THE EVOLUTION OF THE HIGH PERFORMANCE TECHNOLOGY AND MOTORSPORT CLUSTER

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Profound demographic and lifestyle changes are occurring today, and these changes, alongside the longer term trends towards greater urbanisation and globalisation, rapid rates of technological advancement and increased awareness of sustainability risks, are having a major effect on how individuals and corporate occupiers assess their real estate needs. Ultimately, in an increasingly competitive world, global capital will gravitate to where best talent resides, so the opportunity to promote Silverstone Park as a globally recognised centre of excellence in the high-performance technology and motorsport industry makes abundant sense, as it is surrounded by a unique clustering of ‘HPTM’ talent.

In a similar manner, at Hermes, we have witnessed the benefits from the ‘clustering’ of a deep pool of talent at Milton Park in Oxfordshire which is managed by our partner MEPC. The park’s links to the globally leading life science centre of excellence at nearby Oxford University, and this clustering of talent acts as a magnet for global capital looking for expertise within the sector.

These economic drivers are vitally important for long term investors such as Hermes, as ultimately real estate returns rely upon sustainable growth in the real economy and its resultant occupational demand.

We are excited about the role which MEPC can play at Silverstone Park in continuing to attract leading talent and global capital to the HPTM cluster of closely related businesses and in so doing support the sustainable growth of the economy in the local area.
Foreword

James Dipple

Chief Executive Officer
MEPC

When MEPC purchased Silverstone Park in 2013 its notable assets were its global brand name and the central location in the country. With over 2m sq ft of planning consent and more than sixty companies already on site undertaking a variety of advanced engineering activities it was clear that there was an opportunity to grow the park by attracting further similar companies.

Based on our market research with occupiers and potential occupiers we identified anecdotal evidence of a cluster where local companies seemed attracted to the location due to the beneficial interactions between the businesses over time, and when we talked with a number of our stakeholders about this they agreed that a research project to review the economic activity across county boundaries and based on local business activity would be both useful and interesting.

We were therefore very happy to lead the project, supported by the three district councils, the two county councils, the three LEPs, the Motorsport Industry Association, Barclays and PwC and we are really excited by the results and the early positive response to the findings. We therefore look forward to continuing to work with our partners and the local business community to take forward the actions coming out of this report, supporting the evolution and growth of the HPTM cluster.
I have spent my career working within high performance technology and motorsport, with Cosworth, then with TWR Arrows F1 and subsequently with the Renault Formula One team in Oxfordshire. All of my different jobs have been in the area around Silverstone and so, when Doug Cross and I set up Flybrid in 2007, it was the place for us to be.

We both lived locally, but more than that, it was where our professional networks of friends, collaborators, colleagues (past and present) and competitors also lived and worked. In growing Flybrid, we benefitted from working closely with other local firms that we knew well and trusted completely. Sometimes we recruited staff from them, and sometimes they recruited from us. But the network of people with deep professional relationships, sometimes forged over many decades, has been really important in the growth of our company.

This report charts a story surrounding the growth and character of the cluster. It is a story that I recognise fully – and it is good to see it written down. In fact, reading through it has prompted me to pick up the phone to one of the other business owners and to start the ball rolling on something completely new.

The high performance technology and motorsport cluster continues to be a very exciting adventure. We are all committed to winning but the technologies that we are developing and applying have many different potential applications. I hope that the investor community and government will recognise the potential that the cluster represents, and work with the business community to support its future growth.
Gavin Isle

Co-Head of UK Corporate Banking
Barclays

We are excited to support this study as we have been hugely encouraged by the activity in and around the Silverstone area, primarily linked to the motorsport sector but with far reaching application. The crossovers and opportunities for further diversification, together with the collaborative approach shown by businesses in the area are worth understanding in more detail, both to further enhance the value of the cluster itself and to take relevant learning into other sectors.

Intuitively, with the expertise and knowledge base within the area, we felt that all the ingredients were present for a positive and vibrant cluster to exist, originating from the various elements of the high performance technology and engineering sectors.

What this study has uncovered is a cluster with deep roots and a fascinating history. Furthermore, the study has demonstrated the cluster as a whole is currently at an exciting stage. There are interesting opportunities to now apply its “know how” across new sectors and markets. In particular, there is an ever-increasing global demand for cleaner, low carbon solutions, and firms within the HPTM cluster have a key role to play in driving the future.

In addition, we recognised the more general pace of growth across this part of central-southern England. As the report considers, a dynamic cluster in a fast-growing region presents both opportunities that should be encouraged, and some challenges that ought to be addressed.

Describing the cluster’s evolution is just the beginning though; it is now critical for us to concentrate on how we address skills shortages, attract investment finance, support innovation and finally how we create a network to support the process of growth. In taking this forward, a dialogue with all stakeholders, investors and government will be crucial.
The name Silverstone has a proud history in the racing world. But few people are aware of the businesses and industries that have grown up in the surrounding area. This report sheds light on this story, and makes interesting reading both for people that care about the region and its firms and for those interested in the nature of regional clusters and economies more generally.

The report lays out a fascinating story of how chance events, legacy, and evolutionary processes got the cluster in the area around Silverstone to where it is today. There was no ‘big plan’, from government or otherwise. But there were a large number of individual decisions, often made with at least a recognition of the broader impact they might have beyond strengthening an individual firm, organization, or university. And there were many individuals that moved from firm to firm or started something new. These are all elements that will sound familiar to researchers of regional economies and clusters.

One interesting as well as challenging feature of the report and the cluster it profiles is the nature of the boundaries to define it. Geographically, it is located at the intersection of different administrative regions. In terms of industries, it straddles the boundaries of automotive and precision engineering, also having traditional ties to the aerospace industry. In both dimensions, the HPTM story exemplifies many of the broader discussions now going on in the academic community about clusters.

The report raises the question of what can be done to enhance the economic benefits to the companies in the cluster as well as to the region overall? Despite what has been achieved, the story of the cluster is not one of unmitigated success – firms often remain small, and the overall impact on regional prosperity is meaningful but not overwhelming. To get further, collective action of some sort will be needed. What type of specific action and by whom, will be questions that have to be addressed.

For observers from the outside, the HPTM cluster is in some ways emblematic of key economic challenges facing Britain today. It shows the promise of manufacturing to rebalance the service-heavy UK economy, and of economic opportunities existing outside of the country’s large metropolitan areas, London in particular. But it also shows the struggle to scale these success stories, and to find a viable structure within government to work with these clusters that have emerged in a market process.
The evolution of the High Performance Technology and Motorsport Cluster
Final Report

Roger Quince

Founding Partner, Segal Quince Wicksteed
Non-Executive Director, SQW Group
Chair, West Suffolk NHS Foundation Trust

This report is informative and challenging. Despite the international profile of Formula One and the strong association between Silverstone and motorsport, it is nonetheless surprising to find that there are so many interesting companies, with outstanding and varied technological expertise, in the area around Silverstone. The HPTM cluster is not really ‘on the map’ like, for example, the high tech clusters around Cambridge and Oxford. But this report demonstrates that it is a genuine cluster, and with real potential for growth – largely because of the quality and wider relevance of the technologies being developed and applied by many of the firms, but also because the cluster is located in one of the fastest growing and dynamic parts of the UK.

One of the real opportunities is to make the most of the overlaps between different spheres of influence of specialist expertise: for example, between the engineering excellence in Northamptonshire, the growing IT strengths in Milton Keynes and Buckinghamshire, and the expertise in areas such as low energy systems in Oxfordshire.

The challenge is how to realise the growth potential of the cluster. The report clearly identifies some issues to be addressed, including access to finance, and developing management and marketing expertise to match the undoubted technical capabilities of many firms. These issues are typical of many clusters in their relatively early stages: they are, for example, reminiscent of Cambridge in the 1980s and 1990s. This report, and the commitment of its sponsors, should certainly help raise the profile of the HPTM cluster and thereby improve its growth potential.
Profound demographic and lifestyle changes are occurring today, and these changes, alongside the longer term trends towards greater urbanisation and globalisation, rapid rates of technological advancement and increased awareness of sustainability risks, are having a major effect on how individuals and corporate occupiers assess their real estate needs. Ultimately, in an increasingly competitive world, global capital will gravitate to where best talent resides, so the opportunity to promote Silverstone Park as a globally recognised centre of excellence in the high performance technology and motorsport industry makes abundant sense, as it is surrounded by a unique clustering of ‘HPTM’ talent.

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Executive Summary

1. A group of partners led by MEPC commissioned SQW to investigate the existence and character of the high performance technology and motorsport (HPTM) cluster in the area around Silverstone. In a competitive context, clusters may be understood as “concentrations of firms – and related institutions – that produce synergy because of their geographic proximity and interdependence”.

2. The study was substantially completed between August 2015 and February 2016. It relied on a largely qualitative methodology involving interviews with over 70 individuals from HPTM firms and institutions.

The origins of the cluster

3. The origins of the HPTM cluster trace back to the period before and immediately after World War II. They reflect a combination of: government support for aircraft research and manufacture in the inter-war period; a changed emphasis in early professional motorsport to focus more on aerodynamics and weight reduction; and a shift to racing on designated circuits which were established on disused airfields (such as that at Silverstone).

4. HPTM businesses were formed in this context, sometimes by “racing entrepreneurs”. However, many early entrepreneurs had a strong background (and training) in aeronautical engineering. Many of these businesses have seen successive ownership changes and, over time, their competitive focus has evolved. Today, some have little or no connection to motorsport and are better understood in terms of their wider high performance technology credentials.

5. Alongside the businesses, key institutions played a crucial formative role (e.g. Cranfield University). Like the population of firms, new institutions are still emerging today as the cluster evolves. These institutions are playing particularly important roles in relation to research and testing; and training and workforce development.

6. Today, the evolving HPTM cluster has a particular character in the area around Silverstone, but boundaries are neither “hard” nor “fixed”. There are very important wider connections across the UK and also internationally.

The wider spatial and economic context: adding to the HPTM “mix”

7. The HPTM cluster exists across several functional economic areas. It therefore draws on a number of distinctive local labour markets. In some respects, this explains both its character and strength – although the lack of a single city focus sets it apart from some other clusters.

8. The area in which the cluster is situated has grown – and is growing – quickly (in terms of population and employment). One consequence is that labour markets are deepening (as their scale increases and their skills mix grows). This “wider growth of the wider region” is very important in understanding how the cluster is evolving. Within this context, the changing role of Milton Keynes has been particularly significant (insofar as the origins of the cluster...
predate the existence of Milton Keynes; and, in many respects, Milton Keynes is now, functionally, a city).

9. Looking ahead, substantial further growth in housing and jobs is planned through to the 2030s. This is likely to be focused on Milton Keynes, Northampton, Aylesbury and Bicester. This growth itself will shape the cluster’s future evolution.

10. The wider sub-national setting is also formatively important. There are very significant connections to and interactions with: the Midlands, particularly Birmingham, Coventry and Warwickshire (in terms of its very strong automotive sector); Oxford and Cambridge (as international powerhouses with pre-eminent universities and very strong knowledge economies); London (as a global city which itself is growing quickly); and key international gateways, especially Heathrow Airport and also Birmingham Airport.

**Measuring the HPTM cluster**

11. By definition, clusters are fluid, evolving and fundamentally based on relationships. Measurement – which requires clear boundaries – is intrinsically difficult.

12. Informed by previous studies, a proxy definition of HPTM was developed. This leads to an overestimate of scale as not all of the activities captured by it are “actively clustering”. However, distinguishing between the HPTM cluster and activities which are similar in sectoral terms is impossible with available data. In any case, the wider local economy is providing significant resources – particularly in relation to the labour market – on which the cluster can draw.

13. On a very broad definition, we estimate that there are around 36,000 employee jobs within a core geography. However, estimates of scale – on whatever basis – are fraught with difficulty. Moreover, scale alone (measured by job numbers) says little about the strength of a cluster, or its performance or prospects.

**Understanding cluster dynamics today**

14. Discussions with firms and related institutions pointed to the processes which are defining the cluster today. Specifically, the study identified four main aspects of the cluster’s contemporary make-up and dynamics, and the nature and consequences of beneficial interactions across it. These relate fundamentally to the specialist labour market which is at the cluster’s core.

(i) Knowledge “in the air”

15. Throughout the cluster’s history, tacit knowledge has been developed principally through people; knowledge therefore has strong social and cultural dimensions. The turbulence of the cluster’s history and entrepreneurial zeal have compelled individuals to move from one firm

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1 The New Town of Milton Keynes was designated in 1967
2 It is important also to note that the National Infrastructure Commission was tasked – in Budget 2016 – with examining infrastructure priorities across the Cambridge-Milton Keynes-Oxford corridor. This could be significant in relation to the future growth of the HPTM cluster
3 Defined in relation to seven local authority district/unitary areas
to another. This has created a shared culture/mindset which was described by the managing
director of one business as “an obsessive madness about making things better in zero time”. As
individuals have moved, knowledge has been disseminated and built. This process of
knowledge transfer and circulation has been – and is – crucial in understanding “how the
cluster works”. Individuals moving between firms are creating the knowledge-based “glue”
that gives the cluster coherence and form.

16. For individual firms, this process of “churn” is double-edged given wider recruitment
challenges. However, firms are investing in the skills and knowledge base of the cluster,
particularly through the recruitment and training of young people. This has long been a
feature of the cluster through the likes of Cosworth, Reynard and Prodrive. Today, among
both small and larger firms, apprenticeship and/or graduate programmes are often in place.
Specialist institutions have also emerged; important recent examples include the National
College of Motorsport and Silverstone University Technical College. Again, this is a
characteristic of a well-functioning cluster.

17. For the cluster as a whole, churn has led to new businesses being formed and this process is
central to the growth narrative. Strong relationships between individuals who have “grown
up” within the cluster explain the origins and growth of many companies.

(ii) Innovation and adaptation

18. Innovation is a crucial driver of economic growth. The HPTM cluster has long been a prolific
innovator, and today, firms within the cluster are innovating in many different ways. Some of
these are organisational (e.g. taking the disciplines from competitive motorsport into different
spheres). Many others are based on the development, adoption and then dissemination of
different technologies: examples include additive manufacturing, satellite-based navigational
tools and systems, and advanced materials. These products/services are increasingly being
applied in sectors such as automotive, aerospace, marine, defence, medical devices, sensors,
etc.

19. The process of innovation sometimes involves individual firms, but often it is based on more
collaborative approaches. These may involve other companies and/or other research-based
institutions (e.g. Cranfield University). Sometimes these collaborations are contained within
the core geography of the cluster, but wider relationships are also very important.

20. Regulatory frameworks are having a substantial influence on patterns of innovation. Of
particular importance are international regulations linked to carbon emissions and big data.
At the level of individual businesses, these are prompting innovative responses that could be
transformational. At a macro level, the changing regulatory framework is starting to define a
new “industrial paradigm” and this will shape economic growth into the mid-21st Century.

(iii) Financing, networks and growth

21. The overall pattern of financing for growth across the HPTM cluster is – in parts – very
distinctive. In the immediate ambit of motorsport, some elements of the cluster (notably
Formula One teams) are well resourced through sponsorship arrangements. However, many
specialist firms within the wider supply chain have struggled to secure investment and growth
finance.
22. Small HPTM firms have typically financed their own growth – relying on the personal savings of founders and then financing growth through cashflow. Individual firms perceive that securing bank finance can be difficult while equity investors can be unrealistic in terms of the expected scale of financial returns. Some firms are now actively exploring alternative possibilities, linked for example to crowdfunding. However, within the cluster, there are relatively few examples of serial investors/entrepreneurs who have successfully built businesses, exited from them and then reinvested cash (as well as commitment) to grow the next generation; other well-functioning clusters have a stronger endowment in this regard.

23. The lack of external finance could be a market failure. But it could also be a market signal. HPTM firms may need to evolve and adapt to become more “investible”. This is not a reflection of their technological abilities or potential, or the commitment of business leaders; it may though say something about the precise nature and focus of “ambition”.

24. There are some signs that financing solutions may be changing and that new approaches may unlock growth. The source of these seems to be largely external to the cluster and their emergence is a reflection of the potential of high performance technology, particularly in the context of global demand for low carbon, green/clean and energy efficient solutions.

(iv) Links between local and global

25. Although firms within the HPTM cluster are frequently small, many have a global footprint. Within the cluster there are some outstanding businesses in terms of export performance.

26. Another important aspect of the cluster’s global footprint relates to skills and recruitment. With significant national skills shortages (linked particularly to engineering and IT), international recruitment through visas is important. However, the cluster is also a global “magnet” for ambitious people who are looking to build their own careers in activities linked to HPTM. There have been some specialist responses from within the cluster and the role of Cranfield University is especially important in this regard.

Looking ahead

27. The HPTM cluster is continuing to evolve. Currently, it embraces two elements that overlap significantly but are at different stages of maturity:

- The cluster is “mature” in relation to motorsport and it continues to adapt and to demonstrate global competitive advantage as global motorsport evolves spatially (e.g. into China and South America) and in response to regulatory change.

- The cluster is “developing” in relation to high performance technology; this has real growth potential in the context of a fast-emerging industrial paradigm, driven by regulatory changes in the ambit of carbon emissions and big data, and focused around cleaner/greener, low carbon and energy efficient products and solutions. In taking this fully into the mainstream – of automotive, aerospace, marine, defence, medical devices, sensors, etc. – the potential is vast.
28. The social and cultural aspects of clusters are what sets them apart. In this context, the “shared rules and conventions” of motorsport are powerful. However, mainstream high performance technology applications have rules and conventions of their own. The differences are important. These are seen most clearly in relation to growth finance. A failure to adapt to the emerging opportunity will mean that the cluster may struggle to achieve its full future growth potential.

29. The importance of HPTM is recognised through local enterprise partnerships’ Strategic Economic Plans. This reflects both the range of opportunities vis-à-vis the emerging industrial paradigm; and its local significance against a backdrop of planned housing and jobs growth.

30. An adaptive and knowledge-rich cluster with the opportunities, challenges and momentum of a fast growing region ought to be a cocktail for future success. In order to realise this potential, an Agenda for Action is proposed, structured around five main strands:

- **access to appropriate forms of growth finance** – recognising that established approaches will need to evolve further

- **building leadership capability** – acknowledging that the calibre of engineering excellence needs to be matched by strong business leadership skills

- **routes to market – and building visibility** – recognising that the know-how linked to HPTM is technically complicated and its potential needs to be communicated effectively, particularly to the investment community

- **increasing the supply of skilled people** – acknowledging that despite significant investment from within the cluster, there is a national shortage of engineers

- **appropriate infrastructure provision** – recognising the on-going need for a broad range of premises, all with high quality broadband connectivity.
1. Introduction

1.1 In August 2015, MEPC – working with a group of private and public sector partners⁴ – commissioned SQW⁵ to investigate the existence and character of the High Performance Technology and Motorsport (HPTM) Cluster. This report sets out the findings from our study.

Context and purpose

1.2 The context for the study was a recognition amongst the group of partners that the area around Silverstone is home to significant business activity across the field of high performance technology and motorsport. As well as Formula One teams (including Red Bull Racing (in Milton Keynes), MERCEDES AMG PETRONAS/Mercedes-Benz Grand Prix Ltd (Brackley, Northamptonshire) and Sahara Force India (based at Silverstone itself)), the likes of Cosworth (Northampton) and Prodrive (Banbury and Milton Keynes) are household names. However, many more HPTM firms are effectively hidden from view, nested within supply chains for motorsport series (ranging from Formula One to IndyCar and NASCAR to obscure semi-professional or even amateur events) and/or – and increasingly – developing products, services and know-how across the spectrum of high performance technology⁶ with little or no apparent link to motorsport, yet with a heritage and specialist labour market that is shared.

1.3 The intensely competitive nature of motorsport – driven by its link to “the spectacle” and “the business of winning”, and the constant imperative to innovate, improve and solve complex technological problems – has helped to mould an industrial ecosystem which is full of paradoxes. It is restless and volatile, yet intensely conservative; secretive yet highly networked; global in ambition yet strongly localised and deeply embedded; and full of potential yet with an inconsistent track record in terms of the overall pace of growth. However, it is important to recognise that the origins of the ecosystem predated motorsport; and its future – although path dependent – is unlikely to be straightforwardly linear.

1.4 At the outset, this ecosystem was considered to have many of the attributes of a cluster (see Figure 1-1). Whilst achieving global recognition through activities linked directly to motorsport (and particularly Formula One), it is much less well understood across high performance technology defined more broadly. The purpose of this study, therefore, was to examine the existence and character of the cluster; to understand where it has come from and how it is evolving, particularly in terms of the beneficial interactions within and across it; and to reflect on what its broader potential might be.

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⁴ The partners that supported this study were: MEPC, Barclays, PwC, Motorsport Industry Association (MIA), South East Midlands Local Enterprise Partnership (SEMLEP), Northamptonshire Enterprise Partnership (NEP), Buckinghamshire Thames Valley Local Enterprise Partnership (BTV LEP), Buckinghamshire County Council, Northamptonshire County Council, Aylesbury Vale District Council, Cherwell District Council and South Northamptonshire Council
⁵ In completing this study, SQW was joined by Dr Nick Henry from Coventry University and Dr Tim Angus from Motorsport Research Associates
⁶ This is depicted in Figure 1-2
Clusters were not, however, "invented" by an American academic in the late 20th Century. Indeed, the origins of the concept are at least a century older. In 1890, Alfred Marshall observed that once the process of local specialised industrial concentration has begun, it becomes both cumulative and socialised such that "the mysteries of the trade become no mysteries; but are as it were in the air".

Underpinning this process, Marshall identified three conventional – but crucial – "external economies" which were also referenced by Porter: the availability of skilled labour, the growth of supporting trades, and the specialisation of firms in different stages of production. However, the key insight from Marshall, arguably, was the importance he attached to the shared rules and conventions "in the air": these are social and cultural in character – not narrowly economic – and they are largely or generally based on tacit knowledge and trust. Over a century later, these continue to be rehearsed in the academic literature through concepts such as "untraded interdependencies", "institutional thickness" and the powerful – albeit double-edged – "ties that bind". Within a productive and competitive context, these social and cultural dimensions are the lifeblood of clusters. They are also, at times, the Achilles' heel: clusters can, and do, decline, particularly if they lack adaptive capacity. However, it is the depth of tacit knowledge that distinguishes clusters from scale-related agglomerations (which are also important, but different).

The spatial consequence of this form of industrial organisation was identified by Marshall as the specialised "industrial district". This too has been rediscovered by subsequent generations in the guise, variously, of "new industrial spaces", "territorial production complexes", "neo-Marshallian nodes", "regional innovation milieus", "network regions", and "learning regions". Whatever the terminology, the key thesis is: that social and cultural relationships are created and recreated in the course of "doing business"; that these confer some level of competitive advantage (so long as the cluster as a whole is able to adapt to changing circumstances); that they depend crucially on localised face-to-face contacts and knowledge spillovers; and that they are – despite (and in part because of) the increasing pressures and opportunities of globalisation – inherently related to "place".

The cluster concept has attracted its critics. In part, this is because the nature of causality has sometimes been under- (or even un-)specified and "the causal logic is collapsed into a blurred mixture of simultaneous cause and effect". Moreover, it is fair to observe that the concept has – at times – been inappropriately and poorly used in a policy setting.

However, the cluster concept has proved enduring, and it underpins much current thinking internationally on spatial competitiveness (e.g. at an EU-level through smart specialisation). Fundamentally, its power reflects the clear correlation – whether in the Cambridge high tech cluster in the UK, or Silicon Valley in the USA – between strong local economies and a pattern of industrial organisation that is not reducible to simple transactions. Hence whilst there may continue to be a degree of conceptual "fuzziness" in relation to clusters, there is, nevertheless, something "in the air" which policy-makers, businesses, investors and scholars are all still keen to understand better.

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11 For a review, see Doel, C, Delahunty, L, and Hindle, R, "Accelerating Local Economic Growth – Clusters and Deals", SQW Viewpoint Series, July 2014
Approach and methodology

Key definitions

1.5 From the outset, it is important to be clear on some key definitions which have provided the parameters for this study.

1.6 The concept of a cluster was explained in detail in Figure 1-1. At their simplest, clusters are “concentrations of firms that are able to produce synergy because of their geographic proximity and interdependence”12; interconnected institutions also have a central role13,14. However, implicit within this are two further definitional issues. These are more complex – but without some attempt to derive clear working principles and assumptions in relation to them, this piece of work would have been open to many of the criticisms levelled at other cluster studies15.

1.7 The first relates to the question of geographical proximity. Neither SQW nor our Steering Group wanted to be beholden to administrative boundaries, or any other fixed or prescribed “lines on maps”. Hence we focused on a core geography that included two major urban areas (Northampton and Milton Keynes) as well as a raft of smaller ones (e.g. Buckingham, Towcester, Brackley); and was loosely bounded by Banbury and Bicester in Oxfordshire; Daventry and Wellingborough in Northamptonshire; Flitwick in Central Bedfordshire; and Aylesbury in Buckinghamshire. For statistical purposes, this core geography was defined in terms of seven local authority district/unitary areas, but this “hard-edged” map formed only a guide and a proxy, recognising the “messiness” of real-world economic geographies. In addition, we made frequent reference to broader geographies, defined in relation to four local enterprise partnership (LEP) areas and at a sub-national scale16.

1.8 The second definitional question related to high performance technology and motorsport (HPTM). Again, there was little appetite for conventional – but limited – classificatory straitjackets. As with the spatial footprint, we were clearer at the outset on the “centre” than the “edges” (noting that the latter are, in any case, evolving) and we agreed to use the research process to consider the sectoral expression of beneficial interactions. As with the question of geography, however, we had to make use of conventional taxonomies (in this case through the Standard Industrial Classification (SIC 2007) system) to enable any attempt at measurement; our approach to this is considered later in this report.

1.9 What was clear throughout was that the HPTM cluster is on an evolutionary path. An attempt to depict this in broad sectoral terms is provided in Figure 1-2 (below), recognising that illustrations of this nature are inevitably over-simplistic. The central point however – and a key theme throughout this report – is that an engineering heritage, linked in large

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14 It is important to note that “scale” (in terms of employment, GVA or any other metric) is not part of the definition; instead the defining characteristic is “interdependence and synergy”.
15 The challenges surrounding the lack of empirical definition of either the geography or composition of clusters is discussed at some length in Deconstructing clusters: Chaotic concept of policy panacea? Paper by Ron Martin and Peter Sunley, published in Journal of Economic Geography, 3, (1), 5-35
16 Maps are provided in Chapter 3
part to early aerospace, coupled with a series of contingent locational factors, paved the way for a 20th century focus on motorsport\textsuperscript{17}. This was both enabled by – and enabling of – a raft of other disciplines relating to high performance technology; and these were made all the more powerful in the context of developing digital infrastructures and the increasing use of data. Today, these are having an increasingly wide application, both within motorsport but also well beyond it. It was within this fluid and evolutionary context that we sought to investigate the HPTM cluster in and around Silverstone.

Figure 1-2: The broad evolution of the HPTM cluster in indicative sectoral terms

Research methods

1.10 In completing this piece of work, we drew on a range of evidence sources. These included a literature review – encompassing both academic and policy-related sources – and an analysis of secondary data (known limitations notwithstanding). Substantively, however, our methodology relied on in-depth, qualitative, primary research. This was principally in the form of detailed semi-structured conversations with firms, institutions and other organisations working within the field of HPTM. Most were located in the area around Silverstone, but some brought perspectives from further afield.

1.11 Our approach to sampling firms was two-fold:

- First, in discussion with stakeholders (including study partners and members of our Steering Group), we identified some of the known businesses operating in the field. We sought to interview these companies and we asked them to identify their collaborators, competitors and other linked companies; in turn, we sought to interview this second-wave of companies through a "snowballing process" of cross-referral

\textsuperscript{17} "Motorsport" itself has been defined as "competitive racing by similar machines on a frequent basis on designated tracks and circuits" (Henry, N, Pinch, S, and Russell, S (1996) "In Pole Position? Untraded interdependencies, new industrial spaces and the British motorsport industry", Area 28(1): 25-36)
Second – and in order in part to mitigate the risk of the “snow-balling process” simply unearthing the usual suspects – we launched a wide and shallow e-survey, based on a company directory structured by SIC codes and postcodes. As well as capturing some basic information, the purpose of this was essentially to recruit further companies to our interview programme.

In total we conducted interviews with over 60 individuals from HPTM companies. Key findings from these interviews are woven into the narrative and some individual accounts are presented as case studies. We also spoke to a range of institutions and organisations with a role in relation to HPTM activities in the area around Silverstone. In opting for this approach, we did not set out to achieve statistical “representativeness”; instead, we sought to achieve explanatory depth across the spectrum of HPTM and to use qualitative methods to triangulate – and corroborate – the emerging findings.

Structure of this report

The report that follows is divided into eight further chapters:

- Chapter 2 charts the early growth and broad evolution of the HPTM cluster in the area around Silverstone and it sets out – essentially – how an engineering heritage led to a globally significant locale in relation, particularly, to motorsport by the latter part of the 20th century

- in Chapter 3, the focus broadens to consider the spatial setting in which the cluster is now operating and within this context, some of the later “rounds of investment” that are shaping its present form and its future prospects

- Chapter 4 attempts to quantify the scale of the HPTM cluster today

- the next four chapters probe more deeply into the cluster’s contemporary make-up and dynamics, all of which relate fundamentally to its specialist labour market; the different chapters address in turn:
  
  - issues around the development of knowledge “in the air” and the implications for “doing business” within the cluster (Chapter 5)
  
  - the nature and process of innovation and adaptation (Chapter 6)
  
  - critical issues relating to financing, networks and growth (Chapter 7)
  
  - the relationships between local and global (Chapter 8)

- finally, Chapter 9 sets out some thoughts on the future of the cluster and concludes with an Agenda for Action.
Acknowledgements

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2. The origins and growth of the HPTM cluster

Key points from Chapter 2

- The origins of the HPTM cluster reflect: government support for aircraft research and manufacture in the inter-war period; a changed emphasis in early professional motorsport with more focus on aerodynamics and weight reduction; and a shift to racing on designated circuits which were established on disused airfields (such as that at Silverstone).

- HPTM businesses were formed in this context, sometimes by “racing entrepreneurs” although many of the early entrepreneurs had a strong background (and training) in aeronautical engineering.

- Many of these businesses have seen successive ownership changes and, over time, their competitive focus has evolved. Today, some have little or no connection to motorsport and are better understood in terms of their wider high performance technology credentials.

- Alongside the businesses, key institutions emerged – some many decades ago. However, like the population of firms, new institutions are still emerging as the cluster evolves. These institutions are a key part of the cluster and they play particularly important roles in relation to research and testing; and training and workforce development.

- Today, the HPTM cluster has a particular focus and character in the area around Silverstone but boundaries are neither “hard” nor “fixed”. There are important wider connections across the UK and also internationally.

In the beginning…

2.1 There is a substantive – and well-researched – literature from which it is possible to distil the early history of the HPTM cluster18. Specifically, the origins might be explained in terms of three main factors19:

- support from UK government for aircraft research and manufacture in the inter-war period, most of which was in the south of England, leading to a generation of qualified engineers with a high level of aerospace competence within the local area

- a shift – in the 1950s – within professional motorsport away from the heavy cars that had previously been produced in Italy (by the likes of Ferrari, Alfa Romeo, Maserati and Lancia) towards something much lighter with a far greater emphasis on aerodynamics and weight reduction (which in turn demanded, essentially, the disciplines of aerospace)

- a dense network of local racing clubs and motorsport enthusiasts, coupled with a post-war switch from racing on public roads to designated circuits, many of which were established on disused airfields, such as that at Silverstone.

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18 Note, however, that the history of the Cluster (as defined here) overlaps with – but is definitely not synonymous with – the history of motorsport in the UK. The latter is explained in detail in the papers cited at footnote 19. It includes factors which are not discussed in any detail here (e.g. the changing role of sponsorship, and the effect of regulation)

2.2 In this context, a network of small scale “garagists” emerged. As one account explained, “in 1946, the Cooper-JAP consisted of a frame joining together a Fiat Topolino suspension and wheels, a Triumph gearbox and a JAP motorcycle engine”\textsuperscript{20}. Although initially a miscellany of parts, this approach was effective and it led to early success in competitive motorsport. In explaining the evolution of the HPTM cluster, it was important because:

- it transformed the technological and organisational framework for building world-beating racing cars into a vertically disintegrated production system (in contrast to the integrated models which had been prevalent in northern Italy)
- it was capable of being funded through prize money from winning races and from the income linked to selling racing cars, and it led to a set of “racing entrepreneurs”: ex-racers who became team owners and constructors\textsuperscript{21}.

2.3 The other key early ingredient was the role played by Silverstone itself. To be clear, this would not have been sufficient on its own to precipitate the development of the cluster – but in combination with the more general circumstances of the inter- and post-war period outlined above, Silverstone was – effectively – the “grit in the oyster”: Silverstone provided the “spatial anchor” for the emerging cluster in central-southern England. A brief account of the history of the Silverstone Circuit and its evolving role is provided in Figure 2-1 (below).

![Figure 2-1: The history of Silverstone Circuit](image)

Silverstone Circuit straddles the border between the counties of Northamptonshire and Buckinghamshire (and the districts of South Northamptonshire and Aylesbury Vale). The site was used as a military airfield during the Second World War. At the end of the war, part of the site became a working farm.

In 1948, The Royal Automobile Club arranged a one-year lease with the then-Air Ministry. Later that year, it hosted the first RAC International Grand Prix at Silverstone. In 1950, Silverstone Circuit hosted the first ever Formula One race. The British Racing Drivers’ Club (BRDC) took over the lease of Silverstone Circuit in 1952 and in 1971 purchased the site’s freehold from the Ministry of Defence.

From the 1950s to the 1980s, the British Grand Prix was variously held at Brands Hatch (Kent), Aintree (Liverpool) and Silverstone. However, despite some contractual complications, Silverstone has hosted the British Grand Prix every year since 1987 – albeit without any long term assurances.

The expiry of the Concorde Agreement in Formula One in 2007 led to the removal of protection for traditional grand prix races in Britain, France, Monaco and Italy, and increased competition from countries not previously associated with hosting Grand Prix. In this context, it became increasingly difficult for the BRDC to meet the annual fee demands of Formula One Management (FOM) to host the event as well as provide the guarantees on circuit and facility upgrades that FOM required of Formula One circuits.

Understanding these challenges, the then Silverstone management team developed a new business model. This aimed to provide new sources of revenue that could be used to meet the FOM event fee and specification upgrades. Hence:

- Silverstone became an all year round visitor attraction with a full racing calendar, driving experiences and visitor centre
- the British Grand Prix was marketed as a three-day event, involving a wide range of non-racing activities to appeal to the family market
- Silverstone developed a Technology Park which attracted businesses involved in motorsport and high performance engineering
- the Silverstone Innovation Centre was opened, providing space for business start-ups.


\textsuperscript{21} ibid.
HPTM cluster firms

2.4 Within this overall context, a raft of companies has emerged since the 1950s, most of which were – and are – small. With strong engineering roots – often deriving ultimately from aerospace – many of these have had a role within the motorsport supply chain, whilst also – and perhaps increasingly – developing alternative and/or supplementary niches and applications across the spectrum of high performance technology. Sandwell UK Ltd – based in Towcester – is a small company with a growth narrative that is a microcosm of the wider cluster’s evolution (see Figure 2-2).

Figure 2-2: Sandwell UK

Sandwell UK specialises in surface engineering solutions, including improving the fatigue life of mechanical components. This ensures that highly stressed components last longer and therefore perform better.

Today, Sandwell’s clients include motorsport teams, energy companies, and medical and aerospace companies, although the firm’s origins link closely to motorsport. The firm is based in Towcester, near Silverstone. This choice of location was driven by its proximity to motorsport customers. Sandwell currently employs about 20 people.

Sandwell’s founders

Colin McGrory, one of Sandwell’s founders, started his career as a metallurgist in the aerospace sector, working on the development of non-destructive methods and post flight failure analysis. The Arrows Formula One team, based in Milton Keynes, recruited him in the early 1980s. In the early 1990s, he moved to work with Leyton House Racing in Bicester. Following a second stint at Arrows, Colin set up Stewart GP in 1996 alongside Jackie Stewart. The team was sold to Ford in 1999 and subsequently re-branded as Jaguar Racing.

The formation of Sandwell UK

Along with another business partner, Colin formed Sandwell UK in 1997 as a ‘parachute enterprise’ in case Stewart GP did not work as planned. Colin continued to work for Jaguar Racing until 2002, following restructuring at the team.

Colin was keen for a change in lifestyle and therefore opted to focus his attention on Sandwell.

In its first decade, Sandwell’s main clients were Formula One teams based in the Silverstone area, drawing on Colin’s contacts and knowledge of the industry. Central to Sandwell’s offer has been the quick turnaround time in the production and delivery of high quality parts to the teams – and hence the location at Silverstone was important.

Until around 2007/2008, Sandwell’s business almost exclusively came from Formula One teams. However, regulation changes – particularly the restrictions placed on the use of spare cars (up until 2008, teams could have more than two cars available for use at a Grand Prix weekend) – meant that Sandwell diversified.

Diversifying the business – and future plans

Initially, the firm looked to diversify into the oil and gas industry, providing parts for drilling systems. With falling oil prices, Sandwell looked to broaden its client base further still. The firm’s Formula One credentials were key to this – showing potential clients that Sandwell could be trusted to produce high quality products quickly. Sandwell now supplies an array of clients including major transport companies, medical and aerospace firms.

At present, half of the firm’s business comes from motorsport, and the other half from these diverse activities. The expectation is that non-motorsport activity will be the main driver for the firm’s future growth. The firm’s immediate priorities are to consolidate its presence in markets such as aerospace which offer growth potential.
2.5 Over time, some of these companies have seen repeated ownership changes: there are very few that can report a straightforward company history from the second half of the twentieth century to the present day. Cosworth is one of the cluster’s most iconic businesses. Its narrative spans more than 50 years and has been turbulent, with major “highs” and “lows”. This turbulence – driven in part by internal factors and in part by successive changes in the relationship between motorsport and mainstream automotive – has been of formative importance in shaping the wider cluster. It has meant, firstly, that large numbers of highly skilled engineers have “grown up” through Cosworth and have then found themselves as part of the wider local labour market with a deep knowledge of its products, technologies and its culture/ethos. In addition, it is estimated that around 80 companies – most of which are locally based – owe their origins to individuals who have worked for Cosworth at some point in their career; examples include Ilmor, Flybrid, Integral Powertrain, Schumacher Racing Products and Filtration Control (some of which are considered in detail later in this report). These companies have been formed at different times over the last 50 years and their own specialisms vary, but all might be identified within the wider HPTM cluster. A brief summary of Cosworth’s history is provided in Figure 2-3.

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Figure 2-3: Cosworth

Early days

Cosworth was formed in 1958 by Mike Costin and Keith Duckworth, two former employees of Lotus Engineering Ltd. Essentially, it took a well-understood technology – the internal combustion engine – and “made it better”; and this in turn was crucial in the early development of modern motorsport. After six years in north London, the business moved to Northampton. This met two basic criteria: a location “within eight miles of the M1 and reasonably close to Silverstone”; and a “relatively cheap” site (at St James Mill Road).

The Cosworth internal combustion engine was initially sold exclusively to Lotus. However, as the engines were developed, opportunities were identified in North America. This meant that Cosworth’s dependency on Lotus declined and in the mid-1960s, important links were forged with Ford. The result was the Cosworth DFV engine which – for a significant period – dominated Formula One. By 1980, Cosworth employed around 500 people in Northampton.

Subsequently, Ford entered road car racing – for which it needed a production car. The Cosworth engine was developed, making a “race-tuned performance engine” available to the general public through Ford Sierra and Ford Escort models. At this stage, Cosworth opened another facility – at Wellingborough – and its total headcount increased to about 700.

However, by the early 1980s, the two founders were looking to retire. This prompted a series of ownership changes which led to significant turbulence for Cosworth; and over this period, the business changed and its headcount declined significantly. First the business was sold to UE1 – which itself was then acquired by Carlton Communications.

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22 Cosworth has long been important in training engineers and it continues to have significant programmes for both graduates and apprentices.

23 These are, essentially, the “shared rules and conventions” which are “in the air” – as explained in the definition of clusters that was provided in Figure 1-1.

24 “The Cosworth legacy” has been mapped in detail by Bernard Ferguson, a former director of Cosworth. We learned a great deal – about both Cosworth and the wider cluster – by talking to him in the course of this study and we are grateful for the time he made available for this purpose.
Subsequently the whole business was sold to Vickers which retained ownership of Cosworth until the early-mid 1990s. At that stage, the road car engine and racing divisions of Cosworth were split up:

- The engineering/road car division was sold to VW/Audi in 1998; and then acquired by MAHLE (and renamed MAHLE Powertrain)
- Ford (which had worked closely with Cosworth throughout) acquired the other parts of Cosworth.

Recognising that software systems and data were becoming increasingly important in relation to high performance technology, Ford acquired Cambridge-based Pi Research at about the same time; it also took ownership of the Jackie Stewart F1 team.

Ford’s interest in acquiring Cosworth and Pi Research was fundamentally linked to Formula One. However, from the late 1990s to the mid-2000s, it enjoyed limited success – despite significant investment. For this reason, Ford took the view that there was no business case for any of its brands to compete in Formula One and hence, in 2004, it divested the business: Cosworth (with Pi Research) was sold to Gerald Forsythe and Kevin Kalkhoven, owners of the Champ Car World Series, and the Cosworth Group was formed. The Jackie Stewart F1 team, branded by Ford as Jaguar Racing, was sold to Red Bull. Subsequently, Red Bull enjoyed significant success in Formula One; some of this was explained by Ford’s earlier investment.

For Cosworth Group, however, difficulties followed as the Champ Car World Series ceased operation in 2008 – leaving it without an obvious large motorsport outlet. It pursued a diversification strategy – into military applications, aerospace and mainstream automotive – but in the context of the credit crunch and recession.

Cosworth today

Subsequently, Cosworth has focused on its engines, flexing its brand, and developing three areas of business: motorsport for car makers (working especially in the “niche volume” segment); engineering consultancy; and consumer products for performance enthusiasts.

It operates from two main locations – a “campus” of sites at Northampton (which is the home of its engines) and in Cambridge (which is the location of its electronic data acquisition and control systems (formerly Pi Research)). The two divisions have the same senior managers within a Group structure and – in seeking to sell to the same automotive customers – both benefit from the Cosworth brand, even though day-to-day operations are quite distinct. Both divisions have highly skilled workforces but the skills sets are different. In total, Cosworth currently employs around 250 people in Northampton and 75 in Cambridge.

Over the last couple of years, Cosworth has invested in its Northampton operations (with support from central and local government, and the local enterprise partnership). Specifically, it has opened a fully automated, 38,000 sq ft, Advanced Manufacturing Centre. This provides flexible machining, assembly and surface coating capabilities targeted at “niche volume” high value engineering components for OEM automotive companies in the UK and North America. It includes a central computerised production flow and scheduler which was developed with Cranfield University. Cosworth’s site is within the Northampton Waterside Enterprise Zone.

Another highly influential business – and currently one of the larger companies in the cluster – is Prodrive. As set out in Figure 2-4, in terms of its origins, this was an archetypal “cluster company” which was set up at Silverstone by a genuine “racing entrepreneur”. However, it can also be seen as an archetypal HPTM business insofar as it is actively growing in composites and engineering consultancy, with clients spanning the mainstream automotive, aerospace and marine sectors, in addition to motorsport. Today it operates from two major sites – one at Banbury and one in Milton Keynes.
Background

Prodrive was founded in 1984 at Silverstone by Dave Richards, a former World Rally Championship winning co-driver and now one of the most respected figures in world motorsport. He still owns the large majority of the parent company.

The firm has had a long and successful history in motorsport. Since 1984, Prodrive has won six World Rally titles; three FIA World Sports Car titles; four Le Mans titles and four British Touring Car Championships. Today it has programmes with Aston Martin in the FIA World Endurance Championship and global sports car series, for MINI in the World Rally Championship, as well as a new programme for VW in the Chinese Rally Championship.

Prodrive moved to Banbury from Silverstone at an early stage in the firm’s development. It has recently expanded into a new building at Banbury adjoining the M40. Prodrive now employs 500 in total at two locations: 170 at Milton Keynes (Composites) and the remainder at Banbury.

The company is now structured as a holding company with four subsidiaries: Motorsport, Advanced Technology, Composites and Brand&. Each subsidiary has a different Board and ownership structure.

The new Banbury facility has room for expansion. One third of the building was recently sublet to Manor F1. 95% of Prodrive’s Advanced Technology and Composites business is with UK based companies which export globally.

Constraints on labour supply are an issue for the Advanced Technology business in Banbury, where the labour market has been affected by the strong growth of nearby Jaguar Land Rover and its ability to provide excellent remuneration to skilled engineers. There is also an issue with a lack of skilled staff in the growing composites industry, which Prodrive has addressed by a very large composites apprenticeship programme. In 2014, Prodrive Composites business took on 40 apprentices to enable expansion, and now recruits 15 apprentices per year.

Diversification

Prodrive remains very active in motorsport: on its website, Prodrive describes itself as “one of the world’s largest and most successful independent motorsport businesses”. However, to grow and strengthen the business further, it has diversified into composites and engineering consultancy, and into mainstream automotive, aerospace and marine markets, on the back of expertise developed initially in its motorsport business.

(i) The Composites business

The Composites business is now one of the largest of its kind in the UK, having experienced very rapid growth over the last two years, from 70 to 170 employees. Dominic Cartwright, Managing Director of Composites and Advanced Technology, joined Prodrive in September 2013, having worked previously in the aerospace sector, and brought strong market contacts as well as expertise in carbon fibre and composites. Prodrive’s market presence has also been strengthened by the appointment of John Weston (ex BAE Systems) to the Prodrive Composites board.

Prodrive’s 32,000 sq ft factory in Milton Keynes produces advanced lightweight composites for the aerospace, automotive, defence, marine and other specialist sectors. It manufactures everything from bodywork, aerodynamic devices and interior trim for sports cars; to first class cabin interiors for commercial airliners, radars for navy ships and components for orbiting satellites. It has a £15m contract with McLaren to produce much of the bodywork for their sport cars, and also contracts with Bentley to support its new SUV, and with Airbus Defence & Space to manufacture the European Space Agency Mars Rover.

In 2015, Prodrive Composites secured a £6m investment by BGF, a private equity fund with a long term perspective, to accelerate growth in lightweight materials markets. At some stage, further growth is likely to involve a move into higher volume manufacturing, which will require expansion in a lower cost location with a large manufacturing workforce, either elsewhere in UK or overseas.

(ii) The Advanced Technology business

Based on the innovative technology and techniques used in motorsport, the Advanced Technology business works in the mainstream automotive market and beyond. It accounts for half of the Prodrive Group sales, and has over 100 engineers working on projects for leading vehicles manufacturers, as well as businesses in the aerospace, defence and marine sectors. Its largest customer is Jaguar Land Rover. It also has projects with Rolls Royce Aero Engines, with Alstom to improve the efficiency of the braking systems on trains, and with the Land Rover BAR America’s Cup team to help develop its advanced racing yacht.

Prodrive has developed particular specialisms in electro-hydraulic and electro-mechanical actuation systems, the latest electric and flywheel hybrid systems; DC-DC converters for electric cars; as well as the design and manufacture of limited edition performance and luxury cars.

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material
Alongside Cosworth, Prodrive and the Formula One teams mentioned in Chapter 1, the majority of HPTM companies are small. Most are – literally and metaphorically – hidden from view, located on small, anonymous, industrial estates. It is this group of small businesses – and the individuals who formed them and the workers that move between them – that largely define the “untraded interdependencies” and the “ties that bind” at the heart of the HPTM cluster (as defined in Figure 1-1).

A further example of a small company at the core of the cluster is Graphite Additive Manufacturing, based in Aylesbury. With roots in Formula One, this company is now supplying a diverse range of sectors – from aerospace to architects – and it has ambitions to grow further. A brief synopsis is provided in Figure 2-5.

**Figure 2-5: Graphite Additive Manufacturing**

**Early Days**

Kevin Lambourne – the founder of Graphite Additive Manufacturing – completed a Higher National Certificate (HNC) in engineering whilst living in Gloucestershire. He joined a company in Gloucester which was experimenting in 3D printing and he saw the firm grow quickly. Subsequently, he moved to 3D Systems (a US-based multi-national) in Hemel Hempstead (Hertfordshire), and it was there that he first started to work for clients linked to Formula One.

As an engineer, he had always seen Formula One as the pinnacle. In 2005, he applied for a job at Red Bull (in Milton Keynes) and he was recruited to run Red Bull’s rapid prototyping team. Initially this was small. Gradually, however, the designers saw the value of 3D printing and the range and complexity of applications increased. Kevin worked with Red Bull for seven years and over this time, he saw his team grow substantially.

**The formation of Graphite Additive Manufacturing**

By 2012, Kevin wanted a new challenge and he decided to form his own business. He considered that the range of applications for 3D printing was potentially enormous and he took the view that “the market” was now “ready” for the technology (unlike 20 years previously). From his own experience, he was also convinced that the level of quality and service from existing suppliers was not all that it could be, and that there was a clear niche that he could fill.

Graphite Additive Manufacturing was formed in 2012. Its early growth was financed through investments from individuals who Kevin already knew. Graphite Additive Manufacturing secured a small industrial unit in Aylesbury; the choice of Aylesbury was dictated by the location of the Formula One teams – all were “within an hour”. The firm’s early clients were Formula One teams, based on the contacts Kevin had built up and his knowledge of the way their businesses operated (including their particular cultures and pressures). Whilst every order came with a confidentiality agreement, there was no requirement for exclusivity and Graphite Additive Manufacturing was able to work for five different Formula One teams during its first year of business.

**Diversifying the business – and future plans**

Initially, Formula One was responsible for most of Graphite Additive Manufacturing’s order book. However, the Formula One teams have themselves faced challenges – notably the demise of Caterham and Marussia in 2014. Graphite Additive Manufacturing therefore made a conscious decision to diversify into other market segments – recognising the range of potential applications for 3D printing. This process has been very successful and over the last year, it has worked for aerospace firms, composites firms, architects, and automotive firms. These clients are widely distributed across the UK; and some are international. However, some are local and part of the high performance technology and motorsport cluster. For example, Graphite Additive Manufacturing completed a project with Schumacher Racing Cars (which is based in Northampton and produces radio controlled model cars; its founder previously worked for Cosworth).

Currently Graphite Additive Manufacturing employs six people and its turnover is split evenly between Formula One and a diverse mix of other clients. Looking ahead, it aspires to double its headcount within three years and its expectation is that the “non-Formula One” business will account for the majority of growth.

Over this timescale, the firm will seek new premises – it is currently on a split site and would like to bring its office and industrial premises together. It intends to remain in Aylesbury, for two main reasons: it has invested in training its staff (most of whom live locally) and the proximity of its Formula One clients (which remains crucially important for the business).

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material
HPTM cluster institutions and organisations

2.9 Alongside the population of firms, it is important to flag the significance of some key institutions and organisations that have grown up within the cluster and are, functionally, an integral part of it. As noted in Figure 1-1, clusters – certainly on Porter’s definition – are as much about institutions as they are about firms, and the relationship between the two is critical. Some of the key wider institutions/organisations are introduced briefly here, and their roles are discussed in more detail later in this report.

2.10 Reference to Silverstone Circuit has already been made. It is important to note also the deep-rooted and formative (and continuing) significance of, *inter alia*, Cranfield University (which grew out of the College of Aeronautics, created in 1946) and Millbrook Proving Ground (which was developed in the 1960s for automotive testing purposes, initially under the ownership of General Motors). Other key organisations have been formed much more recently. In the crucial domain of workforce skills, examples include the National College for Motorsport and Silverstone University Technical College. In relation to higher education, as well as Cranfield University, Oxford Brookes University has very well established HPTM specialisms, but there is also more recent provision; for example, the University of Buckingham has introduced an MSc course in Lean Enterprise. In relation to technology and innovation, the Transport Systems Catapult was set up in 2013 in Milton Keynes by Innovate UK to drive and promote intelligent mobility. Although a national body with a national remit, it is located in the heart of the HPTM cluster and it will be important in relation to future growth. Also within Milton Keynes, the Open University is important. Looking ahead, further new provision for the cluster is being planned. One example includes proposals for an aerodynamic testing facility at Catesby Tunnel.

2.11 National bodies which are physically based elsewhere have also been significant locally. These include, for example, the Society of Motor Manufacturers and Traders (SMMT) and the Aerospace Alliance. In relation to the cluster’s recent growth, the Motorsport Industry Association (MIA) has played a particularly important role. This has been amongst the most visible and effective trade associations nationally. It has a strong and committed membership, much of which is drawn from the HPTM cluster in the area around Silverstone – although its spatial footprint is broader. A synopsis of the history and strategy of the MIA is provided in Figure 2-6 below.

**Figure 2-6: Motorsport Industry Association (MIA)**

**History**

The Motorsport Industry Association (MIA) is the only global trade association for the motorsport, performance engineering, services and tuning sectors with its international HQ near Warwick in the UK.

In April 1994, a group of British motorsport business leaders joined forces to form their own trade association - the MIA - with the aim of protecting and promoting the business of motorsport. The founder, and original CEO, Brian Sims, formerly Marketing Director of F1 Benetton and Lola, was replaced in 1998 by Chris Aylett. Chris, previously President of the Sports Industries Federation and a race driver and team owner, has remained as CEO throughout the last 18 years, building the MIA to ‘lead trade body status’. The current chairman is Jim Morris, Managing Director of Lifeline, suppliers of on-board fire systems and safety products for motorsport. The Rt Hon the Lord Astor of Hever DL became Honorary President in 1996, a position from which he stepped down in 2010 when he became Defence Minister, to be replaced by Lord Drayson, former Science and Technology Minister, until 2015, when the Presidency returned to Lord Astor. The MIA has therefore benefitted from continuity and strength of leadership.
**Strategy**

Chris Aylott, the CEO of the MIA, has a clear strategy for the organisation, based on his previous personal business experience which includes the Presidency of various trade associations, an understanding of the value of a brand and that trade associations need a clear long-term strategy to survive and grow.

The current MIA strategy has a number of elements:

i) **Global reach, both for the MIA and the industry, where international markets offer increasing opportunities to many UK based motorsport firms.** The MIA actively promotes international trade by UK companies, supported by UKTI, and has established liaison offices in Dubai, Hong Kong, Shanghai, Seoul, Indianapolis, Charlotte and Los Angeles. A quarter of MIA members are international organisations.

ii) **Building the brand and promoting the reputation of the business of motorsport, particularly within UK government organisations and potential investors.** Despite early difficulties, UK government is now an active supporter of the motorsport sector being kept informed by the MIA and others. BIS has a small ‘Motorsport team’ in place and helps to promote UK motorsport as a ‘Great British’ business success story. This business community is continuously and successfully promoted as “Motorsport Valley®”, the collective ‘brand name’ created (and owned) by MIA members to describe the UK motorsport cluster.

iii) **Actively increasing diversification by promoting the exploitation of the unique capabilities and expertise of motorsport firms in adjacent sectors, such as defence, automotive and others.** This required significant persuasion: motorsport firms needed convincing that diversification would make them more commercially resilient and investible, yet would not weaken their valuable focus on ‘winning’; and firms from other sectors had to be persuaded that capabilities available from these motorsport suppliers - substantial R&D investment, endless innovation and rapid solution response – were highly relevant and reasonably priced for their needs. A singular example of the MIA’s strategic role came in 1999 when it identified that motorsport firms had many years of experience in developing ‘energy efficient technologies’. This attracted little interest until oil prices reached a new high in 2000, leading to national protests and widespread realisation of the value of fuel/energy efficiency in vehicle design and operation. The MIA’s ‘Energy Efficient Motorsport’ initiative, launched in 2001, led to it organising the world’s first international low-carbon motorsport conference in 2003, an annual conference which continues today. This visionary concept has helped to stimulate interest and business growth, e.g. Audi winning Le Mans with a diesel-engine car (revolutionary at the time), KERS energy recovery technologies and Formula E. This strategic role helped build the MIA’s global reputation and its value to the wider motorsport industry.

iv) **A broad set of business and sector development activities.** This includes awareness of (invaluable) R&D tax credits; skills and education initiatives; technology and market foresight; leadership, management and HR leadership; government representation; strategic advice and networking.

The MIA currently has nearly 400 corporate members, mostly SMEs, which transact more than £5 billion of motorsport business worldwide. It organises conferences and events to promote knowledge and technology transfer and increase international business networking; it supports a wide variety of business development activities across sectors; and it provides careers advice, supports educational initiatives including Formula Student, and hosts specialist motorsport education and employment groups.

The MIA has been instrumental in initiating important research to improve understanding of the value of the motorsport industry, and its needs, in many countries of the world. Amongst many projects are the National Survey of Motorsport Engineering and Services 2001 (updated second edition published in 2013), the 2003 DTI motorsport cluster study, and the 2007 Motorsport Cluster Development Plan. The MIA plans to deliver a UK Motorsport Growth Plan 2015-2020 in 2016. The current UK Motorsport Strategy aligns to the UK Automotive Technology Strategy and a broader global performance engineering matrix, but also ensures recognition and understanding for the unique demands and value of the industry’s ‘sport’s entertainment’ footprint which is key to its competitive advantage.

**The future**

The MIA will support continued careful diversification of, and globalisation by, its members and the UK industry and so is likely to increase its activities overseas. It will emphasise the growing importance of ‘new entertainment’ industries to the future of motorsport, which currently, collectively, attracts the largest global TV audience of any sport. From 1990, satellite broadcasting brought huge increases in air time and audience size, capturing significant commercial sponsorship for motorsport. Sports entertainment audiences are increasingly demanding more interactive experiences which will provide new sources of revenue for enlightened motorsports series and their suppliers.
The MIA organisation registered the 'Motorsport Valley®' trade mark\(^{25}\) to secure this description of this UK business cluster, after Chris Aylett, its CEO, attended a conference led by Harvard University ‘cluster guru’ Professor Michael Porter. A restrictive, regional definition of the Motorsport Valley cluster, deliberately, does not exist, as this globally-trading business community is spread throughout the UK. However, over time, an economic, business-value core area, roughly circumscribed by Banbury, Northampton, Milton Keynes and Oxford, has evolved with the most intense concentration of motorsport firms. Silverstone, sitting at the centre of this core area, has always been symbolically, and practically, central to the UK motorsport business cluster.

Source: SQW – based on a conversation with Chris Aylett (Autumn 2015) and a review of documentary material

The relationship between the evolving HPTM cluster and Motorsport Valley® – and the importance of cluster adaptation

2.12 The MIA developed the term "Motorsport Valley®" (and registered it as a trade mark). The relationship between Motorsport Valley® and the HPTM cluster is synergistic: the HPTM cluster is broader in sectoral scope but narrower in spatial coverage, although on both axes, the two constructs could be understood in terms of significantly overlapping circles within a Venn diagram.

2.13 The relationship is well illustrated by Force India, one of several Formula One teams which is physically located within the HPTM cluster. A brief description of both its evolution – and its current spatial footprint – provides an appropriate conclusion to this chapter on the overall development of the HPTM cluster.

2.14 Force India – like Prodrive – was set up by a "racing entrepreneur". He had previously driven for March Engineering (based in Bicester) before forming Jordan GP which – after a series of ownership changes – eventually became Force India, based at Silverstone. Figure 2-7, below, maps Force India’s UK supply chain. As of Autumn 2015, Force India had well over 400 UK suppliers – consistent with the vertically disintegrated production system described in paragraph 2.2 (above). Of these, around 40% were located within the core geography of the HPTM cluster. The remainder were scattered across the UK – although with particular concentrations to the south (through Berkshire and Surrey and down towards the south coast) and the Midlands (particularly around Coventry, Birmingham and Derby) and – albeit at a much lower intensity – further north and also into East Anglia.

\(^{25}\) © Motorsport Valley is a registered trade mark of the Motorsport Industry Association (MIA) and held by them on behalf of its members and the UK industry
This broader geography describes, effectively, Motorsport Valley today. The HPTM cluster defines its geographical core whilst also broadening the narrative sectorally (as depicted earlier in Figure 1-2). Despite the depth, strength and continuing importance of local suppliers, motorsport is a global business. Formula One (and other) teams will, at times, seek out bigger and/or specialist suppliers and sometimes these are further afield: illustratively, Xtrac (based in Newbury) is widely cited as a global leader in the design and manufacture of transmission systems; and other key suppliers are based abroad. The key point is that motorsport is constantly evolving and its supply chain geographies are similarly fluid.

The HPTM cluster in the area around Silverstone is implicated in this process. Companies within it are – in part – driving it, and the cluster as a whole is – in part – being shaped by it. The dynamic and recursive nature of this process adds definitional “messiness”, but this is the sign of a strong cluster. There are examples from elsewhere of well-functioning clusters turning quickly into declining ones where they are organisationally, technologically or cognitively “locked in” and where they lack “adaptive capability” and the capacity to evolve.26

A major study from the mid-2000s considered the “Motorsport Valley Cluster” in life cycle terms and it argued that it was “moving to maturity”27 – begging all sorts of questions as to what might happen next. Across the HPTM cluster, parts of it are mature but other elements are being created. Motorsport remains a crucial consideration within this – but by no means the only one. This wider process of evolution and churn – and the opportunities and threats implicit within it – forms the focus for much of the rest of this report.


3. The wider spatial and economic context: adding to the HPTM “mix”

Key points from Chapter 3

- The HPTM cluster exists across several functional economic areas which means that it draws on a number of quite distinctive local labour markets. In some respects, this explains both its character and strength – although the lack of a single city focus sets it apart from some other clusters.

- The area in which the cluster is situated has grown – and is growing – quickly (in terms of population and employment). This process itself is deepening labour markets (as they increase in scale and diversity). The HPTM cluster has contributed to this, and the wider growth process is creating significant resources for the cluster.

- This “wider growth of the wider region” has been – and is – very important in understanding how the cluster is evolving. Within this context, the changing role of Milton Keynes has been particularly significant (insofar as the origins of the cluster long predate the existence of Milton Keynes; and Milton Keynes is now, functionally, a city).

- Looking ahead, further growth in housing and jobs is planned through to the 2030s. This is likely to be focused particularly on Milton Keynes, Northampton, Aylesbury and Bicester. This process itself will shape the cluster’s future evolution.

- In addition, it is important to recognise the formative importance of the wider sub-national setting. The cluster needs to be understood in terms of connections to and interactions with: the Midlands, particularly Birmingham, Coventry and Warwickshire (in terms of its very strong automotive sector); Oxford and Cambridge (as international powerhouses with pre-eminent universities and very strong knowledge economies); London (as a global city which itself is growing quickly); and key international gateways, especially Heathrow Airport and Birmingham Airport.

The local spatial context

3.1 Unlike some others, the HPTM cluster is not co-terminous with a de facto city-region (of whatever scale). An inspection of the Travel to Work Area (TTWA) map – produced in 2015 on the basis of data from the 2011 Census
d – suggests that Silverstone is located literally at the point of intersection between three TTWAs (labelled “Milton Keynes”, “Northampton” and “Banbury” – see Figure 3-1). It is also close to several others. In this respect, it is different from, for example, the Cambridge high tech cluster which exists across a clear functional economic area, defined in overall travel to work terms and mostly contained within one (increasingly large) TTWA.

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28 The new map of Travel to Work Areas was developed by academics from Newcastle University using an algorithm to identify commuting patterns from a 2011 Census matrix of commuting flow data by origin and destination for workers aged 16 and over, based on residence postcode and address of the place of work in main job. The main criteria used for defining TTWAs were that at least 75% of an area’s resident workforce works in the area and at least 75% of the people who work in the area also live in the area; and that the area must also have a working population of at least 3,500 people. For areas with a working population in excess of 25,000, slightly lower self-containment rates were accepted [Source: ONS]

29 TTWAs approximate to self-contained labour markets. However, there is no presumption or inference that every working resident of the “Oxford TTWA” works in Oxford, simply that across the whole TTWA there is a reasonable level of self-containment. Within this, there will be a range of different local commuting geographies – and there will also be commuting to and from workplaces outside the TTWA. Hence the labelling of TTWA in terms of specific places needs to be properly understood.
3.2 Within this overall context, it is important to understand the characteristics of the larger urban areas which are moulding the TTWAs in which they are situated. Two sizeable towns (which Centre for Cities identifies as “cities”) and a number of smaller ones are especially important, for it is here – in the main – that recent growth has been focused and that future growth is planned. A brief synopsis of the main settlements is provided in Figure 3-2, focusing first on the local economy and second on the scale of planned growth.

**Figure 3-2: Key economic growth narratives relating to the main settlements within the core geography of the HPTM cluster**

**Milton Keynes**

Milton Keynes was designated as a third wave New Town in 1967, and it benefited from the work of the Milton Keynes Development Corporation for the following 25 years. Of all the New Towns – most of which are in the Greater South East – Milton Keynes has been the most successful, in part because of its scale. By the time of the 2011 Census, the “usual resident population” of the Milton Keynes Built Up Area (which approximates to the urban footprint) was about 230,000; this was larger than either of the cities of Cambridge and Oxford (on a similar built up area definition). Functionally, Milton Keynes is now a city.

Over the last two decades, Milton Keynes has become a major sub-national economic hub. Located near to the M1 motorway and on the West Coast Main Line (with fast rail services to London Euston, Birmingham and Manchester), it is extremely well connected. It is home to the Open University. Major financial and professional services companies – such as PwC, Santander and Mazars – have a significant presence within the town.

30 Note that this includes Bletchley, Newport Pagnell and Woburn Sands
31 The “built up area” is defined around a “bricks and mortar” definition developed by ONS on the basis of data from the 2011 Census. It relates, essentially, to the contiguous built up area associated with individual settlements. It can result in estimates that are different from what local authorities might expect to see. This is usually because adjacent settlements are physically connected (and therefore counted together). This “built up area” definition is used throughout Figure 3-2
Located within it are the global/European/national headquarters of major companies, some of which have a clear interest in HPTM (such as Mercedes Benz, Suzuki, Volkswagen AG and Nissan’s European Research and Development HQ). It is also home to both Red Bull Racing and Prodrive Composites.

In addition – and importantly – Milton Keynes has a high business start-up rate, a high density of SMEs (per head of population) and within the SME community, a very high incidence of both high tech and digital businesses (ranked 2nd amongst 64 UK cities) and those in professional services (ranked 10th)\(^{32,33}\).

In its *Cities Outlook (2015)*, Centre for Cities identified Milton Keynes as the fastest growing city nationally on indicators relating to population, housing and jobs. Another report identified Milton Keynes, London and Cambridge as the fastest growing cities in terms of Gross Value Added (GVA) in the third quarter of 2015 and the three most likely “to top the list in 2016”\(^{34}\).

Looking ahead, substantial further growth is planned. The Spatial Vision for Milton Keynes in 2026 – published within the Adopted Core Strategy – is for a city of 300,000 people. To this end, plans are set out for 28,000 additional homes and over 40,000 additional jobs in the period to 2026\(^{35}\).

**Northampton**

Although an existing town, Northampton was designated as a New Town in 1965 and planned expansion was carried out between 1968 and 1985 by Northampton Development Corporation. At the time of the 2011 Census, the “usual resident population” of Northampton – on a Built Up Area definition – was around 215,000.

Northampton and Milton Keynes are similar in their current size, and they are only around 20 miles apart. However, there are some major differences in their local economic make-up. Historically, Northampton had a major leather and footwear cluster. It subsequently evolved as a major hub for engineering, creating a heritage that has been – and is – very important in relation to the HPTM cluster. However, engineering employment in Northampton has declined over time, and distribution and finance now account for a greater share of the local economy.

Centre for Cities’ *Cities Outlook (2015)* identified Northampton as a weak city economy in terms of patents and it presented Northampton alongside Burnley and Wigan in terms of declining wage levels. Conversely, like Milton Keynes, Northampton is growing quickly in population terms. In addition, it was identified by Centre for Cities as the third best performing city nationally (behind London and Milton Keynes) in terms of rates of new business starts – so it fares well in terms of enterprise.

Northampton is a major focus for regeneration and growth. Northampton’s Central Area Action Plan was adopted in January 2013, focusing on the town centre. In addition, the Northampton Waterside Enterprise Zone designation commenced in 2012; this is a major initiative and the Enterprise Zone is home to a number of HPTM companies, including Cosworth, MAHLE Powertrain and GE Precision Engineering. West Northamptonshire’s Joint Core Strategy (Part 1) – covering Northampton, Daventry and South Northamptonshire – was adopted in December 2014. It includes provision for just under 19,000 net additional dwellings in Northampton Borough over the plan period (2011-2029); and for 28,500 net additional jobs (2008-2029) across West Northamptonshire, with “the majority to be concentrated within the principal urban area of Northampton”. The inference is that – like Milton Keynes – Northampton should see significant planned growth over the next 15 years.

**Aylesbury**

Aylesbury – in Buckinghamshire – is a smaller urban area with a “usual resident population” (on a Built Up Area definition) of about 75,000 at the time of the 2011 Census. In economic terms, Aylesbury is – like Northampton – an historic centre. In the early 20th Century it was home to a significant early automotive manufacturer (Cubitt). Subsequently, major employers were linked to printing and publishing, and food processing.

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32 Centre for Cities (2015), *Small Business Outlook*

33 An analysis of data provides a clear indication of the pace of Milton Keynes’ growth. More intangible – but arguably at least as important – is the pace with which the role of Milton Keynes has evolved. A study of the Oxford–Cambridge Arc (completed by SQW in October 2001 for a consortium led by the Milton Keynes Economic Partnership) recognised Milton Keynes’ outstanding location and also its appetite for growth, but at the time, the town’s “knowledge economy” was significantly adrift of those elsewhere in the geography. Whilst it has its own distinctive character, this has changed fundamentally over the last 15 years

34 *UK Powerhouse – City Growth Tracker: Outlook for the UK’s economy in 2016* Report for Irwin Mitchell by CEBR (January 2016)

35 *Milton Keynes Council Core Strategy (Adopted July 2013)*
These have now closed and the economy of Aylesbury is dominated by local service activities – although a mapping study across Buckinghamshire identified a number of both fabricated metal product manufacturers and medical, precision and optical instruments firms within the town\(^{36}\). Significant new development is planned.

Work is underway currently on the preparation of a Vale of Aylesbury Local Plan, and the draft plan consultation is scheduled for 2016. This is likely to include provision for substantial housing and jobs growth, some of it focused on Aylesbury. A study completed as part of the evidence base for the new local plan suggested a requirement for well over 1,000 net additional dwellings per annum\(^{37}\).

**Banbury and Bicester**

Banbury and Bicester are both within the Oxfordshire district of Cherwell. They have urban populations of about 50,000 and 35,000 respectively (on Built Up Area definitions). Significant future growth is planned, particularly at Bicester.

In terms of the two local economies:

- **Banbury** is distinctive insofar as it has a strong engineering and manufacturing heritage. Until the 2000s, a major employer was Alcan Aluminium Ltd with the British Alcan extrusion plant and Alcan International’s Research and Development facility. Jacobs Douwe Egberts moved to Banbury from Birmingham in the 1960s, and it continues to be an important employer within the town. Additionally, Banbury is home to a number of major HPTM companies, notably Prodrive.

- **Bicester** has very strong military links, and the Ministry of Defence is a major land owner. Currently, its economy is focused on storage, defence and distribution activities, food processing and engineering; and Bicester Village (shopping outlet) is a significant destination for tourists. Particularly through the new eco-development, it is identified as having potential for eco-construction and low carbon goods and services\(^{38}\). In addition, at Graven Hill (ex MOD), Cherwell District Council has identified the largest area for self-build homes in the country. In December 2014, Bicester was identified by the Government as a ‘Garden City’.

The Cherwell Local Plan, 2011-2031, Part 1 was adopted in June 2015. This makes provision for 22,800 net additional dwellings over the plan period and the strategy is to focus this growth on Bicester and (to a lesser extent) Banbury. Substantial jobs growth is also planned. The surrounding narrative states that “as Bicester lies at the heart of the Oxford – Cambridge technology corridor, and as Banbury has a strong manufacturing base and close links to the motorsport sector, we are looking to strengthen the District’s profile with performance engineering” (Cherwell Local Plan, 2011-2031, Part 1 – paragraph B6).

**The smaller towns**

There are, in addition, a number of smaller towns which are important in relation to the HPTM cluster. Examples include Brackley, Daventry, Towcester and Buckingham. These towns differ from each other – Daventry has links into the West Midlands whereas Brackley, Towcester and Buckingham are historic/market towns. Relative to their scale, however, some significant growth is planned. For example, West Northamptonshire’s Joint Core Strategy (Part 1) makes provision for over 4,600 additional homes in Daventry and over 2,000 in each of Brackley and Towcester.

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3.3 From this analysis, three observations must be drawn out. These are important in seeking to understand the backdrop to the HPTM cluster’s past growth and future prospects.

3.4 The first – and most immediate – is that the HPTM cluster effectively draws on a number of different local labour (and housing) markets with different attributes and characteristics. The “Northampton” labour market (defined in TTWA terms) is really quite different from “Milton Keynes”, and “Banbury” is different again. The area around Silverstone can therefore be seen as a “melting pot” in terms of skills, knowledge and competencies; and the consequence is a very distinctive specialist labour market. The HPTM cluster has

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\(^{36}\) Buckinghamshire High Performance Engineering Industry Report, 2010, Prepared by Buckinghamshire Economic and Learning Partnership – see Map 1-2


\(^{38}\) North West Bicester Masterplan – Economic Strategy Produced by SQW (2014) for A2Dominion
itself been one of the causes of this; but it has also been – and it should also increasingly be – a substantial beneficiary.

3.5 Reference has already been made to the substantial influence of the area’s engineering heritage. Both the Northampton area and that around Banbury are outstanding in this regard; and in both cases, from the narrative set out in Figure 3-2, the strong historic influence of the Midlands is apparent. Bedford and Luton are also significant in these terms. But broadly speaking, the northern half of the cluster geography brings with it very strong engineering and manufacturing competence and knowhow. Some of this is “thoroughbred HPTM”, but the depth of the resource extends further.

3.6 Further south – particularly around Milton Keynes – the striking point is the apparently fast growth in digital high tech; this relies on a very different skills set and knowledge base, but one on which the cluster is increasingly able to draw. In relation to the more recent history of the cluster, the ability to manipulate and respond to data, and to use and develop software, have become ever-more important (see Figure 1-2). The growth of Milton Keynes has been significant in these terms.

3.7 Second, patterns of business demography vary. The high rates of new business starts in Milton Keynes and Northampton were referenced in Figure 3-2. Across the wider local enterprise partnership (LEP) areas, birth rates are lower in the south/west of the overall geography39. However, recent analysis by the Enterprise Research Centre (referenced below) suggests that the relative incidence of High Growth Firms40 has shifted: between 2009 and 2012, it was higher in Buckinghamshire Thames Valley and Oxfordshire, but (in the context of national economic recovery), the geographies linked to Northamptonshire Enterprise Partnership (NEP) and South East Midlands Local Enterprise Partnership performed more strongly from 2012-15.

Table 3-1: Indicators of business demography across LEP geographies

<table>
<thead>
<tr>
<th>LEP area</th>
<th>Births per 100 active enterprises 2012</th>
<th>Rank (among 39 LEPs, where 1 = high)</th>
<th>Net birth rate (birth rate less death rate) 2012</th>
<th>Rank (among 39 LEPs, where 1 = high)</th>
<th>High Growth Firm rate (% of all firms of 10+ employees) 2009-12</th>
<th>Rank (among 39 LEPs, where 1 = high)</th>
<th>High Growth Firm rate (% of all firms of 10+ employees) 2012-15</th>
<th>Rank (among 39 LEPs, where 1 = high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckinghamshire</td>
<td>9.8</td>
<td>30=</td>
<td>0.1</td>
<td>21=</td>
<td>6.5</td>
<td>3</td>
<td>6.4</td>
<td>32</td>
</tr>
<tr>
<td>Thames Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northamptonshire</td>
<td>11.2</td>
<td>11=</td>
<td>1.2</td>
<td>4</td>
<td>5.2</td>
<td>23</td>
<td>7.2</td>
<td>19</td>
</tr>
<tr>
<td>Oxfordshire</td>
<td>9.8</td>
<td>30=</td>
<td>0.6</td>
<td>11=</td>
<td>5.8</td>
<td>9</td>
<td>6.3</td>
<td>35</td>
</tr>
<tr>
<td>South East Midlands</td>
<td>11.3</td>
<td>8=</td>
<td>1.3</td>
<td>3</td>
<td>5.4</td>
<td>16</td>
<td>7.3</td>
<td>15</td>
</tr>
</tbody>
</table>

Sources: Data on business birth rates/net rates are from Business Demography, presented in “Mapping Local Comparative Advantages in Innovation”, Report to BIS by Liverpool John Moores University, July 2015; data on the rate of High Growth Firms (HGFs) from “Spatial Incidence of High Growth Firms”, Enterprise Research Centre Insight, February 2016

39 Although the picture varies depending on precisely which measures are used. For example, analysis completed by Buckinghamshire Thames Valley LEP suggests that Buckinghamshire’s new firm formation rate of 89.4 businesses per 10,000 residents is the fourth highest among 39 LEPs (see http://business.york.ac.uk/commission/7930)

40 Note that High Growth Firms are defined as firms which have at least 10 employees at the beginning of the period, and which record average growth of 20% in employment per annum over the three year period
3.8 Third, for the most part, the local economies within the core spatial footprint of the HPTM cluster are growing quickly. This observation is not a comment on the health of the cluster per se; instead it is a reflection of the local economic setting in which the cluster finds itself. To take some key growth metrics:

- The total resident population of the seven local authority district/unitary areas which provide a proxy definition for our core study area was 1.2 million in 2014. Between 2005 and 2014, the population grew by over 1% (120,000 people); across England as a whole, the equivalent figure was about 7%.

- Data relating to employee jobs are available for the period 2009-2014. Over this time, the number of employee jobs in the core study area increased by over 7% (to about 580,000) while the equivalent figure for England was around 5%.

3.9 The inference, then, is that on both key growth metrics, the core study area has seen recent growth outpacing the national average (and other nearby towns/cities are also growing). The consequence is that labour markets are deepening (as their scale increases and their skills mix grows) and new specialisms – such as digital technologies – are emerging quickly.

3.10 For the HPTM cluster, this could be a potential threat (as, for example, in-moving firms compete for the same staff and the same premises). However, it ought also to be a substantial opportunity: it will (probably) prompt some level of ongoing adaptation, but as noted already, clusters that do not adapt are inclined to fade.

The wider setting

3.11 The cluster’s wider location in central southern England (see Figure 3-3) is also of material significance in understanding its current character and future prospects. In overview:

- Reference has already been made to the influence of the Midlands. This is particularly important in relation to mainstream automotive; and the activities of Jaguar Land Rover (JLR) at both Gaydon (Warwickshire) and Whitley (Coventry) are – as we consider later – having a substantial influence currently. The Advanced Propulsion Centre and Warwick Manufacturing Group (at the University of Warwick) are also very important, as is HORIBA MIRA (near Nuneaton).

- Looking east and west, both Cambridge and Oxford are playing a formative role as technologies and know-how generated through them help to shape the wider cluster; moreover as East-West connectivity improves, the functional importance of both Cambridge and Oxford is likely to grow. Particularly through their universities and the clusters linked to them, both are world class centres of expertise across a range of technological specialisms; these include advanced materials, ink jet printing,

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41 Aylesbury Vale, Central Bedfordshire, Cherwell, Daventry, Milton Keynes, Northampton, and South Northamptonshire
42 Data from ONS Population Estimates
43 Estimates of employee jobs are taken from the Business Register and Employment Survey (BRES). It is important to note that this excludes self-employment jobs
44 Using three year moving averages, the number of employee jobs increased by 3.4% between 2009-11 and 2012-14 (Note that three-year moving averages are used later in this report)
45 This relates most immediately to East-West rail – and plans to link Cambridge to Oxford via Bedford and Milton Keynes. The Western section is funded and under construction. Infrastructure options in relation to the Central section are being considered. In addition, in Budget 2016, the National Infrastructure Commission was tasked with developing proposals and options for long term infrastructure priorities to unlock growth, jobs and housing in the Cambridge–Milton Keynes–Oxford corridor
engineering, software, digital and bioscience. The link between Cosworth and Cambridge-based Pi Research (explained in Figure 2-3) was premised essentially on the different skills and knowledge set that the latter would bring (and in this case, data acquisition was a central strand), complementing Cosworth’s pedigree in relation to engines. Links of this nature abound and more examples will be discussed in subsequent chapters.

- Thirdly, reference to London is essential. The HPTM cluster is – as the map at Figure 3-3 clearly shows – abutting a world city, and one which is booming currently. The larger towns within the cluster’s geography are 30-45 minutes from London by rail and this is having an influence.

- Finally, it is important to acknowledge the cluster’s location in relation to international travel. As we consider in Chapter 8, the cluster has a very strong international dimension and in this context, access to both London Heathrow Airport and Birmingham International Airport is particularly important. In addition, London Oxford Airport handles freight and works with the sector supply chain.

Figure 3-3: The wider spatial context

An adaptive and knowledge-based cluster in a diverse and growing region

3.12 The HPTM cluster needs to be understood in this spatial economic context. It is shaping – and being shaped by – a broader growth dynamic across central southern England. This presents both opportunities and threats, but it means that the composition and character of the cluster is constantly evolving. An adaptive and knowledge-rich cluster with the opportunities, challenges and momentum of a fast growing region ought to be a cocktail for future success. That said, there are no guarantees and, as we consider later, the process of adaptation is itself quite demanding.

3.13 To illustrate the potential, we present two case studies. The first is of Zeta Group. Originally a spin-out from Oxford Brookes University, this electronics firm moved to Bicester in 2004. Although originally focused on the automotive sector, its main growth now is in solar technology and the use of renewable energy. The firm has won many awards for innovation, and it is growing quickly; it expects employment at its Bicester site to double over the next three years.

Figure 3-4: Zeta Group

Early days

The firm was established as Zeta Controls Ltd in January 1989 as a spin out from Oxford Brookes University. Its main initial focus was on the development of electronic control systems for the automotive sector. It set up initially on Oxford Science Park, but moved to its own premises in Bicester in 2004.

Zeta Controls was wholly owned by its two founder Director/Shareholders: Paul Tyrrell (Technical Director) and Philip Shadbolt (Commercial Director). Both trained as electronic engineers, and worked together at Oxford Brookes before forming Zeta. Paul also previously worked in the nuclear, medical, precision machine tool and oil industries.

Diversification and innovation

Automotive was Zeta’s first market and provided the basis on which to develop its other market areas. However, 51% of the Automotive business was sold to Arriva two years ago and it is now a separate company. Zeta Automotive is the leading independent supplier of vehicle control systems and automotive engine management electronics in the UK, and specialises in harsh environment applications such as power-take-off, hydrostatic control, protection and vehicle security.

The remaining business was renamed Zeta Specialist Lighting, which operates in the following areas: solar; signage; street furniture; and commercial lighting.

Zeta Specialist Lighting designs, develops and manufactures engineered products suited to applications ranging from LED solutions that lower energy bills and carbon emissions, including custom luminaires for street lighting, amenity lighting, signage and LED commercial lighting solutions; to the design and manufacture of complete solar lighting solutions.

Zeta LED and solar lighting technology is relevant where speed of lighting installation is vital, the cost of installation, operation and maintenance are critical, the sustainability and the use of a renewable energy are a priority, and an off-grid power supply is needed. The firm is regarded as the leading UK developer and manufacturer of LED lighting systems, signage, energy efficient lighting, LED fluorescent replacement tubes, LED display panels, etc.

In 2014, Zeta Specialist Lighting won the British Sign and Graphics Association product of the year award, and in 2012 and 2013, Zeta products won the ‘Solid-State Lighting Product of the Year Elektra Award’ and the ‘Renewable Energy Design Elektra Award’. Previously, Zeta Controls won five SMART awards between 1991 and 2004. These awards, won throughout the history of the firm, reflect its long term commitment to innovation, which is driven by a combination of internal and external factors, including Zeta’s in-house R&D and changes in the market and technologies underlying Zeta products.
Recent innovative technologies include Zeta’s patented, flexible, vandal resistant PV Panel; the PS800 Controller energy management system featuring a 4-stage intelligent charger to maximise the potential of the battery; the Zeta PIR Detector, which gently increases or dims the lighting in a bus shelter depending on whether there is passenger movement; and the ECOLUX SOLAR – the industry’s first LED trough lighting system entirely powered by solar, which was developed jointly with Portland Lighting.

Zeta today

Zeta Automotive and Zeta Specialist Lighting operate independently but occupy the same 20,000 sq ft building in Bicester, which they own.

Zeta Automotive is 51% owned by Arriva and 49% by Phil Shadbolt, one of the two founders of Zeta Controls. It employs approximately 25 staff designing and manufacturing advanced electronics for fuel economy and engine management such as road speed and acceleration limiters, engine speed control, stop/start, idle cut-out and other control and monitoring devices in cars, vans, trucks, utility and other commercial vehicles.

Zeta Specialist Lighting is now wholly owned by Phil Shadbolt. The other founder, Paul Tyrell, retired three years ago. In April 2015, Adrian Dennis was appointed Managing Director of Zeta Specialist Lighting, having previously joined the firm in 2013 as Sales and Marketing Director.

Zeta Specialist Lighting is growing fast. In 2014 it recorded a 250% increase in turnover, and in 2015 it was on course to achieve a similar increase. In 2014 Zeta also invested £3.5 million to make substantial improvements to its premises including a new LED production facility, a commitment designed to accelerate new product development and business growth.

The firm employs 25 engineers, designers and sales staff, including a team of eight R&D engineers with electronic design and programming skills. It has full production capability, from PCB assembly (although the bulk of this work is sub-contracted) through to detailed mechanical assembly and final test. It also has a fully equipped test facility, which allows all products to be tested to the latest environmental and EMC standards.

Recent product developments include colour changing walls, solar powered bus stop lighting, combined wind turbine and solar array, a specialist control unit for the Ford Transit, LED lighting for commercial vehicles and a network controller system for road sweepers.

Recruitment of production and administrative staff is done locally, and technical and sales staff are sourced nationally. Zeta currently has three apprentices, all of whom have proved excellent. Retention is not an issue but recently recruitment has become more challenging due to the buoyant employment market.

Some 85% of Zeta’s sales are in the UK, and the balance is exported to the EU, North America and UAE. Inputs are sourced from within the UK wherever possible. There is no particular geographical concentration of suppliers.

Looking ahead

Looking to the future, there is a fast growing market for Zeta Specialist Lighting’s combination of LED and solar expertise. Sales of street lighting, signage and commercial lighting are all growing at above 200% year on year and are expected to do the same in 2016. LED technology is increasingly cost effective and therefore adoption rates will continue to rise, and the market is stimulated by the Government’s climate change targets and related regulations.

As a consequence of market growth, Zeta Specialist Lighting expects employment to double over the next three years, to approximately 50 staff by 2018. It is likely that this growth can be accommodated on the existing site. The main constraint on the rate of growth in future is likely to be cash flow.

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material
3.14 The second case study is of Hybrid Air Vehicles. This aerospace company has very strong links with Cranfield University and it is also working with companies in the motorsport supply chain. It is a research-intensive business and its plans for the future are ambitious.

Figure 3-5: Hybrid Air Vehicles

Early days

Hybrid Air Vehicles (HAV) was formed in 2007. Some of the intellectual property that provided the basis for the new firm was effectively bought out from two airship companies, Advanced Technologies Group and Skycat Group Ltd, that had gone into receivership. The concept was to merge aerodynamics and lighter-than-air technology to create a “near weightless” hybrid aircraft, which significantly improved the performance characteristics compared to traditional airships.

Sources of funding

In 2009, partnering with Northrop Grumman Corporation, a major US defence company, Hybrid Air Vehicles won a significant contract to develop a Long Endurance Multi-Intelligence Vehicle (LEMV) for the US Army to provide an “unblinking eye” of airborne surveillance for 21 days without refuelling. In essence, this provided about US$150m to develop the concept from a demonstrator project to a full-scale aircraft. In 2013, however, the contract was cancelled because of US budget cuts and changing US defence requirements, specifically the drawdown from Afghanistan. Hybrid Air Vehicles bought back the ownership and the hybrid aircraft was brought back to the UK to design and build. It was renamed the Airlander 10.

Subsequently, Hybrid Air Vehicles has secured funding from two main sources:

- First, it has relied on a number of different research grants to take the project forward. This has included £2.5m funding from Technology Strategy Board (now Innovate UK) in May 2014; £3.4m from Regional Growth Fund in February 2015; and an EU grant from Horizon 2020 (within a broader programme focusing on smart green integrated transport) of £2.5m in April 2015.

- Second it has raised new equity. The total equity investment to date has been around £13 million (with an additional £4.5 million of shareholder loans). Whilst its main shareholders continue to be predominantly high net worth individuals, Hybrid Air Vehicles has also used the Crowdcube platform to raise crowdfunding equity. Over two rounds, equity of approaching £3m has been raised through this route.

Recruitment, collaboration and the supply chain

With the funding in place, Hybrid Air Vehicles increased its headcount from about 30 to 113 people (of whom about half are on short term contracts and half are permanent staff members). For the most part, employees are engineers (focused on the design and development of the aircraft) and technicians (with a focus on fitting and assembly). Hybrid Air Vehicles has also taken on three apprentices.

The firm continues to operate from a former-airship hanger at the site of RAF Cardington (to the south east of Bedford). There are very few facilities of this scale in the UK – and the aircraft is approaching 100 metres in length. However, the location has proved to be a good one in recruiting people with specialist skills, many of whom have backgrounds in aerospace, automotive and defence-related engineering.

Hybrid Air Vehicles has some important collaborative links locally. It works very closely with Cranfield University in the context of wind tunnel testing. Through its supply chain, it also has links to various local HPTM businesses, including one which is based at Silverstone. It considers proximity to be very valuable, given the developmental and constantly evolving nature of its work. That said, its supply chain is also national (e.g. including Xtrac) and international – although as it moves towards production, it would expect to deepen its network of local relationships.

Looking ahead

Currently, the business is still “pre-revenue”. However, it is currently testing its systems and it will quickly move to flight trials. It expects to launch its Initial Public Offering on the London Stock Exchange’s AIM in late 2016 or early 2017.

Clients for its hybrid aircraft are likely to be defence-related (for surveillance, patrol or communications) and/or linked to commercial logistics, and some specific passenger roles. The hybrid aircraft’s endurance surpasses anything else flying and is significantly more fuel efficient than conventional alternatives. It does not require a runway for take-off or landing. It therefore offers both flexibility and cost-effectiveness.

Source: SQW – based on company consultations (Spring 2016) and a review of documentary material
4. Measuring the HPTM cluster

Key points from Chapter 4

- By definition, clusters are fluid, evolving and fundamentally based on relationships. Measurement – which requires clear boundaries – is intrinsically difficult.

- Informed by previous studies, a proxy definition of HPTM has been developed. This leads to an overestimate of scale as not all of the activities captured by it are “actively clustering”. However, distinguishing between the HPTM cluster and activities which are similar in sectoral terms is impossible with available data. In any case, the wider local context is providing significant resources and important assets for the cluster.

- On this very broad definition, we estimate that there are around 36,000 jobs within a core geography.

- Estimates of scale – on whatever basis – are fraught with difficulty; and it is important to recognise that scale itself says nothing about the strength of a cluster, or its performance or prospects.

Introduction

4.1 Measurement requires "boundaries". Whilst the HPTM cluster has a spatial and sectoral core, the “edges” are porous and evolving, and this characteristic presents very significant challenges in measurement terms. Whilst in many respects, developments on the “edges” are driving the cluster forward, the extension of sectoral boundaries risks rendering the cluster progressively less distinctive in measurement terms. Given the tools at our disposal, quantification is not therefore easy. It is important to understand the headlines from this exercise whilst also noting the very significant limitations.

Estimating job numbers

4.2 Our approach to measurement was essentially to review previous attempts to define the cluster (or something close to it) in sectoral terms, updating definitions where necessary to map onto the 2007 Standard Industrial Classification (SIC). We refined the list of SIC codes in the context of the developments we were observing whilst consulting with firms (particularly the growing importance of digital dimensions) and with reference to various business directories. Finally, we populated a revised list of SIC codes with publicly available data (from the Business Register and Employment Survey) focusing on a core geography, but also considering a wider spatial area and the pattern across England as a whole.

46 See Table 4-1 for key references in this context
47 In particular, we made reference to a database derived from a list of high performance technology firms provided to MEPC by Northamptonshire Enterprise Partnership and then augmented by a market research firm, Market Makers, which looked at firms located within a two-hour drive time radius of Silverstone. This was then sense-checked to remove firms not engaged in relevant activity. Overall, a database of 4,940 firms was produced, with just over 1,200 firms located in our core geography
48 Available on request from SQW
49 Defined as Aylesbury Vale, Central Bedfordshire, Cherwell, Daventry, Milton Keynes, Northampton, and South Northamptonshire
50 Defined as the areas covered by four Local Enterprise Partnerships (those for Buckinghamshire/Thames Valley, Oxfordshire, Northamptonshire and South East Midlands)
4.3 In headline terms, our analysis suggested that:

- the sectors we are associating with the HPTM cluster accounted for around 36,000 employee jobs across the core geography (taking a three-year average from 2012-2014); this was equivalent to about 6.5% of all employee jobs in the local economy.

- the location quotient (LQ) for jobs in sectors identified within the HPTM cluster across the core geography was around 1.1 in 2012-2014.

4.4 At first sight, this finding in relation to the overall location quotient is underwhelming: by definition, clusters ought to have high location quotients compared to national benchmarks, and although 1.1 is above the average, we might have expected a higher number. However, two important caveats need to be taken into account.

4.5 First, our definition was broad in sectoral terms. If we probe the data further, it is possible to derive more granular insights, and these point to notable “sub-cluster” sectoral specialisms within the core geography. Specifically:

- “Technical testing and analysis” represents about 5% of all HPTM employee jobs in the area, and has a LQ of 1.8.

- “Engineering design activities for industrial process and production” accounts for around 5% of HPTM employee jobs in the area, and has a LQ of 1.7.

- “Computer consultancy activities” accounts for nearly a quarter of all HPTM employee jobs in the core geography, and has a LQ of 1.3.

4.6 At the level of individual local authority districts/unitary areas, location quotients for some individual sectors within the HPTM cluster were higher again. Many of these data cannot be reported for reasons of confidentiality and disclosure, but examples include “computer consultancy activities” in Milton Keynes, “engineering design activities for industrial process and production” in Central Bedfordshire, and “technical testing and analysis” in Central Bedfordshire.

4.7 Second, however, it is debatable whether employee jobs really provide an appropriate metric. In terms of readily available granular data with a degree of provenance (i.e. sourced through the Office for National Statistics), employee jobs are the only real option. However, we know that none of the firms within the core of the cluster is a volume producer – and therefore a large employer – and the vast majority of companies are small; the largest firms we interviewed accounted for about 500-600 jobs, but many were employing 20 or fewer people. Jobs therefore tell only part of the story.

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51 A location quotient is a measure of relative concentration: if the incidence of employment in a sector locally (as a share of all employment) is exactly the same as the national average, then the location quotient will be 1.0.

52 It is important to note that the Location Quotient for HPTM jobs in the “wider area” was slightly higher. Southern Oxfordshire, in particular, has significant employment in related sectors.

53 These are identified in terms of SIC codes from HPTM sectors which (a) account for over 1,000 employee jobs; and (b) have a high location quotient (LQ) relative to England (for the period 2012-14).
Comparing this estimate to those from previous studies

4.8 In order to calibrate these numbers, in Table 4-1 we consider six previous attempts to measure something akin to the HPTM cluster. It is important to recognise that these studies span 13 years – and hence they need to be seen as a narrative on growth/decline as much as a comparative statement of methodology. Moreover, two of the previous studies essentially generated national estimates of the scale of Motorsport Valley®, while four were local economy studies focusing on parts of our core geography and with a sectoral focus which was more-or-less closely related to HPTM. Reading through the six studies, all of them comment on the challenges of measurement, and – variously – the short-comings of the SIC, the limitations of BRES (or its predecessor, ABI) and the intrinsic difficulties of definition.

Table 4-1: Estimating the scale of the HPTM cluster – perspectives from previous studies

<table>
<thead>
<tr>
<th>Source</th>
<th>Estimate of scale</th>
<th>Spatial coverage</th>
<th>Sectoral coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorsport Research Associates (2006): High Performance Engineering in Northamptonshire</td>
<td>“The High Performance Engineering sector in Northamptonshire is comprised of 650 business units employing just over 10,400 employees”</td>
<td>Northamptonshire-only</td>
<td>Our definition was informed by MRA (2006) but we added to it (notably activities relating to digital)</td>
</tr>
<tr>
<td>Buckinghamshire Economic and Learning Partnership (2010): Buckinghamshire High Performance Engineering Industry Report</td>
<td>Total employment in High Performance Engineering in 2008 was 7,200 jobs in Buckinghamshire (of which about a third was in Aylesbury Vale) Total employment in High Performance Engineering in 2008 across Buckinghamshire, Northamptonshire, Oxfordshire and Milton Keynes summed to 39,400 jobs</td>
<td>Buckinghamshire, although some data are presented for surrounding counties</td>
<td>Our definition was informed by this one but we added to it (notably activities relating to digital)</td>
</tr>
<tr>
<td>Roger Tym and Partners (2011): High Performance Engineering in Northamptonshire</td>
<td>High Performance Engineering in Northamptonshire consists of 1,474 companies operating 1,564 businesses units and employing between 15,000 and 21,000 people. Annual turnover is estimated at £2bn</td>
<td>Northamptonshire</td>
<td>The RTP study’s focus was on high performance engineering, starting from a SIC 2007 classification – both additions and deletions were made</td>
</tr>
<tr>
<td>SQW (2013): Oxfordshire Innovation Engine</td>
<td>It is estimated that there are 1,500 high tech firms in Oxfordshire employing 43,000 people</td>
<td>Oxfordshire</td>
<td>Based on the wider definition of high tech activity developed by Eurostat</td>
</tr>
<tr>
<td>Motorsport Industry Association (2000): National Survey of Motorsport Engineering and Services, 2000</td>
<td>Total employment was 38,500 – of which 25,000 people were employed in motorsport engineering and 13,500 in motorsport services GVA was estimated at £4.6bn (in current prices)</td>
<td>UK-wide estimate</td>
<td>The sectoral focus was defined as “any company deriving revenue from motorsport activity”</td>
</tr>
<tr>
<td>Motorsport Research Associates (2013) Renewing the Evidence Base of Britain's Motorsport Valley® 2013</td>
<td>Motorsport employment was estimated to be 41,000 Motorsport turnover was estimated to be £9bn (current prices); 86% was generated by companies that generate more than 50% of sales from motorsport Some 4,300 businesses were estimated to be operating within motorsport</td>
<td>UK-wide estimate</td>
<td>This study updated the evidence generated through the MIA (2000) study – so the sectoral definition is likely to be similar (i.e. “any company deriving revenue from motorsport activity”)</td>
</tr>
</tbody>
</table>

Source: SQW
4.9 Our conclusion from this review is that our overall estimate of employee jobs in sectors linked to HPTM is within the right ball-park. However, we must make one more general observation which is important in relation to the analysis that follows: not all of the jobs we are identifying will be defined in relation to highly clustered activity and some are more properly regarded as a statement of the local economic context – albeit that context is integral to the character and prospects of the HPTM cluster for the reasons outlined in Chapter 3.

Understanding growth

4.10 From BRES, it is possible to construct time series from 2009. The data suggest that:

- between 2009-2011 and 2012-2014 (on the basis of three-year moving averages), the total number of employee jobs in sectors linked to HPTM rose from about 34,000 to 36,000 in the core geography, an increase of around 7%

- over this period, the total number of employee jobs in the core geography increased by under 4% (again, on the basis of three-year moving averages), suggesting that sectors linked to HPTM grew more quickly than the local economy as a whole

- nationally, the total number of employee jobs linked to HPTM sectors increased by just over 2% from 2009-2011 to 2012-2014; hence the number of jobs in HPTM sectors grew more quickly in the core geography than it did nationally.

4.11 The headline inference from these data is that sectors linked to HPTM are performing relatively well in the core geography (compared both to the national HPTM average and to the overall local economy of the core area). Again though, it is important to delve deeper and to consider the evidence relating to growth in more granular terms. In this context, the picture is quite mixed:

- across the core geography, over the period from 2009-2011 to 2012-2014, close to half of all employee jobs growth in sectors linked to HPTM was observed in Milton Keynes; across the core geography, two of the seven district/unitary areas saw the number of HPTM employee jobs decline

- Milton Keynes’ HPTM job growth over this period was largely in a group of sectors linked to “IT and telecoms”

- over this period, the number of employee jobs linked to “vehicle manufacturing” increased within the core geography; and most of the increase in the relevant sub-sectors was seen in Central Bedfordshire

- “engineering and technical testing” saw the number of employee jobs increase; here, the geography of jobs growth was more evenly spread than for other sub-sectors

- however, the number of employee jobs associated with “electronic manufacturing” fell slightly across the core geography.
4.12 Hence the pattern of growth – sectorally and spatially – is complicated. Overall, recent jobs growth has been much less in evidence across what we might regard as the traditional HPTM sectors and focused instead on a group of digital sectors, particularly in Milton Keynes.

4.13 Quite how to interpret these observations is a matter for reflection. Undoubtedly, a good proportion of "IT and telecoms" employment is some distance from the traditional heartland of HPTM and the link to the cluster could be regarded as tenuous. On the other hand – and as intimated in Chapter 3 – the growth of this sector is creating a tremendous resource for the HPTM cluster and there is every suggestion that it is having a formative influence on the cluster’s current – and probable future – evolution: autonomous vehicles, hybridisation and light-weighting all owe much to digital technologies, and many of the case studies presented later in this report have a substantial digital focus (see, for example, the case studies relating to Racelogic (Figure 8-2) and Oxford Technical Solutions (Figure 6-5)).

4.14 From the data, it is impossible to resolve this conundrum. And in any case, debating whether particular forms of economic activity are "within" the cluster or providing the "local context for it" is of limited value. Our response is to return to the definition of a cluster set out in Figure 1-1. In our view, a cluster is better understood as a verb (i.e. as ways of behaving and doing business) than a noun (a "thing" to be measured). What really defines the cluster is therefore the patterns of interconnection, and the shared rules and conventions that are “in the air”. Different dimensions of this are considered in the chapters which follow.
5. Understanding cluster dynamics: knowledge “in the air”

Key points from Chapter 5

- Throughout the cluster's history, knowledge – which is often tacit – has been developed principally through people. The turbulence of the cluster's history has compelled individuals to move from one firm to another. As they have moved around, knowledge has been both disseminated and built. This process of knowledge transfer and circulation is crucial in understanding “how the cluster works”.

- This process continues to be very active today. Individuals moving between firms are creating the knowledge-based “glue” that gives the cluster coherence and form. For individual firms, though, this process of “churn” is double-edged, particularly in the context of wider recruitment challenges.

- Individual firms are investing in the skills and knowledge base of the cluster, particularly through the recruitment and training of young people. Among both small and larger firms, there are apprenticeship programmes. Some specialist institutions have emerged to support this process. Again, this can be seen as a characteristic of a well-functioning cluster. It is also a feature of the specialist labour market.

- Strong relationships between individuals who have “grown up” within the cluster explain the origins and growth of a number of companies; this process is very active today.

- There is a theoretical risk that links are “too close” and that they ultimately limit the cluster. However other aspects of the cluster’s character – most especially its strong global focus – mean that it keeps its competitive edge.

Introduction

5.1 As part of the process of “doing business”, the social and cultural aspects of clusters are, fundamentally, what sets them apart. This chapter examines the processes by which, through beneficial interactions, knowledge has been – and is being – produced and disseminated within the cluster such that “the mysteries of the trade become no mysteries; but are as it were in the air”54. The character of the specialist labour market is central to this process. In exploring these issues, we make extensive use of the primary evidence that has been gathered in the course of this study.

Building knowledge through people

Career paths

5.2 A narrative of competitive advantage linked to the movement of key people around the cluster has been developed in a series of earlier studies. For example, Henry and Pinch (2000) describe in detail the career trajectories of Rory Byrne (culminating in a key role at Ferrari F1), Frankie Dernie (Lola Cars) and Sergio Rinland (Benetton)55. In all cases, these individuals had multiple job changes over a period from the 1970s to the late 1990s; some of these were of a voluntary nature and some were "non-voluntary" (i.e. a result of company closures, ownership changes and restructuring), but this process itself was identified as crucial to the dissemination of knowledge around the cluster and its economic vibrancy.

5.3 Our discussions with individuals and firms within the HPTM cluster in 2015/16 found career paths today that are – in many respects – similar. Two examples are provided below. Both relate to individuals who are currently mid-career – so the narrative has some years to run. Nevertheless, in both cases, it is apparent that there have been several changes of employer; that “churn” has been a constant feature; and that the closure of one employer has been followed by new opportunities that have emerged from – or been created within – the HPTM cluster. These two examples provide a really important insight into the way in which the HPTM cluster has evolved over the last decade and is still evolving: some individual companies have “come and gone”, but the cluster as a whole has responded by retaining the key knowledge assets of well-networked and enterprising people who have “grown up” within it and are now driving it forward by leading successful and innovative companies.

Figure 5-1: Simon Dowson (co-founder of Delta Motorsport)

Early days: education, Silverstone, engineering and developing a competitive “DNA”

With a family race team business based at Silverstone, Simon Dowson was brought up on a diet of competitive motorsport. Simon was competitive by nature and, combined with an aptitude for sports, performed at a high level across a number of sports whilst at school: Simon was the British BMX Champion at age 16 and 17, and played top level Rugby for Coventry 1st team aged 19-21.

After graduating from the University of Warwick with an engineering degree in the mid-1990s, Simon enrolled on the Reynard Graduate Scholarship programme.

The rise and fall of Reynard Motorsport

Simon soon realised that his skills and interests were best put to work in production and operations. After eight months, he was taken on as a full time member of staff by the production office at Reynard’s site in Bicester. Working with the Production Director, in 1996 Simon developed the ‘Reynard Production Philosophy’. This provided a framework for pushing production capacity to its limit, but doing so sensibly and professionally and in a way that was mindful of the importance of cash-flow.

At this time, Reynard, which specialised in chassis design and production, was completely dominant in the Indy Car (Champ Car) market in America; this was Simon’s main focus along with a number of other single seat car markets. Reynard also enjoyed significant success in Formula Ford, Formula Three, Formula 3000 and Formula Nippon.

Reynard established Reynard Special Vehicle Projects (RSVP) to provide a business platform for an increasing number of one-off commissions. Eventually, RSVP was merged with the sister Race Car division on Reynard Park in Brackley (Northamptonshire). At this point, Simon was in charge of the day-to-day operation of all Reynard’s race projects.

However, following an abortive attempt to float on the New York Stock Exchange, a series of costly investments, and the resurgence of Lola (Reynard’s main competitor in the Indy Car market), Reynard was declared bankrupt in 2002.

Along with a small team, Simon was retained by the receivers to help package up projects for sale. During this time, Simon spotted an opportunity: the bankruptcy of Reynard meant that racing teams already committed to racing with a Reynard chassis now had no ongoing specialist maintenance service. In response, Simon and two members of the retained design team formally left Reynard, purchased some of the required assets and set up a new business, Oxford Racing Developments.

Oxford Racing Developments – and the formation of Delta Motorsport

Operating from Simon’s father’s business opposite Silverstone Circuit, over the period between 2002 and 2004, Oxford Racing Developments served the Indy Car market; indeed, the decision to include ‘Oxford’ in the title was made to maximise traction in the American market. Inevitably, as teams moved onto other chassis, demand for specialist maintenance reduced and Oxford Racing Developments turned to other projects, including successfully providing developments on the Dallara Formula Three chassis to sell to race teams.

Simon was then approached by Nick Carpenter, a former colleague from Reynard who was heading the design team at London-based engineering consultancy, Piper Design.

Simon and Nick made the decision to set up Delta Motorsport (at Silverstone). Over ten years later, Simon remains the Managing Director of Delta and partner Nick continues to be the Engineering Director.

The development of Delta Motorsport is considered in a separate case study in Chapter 6.

Source: SQW – based on company consultations (Autumn 2015 and Spring 2016) and a review of documentary material
Early days

Kieron Salter completed an undergraduate degree in Mechanical Engineering from Oxford Polytechnic (now Oxford Brookes University) in 1993. Adrian Reynard was a guest of honour at his graduation. On receiving his degree certificate, Kieron asked Adrian whether there were any vacancies at Reynard. Following a positive response, Kieron started on the Reynard Graduate Programme later that year (October 1993).

Kieron thrived on the programme which encouraged risk taking and autonomy from the outset and gave graduates exposure to all aspects of the design and production process. Kieron soon became the Project Coordinator for the F3000 racecar project, and by 1995, he had started to work on Indy Cars.

Over the next three years, Kieron’s career at Reynard developed rapidly:

- Reynard established Reynard Special Vehicle Projects (RSVP) to provide a business platform for an increasing number of one-off commissions. In 1996 and as part of RSVP, Kieron secured a Senior Engineer role on the new Ford Mondeo Touring project, and then in 1997, he became Chief Designer. Over this period, Kieron developed a strong working relationship with a client, Will Phillips, who was the Chief Engineer at West Surrey Racing (based near Heathrow).

- At the end of the 1998 season, the Ford Mondeo Touring contract came to an end. Kieron became the Technical Manager for RSVP and was subsequently involved in a raft of projects including a deal with Virgin Atlantic to develop aeroplane seating. In 1999, RSVP focused on Le Mans sports car projects and as part of this process, Kieron recruited the experienced engineer, Will Phillips, from West Surrey Racing.

However, in 2002, the Reynard business was declared bankrupt. Administrators sold the Le Mans project to IRM and Zytek. Kieron and Will were retained by IRM and asked to set up a small team based at the Brackley site to service Zytek, the engine supplier, and complete the car design and build of the first cars.


KWM development

KWM operated as a consultancy business with Kieron servicing Le Mans clients and Will focusing on the Indy Car market in the USA. The business operated with virtually zero fixed costs, with Kieron and Will working from their respective homes (near Brackley) and calling on ex-Reynard staff as required. Project flow was reasonable, but following a job offer in Indianapolis to work full time in the Indy Car market, Will left for America (although he retained his ownership stake in KWM until 2005 when Kieron took full control of the firm).

The business secured three noteworthy projects:

- Creation Autosportif (based near Bicester), which had acquired the IRM Le Mans car, asked Kieron to provide support on the Le Mans 2003 car. Kieron delivered the project with the help of two Computer Aided Design (CAD) specialists living in Oxford and Bicester.

- In 2004, a previous associate of Reynard Motorsport who was now Technical Director at McLaren Automotive asked Kieron to oversee the development of a new chassis for a road car (the car now known as the 650S and its derivatives, including the P1). Kieron was offered a full-time post at McLaren based in Woking; instead he agreed to work three days a week on a three-month contract (which ended up being extended to nine months).

- In 2006, Creation Autosportif commissioned KWM to support the development of a new Le Mans car. All of Creation Autosportif’s Computational Fluid Dynamics (CFD) work was being undertaken by A-CFD, a firm managed by Rob Lewis (initially as a subsidiary of Reynard Motorsport and subsequently owned by Honda). Knowing Rob from his time at Reynard, Kieron developed a strong relationship with A-CFD and, following its closure in 2007, this relationship continued through Rob’s new CFD firm, TotalSim.

In 2007, introductions from the ex-Marketing Manager for BAR Formula One team (set up by Reynard Motorsport, and subsequently acquired by Honda) led to Kieron meeting Alan Hudd (who was looking to develop a Sports 2000 car). This led to a large project requiring a dedicated design office team for a period of time. In 2008, Kieron secured a modest office in Bicester and identified six engineers to work on the project on a freelance basis.

In 2009, the car was successfully built and KWM went on to expand and develop into a successful firm. By 2015, KWM and its sister company, KW Special Projects, were working on a range of innovative projects using and adapting next generation manufacturing technologies across motorsport, elite sports, cycling, and sea and defence.

The development of KWM and KW Special Projects is set out in a separate case study in Chapter 6.

Source: SQW – based on company consultations (Autumn 2015 and Spring 2016) and a review of documentary material
Staff turnover

5.4 Based on detailed mapping, Henry and Pinch (2000) calculated that job moves for motorsport designers and engineers occurred every 3.7 years, on average, with eight moves in the course of a typical career. They concluded that the inevitable consequence was high levels of staff turnover for individual firms – but that the same process supported the continual transfer of knowledge, innovation and growth within the cluster.

5.5 The desirability of staff churn depends critically on the vantage point: what is good for the cluster may, or may not, be welcomed by individual firms. From our consultations in 2015/16, it was apparent that many HPTM companies continued to recognise staff churn as an intrinsic characteristic of the cluster; sometimes this was described in terms of “poaching” – which is clearly quite risky within a tight community – and sometimes it was considered in more equivocal (or even positive) terms. For example, the founder/owner of one company acknowledged that the volume of churn was “significant” but added that his former employees “act as the marketing department”, because “they are all very enthusiastic about the product, and they take a deep knowledge of it with them”. However, the picture was mixed overall; some HPTM companies actually reported low levels of staff turnover which they attributed, at least in part, to their own investment in staff development (see below).

5.6 In addition, although it affected individual companies to varying extents, a theme that was mentioned repeatedly was the recent influence of Jaguar Land Rover. For many HPTM companies, JLR’s scale of recruitment – in the context of national engineering skills shortages – was posing some difficulties. However, the importance of JLR was also acknowledged: the company was seen as spearheading the revival of the UK automotive sector and, for the HPTM cluster, this in itself had brought (and is bringing) significant opportunities.

Investing in apprentices and graduates, and wider training

5.7 Despite staff churn, it was apparent from our consultations that most HPTM companies are investing significantly in their own workforce and thereby enhancing the “cluster endowment” and building the specialist labour market. Graduate programmes at Reynard were the launch pad for both of the careers outlined above, and reference has already been made to the apprenticeship programme run by Prodrive (Figure 2-4).

5.8 However, the company that was – perhaps – mentioned more than any other in this context was Cosworth (see the narrative surrounding Figure 2-3). One graduate of Cosworth is Andy Cowell, Managing Director of Mercedes AMG HPP – and the formative importance of his time with Cosworth is apparent from Figure 5-3. The case study also shows that Mercedes AMG HPP itself currently has 20–30 apprentices who are working with – and learning from – more established colleagues with a very deep knowledge of the cluster. All of this is sustaining a shared mindset which is “in the air” and Andy himself summarised in terms of “an obsessive madness about making things better in zero time”.

56 ibid. page 195

57 This finding resonated with those reported elsewhere. See, for example, “JLR’s success exposes shortage in engineering skills”, Financial Times, 13th June 2013
it was apparent that many HPTM companies continued to recognise staff churn as an intrinsic madness about making things better in zero time in the air. Established colleagues with a very deep knowledge of the cluster. All of this is sustaining a HPP "act as the marketing department." clearly quite risky within a tight community knowledge, innovation and growth within the cluster.

Investing in apprentices and graduates, and wider training of designers and engineers occurred every 3.7 years, on average, with eight moves in the course. Based on detailed mapping, Henry and Pinch (2000) calculated that job moves for motorsport turnover for individual firms

Mercedes-Benz Grand Prix Ltd. – the Formula One team, branded as MERCEDES AMG PETRONAS – is a separate company from Mercedes AMG HPP. It has a different ownership structure and is 60% owned by Daimler, 30% by Toto Wolff and 10% by Niki Lauda. Mercedes-Benz Grand Prix Ltd currently employs over 700 people in Brackley. Mercedes has a long history of involvement in Grand Prix racing, although its involvement as a works racing team (the Silver Arrows) has been in three main phases: 1934-39, 1954-55, and since 2010. But Brixworth-built Mercedes-Benz engines have competed in the sport continuously since 1993.

The current, highly successful phase started in 2009 when Mercedes acquired Brawn GP, which had won the Formula One championship that year powered by a Mercedes-Benz engine from Brixworth. Brawn’s facility at Brackley had benefitted over previous years from substantial capital investment by Honda. However, in late 2008, owing to the effects of the global financial crisis, Honda along with several other mainstream vehicle manufacturers pulled out of Formula One, leaving an investment opportunity for Mercedes. The Silver Arrows achieved improving results over subsequent years thanks to comprehensive investment and restructuring, targeting the introduction of new Hybrid Power Unit regulations in 2014 as an opportunity to achieve a step change in performance relative to rival teams. The result was that in 2014 and 2015, the works Silver Arrows won both the Formula One Drivers’ and Constructors championships.

Mercedes AMG HPP and the HPTM Cluster

Mercedes AMG HPP develops and manufactures two main types of powertrain: the conventional internal combustion engine and the electric hybrid. The fact that it supplies engines to four Formula One teams means its production facilities are fully utilised, but it also has capacity to provide design and engineering to support Mercedes-Benz road cars and AMG’s high performance programmes. This fully integrated relationship with the parent company is facilitated by the fact that the Chairman of the Mercedes AMG HPP Board, Professor Dr Thomas Weber, is also a Board member of Daimler AG, responsible for Group Research and Mercedes-Benz Cars Development.

Mercedes AMG HPP is vertically integrated and undertakes most of its design, development, manufacturing and testing in-house. However, the majority of its suppliers – for example of composite parts for the hybrid engine, and gears for the internal combustion engine – are within 30 miles of Brixworth.

There are considerable advantages of having suppliers close by: there is more opportunity for interaction, and more scope to deal with rapid changes in requirements and very tight deadlines. In addition, the suppliers in the local area have a similar mentality – described by Andy Cowell, the Managing Director of Mercedes AMG HPP, as “an obsessive madness about making things better in zero time”. There is also a strong element of trust among firms and people who have been doing business together, in one form or another, for many years, and this is really important to ensuring these highly flexible, rapid response supplier relationships work.

Most of Mercedes AMG HPP’s staff are recruited through its graduate or apprenticeship programmes. There is some university targeting and there are personal links between senior managers and the universities they attended, but there are no fixed or research related relationships. Mercedes AMG HPP sponsors the Formula Student event (a student engineering competition) at Silverstone every year, which it finds a useful source of ideas and potential recruits. Currently Mercedes AMG HPP has about 20-30 apprentices, whose apprenticeships last for 3 to 4 years in the firm, when they work with and learn their trade from craftsmen, many of whom have worked with first Ilmor and then Mercedes for 20+ years. Much of the open market recruitment is deliberately from outside the motorsport sector in order to get access to new ideas.

Andy Cowell, Managing Director, Mercedes AMG HPP

Just as the relationship between Mercedes AMG HPP and its suppliers demonstrates well the characteristics of the HPTM cluster, so does the career path of Andy Cowell, the firm’s Managing Director. It includes movement between and progression within famous firms in motorsport, changes to the ownership of the company for which he worked, and some outstanding successes in engineering innovation.
Andy grew up with motorsport; his father builds and races single seater racing cars as an amateur enthusiast. Andy studied mechanical engineering at Lancaster University gaining a first class honours degree and joined Cosworth Racing immediately afterwards, on the basis that Cosworth’s graduate programme provided a professional training approach at a time when involvement in motorsport was still seen by many as just a hobby.

At Cosworth, he worked his way up to lead the engineering project group responsible for the top end of the innovative CK engine used by the Stewart Ford team in 1999. In late 1999, he spent a period with BMW Motorsport, where he managed the engineering group responsible for the concept and detail of the engine used by Williams Formula One. He then returned to Cosworth as Principal Engineer for Formula One design and development, managing the new engine projects in 2001 and 2003.

Andy joined Mercedes-Ilmor in 2004 as Principal Engineer for the FQ V10 engine project. He was then Chief Engineer on the V8 project before taking on responsibility for the technical and programme leadership of all engine projects, including the KERS hybrid, which made its race debut in 2009. Andy was Engineering and Programme Director for Mercedes-Benz High Performance Engines from July 2008 – December 2012 and represented Mercedes in the FIA regulation discussions for the new 2014 Power Unit. Since January 2013, Andy has been Managing Director of Mercedes AMG HPP, a period of outstanding success for the Mercedes-Benz Formula One Power Unit.

In conclusion, the HPTM cluster continues to grow and develop, driven by the commitment of its constituent organisations to professional training and development. The cluster includes a number of specialist training institutions, such as Silverstone University Technical College (UTC) and the National College of Motorsport (NCM), which are outlined briefly in Figure 5-4.

5.9 Throughout – and even among relatively small and new companies – we observed a strong commitment to training young people. Sometimes this was organised through apprenticeship programmes with links to local colleges; and sometimes it was more informally based.

5.10 Alongside the commitment to young people from many HPTM businesses, a number of specialist training institutions have emerged. These exist at different skills levels. For example: with links to the University of Northampton, the Northamptonshire Engineering Training Partnership is important; Aylesbury Training Group is a large independent provider of engineering apprenticeships; and as we consider in Chapter 8, Cranfield University is playing a key role in relation to postgraduate students. For businesses and young people with an interest in apprenticeships, the role of the National College of Motorsport is significant. With a different focus, Silverstone University Technical College (UTC) is also playing a growing role. The work of both organisations is outlined briefly in Figure 5-4, and both should be regarded as part of the HPTM cluster.

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Figure 5-4: National College of Motorsport and Silverstone University Technical College

**National College of Motorsport (NCM)**

The NCM is part of Tresham College of Further and Higher Education. It started at Rockingham 15 years ago, but moved to Silverstone in two phases. It runs pre-apprenticeship and apprenticeship programmes.

The NCM offers a full time one-year course (80 students) for technician/mechanics training. Some 50% of the full time students go on to an apprenticeship programme, and most others find jobs in the industry or related areas. Students come from all over the country. The courses are significantly oversubscribed.

**Silverstone University Technical College (UTC)**

Silverstone UTC was one of the first UTCs to open nationwide. The UTC offers students an alternative to the traditional schooling environment to study GCSEs or A-Levels alongside industry-recognised qualifications focused on meeting the requirements of employers and universities.

The UTC opened in September 2013 as a new centre of excellence at Silverstone for young people wanting to work in the fields of High Performance Engineering and Business and Technical Events Management. The UTC serves a catchment area of central and south Northamptonshire, north Buckinghamshire and surrounding areas.

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58 These observations resonate with those from a national survey of motorsport and engineering services businesses which found, on average, 0.9 apprentices per firm in 2012 compared to 0.7 in 2006 (See Motorsport Industry Association, 2013 Review of UK Motorsport Valley Business Cluster (based on “Renewing the Evidence Base of Britain’s Motorsport Valley® 2013: A report for the Motorsport Industry Association, UKTI and the Department of Business, Innovation and Skills submitted by Motorsport Research Associates))
The UTC is managed by the Silverstone Trust, a company limited by guarantee. Key board members and sponsors include Silverstone Circuits Ltd and University of Northampton. Tresham College has provided extensive curriculum, financial, technical and personnel support to the UTC.

Source: Silverstone Academy Trust Ltd, Annual Report of Financial Statements, for year-end August 2014 Silverstone UTC website; NCM website; and consultation with NCM

Forming and growing a business within the cluster

5.11 It is within this contemporary context that businesses are being born and growing within the cluster and doing so in a way that is tactily cognisant of “the mysteries of the trade”\textsuperscript{59}. \textbf{GE Precision Engineering} is illustrative (see Figure 5-5). Its founders essentially “grew up” through roles at various firms, notably Ilmor Engineering (see Figure 8-1). Following ownership changes and restructuring at Ilmor, they used their own savings to form a new small firm; and this developed essentially through a network of relationships (including with former colleagues at Mercedes AMG HPP (which, as explained in Figure 5-3, had previously been Ilmor, prior to an ownership change)) which generated immediate business. GE Precision Engineering is now investing in its own apprentices and supporting an undergraduate engineer through a university degree. It is also developing new projects and looking to expand. Hence, the cluster is being reinvented and knowledge is being both created and disseminated.

\textbf{Figure 5-5: GE Precision Engineering}

In May 2007, Garry Edwards formed GE Precision Engineering: a manufacturing company offering precision engineering services to the motorsport and automotive industry. The business was based in Towcester, and soon after its inception, Garry was joined by fellow work colleague Andy Spencer.

In November of the same year, Scott Bredda joined Garry and a sister company (GE Design & Technology) was formed. Design Engineer Richard Beetham joined shortly afterwards. Subsequently, the companies merged and Garry and Scott became partners in the business.

Both Garry and Scott have spent their entire working careers within the engineering environment:

- Garry carried out a toolmaker apprenticeship working for TRW Aylesbury and Mall Moulds before working in the motorsport industry for Jordan GP and Ilmor Engineering

- Scott’s engineering background started with an apprenticeship at Ford, followed by an engineering degree at Portsmouth University and employment at Knorr-Bremse, Cosworth and Ilmor Engineering.

Business funding was entirely from Garry and Scott’s personal savings, both re-mortgaging their homes. Profit was reinvested into new equipment which enabled GE Precision Engineering to offer a wider range of services with the intention of attracting larger contracts.

The recession impacted on GE and a number of customers took work back in-house. However, as the company’s skills are transferrable, they undertook design and manufacturing contracts from alternative markets including Optical Systems, Radar and Nuclear.

Growth slowed slightly during this period but soon picked up and by 2009, there were 11 employees. New business included a number of engineering contracts for Mercedes AMG HPP (formerly part of Ilmor), based at Brixworth. Business links and personal relationships gained during the course of Garry and Scott’s careers have been very important.

The evolution of the High Performance Technology and Motorsport Cluster
Final Report

5.13 Our view is that the global nature of the HPTM client base (including, but not restricted to, competitive motorsport) limits the extent of conservatism; but also that there are looking ahead some associated risks. These relate most specifically to the financing of investment and growth and they are considered in Chapter 7. They matter – certainly in terms of the UK’s economic growth prospects – because of the cluster’s capacity and potential to innovate. It is this that provides the focus for Chapter 6.

Growth from 2010

In 2010, GE Precision Engineering moved from a 3,000 sq ft unit in Towcester to a 6,000 sq ft industrial unit on St James Mill Road in Northampton which was (and is) very close to both Cosworth and MAHLE Powertrain; subsequently this area was designated as part of the Northampton Waterside Enterprise Zone. This proved to be a very positive move for GE, operating within a hub of similar companies.

Prior to the move (in late 2009), GE Precision Engineering was invited to participate in a substantial 3-year R&D project. This collaborative project was led by Jaguar Land Rover (JLR) and part funded by the Technology Strategy Board (now Innovate UK). It also involved partners including Shell, Bath University, Lotus, Imperial College and CD Adapco. The project required a significant investment by GE Precision Engineering but both Scott and Garry recognised that it represented a major opportunity. The project was delivered on time and to budget and GE has since undertaken further contracts with JLR.

GE Precision Engineering has developed work-streams with local companies including Mercedes AMG HPP (Brixworth), MAHLE Powertrain (Northampton), Cosworth (Northampton), Prodrive (Banbury) and Formula One teams. Evident throughout the growth of the company has been the network of personal relationships established from working within the cluster. This “small world” – in which key personal relationships survive both individual job changes and corporate ownership changes – has been very significant for business growth.

GE Precision Engineering today and its plans for the future

Currently, GE Precision Engineering employs 42 people. By the end of 2016, it anticipates that its headcount will increase to nearly 50. Over the next three years, turnover is expected to rise significantly. Overall, it anticipates that 50% of its business will be with automotive firms and 40% will derive from motorsport; it will have a particular focus on low volume production for niche vehicles. It will continue to undertake design engineering work for other sectors (e.g. nuclear), but this will be a small part of the business (perhaps 10% overall).

In realisation of its plans, GE Precision Engineering recently moved into a new, larger, building (still on St James Mill Road and within the Enterprise Zone).

Recruitment can be challenging, and in order to grow its team of engineers, GE Precision Engineering has so far employed four apprentices. This has proved to be very successful. The company is also supporting an undergraduate student through an engineering degree.

Source: SQW – based on company consultations (Autumn 2015 and Spring 2016) and a review of documentary material

Risks for the cluster?

5.12 From our consultations, the strength of knowledge-based ties was clearly apparent “from within” the cluster. However, those consultees that were in some sense external to the cluster – i.e. “outsiders looking in” – had a different vantage point. One – describing the strength of activity relating to composites between Daventry and Silverstone – said “everyone knows everyone” and “it is always possible to find someone who knows someone who knows”. A second commented that “engineers will not move”, reflecting a strong attachment to their locale. A third noted the significance of “engineers growing up together and then feeding off each other”, but then added, “it is very conservative”. And this comment does allude to the potential Achilles’ heel of genuine clusters as described in Figure 1-1 and as evidenced elsewhere; in relation to the German Ruhr, this has been described in terms of “the weakness of strong ties”.

In other words, there is a danger that the depth of relationships – particularly when cautious and conservative – is such that the cluster as a whole fails to adapt to changing competitive pressures.

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6. Understanding cluster dynamics: innovation and adaptation

Key points from Chapter 6

- Innovation is a crucial driver of economic growth. The HPTM cluster has long been a prolific innovator, and this process is continuing apace with a huge range of applications.
- Firms within the cluster are innovating in many different ways. Some of these are organisational (e.g. taking the disciplines from competitive motorsport into different spheres). Others are based on the development, adoption and then dissemination of different technologies; examples include additive manufacturing, satellite-based navigational tools and systems, and advanced materials. These products/services are being applied in a wide range of sectors such as automotive, aerospace, marine, defence, medical devices, sensors, etc.
- Regulatory frameworks are having a substantial influence in terms of current patterns of innovation. Regulations linked to carbon emissions and big data are particularly important, and are prompting highly innovative responses that could be transformational in their effect.
- The process of innovation sometimes involves individual firms, but often it is based on more collaborative approaches involving other companies and other research-based institutions.
- Whilst there are many examples of collaborative approaches to innovation and problem-solving within the geography of the cluster, wider relationships are also very important.

Innovation and economic growth

6.1 Innovation is a critical element of economic growth and a substantial body of economic theory has been developed in relation to it. In relation to the HPTM cluster, innovation and adaptation have occurred in many different guises throughout the cluster’s history. Typically, theorists talk in terms of "technology push" and "market pull" as key influences on – and catalysts for – innovation. Within the HPTM cluster, both of these are apparent, alongside a raft of other factors, including regulatory change and – increasingly – the quest for cleaner/greener solutions as part of the transition to a low carbon economy (with particular implications for both materials and energy).

6.2 In this chapter, we examine different examples of innovation and adaptation from within the cluster. In doing so, we draw extensively on company narratives. Each one of these provides important insights into innovation and adaptation (as do other company case studies in this report). These "stories" are complicated. They are highly context-dependent and in the main, they reflect a range of "push" and "pull" factors coming together, galvanising the creativity and ambition of individual entrepreneurs and business leaders, and embedded within the wider cluster.

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61 See, for example, Bascavusoglu-Moreau, E., and Qian Cher Li (2013), Knowledge spillovers and sources of knowledge in the manufacturing sector: literature review and empirical evidence for the UK. Future of Manufacturing Project: Evidence Paper 18 (Foresight, Government Office for Science).
Processes of innovation and adaptation across the HPTM cluster

Innovative HPTM firms

6.3 As intimated in Figure 1-2 and discussed in Chapter 2, the early growth of the cluster owed much to the disciplines of aeronautical engineering finding a new home and focus in the form of competitive motorsport. Latterly, there have been many examples of a parallel process through which the disciplines linked to competitive motorsport are finding new applications elsewhere. The potential of this process is well recognised, and it is globally important.

6.4 This process is, in part, a consequence of the competitive demands of motorsport. The speed and quality of responses demanded by motorsport customers has itself created a competence and discipline that clients/customers from across aerospace, defence, automotive and other sectors are finding invaluable: firms with their roots in motorsport have a pedigree that a wide range of clients for high performance technology products and services both recognise and trust. One firm that exemplifies this process is EDM Precision Technologies (see Figure 6-3). Equally though, there are examples of motorsport “learning” from other sectors – and the influence of mainstream automotive in relation to down-sizing and light-weighting is one example.

6.5 However, with roots in aeronautical engineering, the motorsport supply chain has been a prolific technological innovator, adopter and disseminator. In part at least, it is funded to be so. The motorsport supply chain has often been seen as a “valley of death” asset which benefits many other sectors – as innovations for the purposes of competitive motorsport (particularly Formula One) are always prototypes and always “under development” with mainstream applications always elsewhere. The consequence has been that for many individual HPTM firms, non-motorsport applications – and the associated clients/customers – now feature at the heart of future business plans. Sometimes these are identified as a source of growth and sometimes they are used as a means of smoothing the annual business cycle (given the seasonality of motorsport).

6.6 Examples of wider applications abound. Over the last decade, additive manufacturing has found applications ranging from aerospace to architecture (as exemplified by Graphite Additive Manufacturing (Figure 2-5) and KWM and KW Special Projects (Figure 6-7)). In similar vein, computational fluid dynamics (applied initially within the motorsport supply chain and propelled in part by software advances) is now finding a growing client base in marine, competitive cycling, pharmaceuticals and energy (see, for example, the case study of TotalSim in Figure 6-4). Other key examples range from the early use of carbon fibre composites (initially developed in aerospace and applied to motorsport) to – more recently – the development of Kinetic Energy Recovery Systems (KERS). This sequence from innovator

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62 See, for example, Ahead of the curve: how UK motorsport technology and innovation can benefit your company, UK Trade and Investment, 2015

63 In 2012, a national survey found that motorsport engineering businesses typically spent 17% of turnover on R&D, with 22% taking out technology patents and 32% claiming an R&D tax credit over previous years (Motorsport Industry Association, 2013 Review of UK Motorsport Valley Business Cluster (based on “Renewing the Evidence Base of Britain’s Motorsport Valley@ 2013: A report for the Motorsport Industry Association, UKTI and the Department of Business, Innovation and Skills submitted by Motorsport Research Associates))

64 This refers to the gap between up-front investment in research and securing sustainable revenue streams as a result of that research. The “valley of death” typically accounts for the demise of large numbers of tech-based start-up businesses

65 In this context, the Technology Road Map developed by the Motorsport Industry Association provides an important insight into future possibilities and potentials
to adopter to disseminator is on-going; and it is core to many HPTM firms’ business models.

The influence of regulation

6.7 Within all this, a catalyst for innovation has often – historically and today – been the creative tension between evolving regulatory frameworks and the possibilities of technology. This tension has itself been double-edged. Through our consultations, we talked to some HPTM firms that found the regulations in motorsport (and in particular in Formula One) so burdensome that they positively sought different markets/clients with fewer regulatory constraints to give them more freedom; this has been one driver in relation to the diversification process described above. Equally though, there were many instances of regulatory change demanding some kind of response which in turn was a spur for technological change and competitive advantage. Historically, an important example was the effect of the FIA’s\(^{66}\) changed engine regulations in the 1960s (from a 1.5 litre to a 3.0 litre engine) and the chain of events that led to the Ford Cosworth DFV (see Figure 2-3). A much more recent illustration is the development of kinetic energy recovery systems in response to Formula One regulations (2009). Formula One regulations for 2014 in relation to engine technologies introduced further requirements for much higher levels of energy recovery, and this – in turn – is precipitating further innovative responses.

6.8 The influence of regulatory frameworks however extends well beyond those put in place by the regulators of motorsport. For example, significant regulation (much at an international level) is having a substantial influence on mainstream sectors. Latterly, key regulatory changes have related to big data and environmental performance, both of which are germane to the HPTM cluster. For example, in the EU, new passenger car emissions regulations require a 27% reduction in CO\(_2\) emissions by 2021, and a further reduction is planned by 2025. This presents major challenges, but it is also creating significant opportunities for many HPTM firms. For example, MAHLE Powertrain has focused development work on the downsizing of engines (see Figure 6-8); and we set out the progress of Vayon Group in Chapter 7.

6.9 There are further examples of innovation prompted in part by the regulatory environment but also with other factors significantly at play. The growth of both Oxford Technical Solutions (see Figure 6-5) and Racelogic (considered in Chapter 8) was in part spurred by the growth of Advanced Driver Assistance Systems (ADAS) – linked to safety imperatives – in mainstream automotive. But the solutions they have developed would not have been possible without the US government’s decision to turn off Global Positioning System (GPS) selective availability. This substantially increased GPS signal accuracy and it effectively created a new positioning “infrastructure” which both companies have used to great effect. Increasingly both firms are working across a range of sectoral contexts. In addition to automotive and motorsport, these variously include marine, electronics and telecommunications. Looking ahead, clear opportunities are identified in the domain of autonomous vehicles and unmanned aerial vehicles. Both companies have won significant national awards – for engineering excellence (OxTS) and for innovation and international trade (Racelogic).

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\(^{66}\) Fédération Internationale de l’Automobile is the governing body for world motorsport
An innovative HPTM cluster?

6.10 There is, then, no shortage of current examples of HPTM firms developing innovative solutions. But a bigger question, arguably, is whether – and to what extent – these processes of innovation are themselves a product of the wider cluster. Our view – based on the consultations completed in the course of this study – is that sometimes innovation is deeply embedded within the cluster (in terms, for example, of clear collaborations within and between cluster firms and other organisations). But there are also examples of innovation in which there is limited collaboration. In these circumstances, the role of the wider cluster can be rather dismissed by individual firms. That said, whilst there may have been little or no inter-firm collaboration, businesses in the second group are still drawing on the same specialist labour market. And they still identified the cluster geography as the “right one” in which to be located. Hence even on the more limited interpretation, the importance of the wider cluster should not be underestimated.

Collaborations between firms

6.11 Some examples of deeply embedded innovation systems have already been presented; the growth of GE Precision Engineering is a case in point (see Figure 5-5) and further illustrations are provided later in this chapter. What we have also observed is collaborative relationships across a somewhat wider geography and we would suggest that these are increasingly important. These are emphasising again the fluidity of boundaries, both sectoral and spatial.

6.12 The links between Cosworth and Cambridge-based Pi Research were established in the 1990s (see Figure 2-3). From our research, there are various other examples of HPTM firms working closely with innovative businesses from both Cambridge and Oxford (and further afield). The interactions between KW Motorsport and KW Special Projects and the hub of ink jet printing in and around Cambridge are one example (see Figure 6-7). The links between Delta Motorsport and YASA Motors (a spin-out from the University of Oxford and located on Milton Park in southern Oxfordshire) – focused on high performance electric cars – is another (see Figure 6-6); this collaboration was described at an early stage as “a fantastic blend of skills: the deep understanding of the electromagnetic behaviour of axial flux electric machines held by the team at Oxford, alongside the motorsport-honed mechanical engineering experience and wider “holistic” vehicle installation view of Delta Motorsport”.

6.13 Whilst on a narrow interpretation, relationships of this type might be seen as questioning of the cluster’s existence, we would conclude the opposite. Innovation – in an era of complex and convergent technologies – is absolutely premised on relationships of this nature. Indeed, as one of our consultees noted, “when technology is uncertain and changing quickly, trust is really important”. With knowledge “in the air” (Chapter 5) across a vertically disintegrated production system that has proved capable of adaptation and change for approaching a century, the HPTM cluster ought to be well placed to respond.

Note that during our consultations, we asked firms that described “thin” links within the cluster where – if their business (including key personnel, their families and their wider “life” (e.g. in relation to schools, etc.)) could be put on a “magic carpet” – they would ideally choose to be located. Responses that were other than the existing location were largely within the geography of the cluster.

*Special Commendation – Electric Avenue* The Engineer, 7th December 2009
The role of universities and other research-based institutions and testing facilities

6.14 A second dimension of innovation at a cluster level surrounds the role of research-based institutions, including universities, testing facilities and – more recently – the network of Catapults.

6.15 From our consultations, we found some evidence of collaborative research with universities. The most frequently mentioned in this context was Cranfield University – although reference was also variously made, *inter alia*, to University of Bath, Imperial College London, Brunel University, University of Leeds, University of Warwick, University of Oxford and Oxford Brookes University. The Advanced Propulsion Centre, linked to the University of Warwick, is also very relevant.

6.16 Culturally, there did appear to be some tensions between HPTM firms and the university sector. One firm, for example, bemoaned the lack of continuity in terms of university researchers and another commented on timescales. Nevertheless, there is – evidently – a significant set of relationships. Often this is vested in collaborative R&D projects; illustrative examples are those involving GE Precision Engineering (Figure 5-5) and Vayon Group (Figure 7-2).

6.17 The importance of the *infrastructure for technical testing* should also be recognised. Within this context, Millbrook is now a fully independent UK company which employs around 500 people, many of whom are experienced test engineers (see Figure 6-1). Further afield, HORIBA MIRA also provides a comprehensive independent proving facility. The planned aerodynamic testing facility at Catesby Tunnel (in Northamptonshire) could also be important.

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**Figure 6-1: Millbrook**

**History**

Millbrook Proving Ground is located in the village of Millbrook, between Woburn and Ampthill, half way between London and Birmingham. Following an extensive search across the UK in 1968, the Millbrook site was selected by General Motors (GM) for car and truck testing purposes because of its natural and varied hills (up to 45% gradient), a feature which disused airfields used for the majority of vehicle testing could not offer. In 1970, the Proving Ground opened, offering testing facilities across a 700 acre site for Vauxhall Cars and Bedford Trucks.

The site continued to be used exclusively by GM for the next 18 years. However in 1988, the Proving Ground opened for business to third party companies on a commercial basis. In 1997, an Engine Centre was opened on the site enabling Millbrook to undertake engine development, test and certification for other global manufacturers of cars, trucks, buses and military vehicles.

In 2013, private equity group Rutland Partners acquired Millbrook. This change in ownership marked a significant milestone in Millbrook’s history and Millbrook is now a fully independent UK company. During 2014, the management structure was changed and plans were put in place for investment and export market expansion. This has involved the formation of formal collaborations with partners in China, India, Turkey and South Korea as well the acquisition (in 2015) of Test World Oy in Ivalo, Finland which offers year-round winter tyre and vehicle testing utilising Test World’s unique climate controlled indoor test tracks.

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69 TotalSim – considered in Figure 6-4 – is one of the partners developing the project
Millbrook today

Millbrook employs around 500 people, the majority being experienced test engineers. With a turnover of around £50m, the primary business activities focus on whole vehicle, powertrain, component, safety, petrochemical and tyre testing/certification. Millbrook also provides specialist vehicle conversions, has various conferencing venues and offers office and workshop space to businesses through its New Technology Park.

Plans for the future

Millbrook is currently expanding the 61,000 sq m Technology Park as part of a wider vision with planning consent for the development of three new buildings totalling 6,000 sq m and outline consent for another 30,000 sq m of development space.

Further expansion in Millbrook’s powertrain, emissions and safety capability is underway with additional new engine test cells due on stream mid-2016 and a new state of the art 4WD chassis dynamometer, including full climatic emission capability, under construction. Safety capability has been upgraded with a new ServoSled crash simulation lab (the only one commercially available in the UK) with further upgrades to the full scale crash lab planned. The Test World facility in Finland is also growing, with additional land purchased and new track preparation underway.

Millbrook is not a race circuit. Millbrook’s track activities focus is on road car and vehicle performance/durability/reliability/comfort/refinement testing; it therefore complements activities at Silverstone. Some of the technologies being tested across the two sites are similar. For example, the dynamometer investment noted above will allow testing to take place on motorsport vehicles and supercars, and Millbrook is involved in the testing of both hybrid and autonomous vehicles (which, separately, businesses on Silverstone Park are also involved in testing and developing).

Source: SQW – based on consultations (Spring 2016) and a review of documentary material

6.18 Looking ahead, the influence of the Catapult network is likely to grow. This includes the Transport Systems Catapult which was set up in Milton Keynes in 2013 (see Figure 6-2). Whilst it is a national organisation, it has quickly become a sizeable operation and its focus on intelligent mobility is highly relevant to the cluster’s future growth; indeed, some of the HPTM firms interviewed in the course of this study are already working with the Transport Systems Catapult.

Figure 6-2: Transport Systems Catapult

Overseen by the UK’s innovation agency, Innovate UK, the UK has ten elite technology and innovation centres or ‘catapults’. One of these is the Transport Systems Catapult which is based in Milton Keynes. It was set up in 2013 with the aim of furthering the market for Intelligent Mobility (defined as the use of new and emerging technologies to enable smarter and more efficient transportation of people and goods).

The Catapult employs about 130 people in Milton Keynes. It is therefore becoming a major player within the wider ambit of HPTM. Its presence in Milton Keynes is prompting enquiries from potential (international) inward investors.

The formation of the Catapult

The Catapult was created with an overall vision to “drive UK global leadership in Intelligent Mobility – promoting sustained economic growth and wellbeing through integrated, efficient, and sustainable transport.”

The driving force behind the Catapult’s creation was the lack of co-ordinated research and development across different transport sub-sectors. The lack of a joined-up approach meant that efficient transport technologies and systems were not being developed, and that there was relatively little activity in Intelligent Mobility. The Catapult is seeking to address this by providing the facilities and equipment needed for collaborative research; signposting organisations to other relevant individuals or firms; and by brokering relationships between different parties interested in the Intelligent Mobility agenda.

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Milton Keynes was chosen as the location for the Catapult for various reasons. Firstly, several road and rail networks converge in the area making it appropriate for “cross-sector” solutions (and without a strong association with any one transport mode). Secondly, Milton Keynes is located centrally within England, making it very accessible (including in relation to London, but without being in London). Thirdly, Milton Keynes Council was considered to be progressive and forward-thinking; and it quickly recognised the importance of Intelligent Mobility (not least in Milton Keynes itself). Finally, the cost of commercial space in the area was relatively favourable. In addition – although perhaps with hindsight – Milton Keynes has proved to be a very good location for recruiting staff with expertise in different aspects of Intelligent Mobility.

The Catapult’s current activities

The Catapult works across five main business units: automated transport systems, modelling and visualisation, information exploitation, customer experience, and smart infrastructure. Within these business areas, it provides help to SMEs by providing access to specialist capabilities and facilities; helping to form research consortia; and developing networks. The Catapult is home to the “Innovation Centre”: collaboration space which supports interaction between innovators, entrepreneurs, researchers and business leaders. It also operates at a sector-wide and more strategic level, for example helping set up a cross-industry group for autonomous vehicles.

The Catapult receives core funding from Innovate UK and the Department for Transport. Over time, the intention is that the Catapult should be resourced through three funding/income streams which are similar in scale: core funding; funding secured competitively to deliver collaborative R&D projects; and commercial revenue generated by providing access to the centre’s facilities and expertise.

Interaction with the HPTM cluster

The Catapult sees one of its roles as understanding how skills and expertise from different fields are relevant to Intelligent Mobility. It has worked with a number of HPTM firms in this context – one recent example is Racelogic. In addition, the Catapult recognises the depth of relevant expertise at Cranfield University.

However, the Catapult is a national body. Although there are strong local connections, its work is national in focus.

Case studies providing insights into innovation and adaptation

As intimated above, innovation across the HPTM cluster takes many different forms. Innovation narratives from individual firms tend to reflect a wide range of circumstances – some internal, some external and all working in combination. Below we present six examples – all of which have been referenced in this chapter. Most have multiple processes at play and – in the round – they demonstrate something of the depth and breadth of innovation ongoing across the cluster today.

**Figure 6-3: EDM Precision Technologies**

**Early Days**

EDM was founded in 1992 as a small tool pressing firm based in Towcester. In order to secure a larger unit, in 1995 the firm moved to Silverstone Circuit.

During these early years, the firm invested in a number of wire erosion machines (a type of Electro Discharge Machine (which is where the firm gets its name), a sub-group of the more widely used Computer Numerical Controlled (CNC) machines). These allow metals to be cut more precisely than other methods (such as laser, plasma or water jets) including after heat treatment. This in turn mitigates the risk of distortion that can occur through the heat treatment process – in precision engineering, this can make a significant difference to product quality and performance.

Over the first 13 years of operation, the firm focused on serving other engineering businesses operating across a range of sectors including motorsport – and within this, a number of the Formula One teams. However, it also had clients in the medical/scientific equipment sector and tools for materials testing. The business didn’t experience any real growth over this early period.
Growth, commercialisation and understating the value proposition of EDM

Through its early years, EDM developed a business model around servicing Formula One – this involved being able to deliver high quality low volume products against very tight and challenging timescales with zero tolerance for slippage or error.

In 2006, the owner retired and current Managing Director and owner, Paul Waldron, acquired the business. At this point the firm had just three members of staff and two CNC machines. Paul, who came to EDM with a combined engineering and commercial background, recognised the potential for growth, but to realise this the firm needed to become more commercially focused. With this in mind, he built on the firm’s capabilities of high quality and speed to create a ‘value proposition’. Paul realised that this needed to address the customer experience at all stages from being able to provide a quotation in 2-3 hours to producing the correct parts quickly, on time and in full. This involved developing the firm’s supply chain to ensure that it was highly responsive and reliable but also making continued investment in high quality machines and inspection equipment whilst also developing the skills of its employees. Paul has successfully managed to win clients and sell EDM’s services into other sectors during the last nine years.

Motorsport remains an important focus for EDM (it currently works for six of the UK-based Formula One teams), but as a result of the diversification effort, 70% of the firm’s turnover was derived through the aerospace, defence, energy, and scientific equipment sectors in 2014/15. This process has been demanding: EDM has had to secure stringent certification (i.e. AS9100) in order to serve the aerospace sector as well as carrying out dimensional and geometric tolerance staff training assessed and approved by the National Physical Laboratory.

Future growth through continued diversification, and the importance of the HPT&M cluster and Silverstone

Currently EDM has 11 full-time staff, working with 18 CNC machines. It moved to a new larger unit on the Silverstone site in June 2014. The business offers a 7 days a week operating service. The plan is for continued steady growth. The growth model is based upon retaining a core high performance motorsport client base (and the associated business model) and using this to grow the business through continued investment (in staff and machines) and sector diversification.

With the exception of the Formula One teams (which are within an hour of EDM’s site), the firm’s customer base is spread across the UK, including Scotland and Wales. However, Silverstone – and the cluster around it – is crucial for EDM:

- The nature of the business model and value proposition adopted by EDM means that its supply chain has to be able to deliver materials against very tight timeframes. As a result, most of EDM’s suppliers are within around an hour’s drive time from Silverstone.
- Working with wire erosion machinery is a niche sub-sector of precision engineering. EDM’s staff are virtually all trained in-house over a number of years and most live in and around the area. A number of staff have been recruited by Paul over the years with no prior engineering skills or experience and taught from scratch.
- The Silverstone brand is helpful for EDM – it reinforces the firm’s association with high performance engineering which is useful when trying to cultivate new clients in other non-motorsport sectors.

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material

Figure 6-4: TotalSim

Early Days: Reynard Motorsport, and Computational Fluid Dynamics (CFD)

The origins of TotalSim can be traced back to Reynard Motorsport. In 1997, Adrian Reynard wanted to establish a CFD firm to support the wider Reynard Motorsport operation. In response – and with financial support from Reynard – Advantage CFD (A-CFD) was established. It was led by Rob Lewis, a mechanical engineer with a PhD in CFD Codes for Combustion from the University of Leeds who had previously worked for the international engineering consultancy, FLUENT. A-CFD provided services across all of Reynard’s activities, with a particular focus on the BAR Formula One team, which Reynard helped to found and was a major shareholder in.

Reynard Motorsport was declared bankrupt in 2002. Subsequently, BAR acquired some of Reynard’s assets and restarted A-CFD. In 2005, Honda acquired BAR (including A-CFD). With Honda subsequently deciding to end external consulting services, A-CFD was closed in 2007. At this point, and bringing a number of ex-A-CFD staff with him, Rob took the decision to establish a new CFD-focused firm, TotalSim.
TotalSim, the rapidly changing CFD landscape, firm growth and diversification

Initially TotalSim operated from the Reynard Aviation building, but the new firm needed its own premises. With a desire to remain in close proximity to the UK-based Formula One teams and to where Rob and other key staff lived, TotalSim moved into premises on Top Station Road in Brackley.

Essentially TotalSim uses CFD super computers to analyse airflow, water flow, droplets and spray and to examine how, under different operating environments, these states of matter behave and affect performance and speed. The computer power underpinning CFD – and its application – has developed significantly over the years. In 2000, CFD was used sporadically by racing teams and wider industry; it was expensive; and the geometric models typically involved around two to four million cells (which define the locations where the variables such as compression flow and turbulence are to be measured). By 2015, these models involved around 100 million cells and computation could be undertaken at four times the speed and at a fraction of the cost. The CFD service provided by TotalSim has also changed. With most CFD software now free to download, the firm’s focus has shifted to providing on-going consultancy support to clients using the software.

The firm is majority owned by Rob, with the remainder of shares owned by senior staff and close associate and Board Member, Sergio Rinland.

Over its eight years of operation, TotalSim has grown to 23 staff. All of the UK-based F1 Teams undertake CFD in-house. Outside of F1, TotalSim is the leading contractor for the motorsport sector. However, this only makes up 33-50% of annual turnover. Indeed, TotalSim has successfully developed a wide-ranging client base spanning the marine, aeronautics, pharmaceuticals, oil and gas, renewable energy and turbomachinery sectors. TotalSim has also been heavily involved with British Cycling during two, highly successful, Olympic campaigns (Beijing 2008 and London 2012). Within this context, TotalSim led on the aerodynamic development programme.

The firm also has an independently run sister company in the USA which, called TotalSim LLC, started up in 2009. Operated by Ray Leto, a highly experienced American open wheel racing engineer, in 2015 TotalSim LLC employed 11 staff. TotalSim also has an operating presence in Japan.

Skills and plans for growth

The majority of TotalSim’s workforce are mechanical or aerospace engineers with around a third having a PhD. Although staff levels may grow modestly, there are no plans for major growth at TotalSim: the firm is doing well and continues to provide enjoyable, stimulating and challenging work to Rob and his team. That said, Rob does have a number of higher risk ventures that he is currently pursuing. For example, Rob (as TotalSim) and co-investor, George Howard-Chappell, have submitted a planning application to convert a disused railway tunnel in Daventry into a new R&D and wind tunnel facility.

Spatial definition and importance of the wider cluster

TotalSim’s clients are based around the UK, but with a concentration in Northamptonshire, Oxfordshire and Warwickshire. Collaborations are important for TotalSim as contracts are often part of much wider projects (e.g. Prodrive often sub-contracts CFD activity to TotalSim). Proximity to these firms really matters.

Figure 6-5: Oxford Technical Solutions

Oxford Technical Solutions (OxTS) designs and manufactures products combining the best of Inertial Navigation and GPS/GNSS satellite navigation systems. Inertial navigation systems (INS) use multiple inertial sensors, and a processing unit, to continuously calculate the position, orientation, and velocity using measurements coming from those sensors. A GNSS receiver generates absolute position measurement - latitude and longitude - and timing information. In combination they provide high accuracy measurements and low drift rates during any loss of GNSS. OxTS focuses on low-cost INS using MEMS (micro-electro-mechanical systems) gyro and precision accelerometers. Its products are typically used for testing Advanced Driver Assistance Systems (ADAS) for vehicles, providing navigation information to self-driving vehicles, and mobile surveying such as mapping the conditions of land surfaces, or geo-referencing of airborne LIDAR data (LIDAR is a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected light).

Early days

OxTS was founded in 1998 by Dr. Alex Nairac and Brendan Watts, who met as students at Oxford University. They brought a combination of academic research (immediately prior to establishing OxTS, Dr Nairac was a researcher at Oxford University) and commercial expertise (Brendan Watts gained industrial experience after graduating).
Initially OxTS provided consultancy services whilst developing its own products, the first of which was launched in the early 2000s.

OxTS was based at the Cherwell Innovation Centre at Upper Heyford, near Bicester, Oxfordshire, where it has remained ever since. The location was chosen for two main reasons: it was close to where the two founders lived; and Upper Heyford (a former RAF base) has old runways which OxTS could use for live testing of its products.

**Diversification and innovation**

The main market for OxTS is the automotive sector, where the firm is widely recognized as a leading supplier of high accuracy inertial navigation systems.

OxTS products are used for vehicle dynamics (accurately measuring the position, slip-angle, orientation, velocities and accelerations of a vehicle during dynamic testing) and testing and validating Advanced Driver Assistance Systems (ADAS) such as collision warning and lane departure. The market has grown rapidly in recent years as new technologies such as advanced emergency braking (AEB) systems and intelligent vehicle control have been widely introduced into vehicles, creating the need for more testing and proving during development and manufacturing processes.

OxTS is also developing products in other sectors where high accuracy motion measurement systems are required. For example, in surveying, OxTS products are used for mobile mapping (ranging from surveying open-cast mines and quarries to mobile mapping among inner-city buildings), aerial surveys, and general positioning where GPS and GNSS systems are insufficient (e.g. because of satellite blackout, insufficient update rates or the antenna not being at the required measurement point). Other sectors in which OxTS is active include marine, educational research, and autonomous vehicles. A growth area is unmanned aerial vehicles (UAVs - drones, etc.).

In addition to developing its own products, OxTS also provides OEM solutions for customers to integrate into their own systems.

OxTS was one of seven companies shortlisted for the British Engineering Excellence Awards (BEEA) category “Small Company of the Year” 2011.

**OxTS today**

OxTS is still wholly owned by its founders, who remain active in the business: Dr Nairac is the Board Chairman, and Brendan Watts is a non-exec Director. The firm has grown steadily since formation, and now employs 40 staff, including a high proportion of qualified engineers.

OxTS sells worldwide to automotive manufacturers and system integrators (who also sell their systems to automotive manufacturers). A small proportion of sales are in the UK. There is a small marketing team based in Germany, and it has appointed representatives in other country markets.

OxTS designs and develops all its products. The manufacture of some parts, such as assembly of PCBs, making of cables, and machining of mechanical parts, is outsourced. Its main suppliers are electronic component suppliers and manufacturers of GNSS receivers. Most of these are imported. Its main competitors are Racelogic and Race Technology, both based in the UK, in Buckingham and Nottingham respectively.

OxTS typically recruits through specialist recruitment agencies. The firm recruits graduates straight from university as well as staff with experience. Due to the need for staff with suitable skills OxTS recruits from all over the UK and beyond. The firm does not run formal apprenticeships, but it does invest significant time and resources in training staff, in large part due to the technical complexity of the products and the advanced professional knowledge and expertise of customers i.e. staff are often selling to and dealing with highly qualified professional engineers.

The firm’s location at the Cherwell Innovation Centre at Upper Heyford has proved to be successful for OxTS for three main reasons:

- it is well positioned in relation to its specialist labour market; staff live mainly along the M40/A34 corridors, as far south as Didcot and Newbury and as far north as Northampton and Towcester
- the location in an Innovation Centre has enabled the firm to take more space as it has grown, without needing to enter into new leases or move to another location
- the firm continues to use the old runways at Upper Heyford to test its equipment in vehicles.
Despite minimal wider interest in electric vehicles five/six years ago, Delta saw the potential future market and
engine. At this point, Dr Tim Woolmer established YASA Motors as a spin-out from the University. As part of this
demonstrate. Following an initial assessment, Oxford University commissioned Delta to work on the design of the
contacted by a group from Oxford University which was working on an electric engine design which it wanted to
Demonstrator Programme. This time, it was successful. After attending the competition briefing, Delta was
In 2009, Delta applied for funding to build five cars as part of the Technology Strategy Board Low Carbon Vehicle
Agency (EMDA). Through its R&D grant programme, EMDA funded 25% (£250k) of project costs.

Building on this success, Delta set about establishing itself across a number of service areas: race teams, including
Kontinental GS1000 and Silvia competition, motorsport consultancy, and engineering consultancy (e.g. Delta
premises across from Silverstone Circuit. Simon’s father, Roger, was a respected engineer and developer of race
cars. He had a fully fitted workshop which was the perfect place to start Delta. In 2007, when Simon’s father sold
these premises, Delta moved across the road to Silverstone Circuit.

Coinciding with the decision to create Delta, another ex-Reynard employee, who was now working for the Kenny
Roberts Moto GP team, introduced Simon and Nick to the organisers of the newly launched GP Masters which was
due to have its first race in November 2005. Delta secured the contract to provide the cars based loosely on the
Reynard Indy Car chassis, but the 15 cars needed to be designed and built in five months. This was a significant
reputational and financial risk for Simon and Nick: many industry insiders questioned whether it was possible, and
there were substantial cashflow issues. However, through Nick and Simon’s combined experience, the cars were
delivered on time, the race was a success, and everyone was paid.

Building on this success, Delta set about establishing itself across a number of service areas: race teams, including
Formula One; road and niche vehicle clients; and clients focused on the low carbon vehicle market. Delta’s business
model centred on providing research, design and development capability to its clients. Indeed, Delta’s foresight in,
and subsequent commitment to, the emerging hybrid and electric engine market is testament to this model.

Hybrid and electric engines and vehicles

In the second year of the GP Masters contract, Delta secured an additional project to develop a new hydrogen hybrid
vehicle (the ‘Microcab’). This project highlighted the opportunities in the low carbon sector. Following a market
review (which highlighted the undeveloped nature of the market), Simon and Nick agreed that they would design their
own completely new ultra-low energy vehicle.

With an outline plan in place, Delta then sought to secure funding, and following an unsuccessful bid to the
Technology Strategy Board, it managed to secure support from the then-East Midlands Regional Development
Agency (EMDA). Through its R&D grant programme, EMDA funded 25% (£250k) of project costs.

In 2009, Delta applied for funding to build five cars as part of the Technology Strategy Board Low Carbon Vehicle
Demonstrator Programme. This time, it was successful. After attending the competition briefing, Delta was
contacted by a group from Oxford University which was working on an electric engine design which it wanted to
demonstrate. Following an initial assessment, Oxford University commissioned Delta to work on the design of the
engine. At this point, Dr Tim Woolmer established YASA Motors as a spin-out from the University. As part of this
process, Delta agreed a licensing agreement with YASA Motors for part of the mechanical design.

Despite minimal wider interest in electric vehicles five/six years ago, Delta saw the potential future market and
working in collaboration with partners KS Composites, YASA Motors and Advanced Composites Group, launched the
E4 Coupe, a high performance electric road car.
Delta today

Today Delta employs 20 staff. It continues to operate across its main service areas.

With respect to the hybrid and electric activity, there are now both 2-wheel drive and 4-wheel drive variants of the E4-coupe electric car which act as technology demonstrators for Delta’s own and customers’ new developments. Delta has developed battery systems for marine and automotive applications, charging systems, electric machines and other propulsion devices at a component level. Further to that, Delta has designed and built whole electric/hybrid vehicles integrating existing and Delta components and developing the control systems.

The role and importance of Silverstone

Silverstone is an important location for Delta Motorsport: staff live nearby; the Silverstone brand reinforces Delta’s prominent role in the market; and being close to the circuit is important for staff and clients – “where else can you work and meet with clients against such a fantastic sound track”.

From Simon’s perspective, the 30-mile radius around Silverstone defines the HPTM cluster: it is within this geography that the heritage of people, skills and businesses is concentrated. Delta Motorsport, and its indelible association with Reynard, is strong evidence of this.

Source: SQW – based on consultations (Autumn 2015 and Spring 2016) and a review of documentary material

Figure 6-7: KW Motorsport (KWM) and KW Special Projects (KWSP)

Scale up, diversification and the emergence of KW Special Projects

As described in the career history of Kieron Salter (see Chapter 5), from 2009-2011, KWM operated from modest offices in Bicester. Alan Hudd (founder of Xennia (an industrial ink jet firm in Letchworth, Hertfordshire), who knew KWM through a prior motorsport based commission) approached KWM to support the development of the machinery required for ink jet printing.

This marked a step-change in KWM’s operation – four staff were needed just to service the Xennia contract. In addition, with other opportunities emerging, it was clear that the market for transferring the mechanical engineering know-how and technology from motorsport into other sectors was significant.

In response, Kieron established KW Special Projects (KWSP) to service all non-motorsport activity, and moved to larger premises in Brackley, adjacent to the Mercedes Formula One team (on the site previously occupied by Kieron’s ex-employer, Reynard Motorsport).

In 2013, Kieron purchased KWM/KWSP’s first industrial 3D (additive manufacturing) printer. Through demonstrating the value of additive manufacturing, contracts were secured to provide tooling to F1 teams. KWSP also now holds a contract to make highly accurate and authentic replica prototypes which rely heavily on the firm’s 3D printing capability.

At about the same time, Kieron made a number of important appointments, bringing in a Head of Operations, Sophie Kilmister (which allowed Kieron to focus on business development and diversification); a Head of Advanced Manufacturing, Stuart Banyard, to support existing key appointments; a Principal Engineer, Ian Jones; and an Automation and Controls Engineer, Vinny Viswanath.

KWM and KWSP in 2015, and plans for the future

By 2015, the two operations employed 16 staff. Turnover for 2015/16 is on track to be double that for 2014/15. Around 50% of turnover is derived from motorsport related activity, including on-going work with Formula One, with the other 50% from other non-motorsport activity, including:

- a long term contract with the English Institute for Sport
- work with Chris Boardman and TotalSim on a range of cycling projects
- contracts in the land, sea and defence sector
- a project working with Unmanned Aerial Vehicles (UAVs)
- a project working with a new ink jet technology associated with textile coating and pre-treatments.

The firm now has three industrial 3D printers which are being used across KWM and KWSP. By 2019, it plans to grow to over 40 employees.
KWP’s clients are based across the UK (with centres of research for in-ket printing focused in and around Cambridge, 3D printing in Nottingham, and work for the English Institute for Sport focused in Bath). However, Kieron recognises the importance of the geography around Northamptonshire, Oxfordshire and Milton Keynes due to the high performance technology “value” of the area. It is across this geography that his staff live (and are recruited from). It is also where many of the key relationships for KWM were forged.

**Figure 6-8: MAHLE Powertrain**

**Company overview**

In 1998, the engineering and manufacturing divisions of Cosworth were sold to VW/Audi. On 1st January 2005, these were then acquired by MAHLE Group, one of the largest automotive suppliers globally, and rebranded as MAHLE Powertrain.

Today, MAHLE Powertrain is a wholly owned subsidiary of its German parent. Its headquarters and engineering centre are located in Northampton, adjacent to both Cosworth and GE Precision Engineering. MAHLE Powertrain employs about 600 people globally. Of these, 210 are in Northampton; 150 are in Wellingborough (where the company has three manufacturing sites); 150 are in Detroit; and the remainder are based in smaller Technical Centres in Shanghai, Sao Paulo, Stuttgart and Munich. MAHLE Powertrain turns over about £100m in total – about £40m is linked to engineering services and £60m relates to manufacturing.

The focus of MAHLE Powertrain’s work is road engines and the firm’s principal customers are the major automotive OEMs. In terms of scale, the most important UK client is Jaguar Land Rover (JLR); Bentley and Aston Martin are also significant. Internationally, the firm works for other OEMs including BMW, Audi and Ford. Overall, about 55% of its revenue derives from clients based in the UK.

**Operating within the HPTM cluster**

Although owned by a large German company, MAHLE Powertrain considers itself to be fundamentally part of the HPTM cluster.

MAHLE Powertrain invests in training young people and developing local skills. It takes on about ten apprentices each year, mostly at a technician level, and they work in engine testing and in the vehicle workshop; there are many examples of technicians progressing to engineering roles. In addition, the firm recruits about six graduates each year and it trains them across all parts of the business.

It sees a continual movement of people – particularly at technician levels – to and from Cosworth and other local firms, and the consequence is that local businesses have very similar cultures. This is described in terms of the technical sophistication of automotive combined with the key attributes of motorsport – “getting things right first time” and “always finding a solution”. Hence although MAHLE Powertrain itself has little direct involvement with motorsport, “the mindset of motorsport is very strong”.

MAHLE Powertrain works closely with many other HPTM firms – sometimes as a customer, sometimes as a supplier, and sometimes as a collaborator. Alongside Cosworth, important local connections include those with GE Precision Engineering, RML (Wellingborough), Flybrid/Torotrak (Silverstone), and Flowmaster (Towcester). These relationships are important to the business; and they are “live”, collegiate, and constantly evolving.

**Research, development and innovation**

Much of MAHLE Powertrain’s work is developmental – and some of it is concerned with more fundamental research. In the main, MAHLE Powertrain is designing and improving engines for next generation road cars. Much of its work is virtual, through the use of highly sophisticated CAD/CAM systems; and also test based work using highly sophisticated test facilities. Whilst elements of this work could be done in-house by the OEMs, they often choose to outsource the work because MAHLE Powertrain is a problem solver and it completes the development work more quickly and more efficiently than can be achieved in house.

In addition, MAHLE Group itself funds some research and MAHLE Powertrain also delivers publicly-funded research projects, usually as part of a wider consortium. In the past it has, for example, completed projects for the Technology Strategy Board (now Innovate UK). However publicly-funded contracts are a small part of its total business.

Currently, much of MAHLE Powertrain’s work – whether directly for clients or funded through MAHLE Group resources or research grants – is concerned with the downsizing of engines. Very significant progress has been made over the last decade in maintaining the performance of engines whilst reducing emissions. With internal funding, MAHLE Powertrain led an innovative project to achieve the same performance from a 1.2 litre engine as had previously been achieved by a 2 litre engine, whilst also increasing fuel efficiency (from 45 to 55 miles per gallon of petrol).
Over the last year, it has started to further update the MAHLE downsizing engine to increase the output from 100 to 160 kW/litre through the application of 48V eSupercharging. This maintains high levels of fuel efficiency but with higher performance.

The drivers for innovations of this nature are largely legislative and/or regulatory. They are concerned both with reducing pollutants (such as nitrous oxide, particulates and carbon monoxide), whilst also limiting emissions of carbon dioxide. The potential of the global OEM market for advances of this nature is substantial.

**MAHLE Powertrain’s plans for the future**

Looking ahead, MAHLE Powertrain has ambitious growth plans. The company is looking to increase its headcount in Northampton, and to this end, it is reconfiguring its main building to be able to accommodate about 50 more staff. Some of its growth will be at its international Technical Centres, in part because these have developing expertise in transmission technologies but also because they are physically close to key international clients (particularly BMW and Audi). However, 11 years after the original acquisition by MAHLE Group, MAHLE Powertrain continues to see the HPTM cluster as the core location for its engine business.

*Source: SQW – based on company consultations (Spring 2016) and a review of documentary material*
7. Understanding cluster dynamics: financing, networks and growth

Key points from Chapter 7

- The overall pattern of financing for growth across the HPTM cluster is – in parts – very distinctive. In the immediate ambit of motorsport, parts of the cluster (notably Formula One teams) are extremely well resourced, but many specialist firms within the wider supply chain have struggled to secure growth finance. Instead, small firms have typically financed their own growth – relying on the personal savings of founders and then financing growth through cashflow.

- Sources of external finance have been limited. Firms tend to perceive that banks are difficult and equity investors are generally unrealistic in terms of the scale of financial returns and the speed with which they can be generated. Instead, some smaller firms are actively exploring alternative possibilities, including those linked to crowdfunding.

- However, firms themselves may need to evolve and adapt to become more "investible". This is not a reflection of their technological abilities or potential, or the commitment of business leaders; it may though say something about the precise nature and focus of "ambition" and the vagaries of the markets they serve.

- Within the cluster, there are few examples of serial investors/entrepreneurs who have built businesses, exited from them and then reinvested cash (as well as commitment and expertise) to grow the next generation; other well-functioning clusters have a stronger endowment in this regard.

- There are some signs that approaches to financing may be changing. The source of these seems to be largely external to the cluster and their emergence is a reflection of the potential of high performance technology, particularly in the context of significant global demand for low carbon, green/clean and energy efficient solutions.

The nature of financing within the cluster

7.1 We noted in paragraph 1.3 that the industrial ecosystem across the HPTM cluster is "full of paradoxes". Nowhere is this more apparent than in issues relating to finance and growth. Parts of motorsport – particularly Formula One – are underpinned by substantial sponsorship deals and financing arrangements that are commensurate with a global spectacle and a global TV audience numbering 100s of millions; in this context, very significant sums are spent within the supply chain to achieve marginal performance gains and – much like Champions League football – money is, literally, not a constraint. Separately, within the cluster, some of the larger HPTM businesses have secured significant investment; as set out in Figure 2-4, Prodrive Composites secured £6m growth capital investment from BGF (Business Growth Fund) in 2015.

7.2 On the other hand, our consultations unearthed many examples of small and medium-sized HPTM firms – some of which were suppliers to Formula One teams – identifying finance as the major brake on growth. The gulf between these different "worlds" has been examined previously, and the Motorsport Competitiveness Panel gave the issue significant consideration in the early 2000s. In this chapter, we set out some current issues and observations surrounding the financing of growth across the wider HPTM cluster, as evidenced through our fieldwork.

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71 See Report of the Motorsport Competitiveness Panel, presented to the Secretary of State for Trade and Industry, July 2003
Sources of revenue and early stage finance for HPTM firms

7.3 Within the context set out above, the Formula One teams continue to be an important source of revenue for HPTM firms. However, a view expressed during our consultations was that – notwithstanding their financial wherewithal – Formula One teams can be “terrible customers”. Whilst they will ”pay a premium to get things done quickly“, the flow of work – even to well established supply chain partners – is “all very seasonal and unpredictable”.

7.4 This in itself presents a range of challenges. For one thing, it can be difficult to position HPTM firms as an “investible proposition” through business plans with the consequence that mainstream investors find it difficult to invest (see below). Firms also commented that with chronic financial uncertainty, it can be “very difficult to hold onto talented groups of staff”. In this context, contrasts were drawn especially with the aerospace sector. From the perspective of individual HPTM businesses, part of the rationale for the process of diversification outlined in Chapter 6 was – simply – the quest for more stability.

7.5 In parallel, another set of observations also needs to be made. In the course of our conversations with HPTM businesses, some reference was made to tax credits. Research and Development (R&D) tax relief (or credit) is a company tax relief that can either reduce a company’s tax bill or, for some SMEs, provide a cash sum. It is based on the company’s expenditure on R&D, which is defined by HMRC as “a project that seeks an advance in science or technology”72. To qualify for the R&D tax relief it is necessary to be able to state what the intended advance is, and to show how, through the resolution of scientific or technological uncertainty, the project seeks to achieve this. The Motorsport Industry Association (see Figure 2-6) has worked closely with the Motorsport group in BIS to establish the principle that motorsport firms undertake R&D and therefore qualify for the tax relief on certain activities; this in turn is considered to have increased the global competitiveness of the sector73. Typically, HPTM firms have been able to obtain tax relief to the value of around 18% of the cost of R&D successfully claimed (i.e. every £100 of qualifying expenditure results in a saving of around £18 in tax paid).

7.6 In addition, we were struck by the frequency of references to grants secured through publicly funded research and development programmes. These included, for example, the European Union’s Framework Programme 7 (FP7)74; grants from Innovate UK (or its predecessor, Technology Strategy Board), particularly through SMART awards75; research grants from the former-regional development agencies, notably that for the East Midlands (emda); and awards from Local Enterprise Partnerships (funded through the Regional Growth Fund and European Regional Development Fund)76,77.

72 http://www.hmrc.gov.uk/manuals/cirdmanual/cird80150.htm
73 Ahead of the curve: How UK motorsport, technology and innovation can benefit your company UKTI January 2015
74 This ran from 2007 to 2013. The successor programme – which is also substantial – is Horizon 2020
75 This is a grant scheme which offers funding to small and medium-sized enterprises (SMEs) to engage in R&D projects in the strategically important areas of science, engineering and technology, from which successful new products, processes and services could emerge. Grants are available in relation to “proof of market”; “proof of concept”; and “development of prototype”
76 An important example in this context is Northamptonshire Enterprise Partnership’s High Performance Technology Investment Programme which was established to support research and development and capital investment in high performance companies in Northamptonshire. For example, in 2015, KWM secured a grant from this source
77 Separately, and in addition, it is important to acknowledge the role which has been – and is being – played by the public sector financing in relation to sites and premises for HPTM firms. For example, Gosworth, MAHLE Powertrain and GE
The variety – and frequency – of references to public sector funding suggest that it is, *de facto*, playing an important role in the cluster’s evolution. Some of this is national or international in scale, but the elements that are local – like, for example, Northamptonshire Enterprise Partnership’s *High Performance Technology Investment Programme* and *High Performance Technologies Network*79 – should be recognised as part of the cluster’s “soft infrastructure” and as a core part of its current institutional make-up. The role of relevant LEPs was explicitly flagged by a number of the firms that were interviewed.

Most of the businesses we spoke to relied on their own funds – including through redundancy payments and/or re-mortgaging their homes – for start-up funding. Sometimes these were supplemented by what has been dubbed the “three Fs – friends, family, and fools” (or at least supportive spouses). Beyond that, subsequent growth was mostly financed through cashflow – albeit at a pace which was often limited because the cashflow itself was so uncertain.

In relation to early stage finance, the following comments and observations were also made – by HPTM firms – in the course of our consultations:

- mainstream banks can be perceived to be “unhelpful” and inclined to place substantial burdens on small HPTM businesses in the form, for example, of expensive requirements for due diligence statements
- equity investment is “rarely available on terms that are either realistic or acceptable”
- the business angel/specialist venture capital market is “under developed”; indeed, most firms could not identify any serial investors that they considered to be of potential relevance
- several firms are “actively exploring” opportunities linked to crowdfunding as an alternative financing solution.

It is important to note that these observations are made entirely from the perspective of firms. The fact that investors appear unwilling to invest may be a market failure. But equally, it could be a market signal and one to which the cluster itself needs to respond. Indeed, the observation from one small firm is, perhaps, insightful in this context:

> “it is no longer enough to be just a man operating in a workshop; people need good business plans, need to take care of marketing and PR, and generally need to come across in a more professional manner” (HPTM business consultation, Autumn 2015).

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79 See, for example, *Northamptonshire Enterprise Partnership, Annual Report, 2015*
Case studies: financing development and growth

7.11 Whilst financing growth has – in general – been a major challenge, we did talk to a few companies that are progressing in different ways (whilst noting that future success is always uncertain).

7.12 One example – which is well known within the cluster – is Flybrid Automotive. The company was formed in 2007 and the early funding for the company came from two redundancy packages, personal savings and what would have been the deposit on a house. Recognising that the founders “had to sell it to let it grow”, Flybrid was acquired by the low carbon technology engineering group, Torotrak plc, in two phases, for over £20m, in 2013/14. This has led to investment in the further development and testing of its Kinetic Energy Recovery System (Flybrid KERS), working with global partners.

Figure 7-1: Flybrid/Torotrak Group

Early days

Flybrid Automotive was formed in 2007 by Jon Hilton and Doug Cross.

The two founders had previously worked together at the Renault Formula One team, based in Oxfordshire. Prior to this, Jon – a graduate of the University of Hertfordshire – had had senior engineering roles at Cosworth (in Northamptonshire) and TWR Arrows F1 (Oxfordshire), while Doug’s experience derived from spells at both Ricardo and Toyota.

Whilst working for the Renault Formula One team, Jon and Doug alighted on the idea of mechanical Kinetic Energy Recovery Systems (KERS). Essentially, this is a process through which energy is stored as vehicles are slowing down and then recovered in order to help vehicles accelerate. The consequence is that much less energy is wasted and levels of fuel efficiency are significantly enhanced.

At the time, the Renault Formula One team took the view that this new system was not a priority. Subsequently, following a change in the Formula One rules, Renault decided to downsize its technical team and both Jon and Doug were made redundant. The announcement came five days after Renault won the Formula One Drivers’ and Constructors’ Championship in 2006.

In the context of redundancy, Jon and Doug decided to back their own ideas and “give it a go”. The new start-up was formed with funding from two redundancy packages; personal savings; and what would have been the deposit on a house. Flybrid was located at the Silverstone Innovation Centre, for two main reasons: it was mid-way between the homes of the two founders; and it was seen as the “home of British motor racing” (which Jon and Doug considered would be helpful in opening doors to mainstream vehicle manufacturers).

By May 2007 – through an order which came from one of Jon’s ex-Cosworth colleagues – Flybrid was supplying the Honda Formula One team. Over the years that followed, Flybrid grew to the point at which it employed 22 people. However, it had significant outgoings (in terms of the monthly salary bill) and was exposed to substantial risk. The financing of the business at this stage was challenging and the two founders of Flybrid recognised that they “had to sell it to let it grow”.

The sale of Flybrid Automotive to Torotrak plc

Flybrid was acquired by Torotrak in two phases: 20% was acquired in March 2013 and the balance of the business was acquired in January 2014.

Torotrak – based in Leyland, Lancashire – is a listed company which floated on the London Stock Exchange in 1998. At about that time, it identified itself as a “technology development and transfer company” with operations “sharply focused on the promotion of the Infinitely Variable Transmission (IVT) technology, to the point of launch on the market, initially in the passenger car segment” (Torotrak Annual Report, 2001).
In early 2014, Torotrak raised around £16m through a placing and open offer to finance the full acquisition of Flybrid, but also to “finance the investment required for the commercialisation of Flybrid’s first manufactured product for the commercial vehicle market and to finance the on-going design, development and testing of Torotrak’s V-charge technology and Flybrid’s M-KERS technology for the passenger car markets, as well as enhancing Torotrak’s testing and engineering capabilities” (Torotrak Annual Report, 2014, and Torotrak Prospectus, 2014).

For the founders of Flybrid, the acquisition created possibilities in helping to “get the product to market” in a way that had not previously been possible for a small, privately-owned, business (given the scale of resources available within Flybrid). Commenting at the time, one of the founders noted that “the conclusion of this acquisition will enable us to race to market faster and with more resources, to expand our profitable business and provide engineering and manufacturing jobs in the UK”.

Torotrak today

With the acquisition of Flybrid, Torotrak essentially brought together three fuel-efficiency technologies. It considers each of these to be capable of bringing significant change to the future of automotive engineering. These are: Torotrak commercial IVT (ininitely variable transmission); V-Charge (variable boosting); and Flybrid KERS units. All three are being developed as distinct products for the passenger car and commercial vehicle markets.

For Flybrid KERS, major opportunities include mainstream automotive (e.g. Jaguar Land Rover and Volvo); buses (through, for example, Wrightbus); and off-road applications (e.g. JCB). Substantial development work has been undertaken and is on-going. KERS-enabled vehicles have, for example, undergone extensive testing at Millbrook (Torotrak Annual Report, 2015).

Operationally, Torotrak’s site in Leyland has changed from having predominantly a design and development focus to now include development for manufacture including long-term testing, component manufacture and lower-volume assembly for high-value products. Its Silverstone site, previously the base for Flybrid, remains focussed on product design and development (Torotrak Annual Report, 2014).

Links between local and global

Flybrid – now part of Torotrak – retains very strong local links, but it is also (increasingly) a global business:

- In terms of recruitment, Flybrid has relied heavily on strong links with Cranfield University. Roughly a third of the workforce has completed the MSc in Advanced Motorsport Engineering at Cranfield, and Doug and Jon are both on various steering groups within the University. Links to the University of Hertfordshire and to Oxford Brookes University are also important.

- Increasingly Flybrid “does quite a lot of business with people on the Silverstone Circuit”. Jon comments that enquiries are referred between businesses; and that they “help each other out” if there is a need.

- Much of Flybrid’s business is international – as well as the UK, Flybrid/Torotrak’s major clients are in North America, Sweden, Germany, France, Italy, Switzerland and, increasingly, the Far East.

7.13 Another example is Vayon Group. Its business model is described in Figure 7-2. Vayon is being led by a genuine serial entrepreneur/investor – in other words, someone who made money by building companies and releasing equity, but has then opted to reinvest actively in developing further companies. The important observation is that the finance for what should now be seen as a core HPTM cluster business – headquartered in Northamptonshire (albeit with sites elsewhere) and firmly within the HPTM “universe” – is from outside of the cluster. The culture of – and ambitions for – growth have effectively been imported from the wider tech sector (and with some reference to the achievements and ambition of Silicon Valley).
### Figure 7-2: Vayon Group

**The opportunity**

Shane Hussain – the founder and chairman of Vayon Group – is a serial entrepreneur.

Before forming Vayon in 2014, Shane had successfully built and exited three technology companies. The last of these – Transmit (based in Andover, Hampshire) – was sold in 2006 to Nasdaq-quoted Bottomline, a major US-based global payments provider. Shane stayed as a board member at Bottomline until 2008. Subsequently, he worked as a “turnaround” specialist within a wide range of tech-based businesses (including telecoms, bioscience and software services firms).

However, as he turned 50, Shane found himself wanting a new challenge. He was intrigued by electric and hybrid powertrains – partly because he could see the huge potential scale of the electric vehicle market, and partly because, as a self-confessed “petrol head”, he was fundamentally enthused, interested and excited by the surrounding opportunities.

**Emergence of the Group**

The origins of Vayon Group can be traced to Shane’s involvement in Goodwolfe Energy, initially in a “turnaround” capacity. This was a small company based in Southend. It had an impressive battery product, but a flawed business model, and the firm was in some difficulty. Shane worked with Goodwolfe for a few months before acquiring it – from his own funds – in 2014.

Through Goodwolfe, Shane was introduced to Richie Frost, founder of three related businesses: Frost EV Systems (engineering consultancy specialising in low carbon vehicles); Frost EV Parts (online webstore for automotive high voltage components); and Frost Electronics (R&D hub for automotive high voltage products). Richie was based in Northamptonshire and prior to forming his businesses he had worked for both Viper Motorsport and for Prodrive. In 2015, Frost EV Group was acquired by Vayon. Richie subsequently played a key technical role across the emerging Vayon Group.

Over 2014 and 2015, Vayon completed a number of other acquisitions. These included:

- Ashwoods Energy, based in Exeter, with expertise in battery charging systems. Ashwoods had been a supplier to Goodwolfe, but was also involved in developing charging systems for a major niche high performance vehicle provider
- Hardstaff Dual Fuel Technology, based in Nottingham
- Clean Air Power, which had been listed on AIM, with operations in the UK and USA, and a large number of patents across compression ignited natural gas engine systems
- RDVS, based in Banbury, with a focus on battery management systems, and a supplier to both F1 teams and major automotive OEMs

Through these acquisitions, Vayon is seeking to become a single-source, “one-stop-shop” first-tier supplier of low carbon propulsion technology products and solutions.

In addition, Vayon Group is part of the AMPLIIFI (Automated Module-to-pack Pilot Line for Industrial Innovation) Consortium, led by the University of Warwick. This received £10m funding from Innovate UK in 2015 to develop the next generation of traction batteries for electric and hybrid vehicles. Other Consortium members include, inter alia, Delta Motorsport (based at Silverstone), Jaguar Land Rover and the University of Oxford.

In time, Vayon’s intention is to supplement capacity by building battery packs in Northamptonshire. It also intends to develop a new technical centre in Northamptonshire – at the site of the Frost businesses. This location is important: most of Vayon Group’s key staff members have some kind of link – usually through earlier career jobs – with (some of) Prodrive, Williams, Jaguar Land Rover and Aston Martin.

**Future Strategy**

Vayon Group has been described as “a conglomerate in the making”. It is based, fundamentally, on bringing together companies with outstanding technologies and customers, but needing funding and broader management support. Many of these companies received substantial private and public sector investment in the 2000s, prior to the credit crunch and (in some cases) the withdrawal of public sector grant funding.
In essence, Vayon is developing – quickly – through a “buy and build” strategy across the technologies needed for low-carbon transport fleets and niche automotive. The company is headquartered at Woodford Halse in Northamptonshire. By the end of 2015, it had 116 staff. Turnover in 2015 exceeded £8m; and the Group’s business plan anticipates that this will double in each of the two subsequent years. Its intention is to acquire further companies, to integrate back office functions where appropriate, to diversify into allied customer sectors (e.g. marine and battery storage), and then to prepare for some form of exit by 2020.

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material

Implications

7.14 The observations set out above constitute both challenges and dilemmas. Whilst the HPTM cluster has attracted investment, we have not found many serial investors/entrepreneurs who are generating wealth and then actively reinvesting and effectively recycling it within the cluster. There is, in other words, nothing akin to the likes of Cambridge Angels79. In principle, the fact that “knowledge is in the air” ought to de-risk early stage investment; and indeed, the observation made of Cambridge is that it is a “low risk place to do high risk things”. In relation to the HPTM cluster, there is, obviously, something of a vicious circle: until an investor/entrepreneur has made some money, he/she is not in a position to invest it, so the question that follows is why more wealth has not been generated.

7.15 During our discussions, various explanations were posited, and none of them reflected on the commitment or technical expertise of individual business owners. Instead, the continuing role of Formula One was seen as one factor. Another issue surrounded the effectiveness of HPTM firms’ business models and, specifically, the extent to which these were organised and managed as a platform for commercial growth. A third – and related – observation surrounded the underlying motivations of business leaders. In some cases at least, these were considered to be driven fundamentally by enthusiasm (for the technology, the problem-solving and – for some – for the “business of winning”); ambitions in relation to business growth in straightforward financial terms sometimes appeared to be a second-order consideration. Finally, there was some indication that propositions located firmly in high performance technology – and in markets with mainstream growth potential – were more attractive than those that might be seen as “core motorsport”; but also that investors sometimes confused and conflated the two.

7.16 The question which follows – which can only be posed rhetorically – is whether a HPTM cluster which consistently had the commercial ambition of Silicon Valley would thrive or whether it would die (on the premise that it would lose some of what is clearly “in the air” currently). Behaviours would change and the cluster would certainly adapt. But then – as argued throughout – the cluster has constantly adapted and the HPTM cluster of the 2010s is very different from that of the 1980s. The cluster of the 2020s will need to be different again.

79 From its website, this is described as “a group of high-net worth investors who have proven experience as successful entrepreneurs in internet, software, technology and bio-technology. Members invest in and mentor high quality start-up and early-stage companies in these sectors in the Cambridge (UK) area and throughout the UK” (see http://cambridgeangels.com/)

SQW
8. Understanding cluster dynamics: relationships between local and global

**Key points from Chapter 8**

- Firms within the HPTM cluster are frequently relatively small, but many have a global footprint.
- Within the cluster there are some outstanding businesses in terms of export performance, and some sell relatively little to UK customers.
- Another important aspect of the cluster’s global footprint relates to skills and recruitment. In the context of significant national skills shortages (linked particularly to engineering and IT), international recruitment through visas is important.
- However, the cluster is also a global “magnet” for ambitious people who are looking to build their own careers in activities linked to HPTM. This is another dimension of the specialist labour market.
- There have been some specialist responses from within the cluster and the role of Cranfield University is especially important in this regard.

**The global character of local firms**

8.1 In this final substantive chapter, we consider another of the paradoxes flagged in paragraph 1.3 – namely, the fact that a cluster that is locally embedded (whilst recognising also that individual companies may be more-or-less deeply ensconced) is also intrinsically global – what has been termed in cluster studies as “global pipelines and local buzz”. In practice, HPTM applications have a global reach and ultimately, the strength and resilience of the cluster must be considered on a global stage: markets – whether for products and services, talented people or investment capital – have been global from an early stage in the cluster and, as global markets have grown, so the cluster’s global footprint has been similarly extended into newer far-flung markets.

8.2 Two of the companies interviewed in the course of this study – Ilmor Engineering (Figure 8-1) and Racelogic (Figure 8-2) – are illustrative. The founders of Ilmor had previously worked for Cosworth and – based in Brixworth (Northamptonshire) – Ilmor is, in many respects, an archetypal cluster company (noting that two of its former employees were in turn the founders of GE Precision Engineering (Figure 5-5)). For Racelogic, formative links into the cluster were more limited and more conventionally transactional, but Racelogic was born – and remains – in Buckingham, and it too can point to former employees who have formed HPTM businesses locally. Both companies’ initial focus was motorsport, albeit through different parts of the supply chain (summarised in Figure 1-2). Ilmor specialises in engines whereas Racelogic is concerned with electronic control systems. Subsequently both companies have sought to diversify their client base although to varying extents; motorsport continues to account for the majority of Ilmor’s revenue while for Racelogic, the proportion has fallen to about 25% (in the context of very rapid growth across other parts of its business).
8.3 What also defines both companies is the extent to which their sales are international. For Ilmor Engineering, some 80% of revenue is derived internationally and for Racelogic, the equivalent figure is around 90%. Both businesses are therefore strongly outward facing. Indeed, Racelogic has twice won the Queen’s Award for International Trade (in 2007 and 2012).80

Exports and international trade

8.4 For the cluster as a whole, the extent to which businesses "look outwards" is important in relation to growth prospects. It is also crucial in providing a check on the "ties that bind" and preventing them morphing into "ties that blind" with the cluster as a whole potentially losing its competitive edge.

8.5 The evidence from this study – and indeed that gathered elsewhere – suggests that the cluster is in good health in these terms. Although the picture obviously varies from one business to another, the cluster as a whole does appear to be looking outwards – and doing so effectively.

8.6 This observation is corroborated by the findings from other research. For example, through a national survey of motorsport engineering and services, MRA found (in 2012) that:

- some 87% of companies were engaged in some level of export
- among core motorsport engineering businesses, the proportion of turnover deriving from export was increasing – from 12% in 2006 to 15% in 2009 to 20% in 2012; and for firms identified as "engineering only", the equivalent proportions were slightly higher
- the top three export markets were USA, France and Germany
- some 55% of survey respondents expected the proportion of their sales deriving from export to increase in the following five years.81

8.7 It should also be acknowledged that a strong focus on exports is not solely a 21st Century phenomenon. Reporting a survey from the early 1990s, an academic study noted that nine (of ten) firms indicated that international sales accounted for at least 75% of sales, and "even the odd one out still had 44% overseas".82 In terms of sales, the cluster has long looked outwards, and this continues to be the case – as individual companies such as Ilmor Engineering and Racelogic (amongst others) demonstrate amply.

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80 It has also won a Queen’s Award for Innovation (in 2012)
Ilmor was formed in Brixworth (Northamptonshire) in 1984 by Mario Illien and Paul Morgan, both of whom had previously worked for Cosworth on its IndyCar programme. The third founding partner was Roger Penske, the American owner of Penske Racing (which owns both an IndyCar Series Team and a NASCAR Team) and Penske Corporation (which now has global revenues in excess of $23bn). Roger Penske’s involvement was crucial in financing the new venture and securing the early backing of General Motors, under the Chevrolet banner. At the outset, the three founders and General Motors each owned 25% of the business.

The first major project was the Ilmor Chevy Indy engine; and the first IndyCar race win was achieved in 1987. Over the late 1980s and early 1990s, Ilmor grew to employ around 75 people at its Brixworth site.

The mid 1990s was a turbulent period as Ilmor lost the link to Chevrolet and – for a period – its engines were “unsponsored”, meaning that relatively little development work took place. However – again through Roger Penske – important deals were forged with Mercedes (which also took an ownership stake) in relation to both IndyCar racing and Formula One, and with McLaren. The late 1990s saw rapid growth and by the early 2000s, Ilmor employed around 500 people at Brixworth.

At about this time, two major developments shaped the future growth of Ilmor. First, Paul Morgan, one of the founders, tragically died in a plane crash. Second, the major car manufacturers started to want to control Formula One teams. For Ilmor, the consequence was that Mercedes started to effect a phased buy-out of the Formula One business; this became Mercedes AMG HPP (which continues to be located nearby in Brixworth). The non-F1 business – which accounted for about 10% of the total and 56 (of about 500) staff – was bought out by Mario Illien and Roger Penske, retaining both the Ilmor name and the “good will” of Honda (which had been an important customer of the combined business but – as a direct competitor – was anxious about Mercedes’ changing role).

Ilmor Engineering – post 2005

The new Ilmor business was “born” on 1st July 2005, and Steve Miller – who had previously worked at Cosworth, before joining Ilmor in 1998 – became the Managing Director.

However, there were some early challenges as Toyota and Chevrolet withdrew from the IndyCar market leaving Honda as sole supplier; Honda’s effective monopoly was – perhaps perversely – very problematic for Ilmor as the consequence was a sharp decline in research and development spend (and hence the flow of income to Ilmor). This all coincided with the beginnings of the credit crunch and global recession; and the automotive industry in general went into “lock down”.

In response, Ilmor sought actively to diversify its business. It had some success in this regard. It sold engineering services to a wide range of customers (including Boeing in aerospace; and a number of manufacturers in the high horsepower marine sector). It also sold timing and automotive manufacturers within its test facility and machined components for a broad range of customers in its machine shop. However, this was a difficult period for Ilmor and the willingness of its major shareholders to “take a long view” was important.

For Ilmor, a major turnaround happened in about 2011. It was achieved through an “amicable divorce” with Honda and re-establishing the relationship with Chevrolet – as both Honda and Chevrolet wanted to reignite genuine IndyCar competition. For Ilmor the consequence was a new source of development revenue and an agreement with Chevrolet, allowing it to resume its work on developing and enhancing engines for motorsport. Subsequently it also secured important contracts in World Rally. It is also seeing new opportunities in relation to Formula One.

Currently, Ilmor employs 82 people in Brixworth. Its turnover is about £14.5m and some 80% of its income is derived internationally. Approximately 85% of its business is concerned with motorsport; the balance relates to a huge range of engineering applications (in aerospace, marine, defence, etc.). It expects to retain this balance across the two areas of business: the “non-motorsport” elements are very important in terms of stability, overall resilience and the de-risking the volatility that is intrinsic to motorsport.

Ilmor and the wider cluster

Today, Ilmor has some links across the wider cluster, but it is fundamentally an internationally-orientated business. It has important links with Cranfield University in terms of recruitment (particularly through its MSc Advanced Motorsport Engineering Yearbook). In general, it relies on recruiting, training and then retaining young engineers; this approach has been successful and levels of staff turnover have generally been low.

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material
Skills and the labour market

8.8 Another aspect of the cluster’s global character relates to skills and the labour market. Whilst again capable of being interpreted as inconsistent with narrow definitions of “what a cluster is”, an international workforce and labour market is the contemporary reality, and increasingly so. From the work completed in the course of this study, there appear to be two main dimensions at play.

Global recruitment in the context of skills shortages

8.9 The first of these dimensions surrounds the strategies individual companies are adopting in order to recruit skilled people in the context of substantial national skills shortages in engineering and IT. In 2003, a major motorsport study identified skills shortages as a threat\(^{83}\), and the issue appears to have intensified subsequently. For example, a major recent national research study estimated that engineering employers are likely to need to recruit 1.82 million people with engineering skills from 2012 to 2022. Meeting this demand would imply a doubling of the number of engineering apprentices and graduates entering the industry. The study concluded that “the UK at all levels of education does not have either the current capacity or the required rate of growth needed to meet the forecast demand for skilled engineers by 2022”\(^{84}\).

8.10 HPTM companies are responding in a variety of ways. One important component – discussed earlier – surrounds the recruitment and training of young people, often through apprenticeship programmes (see paragraph 5.7 on page 36). Another relates to an on-going dialogue with universities, particularly in this context with Cranfield University (see below), Oxford Brookes University and the University of Hertfordshire – all three of which have a deep heritage in relation to advanced engineering/manufacturing and are reasonably local. A third key element is global recruitment. Firms – such as Racelogic (see Figure 8-2) – are recruiting through Tier 2 visas, a process that is not straightforward but is vitally important in terms of business growth.

Figure 8-2: Racelogic

Early days

Racelogic was formed in 1992, by Julian Thomas. Previously, Julian had worked for Superchips (an electronic engine tuning company based in Buckingham), but when Racelogic was formed, he was essentially a new graduate (with a physics and electronics degree); Buckingham was his home town.

During the early years, Racelogic was effectively a series of “projects” focused on the application of electronic control systems to automotive and motorsport. The firm’s first real “product” was concerned with traction control and early clients included Aston Martin (in Newport Pagnell, Buckinghamshire) and Rolls Royce. However, during the early years – through to about 2000 – Racelogic was very small (employing less than ten people); its portfolio of possible products was broad; and it was making very little profit.


\(^{84}\) Engineering UK 2015: The state of Engineering, published by Engineering UK – page xii
Developing the business

At the turn of the century two major developments proved to be very significant. One was the appointment of Harry Thuillier as commercial director; Harry had previously grown and sold a significant local computer business and was looking for a new challenge. His appointment brought a new commercial discipline to the firm and this was important in allowing the firm to grow. The second was the US government’s decision to “turn off” Global Positioning System (GPS) selective availability. This substantially increased GPS signal accuracy and it effectively created a new positioning “infrastructure”.

Since the early 2000s, Racelogic’s growth has been premised on this infrastructure and there have been three main elements of it.

- First, Racelogic quickly recognised the potential scope of GPS devices – which could accurately measure both location and speed – within the vehicle testing market. On this basis, it developed and launched a series of VBOX products. These have had many different applications in mainstream automotive testing. Initially the focus was on calibrating braking distances accurately (under different road conditions, at different speeds and with different tyres, etc.). More recently, major opportunities have emerged through Advanced Driver Assistance Systems (ADAS) which focus on driver safety, collision avoidance, etc.; these are increasingly featuring in volume automotive.

- In parallel, Racelogic has developed a substantial market in relation to motorsport. In combination with video technologies, data logging devices through the VBOX range have been used by amateur racers and semi-professional teams with an interest in all forms of motorsport – from touring cars to Caterham Series events, etc. The Video VBOX can significantly help improve performance – particularly in terms of navigating corners safely and at speed.

- The third strand of Racelogic’s business has been developed more recently. It relies on GPS simulation through which real data is used to allow testing to be carried out under controlled conditions. Racelogic’s principal GPS simulation product, LabSat, was developed internally by one of the firm’s engineers and launched in 2009; it reflected Racelogic’s desire to find a reliable and repeatable testing regime for its own GPS-enabled products. LabSat is extremely broad in application; clients include automotive businesses but also major global corporates from a wide range of sectors including Bosch, Garmin, Telefonica, Panasonic and Hitachi.

Currently, the mainstream automotive sector accounts – through the VBOX brand – for about 60% of Racelogic’s £12m annual turnover; motorsport clients account for around a quarter; and the balance (about 15%) is linked to GPS simulation. The business is very profitable. It remains in private ownership and throughout, its growth has been funded from retained profits with no external investors. Its headcount has grown steadily; Racelogic currently employs about 62 people at its site in Buckingham and around 75 in total.

The importance of the global...

Overall, some 90% of Racelogic’s sales are currently achieved through export; the automotive and LabSat customer bases are almost entirely international while motorsport has a relatively stronger UK client base.

To achieve this international profile, Racelogic regularly exhibits at trade fairs around the world. It has developed a network of distributors working across 20 countries. It has also set up more localised arrangements with agents and dealers. In addition, Racelogic has formed its own sales teams: first, in 2006, in Germany (reflecting the major automotive focus); then, in 2013, in the USA; and – most recently – in China (with a particular emphasis on LabSat, complementing a strong, pre-existing, automotive-focused distributor network). Currently, the USA is Racelogic’s largest export market, followed by China; but sales to China are growing most quickly.

Racelogic has twice won the Queen’s Award for International Trade (in 2007 and 2012). In 2012, it also won the Queen’s Award for Innovation.

…and the local

Racelogic’s development and manufacturing work continues to be based entirely in Buckingham. Over its history, the firm has moved four times to progressively bigger premises; but all of these moves have been local ones.

Initially, Racelogic grew through local recruitment. There was a flow of people between Racelogic and a nearby firm, and – supplemented by advertising through two local newspapers (the Buckingham Advertiser and the Milton Keynes Citizen) – recruitment was almost entirely local. However, recruitment now is national and international – including four members of staff who have been recruited through Tier 2 visas. In response, Racelogic has established a dialogue with Oxford Brookes University and University of Hertfordshire in order to source internships; and also with Cranfield University in relation to postgraduate students.
8.12 In relation to Motorsport Valley, a study from 2001 observed that:

Motorsport Valley has become the training ground for designers and engineers from all over the world; it is rare for an individual in motorsport not, at some point in his or her career, to spend some time within Motorsport Valley (and, very often, the majority of the career). This process is about joining the knowledge community (interacting in the knowledge structure) of global motorsport.

8.13 Our focus is broader sectorally and narrower spatially, but from the evidence gathered in the course of this study, there is much to corroborate these early observations, particularly in relation to motorsport.

8.14 Within this context, it is important to flag the crucially important role of Cranfield University, an institution which we would identify as a key part of the contemporary HPTM cluster across its sectoral breadth. As explained already, the roots of Cranfield University are in aeronautical engineering. Cranfield is an exclusively postgraduate university with well over 4,000 students, over half of whom are from outside the UK. Its facilities include, inter alia, the Aerospace Integration Research Centre (due to open in 2016 with co-investment from Airbus and Rolls Royce); and the National Wind Tunnel Facility (which is being used for research into energy and cost savings for transportation companies). This depth and breadth of resource is of formative significance across the wider HPTM cluster and – as noted earlier – a number of companies referred to collaborative research links with Cranfield.

8.15 There is one further element of the University’s work that needs to be flagged explicitly. It concerns the University’s MSc in Advanced Motorsport Engineering (see Figure 8-3). The course itself is highly regarded by HPTM cluster firms and student placements with HPTM firms are a very significant feature. The course is supported by an Advisory Group which has a very strong representation from the HPTM cluster, both firms (e.g. Red Bull Technology) and wider institutions/organisations (e.g. British Racing Drivers Club (BRDC) and Northamptonshire Enterprise Partnership).

Source: SQW – based on company consultations (Autumn 2015) and a review of documentary material

8.16 It is also important to note that of those completing the MSc, two-thirds are international students. Hence the course itself is both a product of – and contributor to – the global reach of the HPTM workforce. However, there is some concern about changes in relation to post-study visas. Given the extent of skills shortages outlined above and the quality and reputation of the MSc course, any restriction on the recruitment of graduates locally is unlikely to be helpful in terms of the cluster’s future growth.

**Figure 8-3: Cranfield University’s MSc in Advanced Motorsport Engineering**

Launched in 2000, the Advanced Motorsport Engineering MSc was developed, and is still led, by Clive Temple, Programme Director and Senior Lecturer at Cranfield. Following discussions with local businesses, the course was designed to provide students with a combination of advanced engineering skills and insight across the ‘business of motorsport’.

Initially, the MSc was called “Motorsport, Engineering and Management”, but following feedback from motorsport companies and the professional engineering bodies, it was redesigned – and re-branded – with a stronger emphasis on engineering.

The MSc is overseen by an Advisory Panel which is chaired by Adrian Reynard. Other Panel members are drawn, *inter alia*, from companies such as Red Bull Technology, Mercedes AMG High Performance Powertrains, Prodrive, Xtrac, the BRDC and Northamptonshire Enterprise Partnership.

**Course design and student profile**

The MSc course consists of eight one-week assessed modules, a group design project and an individual thesis project. Group design and individual projects are usually sponsored by industry partners and provide students with experience of working on real challenges in motorsport. In 2014/15, the Group Project involved five teams of students conceptually designing the thermal management system for an electric version of a Formula BMW, with the aim of achieving maximum performance and safe operation throughout a twenty-minute race on the Donington Park GP circuit. The project was supported by Williams Advanced Engineering, DS Virgin Racing Formula-E Team, the National College for Motorsport, Cranfield Motorsport Simulation, Altair Hyperworks, AVL and ChassisSim.

In the early 2000s, an average of around 20 students enrolled on the course each year; this has now risen to around 35. The profile of students has also changed with more students coming from overseas – in 2015, around a third of students were from the UK, a third from Europe and a third from elsewhere overseas.

**Leaver destinations and ongoing interaction with the alumni**

Of the 35 graduates from 2013/14, all secured subsequent employment, with 70% (25) of these jobs based in the UK and 25% based in the area around an hour from Silverstone. Most of these jobs were based in the motorsport sector. Since its inception all of the UK based Formula One teams have recruited graduates from the Cranfield MSc course. It is also important to note that the alumni network linked to this course is very active.

*Source: SQW – based on discussions with staff from Cranfield University (Autumn 2015) and a review of documentary material*

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86 See https://www.cranfield.ac.uk/courses/masters/advanced-motorsport-engineering.html
9. Future opportunities and challenges for the HPTM cluster

Key points from Chapter 9

- The HPTM cluster is evolving. It is “mature” in relation to motorsport but “developing” in relation to mainstream high performance technology. The latter has substantial growth potential in the context of a fast-emerging paradigm. This is being driven by regulatory changes in the ambit of carbon emissions and big data, and is focused around cleaner/greener, low carbon and energy efficient products and solutions with applications across automotive, aerospace, marine, defence, medical devices, sensors, etc.

- The “shared rules and conventions” of motorsport are powerful but mainstream high performance technology applications have rules and conventions of their own, and there are some differences. These are seen most clearly in relation to growth finance. Aspects of the cluster will need to adapt for the cluster as a whole to achieve its full future growth potential.

- Local Enterprise Partnerships (LEPs) emphasise the importance of the HPTM cluster in their Strategic Economic Plans. Given the pace of planned growth across the core geography, a vibrant cluster is a priority.

- Many aspects of the “hard infrastructure” (relating particularly to physical provision) are already in place to facilitate and enable this growth process. What is needed in parallel is the further development of elements of the “soft infrastructure” (e.g. financing and networks).

- An adaptive and knowledge-rich cluster with the opportunities, challenges and momentum of a fast growing region ought to be a cocktail for future success. In order to realise this potential, an Agenda for Action is proposed, structured around five main strands: access to appropriate forms of growth finance; building leadership capability; routes to market – and building visibility; increasing the supply of skilled people; and appropriate infrastructure provision.

How “mature” is the HPTM cluster?

9.1 Throughout this study, a recurring debate has surrounded the “maturity” – or otherwise – of the HPTM cluster. At one level, the fact that this was even discussed was odd: the roots of the cluster in aeronautical engineering extend back a century; some of the key companies and locations within it are known around the world; and in many respects, it has the core attributes of an archetypal cluster (as defined in Figure 1-1). Yet the debate persisted.

9.2 If the HPTM cluster is understood principally in relation to competitive motorsport, then the maturity – and, indeed, the pre-eminence of the cluster – is beyond dispute. However, if we shift the goalposts and talk in terms of, effectively, an emerging “industrial paradigm” – defined particularly around cleaner/greener, low carbon and energy efficient products and solutions with widespread mainstream application – then the overall judgement is different. Through really quite significant regulatory change, these imperatives are fundamentally re-shaping the ground-rules in terms of 21st Century economic growth. Potential applications from the domains of, for example, additive manufacturing, digital fabrication, computational fluid dynamics, energy efficient systems and carbon composites, are substantial.

9.3 The HPTM cluster has assets, competencies, knowledge and potential in relation to this new paradigm; and indeed, many of these attributes have been developed in the ambit of competitive motorsport. In taking these fully into the mainstream – of automotive, aerospace, marine, defence, medical devices, sensors, etc. – the potential is vast. However, on this broader stage, the cluster as a whole is still currently “under
The cluster is making a contribution, but at this stage, it is a slightly hesitant and embryonic one; there are exceptions in relation to individual businesses, but for the cluster as a whole, we think that assessment is a fair one.

The clearest expression of the difference between these two domains is that in relation to the financing of company growth (considered in Chapter 7). Outside of the heavily-sponsored Formula One teams, small companies within the HPTM cluster have generally grown through their own resources (initially through savings or redundancy payments (or both), and then through cashflow). This model has – demonstrably – “worked” within the arena of motorsport. Where it is in danger of underperforming – or even faltering – is in relation to mainstream applications. To be grown significantly, these need to be nested in their own set of “shared rules and conventions” (as defined in Figure 1-1). Here, there will be a need for financing arrangements that are commensurate with the undoubted market potential. Those in turn must be premised on clear business plans, disciplined management and a strong commitment to the “bottom line” and the growth of shareholder value.

This observation immediately raises questions as to the nature of the appetite for growth amongst cluster companies. As far as we could tell, all of the people we spoke to from HPTM businesses were ambitious, committed and motivated. However, the balance between ambitions directed towards “growth in the business” vis-à-vis “solving complex technological problems” and/or “the business of winning” varied. In practice, every individual from every firm was different. This is wholly unsurprising, but in seeking to grow the cluster, the nature of underlying ambition is important. A deep-rooted commitment to “the business of winning” will position forays into high performance technology applications as a sound strategy for business resilience, smoothing the vicissitudes and seasonality of competitive motorsport. Conversely, a fundamental commitment to “growth in the business” – which recognises the wider value and potential of firms’ knowledge, competencies and intellectual assets – will see high performance technology applications as a phenomenal growth opportunity, albeit one that demands rather different disciplines and brings challenges of its own. The difference between these two scenarios matters for individual firms – not least in seeking to secure finance – and, arguably, for the cluster as a whole. There is nothing “wrong” with either approach, but they are different and the wider growth potential linked to the latter is greater.

A perspective from the growth of the Cambridge high tech cluster – and the early report on the “Cambridge Phenomenon”

In making these observations, we were reminded of elements of what SQW observed in the Cambridge area in drafting the original study of the Cambridge Phenomenon in the mid-1980s. At the time, there was no shortage of clever and motivated engineers and scientists who assumed funding should follow because of the possibilities linked to their technologies, knowledge and intellectual assets; but many were initially disappointed. However, referring back to the original study and particularly the chapter on “prospects and issues”, the authors expressed optimism about “long-term prospects for high tech industry in the Cambridge area” for ten different sets of reasons; and over 30 years later, this optimism has proved to have been well-founded. The seventh and eighth of the factors identified are germane:
“Seventh, the increasing availability and sophistication of financial and business services will continue to strengthen the young company sector....

The informal (even if tough) style of some of the London-based venture capital firms... becoming active in Cambridge, and the qualities brought to bear by highly experienced individuals or small groups of businessmen now operating on the Cambridge “network”, are particularly well suited to playing this role...

Eighth... a number of new style venture management firms are setting up in Cambridge: small, technologically very strong... seeking to play a hands-on management role in the companies they support and locally founded by people recycling from other high tech firms in the area... backed up by venture finance as appropriate.”

What was being observed in 1985 was the emergence of a “soft infrastructure” that helped – eventually – to nurture the likes of ARM, Abcam and Autonomy.

9.7 In relation to the HPTM cluster, the soft infrastructure surrounding motorsport is well-developed. Arguably the equivalent in relation to mainstream applications of high performance technology is more embryonic. Within this context, there is a particular additional risk which the Cambridge high tech cluster did not need to navigate 30 or so years ago; that risk relates to confusion, or to a significant missed opportunity, or both. The financial community may be conflating high performance technology and motorsport and assuming that the maturity of the latter means that the development process for the former “is sorted”. In our view – despite the overlaps and commonalities – firms will struggle to succeed in the wider ambit of mainstream high performance technology applications if they rely too heavily on the disciplines of motorsport, notwithstanding its undoubted strengths. The relationship needs to be navigated carefully, both by individual firms and by the cluster as a whole.

9.8 The ninth of the “reasons for optimism” in relation to the Cambridge high tech cluster of thirty years ago was:

“an unprecedented number of new, high technology, or similar property schemes are committed or being planned.... to provide the companies with an appropriate range and choice of property and to ensure that growth of the phenomenon is not constrained by lack of sufficient and suitable accommodation.”

9.9 Whilst the transport infrastructure needs some investment, key elements of the “hard infrastructure” required for the HPTM cluster’s growth are being developed. This includes, inter alia, Portfolio and Avenue Innovation Centres in Northampton; iCon in Daventry; Bicester Innovation Centre; Cranfield Innovation Centre; and Silverstone Innovation Centre. Reference to Millbrook Technology Park and its planned growth has already been made (see Figure 6-1) and in addition – as science parks – both Cranfield University Technology Park and Silverstone Park are set to see further development which will support the cluster’s growth (see Figure 9-1). The latter has been given a further fillip by its inclusion in the Aylesbury Vale Enterprise Zone. This was announced in November 2015 and is the second Enterprise Zone of immediate relevance to the cluster – the first being...

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87 The Cambridge Phenomenon: The growth of high technology industry in a university town, Segal Quince Wicksteed, 1985
88 ibid.
Northampton Waterside Enterprise Zone (home of several HPTM businesses). EZ designation means, *inter alia*, that businesses moving into the site will benefit from discounts on business rates and it ought to be a useful additional catalyst for growth. It is important now that the “soft infrastructure” catches up.

### Figure 9-1: Cranfield University Technology Park and Silverstone Park

#### I: Cranfield University Technology Park

Cranfield University Technology Park is adjacent to Cranfield University. It has been developed in a phased manner over several decades. One of its key tenants is the Nissan Technical Centre Europe which has been at Cranfield since the early 1990s.

St. Modwen was appointed as Cranfield University’s Development Partner in 1999 and various phases of development were subsequently completed, including:

- the development of a 38,000 sq ft Cranfield Innovation Centre (which now provides hot desk pods and virtual office space, together with individual units of between 280 sq ft and 1,780 sq ft) and the provision of 40,000 sq ft of grow-on accommodation
- the provision of 39,000 sq ft of office accommodation.

Cranfield University identifies what it describes as an “innovation habitat”. The University itself operates a subsidised business incubation and service facility called Cranfield University Business Incubation Centre (CUBIC); this provides support to entrepreneurs and fledging companies, some of which progress to the Cranfield Innovation Centre and the Cranfield University Technology Park. For companies associated with Cranfield Technology Park, available facilities include “at, or near industrial-scale research facilities, ranging from large windtunnels and gas turbine test rigs to a research farm and full-scale water treatment plant” ("Innovation in Action", Cranfield University)

Today, there are estimated to be approaching 60 science, technology and knowledge-based businesses operating from the Cranfield University Technology Park. These range from start-up companies through to large firms including, in addition to Nissan’s European Technical Centre, Trafficmaster (now a division of Telesat Navman, a global telematics business), the UK subsidiary of Physik Instrumente GmbH (a leading global provider of precision motion and positioning systems) and Pro-Lite Technology (a specialist photonics company).

St Modwen disposed of its assets linked to the Technology Park in 2015. A Cranfield University masterplan – relating to the whole site (including, but bigger than, the Technology Park) has been developed, relating to the period 2014-2030.

#### 2: Silverstone Park

Since September 2013, Silverstone Park has been managed by MEPC (reporting to Hermes Real Estate Investment Management, funded by the BT Pension Scheme).

There are already over 70 organisations located on the Park in over 300,000 sq ft of office and industrial buildings and a purpose built innovation centre. These include Porsche, Ducati and Lotus as well as a wide variety of specialist manufacturers and service providers such as the National College of Motorsport (part of Tresham College), iZone Driver Performance, EDM Precision Technologies, Flybrid/Torotrak and Delta Motorsport.

Within Silverstone Park is Silverstone Park Innovation Centre. This offers flexible office units from 200 sq ft and services include superfast broadband, professional meeting rooms, and hot desk facilities; it also provides scope for “virtual” tenancy agreements.

Major development is planned at Silverstone Park. There is already a planning consent for over 2m sq ft of mixed office, workshop and ancillary space. It is anticipated that during the next decade the number of companies on site will increase to more than 200 with over 8,000 jobs being created. The development – and its management by MEPC, a high profile, well regarded development company – will create greater opportunities to attract inward investment by large HPTM firms, as well as space for local firms to grow.
The importance of growing the cluster

9.10 But does it matter whether the cluster achieves its potential in relation to the full range of high performance technology applications across mainstream sectors such as automotive, aerospace, marine, defence, medical devices, sensors, etc.? We would argue that it matters fundamentally for two different reasons.

9.11 The first and most obvious is that unrealised potential is simply a waste: the agendas wrapped up with cleaner/greener, low carbon and energy efficient products and solutions, with widespread mainstream application, are enormous. The creativity, enterprise and knowledge of HPTM businesses – and the individuals who run them – needs to be harnessed to the full.

9.12 The second relates to the wider spatial context in which the cluster finds itself. As outlined in Chapter 3 – and specifically in Figure 3-2 – the cluster’s core geography is set to see substantial population and housing growth over the next two decades (on the back of rapid growth over the last two decades). This needs to be accompanied by high value economic growth. This was recognised in the original strategic economic plans (SEPs) of the local enterprise partnerships (LEPs) with an interest in the cluster’s geography (see Figure 9-2). It also resonates strongly with the announcement in Budget 2016 that the National Infrastructure Commission should “make recommendations to maximise the potential of the Cambridge-Milton Keynes-Oxford corridor as a single, knowledge-intensive, cluster that competes on a global stage”\(^\text{90}\). More broadly, the prospectus for the Midlands Engine for Growth\(^\text{90}\) includes similar commitments; and emerging devolution deals will need to be equally ambitious.

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\(^{90}\) The Midlands Engine for Growth: Prospectus, published 2015

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Source: SQW – based on consultations (Spring 2016) and a review of documentary material
The evolution of the High Performance Technology and Motorsport Cluster

Final Report

- The SEP sets out proposals for stimulating growth in Buckinghamshire’s electronics & telecommunications sector through early access to 5G technologies (page 92) and proposes to employ an Innovation Adviser at Silverstone Innovation Centre, in order to help stimulate the high performance technology sector through innovation support (page 115).

Northamptonshire Enterprise Partnership (NEP)

- High performance technology is a ‘key sector’ in Northamptonshire, and Silverstone is noted as the hub for the sector (Page 3 and 8).
- The SEP sets out a priority to improve the productivity and competitiveness of SMEs, through investing in innovation and targeted business support (page 40), and as part of this, it details plans for enhancing supply chain performance in key sectors including high performance technology (Page 44).
- Proposals set out ambitions to build upon the High Performance Technologies Investment Fund, to develop a fund to support business innovation in key Northamptonshire sectors (page 46) as well as develop a High Performance Technologies Network in order to develop a programme of inter-related support for the sector in order to improve supply chains, boost interaction between firms and build a sense of identity across the sector (page 43).
- Two specific projects with MEPC (which are also supported by BTV and SEMLEP) are described in the implementation plan: (1) development of a Metrology Centre at Silverstone Park to support SMEs in the development of new product ideas; and (2) provision of dedicated business support to unlock the full potential of High Performance Technology on the Silverstone site and support the development investment by MEPC (page 47).

Oxfordshire LEP (OxLEP): Strategic Economic Plan, 2014-2030

- Oxford, as a part of the UK’s ‘Golden Triangle’, has an internationally competitive technology cluster which comprises four overlapping technologies: life science - bioscience/medical technology/pharmaceuticals; physics related specialisms including cryogenics, instruments and magnets; engineering and electronics, including motorsport; and telecoms and computer hardware and software (page 5).
- The SEP sets out an objective to grow Oxfordshire’s world-class technology cluster leading to a GVA uplift of £6.8bn to 2030 (page 45).
- It proposes a series of major projects including a new Centre for Applied Superconductivity on Harwell Campus and Culham Centre for Fusion Research Campus, and a new nanofabrication facility in collaboration with Samsung in Oxford (page 48).

South East Midlands LEP (SEMLEP): Strategic Economic Plan, 2015-2020

- High performance technology is recognised as one of the area’s ‘showcase sectors’, with the capability, assets and greatest potential to grow rapidly (page 12).
- SEMLEP aims to develop its capabilities in advanced technologies and precision engineering, including environmental and low carbon technology, high performance engineering, motorsport, aerospace, automotive and sustainable construction (page 19).
- The call for a High Performance Technology Strategy is set out within the SEP including a strategic framework and action plan which aligns objectives, ambition and future investment and addresses potential future skill shortages, with the aim of becoming a global leader in newly emerging technologies and markets (Table 4, page 51).

Cross-LEP strategic collaboration (as referenced in relevant Strategic Economic Plans)

- Northamptonshire LEP, Buckinghamshire Thames Valley LEP and SEMLEP all have an interest in Silverstone (which is on the Buckinghamshire/Northamptonshire border). The commitment to supporting industry around Silverstone, including the development of Silverstone Park, is referenced in three Strategic Economic Plans.
- Buckinghamshire Thames Valley LEP, Northamptonshire LEP, Oxfordshire LEP, SEMLEP, Leicester and Leicestershire LEP and Coventry and Warwickshire LEP – in collaboration with UKTI, BIS, Silverstone Circuits and the Motorsport Industry Association – are working together to grow ‘Motorsport Valley’ and attract inward investment.

Source: SQW – based on a review of the strategic economic plans published in March 2014
Agenda for Action

9.13 For the HPTM cluster to realise its potential in the ambit of high performance technology, there needs to be a continuing flow of entrepreneurial new firms; but in addition, more HPTM businesses must grow to medium size and beyond. The challenges within the HPTM cluster resonate with those identified more generally; and the “Scale Up” Report to government considered many of the surrounding issues. In its own specific competitive context, the HPTM cluster – and the wider ecosystem – will need to evolve in response.

9.14 Based on the findings from this study, there appear to be five broad priorities for action. Many of these are in practice inter-related and they potentially build on the progress made through the High Performance Technologies Network and the High Performance Technologies Investment Fund which have been developed by Northamptonshire Enterprise Partnership.

1: Growth finance – and the process of investment and reinvestment

9.15 There is a clear need to facilitate access to appropriate forms of growth finance. A complex mix of factors is currently at play in this domain. On the supply side, since the global financial crisis, high street banks and established venture capitalists have tended to become more risk averse. However, an array of alternative financing mechanisms has emerged, some enabled by technology, and the overall landscape has become far more complicated.

9.16 In general terms, awareness of different sources of finance has increased but the evidence suggests that nationally, actual take-up is limited (for example, 1% of SMEs have sought equity finance in the last three years, and this has not changed since 2012). A study by Mason and Kwok (2010) identified three main challenges in relation to equity finance, and these have broader relevance to other sources of finance: equity aversion (owners of growing/growth potential firms not being able to realise full growth potential because they do not want to relinquish control); investability (applications to venture capital and business angel funds being rejected because the business is not a good “fit” for the investor, or because they do not believe the business would offer strong returns); and presentational failings (small businesses lacking the knowledge or experience of making an investment proposition, and therefore not promoting themselves effectively).

9.17 These challenges are generic. However, they resonate with the findings from this study. Overall, in relation to the HPTM cluster, the market for growth finance does not appear to be functioning effectively. In part, this is because the “market” itself has evolved very significantly in recent years (with new products, platforms and services). Resources have been produced to improve awareness and knowledge of different types of finance. But there is a clear need, in addition, for on-the-ground referrals and advice including, ideally, from

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92 Note that these largely map onto the “key reasons why companies are unable to scale in the UK” which were identified in “The scale-up report on economic growth”, referenced in footnote 91
95 See, in particular, “The Business Finance Guide: A journey from start-up to growth” – updated August 2015 ICAEW Corporate Finance Faculty / British Business Bank
peers. Networks need to be developed better, perhaps supplemented by more formal investor readiness programmes; and “beneficial interactions” need to be nurtured specifically in relation to the financing of growth. In this domain, the cluster ought to be encouraged to find its own solutions, premised on cycles of reinvestment, and capable of unleashing the growth of HPTM businesses over future decades.

2: Building leadership capability

Alongside better access to finance, there is a need to build leadership capability. Businesses within the HPTM cluster are generally managed and owned (in whole or in part) by highly skilled engineers. However, the calibre of engineering excellence can appear in contrast to more general business leadership skills. Among some of the HPTM businesses that are developing quickly, the influence of a management and financial resource that has come – effectively – from “outside” is clear (and the imperative to “sell it to let it grow” was articulated by the founder of Flybrid (see Figure 7-1)). More generally, for HPTM businesses to grow, there is a need for a greater management resource and stronger business capability – not to stifle the creativity of the engineers, but to harness and galvanise it to maximum effect.

3: Routes to market – and visibility

Engaging effectively with a new management cadre – whether grown from within the cluster or recruited into it from other sectors – and securing better access to finance will both be premised, in part, on better visibility. Specifically, there is a need for a greater understanding of the potential of HPTM applications, particularly among potential investors (who are unlikely to be trained engineers). This report should itself help; and the work of organisations like the Motorsport Industry Association continues to be influential. In the future, it will be necessary to continue to showcase innovations from within the cluster and to do so with other market sectors firmly in view. In relation to international markets, the role of UK Trade and Investment (UKTI) is likely to continue to be significant.

4: Increasing the supply of skilled people

A fourth crucial area for action relates to the supply of skilled people – particularly skilled engineers. As noted already, the HPTM cluster should be regarded as exemplary in relation to the training of young people through apprenticeships: many of the firms that we spoke to, including some of the very small ones, were investing actively in the “next generation”. Given the current Government’s commitment to apprenticeships, the effectiveness of the cluster ought to be noted and celebrated in this context.

However, recruitment continues to be a challenge. Action needs to be taken to increase further the supply of appropriately qualified engineers (of all forms, including software engineers). In the short-medium term, part of this will have to include an appropriate response from Government to the need for highly qualified individuals who are not UK nationals.
5: Appropriate infrastructure provision

9.22 Finally – to coin a phrase from "The scale up report" – there will be a need to ensure that growing HPTM businesses are equipped to "navigate infrastructure". Of the five “areas for action”, this is arguably the least problematic – not least because a network of innovation centres and science parks already exists and there is substantial further planned investment (see for example Figure 6-1 and Figure 9-1).

9.23 However, it is important to flag one cautionary point in this context. As noted in Chapter 2, many HPTM businesses are currently hidden from view on obscure industrial estates. For some, a more “visible” location would itself facilitate networking and business growth. Nevertheless, there will be a continuing need for a broad range of premises, all with high quality broadband connectivity. In the context of substantial development pressures across much of the cluster’s geography, ensuring an appropriate mix of employment sites and premises will need to be a clear policy decision for the local planning authorities.

Priorities for further research

9.24 The HPTM cluster is evolving. This study sought to investigate whether a cluster existed and then to examine aspects of its character. However, there is more to be done. In terms of an agenda for future research, we would make two overarching comments by way of conclusion.

9.25 First, this study – like every other study of its nature – was challenged by issues relating to definition and measurement. The fluidity of HPTM activities and the fact that it is “relationships” (rather than individual businesses) that define the core of a cluster render definition and measurement intrinsically difficult. Our response was to use a predominantly qualitative research methodology and to focus on investigating “how the cluster works”.

9.26 We are aware that new approaches to cluster/sector measurement are starting to emerge. These are relying less on standard taxonomies and official datasets and more on big data methods and approaches. A major review of manufacturing metrics argued that national statistics should be supplemented by new data sources to provide more of an insight into the value chain. In addition, the second annual Tech Nation Report was published early in 2016. Its central methodology relied on generating a core dataset that was built using machine learning techniques on data scraped from company websites; it was therefore very dependent on the precise content of company websites. The methodology is evolving but it is potentially exciting. As it stands though, working with pre-defined geographies (in this case Travel to Work Areas from 2001), it is debatable whether the Tech Nation Report fully captured or measured the process of clustering. Nevertheless, the results of an analysis of this type, focused on the HPTM activities, would be fascinating.

9.27 Our second point is different. Arguably, rather than further attempts to define and measure the cluster (which are resource intensive and will always be imperfect), it may be more appropriate to focus on action learning through one or more “network managers”. The role would be to work with HPTM cluster firms and, effectively, to animate the network and thereby develop the “soft infrastructure”. This could in itself start to address some of the

generic challenges identified above – like improving access to finance. In addition, it could start to explore cluster-specific priorities: one possibility might be the development of a standard set of terms and conditions for collaborative ventures across the cluster; a second could be a process for “banking” and “aggregating” potential ideas and innovations that might not otherwise be advanced; and a third could involve the identification of supply chain “gaps” that might become a focus for inward investment. More generally, the work of the “network manager” would start to provide real-time insights into the constraints and challenges facing individual businesses. Recruiting the right “network manager” would be critical – and, ideally, he/she should be someone who is already well-known within the cluster. However as well as generating “real time” evidence, this role could also contribute significantly to the cluster’s long term growth.
Annex: Wider acknowledgements

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