Changing policies for the automotive industry in an 'old' industrial region: an open innovation model for the UK West Midlands?

Stewart MacNeill*

Centre for Urban and Regional Studies,
Birmingham Business School,
Birmingham B5 2TT, UK
E-mail: s.macneill@bham.ac.uk
*Corresponding author

David Bailey

Coventry University Business School,
Priory Street, Coventry, CV1 5FB, UK
E-mail: david.bailey@coventry.ac.uk

Abstract: Automobile manufacture in the UK West Midlands peaked during the 1950s and early 1960s but, with overseas competition, declined thereafter. Successive policies, such as government supported mergers to form the British Motor Corporation in the 1950s, green-field development away from the region in the 1960s, nationalisation of the (then) British Leyland in the 1970s, Japanese FDI in the 1980s and the Rover-centric Accelerate Project in the 1990s have failed to halt the decline. Since early 2000, regional policy has been the responsibility of the Regional Development Agency, Advantage West Midlands. The RDA has moved away from traditional support based on the needs of big companies or 'champions' and adopted an approach centred on a mix of small and large businesses and high level research, and – arguably – an 'open innovation' model. Here, we examine these new policies and their potential to create an innovative and competitive regional environment.

Keywords: regional innovation systems; RISs; clusters; open innovation; OI; regional development agencies; auto industry; industrial policy; UK.

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Biographical notes: Stewart MacNeill is a Lecturer in Economic Development at the Centre for Urban Regional Studies at the Birmingham Business School, UK. His research interests cover the knowledge economy, innovation, the automotive industry, the interface between public policy and business strategies, regional economic development and technology foresight. He is currently coordinating the EC funded EURODITE Project under the Sixth Framework Programme.

David Bailey works at Coventry University Business School, UK. He has written extensively on industrial and regional policy and globalisation, especially in relation to the auto industry. He was the Principal Investigator on

an Economic and Social Research Council (ESRC) Project looking at the impact of the MG Rover closure and the policy response to this. He has held visiting posts in Italy, the US, France and the Czech Republic.

1 Introduction

In the course of its history, the automotive industry has on several occasions set the paradigms for analysing industrial organisation, including assembly line production (Ford), and – arguably – 'lean production' (Toyota).[1] In the past four decades, further radical changes have affected the entire value chain, from manufacturers and suppliers to service providers and dealers (Chanaron, 2004; MacNeill and Chanaron, 2005; Womack et al., 1990). The main drivers have been the pressures of cost recovery and intense competition which, together, have driven scale economies, the outsourcing of 'non-core' activities and the gradual inclusion of a range of high value electrical, electronic and communications components where cost recovery is more readily attained. In addition, increasing regulatory pressures (and consumer demands) – for example, on the environmental front – have led to the development of new technological developments such as the search for more efficient powertrains as well as a drive for efficient alternative propulsion.

In contrast with expected 'life cycle' models of industry development, the 'crisis of cost recovery' has intensified over time (Bailey and MacNeill, 2008). As a result, large-scale production over different models and brands using a platform sharing approach has been adopted to generate the cash for future model development. Simultaneously, major manufacturers are developing assembly operations in low cost locations such as Central and Eastern Europe or the southern states of the US. The industry is now confronted with further major and profound challenges (Maxton and Wormald, 2005). The financial crisis has exposed the business model and financial position of most companies as fundamentally weak; profit margins are low and the need for scale efficiency has led to over-investment in production capacity (Bailey et al., 2008), now exacerbated by the global recession. During 2009, compared to 2008, both private and fleet sales have fallen in all major 'developed' markets. Even in the 'auto-boom' areas of Central and Eastern Europe, India and China, the same picture is evident.

The industry is ill-equipped to face this economic crisis. Recently, the CEO of FIAT, Sergio Marchionne, expressed doubts that all companies could 'go it alone' and proposed that the minimum scale for a volume producer will be around 5.5 million vehicles per annum suggesting a further round of consolidation and/or strategic alliances to share costs. Vehicle producers will seek more cost-cutting and expect more parts to be made in low cost regions with 'knock-on' effects in the supply industry. This will have a further negative effect on companies and jobs with many smaller suppliers, who have little cash reserves, becoming particularly vulnerable. As liquidity runs short, many will face bankruptcy – perhaps between 10% and 20%.[2]

In addition, political and consumer pressures are forcing a reassessment of the accepted thinking on vehicle construction, technology and marketing. Thus, there are, potentially at least, a number of major changes in the pipeline that may influence the

industry's development over the next decade. For the policy community, such changes present the challenge of maintaining support for production while adopting policies appropriate to a rapidly changing economic and political environment. Our case study focuses on the automotive industry in the UK West Midlands, one of the 'old' automotive regions in Europe where recent years have seen the decline of the region's once dominant volume production. We observe a parallel development towards a form of 'open innovation' (OI) model that may have wider applicability beyond the current recession. The paper proceeds as follows. Section 2 examines innovation challenges in the auto industry and the variations across innovation systems in different regional and corporate settings; Section 3 details the auto industry in the UK and the West Midlands; Section 4 moves on to look at the industrial and regional policy framework and how policy has developed to meet both the changing situation of the UK industry and the environmental challenge; Section 5 then looks at possibilities for a shift towards an OI system where trust and reciprocity might replace the prevalent hierarchical model. Some conclusions round off the paper.

2 Innovation challenges in the auto industry

Production is dominated by the vehicle makers, or OEMs, with the largest ten of these accounting for some 75% of world output. These firms rest at the centre of a matrix of upstream supply (as oligopsonistic purchasers) and downstream distribution and sales (as oligopolistic sellers). In consequence, they have controlled the industry's innovation model which for the most part is 'top-down' – i.e., hierarchical – and proprietary with closed interfaces and few open areas where independents can easily plug in (Jürgens et al., 2008). Only in very limited cases are supplier brands apparent to consumers. As observed two decades ago by Pavitt (1984) and more recently by authors such as Cooke et al. (2007), in reference to the knowledge economy, the automotive sector is a mature industry, dominated by large companies and, therefore, not regarded to be at the cutting edge of innovation or economic growth. Thus, for the most part, innovation is incremental and process-oriented. These features reflect the socio-economic maturity of the market, where companies are risk averse and the need to extract maximum returns from production under the 'lean model' (Womack et al., 1990) of squeezing resources and continuous improvement (or cost-cutting); the so-called 'quality-cost-delivery' (QCD) challenge.[3]

Thus, the industry has tended to be conservative in its approach. Nevertheless, the need for cost recovery has driven a great deal of technological change such as the inclusion of electronic control devices which have made vehicles more fuel efficient and improved both safety and reliability. However, the rise in oil prices, concerns over global warming and, more recently, the financial crisis have led governments and consumers to seek fuel economies and vehicles with lower emissions and higher levels of environmental sustainability, thereby, presenting major challenges to the industry. The $50 billion+ of funds offered to support the US carmakers through soft loans and Chapter 11 over 2008–2009 has been well-publicised. Similar schemes to provide loan guarantees and loans have been developed across Europe, despite the strictures of State Aid provisions under the Single Market regime. Partly because of this, in most cases, the 'aid' is tied to greater innovation and the green agenda. The UK industry Secretary

Peter Mandelson has, for example, announced €2.3 billion of loans and loan guarantees to the industry, but has made it clear that funding will be directed towards new low carbon investment projects (Birmingham Post, 2009). At the same time, agreement has been reached between the European Commission and the European carmakers that the current voluntary target on CO_2 emissions, of 120 gms/km, should become a binding agreement for new cars of 130 gms/km by 2015. In the US, President Obama has also warned manufactures about their continued production of 'gas-guzzlers'. It is thus possible that in the next decade, demands for more radical change will challenge the traditional carmaking paradigms of high volumes, steel bodies and ICE drives.

A number of technological routes to emissions reduction are currently being explored by the OEMs (large and small), major suppliers and R&D organisations. The different possibilities are explored in the UK Report on low carbon vehicles (King, 2008), which distinguishes between short- and long-term changes to both fuels and vehicle technologies. The former are largely based on the current paradigms and involve the adoption of technologies such as stop-start, variable valve timing, turbo-charging and weight reduction. Fuel changes include the use of liquid petroleum gas (LPG), compressed natural gas (CNG) and biofuels made from crops either used directly (notably in Brazil, with the use of ethanol made from sugar cane) or as blends with petrol or diesel. In Europe, the Biofuels Directive (2003) requires that, by 2010, 5.75% of fuel for road traffic is from renewable sources. More radical change includes full hybrid vehicles where a conventional gasoline or diesel engine is supplemented by electric motors powered by batteries charged by the conventional engine and through regenerative braking. The new GM 'Volt' (Opel Ampera in Europe) provides a 'plug-in' variant to the hybrid concept where batteries can be charged from mains electricity and/or a conventional engine, but the drive to the wheels is 'all electric'. An alternative is the 'mild' hybrid which employs a starter generator device in the driveline to utilise regenerative braking energy.

Another 'conventional' way to reduce fuel use is by weight reduction through the use of lightweight Al/Mg alloys and increased use of plastics. More radical or long-term changes include a possible move to full electric vehicles where the drive is entirely by electric motors powered by batteries. Even more radical is to switch to using hydrogen as the main fuel source. However, despite its potential environmental benefits, there are major challenges associated with the production, distribution and storage of hydrogen. It is also clear that the total life cycle emissions (LCEs) may be higher or lower than conventional petrol and diesel depending on the mode of production of hydrogen.

2.1 Innovation models in the auto industry

Such innovations, of course, cannot take place in isolation. That innovation is a systemic process, based on a series of networked interactions and institutional learning, stems from the writings of authors such as Lundvall (1992), Nelson (1993) and Nelson and Rosenberg (1993). That innovation systems could be characterised at regional level was first proposed by Cooke (1992). Subsequent writings have further defined the concept (see Cooke, 1998). Thus, national and regional innovation systems (RISs), related to the automotive industry, can be divided between those closely connected to company headquarters where new knowledge is produced, and innovation is developed, and those in 'branch plant' countries or regions that are primarily users, rather than producers, of

knowledge and therefore innovation followers.[4] In the latter, the innovation system is geared to incremental process improvement with networks aimed at cost reduction. New, radical, change is controlled by gatekeepers outside the region, or the country, in question. Here, relationships between the players tend to be old fashioned and adversarial and based on asymmetries of power and knowledge (Bathelt and Taylor, 2002). Innovation systems tend to be reactive and reflect a production system being for the most part closed, proprietary and dominated by a small number of large transnational companies. By contrast systems that are more pro active are characterised by high levels of trust and reciprocity. Cooke (1998) distinguishes three types of innovation system as 'dirigiste', where external control is exerted by industries or governance organisations, those that are 'networked' amongst different levels of governance and funding sources and those that function from the 'bottom-up' or 'grassroots' level. With the changes described above, we might expect to see the divisions between innovation systems reinforced with the more radical developments taking place in those areas where the major firms have their headquarters and only incremental developments occurring in the follower regions. Furthermore, Chesborough and Teece (1996) differentiate 'systemic' from 'autonomous' innovation, and in this context, they discuss alternative forms of organisation within innovating sectors, a point which we pick up again in Section 5 below in relation to the concept of 'OI'.

However, the changes described above not only affect the vehicle paradigms, but they also open markets to new players with particular expertise in these new technologies. Two examples (amongst many) are Tesla Motors of Silicon Valley, California and the US-Indian electric car manufacturer Reva whose G-Wiz electric car is marketed in Europe, USA and Japan. The former has signed an agreement with Lotus for manufacturing in the UK and recently Daimler purchased a 10% stake in the company in order to integrate Tesla's Li-ion battery technology into the electric SMART that has a drive developed, manufactured and fitted by the UK firm Zytec. These examples illustrate how new players can develop innovations, but may need to enter into ventures with established assemblers to bring them to the wider market. Such ventures bring change to the territorial organisation of the industry since, as in some of the examples above, the players may be located outside 'traditional' areas. In addition, the new actors are developing research-based knowledge with a largely codified content. However, this needs to be allied to traditional knowledge of the major companies and linked to their networks of upstream supply and downstream logistics and marketing. At this stage, knowledge networks may be distant.

In a later work, Cooke (2008) distinguishes between what he terms the 'industrial paradigm' of policy based upon sectors (or clusters), closed innovation, closed sources and disciplinary science and a new 'knowledge-based paradigm' of networks, open sources and interdisciplinary science. Policy in the former circumstances has tended to be geared towards support for efficiency savings through business support mechanisms such as subsidised management consultancy or training. Such policy measures have often followed the expressed 'needs' of the major OEMs and suppliers in their quest to reduce costs. These companies have been adept at playing countries, regions and plants against each other within their own 'internal bidding' procedures (Bailey and Cowling, 2006). However, as the industry changes to deal with the political and economic constraints of the 'post-crisis' period, there is a challenge for policy to be geared to the transition.

3 The auto industry in the UK and West Midlands

The motor industry continues to be an important part of the UK economy. In 2007, there were more than 3,000 businesses, a total manufacturing workforce of 180,000 and overall GVA in excess of €11,000 million (BERR, 2009).[5] A further 552,000 people were recorded as employed in related trades such as retailing and fuel. The industry trends of globalisation and consolidation are well-illustrated by the UK experience where the open nature of the economy has enabled and encouraged these trends more than in other European countries. Government policies, and flexible labour laws, have encouraged inward investment by Toyota, Nissan, Honda and BMW. The UK has also become a major engine producer with investments by Ford (Wales, Dagenham), Toyota (NW England) and BMW (West Midlands). Although overseas ownership makes the UK industry vulnerable to global decisions on cost-cutting, and the relocation of production, there are a number of plus points. It has brought major investment and the innovative capacity of UK engineering is still strong. In addition, the UK has a major concentration of high value automotive design and engineering businesses. It is also the centre of a major motorsport cluster, with most of the major teams in Formula 1 being located in 'Motorsport Valley' (Pinch and Henry, 1999), an area stretching across the southern half of England. The 'Valley' has around 4,000 businesses, with a turnover of approximately €7.5 billion, employs approximately 38,500 people (including 25,000 engineers) and is a global centre for the production of performance cars and a wide range of other products, services and facilities (MIA, 2009).

3.1 The West Midlands region

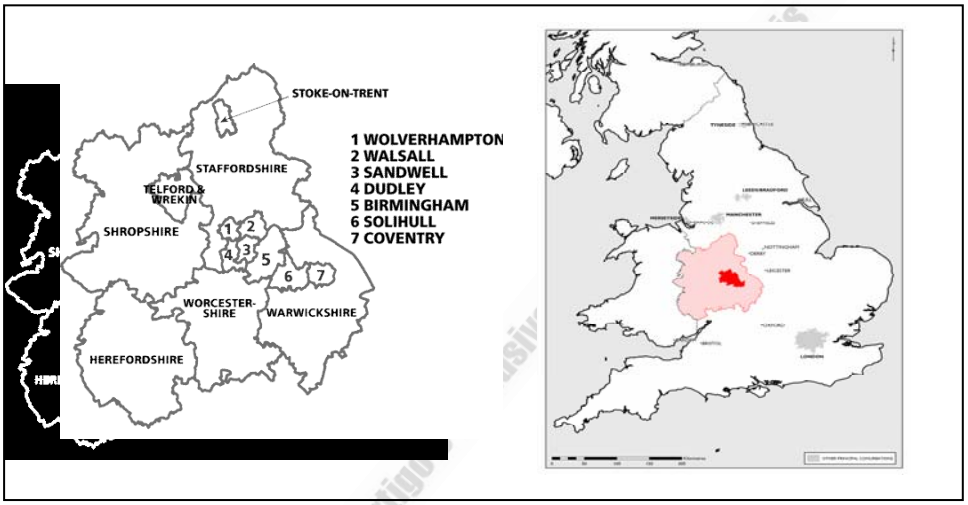
The West midlands region is located in the central area of England, as shown in Figure 1, and covers an area of around 13,000 sq km from Stoke-on-Trent in the north to Hereford and Evesham in the South. It comprises two major conurbations of Birmingham – the 'Black Country' together with Coventry and Solihull in the central area and the North Staffordshire conurbation around Stoke on Trent plus the rural counties of Shropshire, Staffordshire, Warwickshire and Worcestershire.

The region has around 5.3 million inhabitants of which more than 65% live in the main urban areas. The population increased slowly in the three decades from 1971 with a combination of net 'internal' (intranational) outflow and net 'international' inflow reflected in the increasing diversity of the population. The region was the birthplace of the industrial revolution and became famous for manufacturing a wide variety of metal, leather, ceramics and glass products. Restructuring of these industries has reduced the number working in these sectors, but manufacturing still accounts for 21% of the region's GVA and 19% of employment. Approximately 2.3 million people work in the region in approximately 211,000 business sites – of which 10,300 are engaged in manufacturing. The total regional GVA in 2004 was €84.9 billion out of a UK total of €1,104.4 billion. This represents a figure for GVA per head of €16,857 per annum which is 91% of the UK average. Current regional unemployment on an ILO basis is 10.3% – above the national average of 7.8% (ONS, 2009), after rising rapidly during the recent recession.

The region is one of the long standing areas of global motor industry production. The heyday of production was after World War II, but, in the following decades, with open trade rules and globalisation, the industry declined. A popular view is that local

companies could not compete in global arenas as a result of insufficient investment, poor labour relations, poor quality and cost control, and – critically – the lack of a supportive industrial policy on the part of the government.[6] Despite a number of foreign takeovers, the industry's fortunes continued to decline. The recent closures of the MG Rover and Peugeot plants effectively ended volume manufacture in the region. Most recently, Jaguar land Rover has announced a further plant closure, which is planned for the middle of the next decade. In parallel, there has been a decline in activities by the major suppliers. Bosch recently closed its automotive lighting plant in the north of the region and TRW its electric power steering plant in Birmingham. These changes have affected employment in the sector with a 34% reduction in the ten years from 1997 to 2007 (ONS, 2008).

Figure 1 The West Midlands region (see online version for colours)



In parallel to the decline in volume manufacture, there has been a relative growth of higher value or specialist production where profit margins are greater and which can (therefore) be more sustainable in a high wage cost economy. Companies involved range from relatively large producers, such as Jaguar Land Rover, through medium sized companies such as Aston Martin to small-scale producers such as the sports car producer, Morgan Motors. Many of these businesses have developed out of the motorsports sector. For example, the electric car developer Zytec is best-known for racing, and developed its expertise in electric vehicles from producing a high performance electric version of the Lotus Elise. Alongside this niche manufacturing, there is a growing (and relatively new) base in engineering design and development services ranging from major international businesses like TRW, Ricardo and MIRA to small and medium sized companies like Zytec, Prodrive and others. Like the SMEs in the volume sector, they are also a legacy of past volume-based manufacturing, but differ in two important respects. Firstly, they are largely vehicle (product) oriented, rather than manufacturing (process) oriented and, secondly, they are in a high value segment of the supply matrix. These Knowledge Intensive Business Services (KIBS) have largely developed as a result of the vehicle makers' trend towards outsourcing to experts to save on the sunk costs of research and development departments (Antonelli, 2005) – although the recent decision by the Chinese

firm Shanghai Auto to take its West Midlands-based '20/20' joint venture with Ricardo in-house contrasts with this trend. In particular, a number of companies are working in areas connected to 'green technologies' including indirect technologies such as telematics systems through to direct low carbon vehicle technologies such as hybrid or electric drives. Research activity has also been stimulated and supported by public investment in the region's universities such as Warwick (lightweight construction), Birmingham (hydrogen fuel cells) and City of Birmingham (ICE engines), as well as the demonstration testing of electric vehicles (Birmingham and Coventry).

3.2 The West Midlands' innovation system

As would be expected for a region with significant manufacturing, the West Midlands scores reasonably well on the European Innovation Scoreboard (INNO Metrics, 2007) and stands as Europe's 42nd most innovative region, despite a history of a long 'tail' of firms with poor innovative performance (De Propris, 2000). However, the significant level of overseas ownership in the mass vehicle sector has resulted in strategic decision-making being carried out elsewhere. Thus, high level technical knowledge inputs to the larger businesses comes from outside the region. Even the most embedded companies, such as the top tier suppliers GKN and TRW, have transferred much of their advanced R&D work to Germany in order to be closer to major OEMs and the centre of gravity of automotive technologies. It is, therefore, clear that the region has missed a generation of investment in many modern technologies. As a result, local knowledge networks are mostly concerned with manufacturing and with process or incremental innovation. The innovation system, therefore, fits Cooke's (1998) *dirigiste* model dominated by outside interests and with little in the way of unique or 'sticky' knowledge (Malmberg and Maskell, 1997).

For the KIBS and niche sector, however, the knowledge balance is rather different. Here, the region is clearly a producer of knowledge since the companies are either knowledge producers *per se* because they are in the KIBS sector or are able to control their own knowledge flows by virtue of local ownership. Amongst these niche and specialist companies, a significant group is the 'Niche Vehicle Network'. This comprises some 25 specialist vehicle manufacturers and engineering services companies, most of which have their origins in motorsport, specialist vehicle manufacture, engineering KIBS or high technology parts production. The participants are developing particular technologies, but are too small to be able to market these in whole vehicles for general sale. Instead, the objective is to develop and prototype these for sale or licence to the major companies. Inevitably, these will be outside the region or, at least, will be controlled by companies outside the region. Examples include Zytec's prototyping of the electric drive train for the SMART and a joint venture with Daimler, as well as the firm's development of electric delivery vans and a prototype fuel cell van being tested by the University of Birmingham as part of the Science City Project[7]. A more speculative venture is the Morgan Motor Company's venture to develop a hybrid and then a fuel cell powered sports car. One firm which has developed end vehicles is the Coventry-based electric commercial vehicle manufacturer Modec, which through its joint venture with the US firm Navistar, is set to benefit indirectly from the Obama government's support for green vehicle technologies.

4 The European and regional policy framework

At the European level, three major policy areas impact on the industry. The first is the macroeconomics of free trade inside and outside the EU. The second involves common standards (regulation) on emissions (EURO IV, EURO V, late 2009 and EURO VI, 2014) and safety (EURO NCAP tests) which are compulsory in all Member States. Another important area is recycling and the End-of-Life Vehicle Directive which came into force at the beginning of 2007.

At the national (UK) level, policies have been, for the most part, non-interventionist and concentrated on improving the business environment (Bailey and Driffield, 2007). For example, labour laws have remained 'flexible' in order to attract and retain inward investment. Thus, while indigenous companies have declined, new inward foreign direct investment, both green-field and acquisition, have meant that foreign owned transnational firms have maintained 'a car industry in the UK' (as opposed to a UK car industry). The non-interventionist approach has been shelved for the present with the Automotive Assistance Package (AAP) with the promise of support to Vauxhall (Opel) and the introduction of a scrappage scheme in common with other Member States.[8] In the manufacturing arena, national policy has shifted away from sector-specific support to general support for all manufacturing sectors (i.e., from vertical to horizontal industrial policy measures). Much of the automotive specific effort has been directed through the Foresight Vehicle Programme which has sought to fund collaboration amongst companies and research organisations in order to address forecasts for 'future vehicle capabilities' as outlined on a technology road map. Reduction of LCEs has been a major policy imperative. One example is the CENEX initiative to promote UK market development and competitiveness in low carbon and fuel cell technologies for transport applications. CENEX, which was established with support from the then Department for Business, Enterprise and Regulatory Reform (BERR) seeks to stimulate market transformation and networking amongst providers and end-users including the Low Carbon Vehicle Procurement Programme and the Low Carbon and Fuel Cell Technology Knowledge Transfer Network.

The King Report (2008) concludes that considerable reductions in CO_2 emissions (up to 30%) could be achieved in the short-term by enhancements to conventional vehicle systems, whereas in the medium-term advances in hybrid and battery technologies could bring a 50% reduction in CO_2 emissions per kilometre by 2030. A second report, that will guide future UK policy, is the Automotive Industry Growth Team Report (BERR, 2009). This makes a number of recommendations to improve the business environment, to stimulate further inward investment, to improve the market conditions for low carbon vehicles, to coordinate R&D efforts and to set up small-scale demonstrator fleets as well as continuing the policy of improving supply chain efficiency.

At the regional level, policy is implemented by the RDA (Advantage West Midlands) through successive iterations of the Regional Economic Strategy (RES). While the strategic direction has remained the same, the method of approach has altered significantly. The first RES '*Creating Advantage*' (AWM, 1999) adopted a sectoral approach for the delivery of its priorities, whilst the second focused on ten priority 'clusters' including transport technologies The current RES '*Connecting to Success*' (AWM, 2008) emphasises cross-cluster activities and the benefits of networking and linkages across the different priority areas.[9] Nevertheless, in spite of changes in the

method of delivery, there is a clear agenda in the region's economic strategies to reduce its dependence on low value added industries while concentrating on areas that offer growth potential (Donnelly et al., 2005; Bailey and De Propris, 2009).

As might be expected, national policies have been highly influential. Thus, the RDA's strategy is aligned with the national strategy to support low carbon vehicles and intelligent traffic systems. The most recent substantive policy statement from the Agency, the 'automotive strategy 2008–2011' (AWM, 2007) affirms the RDA's support for manufacturing process improvement, but also emphasises the need to improve technologies, raise skill levels and support the niche vehicle sector including that part of the 'Motorsport Valley' cluster located in the region which supports some 2,400 local jobs. Not surprisingly, much of the RDA's strategy is aligned with the national strategy to support low carbon and intelligent traffic systems. Particular priorities include Low Emission Vehicles, Intelligent Transportation Systems (ITS) and the Niche Vehicle Cluster Growth Programme. In addition, policy has supported technology development through funding to local universities. An example is the investment of some €20 million in the Premium Automotive Research and Development (PARD) Programme based at Warwick University Manufacturing Group to develop new vehicle and environmental technologies in the region.

4.1 Shifts in policy support

Overall, businesses and policy makers in the West Midlands region face a number of issues if the sector is to be retained and developed. Employment costs are high; outsourcing and the flight from high wages and employment legislation in more developed countries will no doubt continue (Jürgens and Krzywdzinski, 2008). Also, the UK's flexible labour markets make shedding labour relatively easy (Bailey and Cowling, 2006). The recent economic crisis, with the global drop in sales and production, has brought additional difficulties. In addition, the legacy of the previous age of volume manufacturing is a supply base still geared to volume and a knowledge base where the main expertise lies in traditional mechanical (physics-based) technologies which represent a declining proportion of the value of new vehicles and, given the cost pressures of the 'lean manufacturing' paradigm, provide small profit margins.

It is also clear that the environmental concerns of policy makers and the public will impact at regional level. For example, government support for Jaguar Land Rover during the current crisis is focused on the development of low carbon technologies (Birmingham Post, 2009). Thus, regional policy makers and companies in the sector seek a 'reinvention' as a base for new technologies, particularly related to the emerging 'green agenda', and a possible new vehicle manufacturing paradigm. Such a change could be a portent of a new image (or brand) for the regional automotive industry where niche, high value vehicles, advanced engineering, green technology and motorsport[10] replace high volume vehicle assembly and a supply sector based largely upon low value 'metal bashing'. These changes are consistent with the 'worlds of production model' (Storper and Salais, 1997). However, the social implications are significant in employment terms. Not only will overall numbers continue to fall, as the existing supply matrix continues to shrink, the traditional networks based on a strong tacit understanding of the 'old' automotive paradigm cannot immediately evolve into 'new' high technology networks with higher inputs of codified (research-based) knowledge. This evolution puts further

pressure on a workforce with 'traditional' skills and creates new imperatives for policy makers.

Thus, from the preceding analysis, we can identify a shift in local knowledge requirements (a regional knowledge dynamic), as the local automotive sector moves away from volume production, and the traditional knowledge of manufacturing (process) technologies, towards a new higher technology knowledge base in vehicle (product) technologies and low carbon (green) technologies. However, the new paradigms described here may shrink the supply matrix given the higher value added of the technologies and processes involved – i.e., a move away from largely cost-based competition. Linkages to other regions in the UK and other European countries are essential for such components as electric motors, electronic control units (ECUs) and fuel cell technologies.

In the West Midlands, some 25 niches and specialist businesses have formed the Niche Vehicle Network and announced a new research programme (with a small amount of public financing support of €2.7 million from the RDA) in late 2008. The programme is closely aligned with national as well as regional policies and is intended to build a specialist knowledge base with: a new product development capability for niche vehicle manufacturers; joint ventures into overseas markets; an expansion of the skills base, with more graduate recruitment and an upskilling of the wider workforce; and the promotion of the region as an area of high innovation. The network's research and development themes include: improved fuel efficiency and carbon reduction (electric vehicles, hybrid technologies, reducing emissions from existing petrol engines, alternate fuels including biofuels, aerodynamics); weight reduction and an improved capacity to recycle (aluminium chassis technology, vehicle interior plastics, composite/plastic body panels/structures); and vehicle safety (advanced vehicle dynamics, vehicle telematics/electronics systems and crashworthiness).

Links by companies in the Niche Vehicle Network include those to Bosch (ECUs), BMW (IC engines), Johnson-Matthey (fuel cells) and the engineering departments at Oxford and Cranfield Universities (hybrid technologies). Thus, new technical knowledge is derived from outside the region. However, the policy objective is that it can be anchored in the region, through development, manufacture and testing.

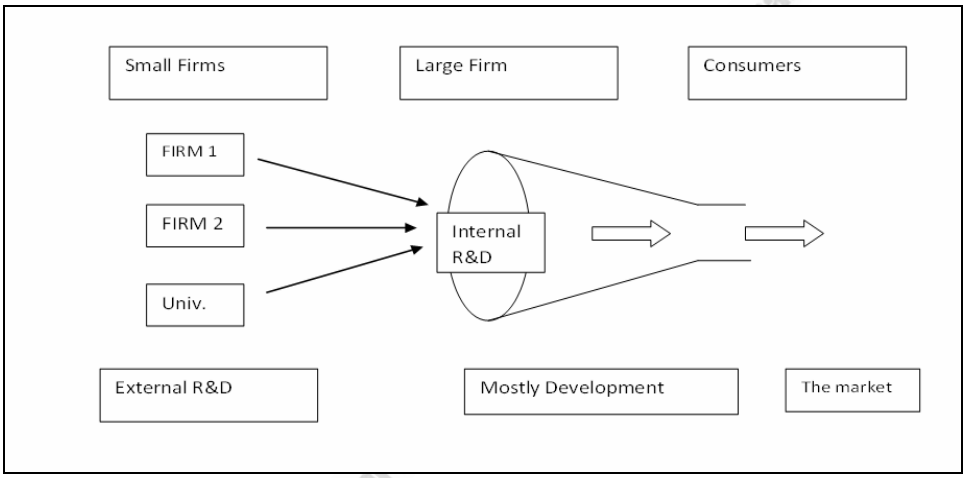
4.2 Towards an OI model?

As a consequence of the trends described above, regional actors are confronted with managing a major transition. The former volume producers (MG Rover, Peugeot) have closed along with some significant suppliers. However, much of the broad supply matrix is still geared to this former volume production and is seeking new customers and a diversified product range. Until recently, most local policy spending was geared to the retention of this segment of the industry, but over the last five years, or so, a policy shift has occurred. Now, as well as concentrating on process improvement, private and public actors are trying to develop new generations of technology – such as low carbon vehicles and telematics. The current crisis, and the political pressures that have followed, may, arguably, be giving further impetus to these efforts with the promotion of more environmentally friendly vehicles and more sustainable business models.

The Niche Vehicle Network is one manifestation of this new direction. Its attempts to develop new technologies through a network of small and medium sized companies can be compared to the OI model (Chesbrough, 2003a) as illustrated in Figure 2. As

Chesbrough (2003a) has noted, 'OI is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology'. In this sense, the boundaries between firms and their 'external' environment become more permeable, with an easier flow of innovations in and out of firms. In essence, where knowledge is widely distributed, firms cannot just rely on their own innovative activities: they can and should access patents and processes from other firms, whilst also allowing their own unused innovations to be utilised externally through licensing, spin-offs and joint ventures (Chesbrough, 2003b). Earlier work by Chesbrough and Teece (1996) also looked at the appropriate organisational form required where innovations could be autonomous or systemic, and whether the capabilities firms need exist internally or externally.

Figure 2 An OI system



Source: After Chesbrough (2003a)

Trust is a strong element of relations in the Niche Vehicle Network. The companies are of similar scale and have complementary skills. They, thus, feel able to be open and share ideas. As such, they fit more closely the third of Tully and Berkeley's (2004) cooperation groupings – companies that cooperate in a Granovetter type 'social network model' and contrasts with adversarial interactions prevalent in the industry. An open knowledge flow is also conducive to innovation as observed by Cooke (2005) and Antonelli (2005).

Of course, the network members, and the region itself, is competing with the major German, Japanese and US carmakers and suppliers and such changes should not be taken as portents of a completely different geography of automotive manufacture. However, if the OI model, described above, represents a significant way in which regional players can gain a foothold in new automotive technologies, then future policies might usefully incorporate an explicit target of open networking amongst diverse players to stimulate combinatorial knowledge dynamics.[11] However, quite how the policy then needs to change is a moot point. 'OI' may itself be partly driven by certain dimensions of policy, whilst simultaneously being constrained by others (for example, some aspects of OI may be seen as anticompetitive). Of course, innovation policy has been evolving over time, and policy makers are already examining changing innovation issues and dynamics

(including the role of OI) for innovation policy and related areas such cluster policies, support for SMEs, education, skills and more (see de Jong Jeroen et al., 2008 for policy implications arising from the emergence of OI).

In this regard, policy needs to recognise the technological paradigm shifts taking place and adapt accordingly. An interesting analogy is with technology policy in the US. Here, there has been the use of a hidden but *de facto* industrial policy via the Pentagon and other areas of government in terms of the procurement and stimulation of high technology products over many years, including computers, aerospace and semi-conductors (Geroski, 1990), and more recently, dual-use flat screen technologies (US Congress, 1995). As Geroski notes, in the case of the computer industry, such government action 'almost single handedly brought into being what has now become an enormous commercial market'. Of particular relevance here, this *de facto* industrial policy of targeting new technologies with widespread civilian spillovers has included the use of 'second sourcing' to deliberately stimulate a diffuse, competitive industry, rather than simply placing orders with giant firms (Geroski, 1990). This would seem be a key in the OI approach; stimulating and maintaining a range of diverse actors with diffused strategic decision-making. To what extent large firms outside the region still control the direction of innovative activities and how far they can control smaller innovative firms is also a key question for policy in attempting to stimulate an OI approach.

5 Conclusions

The traditional base of low to medium technology manufacturing in the West Midlands region has seen the development of an RIS dominated by external influences and geared to incremental process innovation. However, the West Midlands region's economic strategy (AWM, 2007) makes clear the intention to reduce the region's dependence on low value added industries and to concentrate on areas that offer growth potential. Economic actors in the region are thus seeking to reinvent the region as a leader, rather than a follower of technology.

Until very recently, regional policy towards the automotive sector was geared to the top-down influences of the prevalent lean manufacturing paradigms and the short-term needs of a small number of large companies dominated the agenda (Bailey and MacNeill, 2008). However, the latest policy for the sector seeks to adapt policy to the changing regional circumstances of the industry and the demise of volume car production. The RDA's support for the Niche Vehicle Network seems to be shifting at least towards an OI model or at least an innovation system with OI elements.

Such a model may be a portent of a general trend as the industry globally struggles to adapt to the changing political economic circumstances in which the existing production paradigms are being questioned by politicians and the public alike. Such models are already prevalent in other industries such as pharmaceuticals and may ultimately replace the closed, proprietary and cumulative knowledge dynamics currently prevalent. That is not to say that the vehicle makers will no longer control the supply matrix through their ownership of brands and direct interaction with vehicle purchasers. There are indeed limits to 'openness'. It is also clear that conventional production modes will persist for some years to come – because of scale, resources and the 'lock in' of the existing technological paradigm.

Yet times of economic uncertainty and recession have been argued to create opportunities for leaps in innovation and technological breakthroughs as the scramble for survival triggers new ideas and creates new forerunners. Indeed, processes of 'creative destruction' (Schumpeter, 1943) can redesign the map of competitors' strengths and weaknesses. If there is to be such a change, the model emerging in the West Midlands and other locations is worthy of examination. Small companies can often be more innovative than major multinationals. It is notable in this context that Daimler has decided to work with the West Midlands-based company Zytec for electric vehicle development. The implications for policy arising from a possible shift towards an OI approach also need further examination. Here, we have highlighted just one aspect of policy – the need to foster a diverse range of actors with diffused strategic decision-making, in contrast with the 'top-down' and hierarchical nature of the 'old model'. Assuming that an OI approach is possible in a regionally-based innovation system, further research on the policy implications of such an approach is called for.

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Notes

1 Although Coffey (2006) is critical of what he terms the 'myth of Japanese efficiency'.

2 Roland Berger Consulting quoted in Automotive News Europe, January 2009.

3 Despite widespread use of the term in this way, it should be noted that Womack et al. (1990) stress that they do not view lean production in this way, i.e., in terms of cost-cutting. They also present their approach on the basis of a 'radical' or 'revolutionary' transformation to 'lean' away from 'mass'. This suggests a fairly conservative industry from the 1920s to the 1970s, up until the Japanese producers 'arrived'.

4 For example, Cantwell and Iammarino (2000), in investigating transnational firms' location of 'technological innovation' in British regions, find results consistent with the hypothesis that the pattern of transnationals' networks for innovation 'conforms to a hierarchy of regional centres and that the pattern of technological specialisation of foreign owned affiliates in different regional locations depends upon the position of the region in the locational hierarchy'. This confirms the earlier work by Cantwell and Iammarino (1998), which found that transnationals' networks for innovation and location choices across the EU conform to a 'geographical hierarchy of centres', where the 'technological specialisation of foreign-owned affiliates' in different regions also depends on the position of that region in the hierarchy (Cantwell and Iammarino, 2000).

5 BERR is the Department for Business, Enterprise and Regulatory Reform. Formerly the Department of Trade and Industry, it was recently renamed as the Department for Business, Innovation and Science (BIS).

6 There is, not surprisingly, a great deal of controversy over reasons for Britain's experiences of Post-World War II deindustrialisation, which had become evident by the 1970s (see Singh, 1977; for a wider and later survey, see Coates, 1996). On the specific case of the auto industry, Cowling (1986) suggests a somewhat different approach to the now popular view, which is further developed in Coffey and Thornley (2009).

7 Science Cities are a UK initiative whereby certain cities received resources to develop innovation through large-scale initiatives linking business and the science base.

8 Although it should be noted that as of September 2009, no AAP funding had as yet been forthcoming, and Tata turned down the offer of support given the onerous conditions attached.

9 As well as cumulative learning and incremental innovations, radical technological leaps often emerge from idiosyncratic synergies between sectors or clusters. In this context, in the West Midlands, cluster-to-cluster networking between, for instance, aerospace and services, auto and services, aero and auto, medical technologies and serious gaming, could be critical. Enterprises and policy makers arguably need to work harder to exploit the synergies of cross-cluster working.

10 Whilst the connection between green technology and motorsport may not be immediately obvious racing is often a test bed for new vehicle technologies. The 'harshness' of the racing environment exceeds that of normal road use and requires durable and high quality components. In addition, fuel efficiency is a clear priority. Until recently, F1 teams have also been able to spend large amount on R&D to gain a competitive edge over rivals. That may change with the push towards a cap on spending in future years to try to retain a 'competitive balance' in the sport in an environment of restricted sponsorship revenues.

11 Another interesting case is that of Riversimple LLP, which is developing hydrogen cars in conjunction with the gas producer BOC. Its technological blueprint is open source and the enterprise is inviting anyone to develop and add to the technology.

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