variable Transmission) and TCVT (Toroidal Continuously Variable Transmission)
<i>Clean Air Power Ltd</i>	Clean Air Power has pioneered the move towards using natural gas to power vehicles by developing Dual-Fuel™ technologies that guarantee diesel engine performance, with significant cost savings and low carbon emissions
<i>Libralato Engines Ltd</i>	Clean tech research company developing the Libralato rotary engine
<i>Acal Energy Ltd</i>	ACAL Energy is developing Fuel Cell systems, modules and consumable chemicals for a range of uses including stationary, residential and automotive applications requiring larger than 1 kW of power.
<i>Kestrel Powertrain Ltd</i>	KESTREL designs mechanical regenerative braking systems employing infinitely variable transmission that can be retro-fitted to existing buses and trucks to give up to 30% energy savings for a typical urban cycle
<i>Lodematic Ltd</i>	Lodematic is a leading UK Manufacturer of Hydraulic Cylinders, Hydraulic Jacks, and Hydraulic Rams
<i>Original equipment Ltd</i>	Design and Manufacture Fifthwheel Sensor Systems - TrailerSafe and SliderSafe systems
<i>Oaktec Ltd</i>	Oaktec is an engineering research and development partnership that focuses on energy efficient vehicle design. Oaktec have developed two successful hybrid rally cars based on Honda IMA hybrid vehicles
<i>ATP Consultants Ltd</i>	ATP provides expertise which covers all facets of electrical and electronic systems for industrial, commercial and automotive applications, from system specialists to manufacturing support.
<i>Trantor International Ltd</i>	Trantor International Ltd is a UK based marketing and sales company which builds markets and sells the Trantor tractor technology overseas
<i>Mitras Automotive UK Ltd</i>	Mitras is a leading supplier of engineered composite components to industry
<i>Scorpion Systems Ltd</i>	Scorpion designs manufactures and distributes vehicle security, vehicle tracking, Cellular Communications and parking sensors
<i>Performance Springs Ltd</i>	Performance Springs manufactures high quality and precision spring products. The company specialises in the design, development, manufacture and testing of high quality made to order spring products.
<i>RHKL Ltd</i>	RHKL researches develops and commercialises emissions control technology
<i>Origo Industries Ltd</i>	Origo developed the Ecobox an all vehicle modification unit to reduce the emissions output of a given vehicle by utilizing the emissions captured to regenerate bio fuel.
<i>OMIC</i>	OMIC is a UK government supported University Innovation Centre for the speciality organic materials and polymer industries, and is bridging the gap between the knowledge which UK Universities generate and that which businesses need in order to innovate and grow
<i>RTC North West Frameworks Northwest</i>	FrameworksNW is a free support service funded by NWDA to help organisations across the region access European funding for Collaborative Research through the European Framework Programmes.

<i>Daresbury and Campus</i>	<i>Science Innovation</i>	Daresbury Science & Innovation Campus is world class location for hi-tech business and leading edge science. It provides a unique environment for innovation and business growth, with knowledge sharing, collaboration and networking
<i>Chemicals NW</i>		Chemicals Northwest is the industry-led chemical cluster support organisation for North West England, funded by the Northwest Regional Development Agency (NWDA). It is a membership organisation that represents the interests and activities of the chemistry-using industries
<i>Northwest Alliance (NWAA)</i>	<i>Aerospace</i>	NWAA is the industry-led aerospace cluster support organisation for North West England, funded by the Northwest Regional Development Agency (NWDA). It is a membership organisation that represents the interests and activities of the aerospace industry sector
<i>Envirolink</i>		Envirolink Northwest is supported by the Northwest Regional Development Agency (NWDA) to improve the competitiveness of the region's energy and environmental technologies and services sector
<i>NWDA</i>		Regional Development Agency departments Inward Investment, Clusters, Innovation, Finance
<i>Liverpool Academy</i>	<i>Innovation</i>	Delivering Innovation through an innovation network

Meetings with Universities - These identified and discussed Foresight Vehicle Technologies

<i>University of Liverpool</i>	Foresight Vehicle Technologies
<i>Liverpool John Moores University</i>	Foresight Vehicle Technologies
<i>Salford University</i>	Foresight Vehicle technologies
<i>Manchester University</i>	Foresight Vehicle Technologies
<i>University of Bolton</i>	Foresight Vehicle Technologies
<i>University of Central Lancashire (UCLAN)</i>	Foresight Vehicle Technologies
<i>Lancaster University</i>	Foresight Vehicle Technologies

Other Government Bodies and Delivery Partners

<i>DBERR</i>	New Automotive Innovation Growth Team
<i>TSB</i>	High Value Manufacturing, Low Carbon Vehicle, Materials
<i>CENEX</i>	Low Carbon Vehicle Programmes, Low carbon Networking Events

Appendix 3 Action Plan 2009 – 2012

Strategic Theme	Theme Area	Activity	Action Number	Action	Lead	Progress / Comments
ST1: Support the regional sector through the current economic situation by, understanding the impact it is having and provide support where possible, preparing the sector for a future upturn, ensuring all public sector support is co-ordinated and customer focused	Economy	Monitor the impact that the current economic situation is having on companies in the region and report and lobby support.	1.1	Host quarterly breakfast meetings with companies in the region to identify issues and concerns and raise awareness of support available	NAA	Initial meeting on 29th January 09
			1.2	Report back to NWDA and BERR on a quarterly basis on company impact, issues and concerns	NWDA/NAA	Feedback from initial breakfast meeting fed back to NWDA and BERR
		Facilitate support where appropriate ensuring a joined up approach	1.3	Establish a stakeholder group of relevant public sector organisations	NWDA	Identify key persons to join the group e.g NWDA, NAA, BLNW, MAS, UKTI & SRPs. Peter Holland to develop ToR and membership of group.
			1.4	Share issues and concerns and identify actions to provide support	Public Sector Stakeholder Group	Group to meet on a quarterly basis
		Establish and support a network of tier 2 and 3 (SME) companies to share issues and best practice	1.5	Submit and have approved an SME Excellence Network proposal	NAA	Concept submitted to be funded from ERDF monies and linked to AMSC programme
			1.6	Establish steering group and undertake pilot activity to support SME Excellence Network model	NAA	Steering group established and pilot activity underway
			1.7	Facilitate SME Excellence Network activity	NAA	Subject to project approval
ST2: Enhance current supply chains by, enhancing the logistics capability of the vehicle manufacturers, providing the right infrastructure and facilities, developing people with the right skills, supporting continued investment in the regional based companies	Supply Chain Competitiveness	Identify the current and future infrastructure needs of the vehicle manufacturers and put in place an action plan to respond to those needs.	2.1	Commission and undertake a feasibility study into the need for and impact of a common Sequencing/Logistics Park for the regional OEMs	NAA/NWDA	Outline proposal to be submitted to NWDA
			2.2	Act upon recommendations from feasibility study	NWDA/NAA	Follow on actions will be dependent upon findings and recommendations from feasibility study
		Map the current vehicle manufacturers' and tier one suppliers' supply chains in order to identify capabilities, competencies and gaps in the provision.	2.3	Collate existing data on supply chains in the region and identify gaps	NAA	Initial work has been carried out as part of mapping activity. Gaps need identifying particularly at tier 1 supplier level.
			2.4	Develop and maintain a comprehensive map of the Northwest automotive supply chains	NAA	The supply chain map needs to be regularly maintained/updated.
		Support companies to understand and implement business process and product/service innovation both internally and within their supply chains.	2.5	See action plan in Advanced Supply Chain Programme - Automotive and SME Excellence Network project	NAA	The support for companies to improve their competitiveness is delivered through the AMSC and SME Excellence projects.
		Promote and share best practice with the region's automotive companies using regional competencies as exemplars.	2.6	See action plan in Advanced Supply Chain Programme - Automotive and SME Excellence Network project	NAA	The support for companies to improve their competitiveness is delivered through the AMSC and SME Excellence projects.
		Facilitate supplier network events in areas which support the needs of the Northwest automotive companies	2.7	Schedule and run quarterly network events on topics which are relevant to the sector	NAA	Supplier network events supported by the AMSC project
		Monitor and report on improvements made in the competitiveness and performance of the Northwest automotive sector and benchmark against the rest of the UK and other established automotive markets e.g. EU, USA and Japan.	2.8	Establish benchmark performance figures for companies in the region and compare with other UK and international regions.	NAA	Relevant performance indicators are: Turnover, GVA, Volumes, Headcount,
			2.9	Monitor and report performance improvements made in the region and continue to compare with other relevant UK and international regions.	NAA	Measures in place thru' AMSC programme. Needs to be extended to all NAA companies and monitored on regular basis. Include as part of action 2.6. Need to also benchmark regional companies against sister plants throughout Europe.
	Skills	Establish an industry led skills working group, facilitated by the NAA, to develop and oversee the delivery of an action plan which will establish the current baseline skills level and future skills needs.	2.10	Submit an outline proposal to NWDA for funding resource to facilitate a skills group and undertake a skills needs analysis	NAA	Proposal submitted - awaiting response. Need to also look at how other UK automotive regions are supporting skills strategy.
			2.11	Establish Skills Working Group	NAA/NWDA/SE MTA	
			2.12	Undertake skills needs analysis		
		Develop people with the necessary skills and knowledge to work in a modern automotive manufacturing environment	2.13	Develop and implement skills action plan	Skills W.G.	Activities to be delivered thru' an industry led action plan
Work with relevant organisations to improve the image of and recruitment to the automotive sector.						
Work with relevant organisations to establish and retain better technical graduate provision in the region.						

Strategic Theme	Theme Area	Activity	Action Number	Action	Lead	Progress / Comments
ST3: Develop future value chains by, exploiting now/emerging technologies, building on and exploiting regional competencies, facilitating collaborative networks, supporting inward investment	Internationalisation	Promote and market the region's automotive manufacturing capabilities to key automotive markets throughout the world Work with relevant organisations to promote the region to existing and potentially new inward investment companies.	3.1	Host companies on Northwest stand at relevant international fairs/exhibitions	NAA/UKTI	Included as additional programme funding request in core funding for 09/10
			3.2	Update company capability guide	NAA	2008 edition needs updating. Included as additional programme funding request in core funding for 09/10
			3.3	Support UKTI and NWDA inward investment teams	NAA	
	Innovation	Develop better linkages between the region's knowledge base and the automotive manufacturing community to support the exploitation of new technologies for future vehicles. Support collaborative R&D initiatives between the Northwest knowledge base and the automotive companies in the region.	3.4	Establish a Northwest Automotive Innovation Network facilitated by NAA	NAA	Need to identify key stakeholder organisations and companies to participate in the network
			3.5	Host quarterly meetings of the network	NAA	
			3.6	Establish an Innovation Working Group of key stakeholders	NAA	Working group to be led by an NAA Industry Board member and report into the NAA Board
			3.7	Launch the Northwest Future Vehicle 3D portal	NAA	Prototype portal has been developed but needs populating and enhancing.
			3.8	Continue to maintain and populate the portal and use it as the main source of information and support for the network	NAA	
			3.9	Develop invention-innovation routes to market advice support infrastructure for automotive related ideas and/or concepts	NAA	
			3.10	Provide 'mentor' approach to navigate funding sources and routes to market	NAA	Need to develop programme concept using the WM Niche vehicle programme as a model. Need to ensure that it makes best use of and links with proposed regional innovation support/advisory services. WM Niche Vehicle programme to be used as a model
			3.11	Develop a regional funded collaborative R&D programme designed to support business to business and business to HEI partnership R&D activities	NAA/NWDA	
			3.12	Commission and undertake a feasibility study into the market demand for a regional test bed facility for Low Carbon Technology development.	NAA/NWDA	Outline proposal to be submitted to NWDA
			3.13	Act upon recommendations from feasibility study	NWDA/NAA	Follow on actions will be dependent upon findings and recommendations from feasibility study
			3.14	Explore change management approach to unlock innovation potential in small companies	NAA	Reference Liverpool University's model
ST4: Respond to the environmental agenda by supporting companies to, use resources efficiently, minimise waste, respond to climate change	Environment	Support companies in their activities which seek to respond to environmental legislation Assist companies to improve their business resource efficiency and waste management	4.1	Support companies in their activities which seek to respond to environmental legislation	NAA	Through existing support programmes e.g. AMSC and SME Excellence networks
			4.2	Engage with Envirolink and Enworks and promote activities and services to our companies	NAA	As part of core cluster activities
			4.3	Develop a sector specific environmental awareness brochure	NAA/Envirolink	Initial discussions have taken place