Maximising productivity through managing new technology

A report prepared for the Midlands Productivity Forum

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Abstract

This report focuses on the relationship between the management of new technology and productivity – an issue that has become salient with the emergence of new digital technology. In particular, it examines the extent of education and training in the West Midlands that might support managers in the region to better lever the potential productivity gains of this new technology. To this end, it assesses West Midlands' universities (high education institutions, HEIs), further education (FE) colleges and independent training providers (ITPs) provision of education and training that might support the management of technology and presents findings from a series of employer interviews.

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Glossary

AI	Artificial Intelligence
AR	Augmented Reality
BEIS	Department for Business, Energy and Industrial Strategy
CAD	Computer aided design
CRM	Customer Relationship Management
ERC	Enterprise Research Centre
ERDF	European Regional Development Fund
ERP	Enterprise Resource Planning
FE	Further Education
GFC	Great Financial Crisis
GVA	Gross Value Added
HE	Higher Education
HEI	Higher Education Institution
HVM	High value manufacturing
IoT	Internet of Things
ITPs	Independent Training Providers
LSIP	Local Skills Improvement Plan
KTP	Knowledge Transfer Partnership
MD	Managing Director
MRP	Materials Planning Requirements
MTC	Manufacturing Technology Centre
PDR	Personal Development Review
R&D	Research and development
SME	Small and medium sized enterprise
SMT	Senior Management Team
SPF	Shared Prosperity Fund
TFP	Total Factor Productivity
VR	Virtual Reality
WMCA	West Midlands Combined Authority
WMG	Warwick Manufacturing Group

Executive Summary

Introduction

Productivity in the UK is a concern because it is generally lower than its main international competitors and the gap has widened. New technology is generally seen as a mechanism for improving productivity but anticipated outcomes have not been fully realised.

The main aim of the project is to support WMCA in identifying how it can assist businesses to maximise productivity gains from new technologies. WMCA, through its devolved responsibility for adult skills investments and business support, can help support managers acquire the knowledge and skills to successfully manage the implementation of new technology. The project's research aims were developed in consultation with WMCA who supported the researcher's grant application. Senior officers from WMCA formed the project's steering group and were involved in refining the methodological approach, identifying case study respondents, and providing comments on project reports.

Rapid evidence review of management skills and technology

The ability of firms to manage the introduction of new technology rests in large part on management competencies, which include technological, strategic and HR skills. However, these skills are often lacking in the UK because of low levels of management training.

Review of current education and training provision

A review of training provision across the West Midlands was undertaken to identify any programmes providing training in the management of new technology, and what skills they imparted. This encompassed provision at all 73 contracted WMCA training providers plus all regional higher education institutions (HEIs) and the Open University.

The review identified very few education and training courses concerning the management of new technology. Only 48 courses were available that included both management and digital technology elements. Most of these courses were business or management HEI courses with technology modules within them or digital/technology-oriented management/business courses. These 48 courses tended to be degree level, full-time courses delivered by HEIs i.e. formal management degrees. There were only a handful of short courses which were directly targeted at businesses i.e. short-term and flexibly delivered.

WMCA contracted providers were also sent a self-assessment checklist, asking for more details of their provision and the management and technology competencies it covered. This identified few courses in the West Midlands with scant coverage of managing technology skills.

Interviews were also undertaken with WMCA Growth Hub representatives. These identified several publicly funded business support programmes. Most of these are for manufacturing businesses only, and several have only lasted a few years. Growth Hub staff identified amongst firms a technology first approach rather than business-focused, and a reliance on suppliers for support in selecting and implementing new technology.

Employer case studies

In-depth interviews were undertaken with 11 businesses based in the West Midlands. Businesses ranged from very large global service companies to small, regionally based manufacturers. All businesses had previously received business support.

Organisations were selected in partnership with WMCA and Growth Hub staff, and covered WMCA's Plan for Growth clusters.

New technology investments, for most firms, were an inherent part of their business strategy. But for a minority, technological investments were ad hoc, arising when a business need or opportunity arose.

For most businesses, management skills development was regular and ongoing. Management skills development was systematic and derived from the business strategy. For a minority of organisations management skills development was ad hoc, informal and reactive. For these management skills development was often 'learning by doing'.

Few companies provided technology training to managers. Rather managers are observant of trends in their sectors and have a range of informal networks through which they identify future priorities. For those companies which did provide training, most covered the technological aspects only, and not requisite core management skills.

All businesses had recently invested in new technology, investing between 0.5% to 3% of their turnover. For the regional manufacturers this investment was often facilitated by their contact with Growth Hubs and being signposted to Made Smarter and similar programmes.

Productivity was the main driver for these investments, and was much more important than profit. Productivity was defined in terms of making the business more efficient, reducing costs and 'doing more for less'. Cyber security was the second most significant driver. Some organisations had suffered cyber-attacks which had seriously impacted the business, whilst others wanted to upgrade to more secure technologies. Production drivers included improving production control and quality, replacing older machines, and addressing skill shortages. Innovation was also mentioned in terms of future proofing the business or being seen to be an innovation leader.

For the regional manufacturing businesses, working with Growth Hubs and/or the Made Smarter programme helped them identify the potential utility of new technology. The large service companies had dedicated internal functions to undertake these tasks for them.

For SMEs with an ad hoc approach to new technology investments and management skills development, contact with external business support was associated with quantum leaps when the business leader realised that fundamental changes needed to be made. In these cases, investments tend to be made as transformative changes. Whereas for those with a more strategic approach investments were made incrementally.

The 11 organisations were divided into four clusters depending on whether they had a strategic approach to new technology investments and management skills development:

- Group A businesses were all large service companies which were managerially and technologically sophisticated, and well resourced. Management and technological approaches were strategically linked, assessed regularly and addressed comprehensively and systematically.

- Group B businesses were all medium-sized manufacturers. They had strategic approaches to both new technology investments and management skills development. Their management skills development was ongoing and systematic. They had greater clarity in their focus for new technology investments. Technology investments were process driven i.e. what is the problem, what are the solutions, does the solution require technology?

- Group C businesses had strategic approaches to new technology but not management skills development. In both cases, the MDs were technophiles and this created gaps between their skills and vision, and the rest of the business. However, both had successfully implemented new technologies and expected positive productivity gains.

- Group D businesses had neither a strategic approach to technology nor management skills development. However, there was an understanding that changes in these approaches needed to be made and, as a result, all three firms had been involved in the Made Smarter programme. However, new technology investments were still ad hoc and reactive, driven by immediate problems. Workforce engagement was more inclusive than for other manufacturers but created challenges.

Conclusions and Recommendations

Management skills are critical to the effective investment and implementation in new technology. From case study interviews evidence indicates that firms who took a strategic and integrated approach to both new technologies and management skill development had a more straightforward implementation. In short, the case study interviews confirmed what the literature suggests: realizing productivity gains from new technology investments requires suitable management skills. Larger firms had the internal capacity and resources to undertake ongoing strategic reviews of management training and a dedicated business function focused on identifying the potential of technology to achieve business aims. Smaller and less resourced firms rely on business support programmes to accomplish these strategic tasks. For the SMEs in the study, business support had been instrumental in driving their recent technology investments providing advice, support, access to grant funding, help in identifying suppliers, and a structured process to implement their new investments. What some SMEs lacked were the socio-technological management skills to do this smoothly and effectively.

How then **can managing technology skills become more widespread across the West Midlands?** The review of provision showed that there was little management training or business support available to firms in the subregion. The business focused and appropriate support that is available is through Made Smarter and similar programmes, accessed via Growth Hubs. Few SMEs take-up this support, and it is often only available to manufacturing businesses. The firms in the sample relied very much on other sources of support to identify and implement new technology. This included competitors, customers, suppliers, trade shows and, importantly, technology suppliers. The role of technology suppliers seems especially important in providing informal managing technology skills development and support. They are trusted and able to provide support when businesses need it. Publicly funded programmes (no matter how close or trusted the provider) may not be able to offer relevant training or support when required. The SMEs in the study also relied on HEIs and the catapults as a means of keeping abreast of technological developments.

The review of provision also suggests that there is a distinction between management skills development as training on the one hand and, business support on the other. This distinction is not new, and having such a dividing line cannot be helpful to meeting business needs.

Recommendations

These findings suggest a number of key recommendations to deliver the management skills needed to successfully implement new technology and thereby realise its productivity benefits for the West Midlands. Whilst the WMCA is the primary focus for these recommendations, there are other organisations that are involved in and/or effect these policy areas. These

recommendations are therefore relevant to a range of organisations including: the UK Government, local authorities, HEIs, business representative organisations, business support providers, employers, and employer representatives.

1: More and better provision of new technology implementation management skills. There is currently little education and training provision in the West Midlands delivering these skills. It is mostly available through the business support route which tends to be separate from management education and training. However, much of the business support provision is focused on manufacturing SMEs. Service sector SMEs should also be provided for.

2: Delivery of such management skills needs to be demand responsive, tailored to firm's needs. Firms are at varying starting points in their management of technology investments, and provision needs to reflect this. A pipeline of provision could be created that incorporates entry level and progression opportunities., for example, from taster days to more intensive skills development programmes. These opportunities would help firms engage at a number of different entry points relative to their needs and provide opportunities to progress their managing technology skills further. Informal support could also be levered alongside formal provision as part of this progression pathway.

3: Consider WMCA's adult skills investments as a source of funding to develop provision. Through its management of both adult skills investments and Growth Hubs, and links to HEIs and FE providers, and employers, the WMCA is in a unique position to stimulate and finance the development of a coherent pipeline of managing technology skills.

4: Encourage firms to adopt a business, not technology, approach. A key reason why productivity gains have not been achieved is that the focus is primarily on the technology rather than how it functions within the context of the business. A business first strategic approach to both new technology investments and management skills development is required. This message should be central to education and training, and support.

5: Make available, and encourage, business support programmes to disseminate findings on the benefits of training to manage technologies. The findings of this study, along with the wider evidence, should be summarised so that business support practitioners have an available evidence resource to present to employers to encourage them to invest in management training as a mechanism for boosting survival and growth prospects.

6: Consider developing a regional ecosystem approach to the management skills for implementing new technology. Gaps and weaknesses in the uptake of provision currently exist in part because greater coherence is needed, in particular between education and training, and business support. The WMCA should adopt an enabling role in establishing such an ecosystem because of its relationships with all of the key stakeholders.

These recommendations offer the WMCA the opportunity to co-develop interventions with firms as well education and training, and business support providers. The aim has to be to equip managers with the skills to successfully implement new technology in order to realise its potential productivity benefits. In doing so, there is an opportunity to improve the provision of education and training for managers in the West Midlands, improve the quality of management in the region and future proof the performance of the region's firms, particularly SMEs, in an era of significant technological change.

1. Introduction

1.1. Introduction

This report focuses on the relationship between the management of new technology and productivity[1] – an issue that has become salient with the emergence of new digital technology. In particular, it examines the extent of education and training in the West Midlands that might support managers in the region to better lever the potential productivity gains of this new technology. To this end, it assesses West Midlands' universities (high education institutions, HEIs), further education (FE) colleges and independent training providers (ITPs) provision of education and training that might support the management of technology and presents findings from a series of employer interviews.

1.2. Background to the project

There is a tacit understanding that firm-level productivity can be improved by the introduction of new technology which, in turn, can boost regional and national competitiveness. This possibility matters because productivity levels in the West Midlands Combined Authority (WMCA) are lower than the English average (2019 figures, Gross Value Added [GVA] per hour worked) (Wickham 2023).

However, past experience shows that new technology often fails to deliver expected productivity gains because of its poor implementation within firms.[2] Expected productivity gains can be lost if technology is not properly managed within firms. In particular, there can be a disconnect between the technical and social aspects within firms in that implementation (Guest et al. 2022). Managers can help reconcile the technical and social and thereby lever the potential productivity gains. To do so, managers require the right skills. Unfortunately, a gap in understanding generally exists on this issue. As Tuncalp (2022) notes, the management literature on technology in organisations has been 'relatively slim'. This project goes some way to plugging this gap for the West Midlands.

1.3. Project aims

The aim of the project reported here is to support businesses in the West Midlands to maximise productivity gains from new digital technologies by ensuring that, through education and training, managers have the knowledge and skills to successfully manage the implementation of new technology.

The project's research aims were developed in consultation with WMCA who supported the researcher's grant application. Senior officers from WMCA formed the project's steering group and were involved in refining the methodological approach, identifying case study respondents, and providing comments on project reports.

The project first explores the relationship between the implementation of new technology, productivity and management skills. The review identifies those factors which support productivity gains from new technology in relation to these skills. It then assesses the provision of West Midlands' HEIs, FE colleges and ITPs in these aspects of management training and

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[1] Definitions of new technology and productivity are provided in Appendix 1.

[2] Throughout the report the terms 'firms', 'businesses' and 'companies' are used interchangeably because the data sources use different terminology in referring to what are, for the most part, private sector organisations.

business support. Strengths, gaps and areas for development in provision are identified. Finally, a series of case study interviews with employers explored their experiences of implementing new technology, management training and business support they received to help them do so as well as the outcomes and impacts from those technology investments.

This information will help inform WMCA's co-development of interventions with firms as well education and training providers to better lever the potential productivity gains from new technology.

1.4. Methodology

The project was commissioned in Autumn 2022, and the employer case study interviews were undertaken in Spring 2023. The project had a three-stage research process. The first stage involved a **rapid evidence review** of research into management practices which help or hinder the implementation and utilisation of new technology. The aim was to identify the practices that most effectively help implement new technology and how these practices can be best supported. The review included:

- academic literature – focused on management and technology publications.

- grey literature – covering policy and practitioner publications.

The findings of the review were published in the study's interim report and an abridged, slightly updated version features in this report.[3]

The second stage involved a **review of existing West Midlands regional education and training provision** to assess the extent to which employer needs are currently being met with regard to managing technology. This review had two parts:

- An online review of the main Higher Education (HE) and Further Education (FE), and independent training providers across the region. This review provided an initial mapping of provision to identify the extent to which support is available to employers on the implementation and utilisation of new technology.

- Based on the previous tasks of the evidence review and mapping, the development of an analytical framework of provision which was sent to providers covering: the nature of provision (e.g. full programmes, units, accreditation etc.); how it is delivered (e.g. mentoring, face-to-face, 'buddying', on-line etc.); relationship to other provision (e.g. IT and management training, business support etc.); participating and target employers (e.g. by size, sector, business model and location); funding; and future plans and developments. Management skills associated with technology implementation from the literature review provided a checklist against which regional provision could be benchmarked (see Appendix 2).

The third stage involved **in-depth employer and business support staff interviews.** A case study approach was adopted in order to explore in detail the complex area of how firms select, introduce and implement new technology, and the support the firms accessed. Organisations are investing in a wide range of technologies (hardware and software) in order to meet varying business objectives, in different contexts and, in doing so, seek assistance from a number of external organisations. Undertaking qualitative interviews enabled the researchers to focus in

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[3] Dickinson and Erickson (2023).

on the particular paths organisations adopted, the decisions they took, and the context and rationale for those decisions. A case study approach also enabled the researchers to explore the relationship between business strategy, management training and the effective implementation of new technology.

Interviews with 11 employers were undertaken (including those in WMCA's Plan for Growth clusters[4]) exploring their organisations' experiences of managing the selection, introduction and implementation of new technology, how they can best be supported, what works and what could be improved, gaps in provision, barriers to success, and outcomes and impacts. Employers were identified through WMCA business managers and contacts at the three Growth Hubs – Black Country, Coventry and Warwickshire, and Greater Birmingham and Solihull. As we wanted employer views on business support for new technology implementation, interviews were undertaken with a number of SME employers who had undertaken the Made Smarter programme. These businesses were all manufacturers. The SMEs are not representative of companies in the West Midlands because they are manufacturers and have accessed external advice.[5] Atypically, these SMEs are likely to be proactively managing the development of their businesses and willing to seek external support to do so and this should be considered when interpreting the findings and conclusions from the study. Lead business support practitioners in each of WMCA's three Growth Hubs were also interviewed to get their views on what business support is available for firms wanting to invest in new technology, and the propensity of businesses to access it.

The findings from these three research stages are reported here. From the findings, the report generates recommendations on how the management of technology can best be supported within firms and how the WMCA can better provide support for businesses in the region.

1.5. Structure of the report

The report is divided into four further sections:

- Section 2 provides a summary of the rapid evidence review of technology and management skills;

- Section 3 reports the review of training and education provision;

- Section 4 presents the data from the 11 employer case studies, and interviews with Growth Hub business support practitioners;

- Section 5 presents the main conclusions and recommendations.

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[4] There are eight clusters: manufacture of electric vehicles and battery storage devices; modern and low carbon utilities such as solar and wind power technology; logistics and distribution; manufacture of the low carbon, factory-built homes of the future; professional and financial services; health and medical technology; aerospace; and creative content production and video gaming.

[5] According to the 2021 small business survey (BEIS 2022) around one quarter (26%) of firms use externally sourced information and advice, and only one in five of these (or 14% of all SMEs) get 'strategic' advice and information on changes to the business (i.e. that is not related to the day-to-day running of the business). Seeking such advice tends to come from growing businesses looking to grow further, and receiving advice tends to impact positively on growth, though not necessarily productivity (What Works Centre for Local Economic Growth, 2022).

2. Rapid evidence review

2.1. Introduction

A rapid evidence review (Dickinson and Erickson, 2023) was undertaken to provide an overview of the UK's productivity challenges, the role of technology in driving productivity, the relationship between technology, its management and productivity impacts, and how businesses can best be supported.[6]

2.2. Profile of productivity in the West Midlands and UK

Productivity in the UK is a concern because it is generally lower than its main international competitors. Since the Global Financial Crisis (GFC) in 2008, the gap has been widening (Ford and Rincon Aznar 2018; Bughin et al. 2018). The productivity gap is broad based affecting most regions, sectors and size of business suggesting that its underlying causes are systemic (Bughin et al. 2018).

Productivity levels vary by firm size (HM Government 2019). Small and medium sized enterprises (SMEs) tend to have lower productivity levels than larger organisations and are more likely to populate the 'long tail' of low productivity. However, sectors differ in terms of the productivity levels of different sizes of firms.

In the WMCA, productivity is around 90% of that of the UK (ONS 2022). As in the UK, productivity in the West Midlands region slowed after the GFC, although since 2004 the gap with the UK has narrowed slightly.

2.3. The main drivers of productivity

There are three components of productivity: labour, capital and how the two are utilised (TFP). How well these components contribute to productivity depends on their quality and (in the case of capital) their quantity. The UK underperforms on these three measures relative to other G7 countries, including TFP in which a key component is the quality of management.

A number of studies highlight the relationship between management and productivity and the relatively poor quality of management in the UK (e.g. Be the Business 2018; HM Government 2019; Morgan and Clifton 2020). Roland (2020) estimates that over half of the TFP gap between the UK and US, for example, could be due to poor management. Studies have also highlighted management quality as a particular issue in SMEs (ERC 2022).

A key element of relatively poor management quality in UK firms in general, and SMEs in particular, are low levels of management training. The UK underperforms in management training and skills compared to its main competitors (Tamkin and Ni Luanaigh 2016). Be the Business (2018) found that four fifths of UK managers are 'accidental managers' given very little or no management training.

Recently underpinned by greatly enhanced computer power, new digital technologies have emerged. These technologies include advanced automation using Artificial Intelligence (AI), the IoT, Big Data and machine learning and effect the production of good and services by firms and have labelled Industry 4.0 as part of claims of a new 4th Industrial Revolution (Warhurst et al. 2020). Implementing new technology impacts productivity (HM Government

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[6] 54 documents, mostly grey literature, were reviewed. The full bibliography is included in Section 6.

2019; ERC 2022) and the championing of Industry 4.0 occurs because of its potential to increase productivity within firms.

However the UK also lags its main competitors in terms of technology adoption (OECD 2019). It is not just the introduction of new technology that matters but also how it is used within firms (Penney and Pendrill, 2022). Indeed, in extending Industry 4.0, the premise of the new Industry 5.0 is that digital technology works best when it is human-centric in operation and outcomes (Cotta and Breque, 2021). In this regard, management becomes the most important enabler within an organisation (Imran et al. 2021). The ability of firms to manage the introduction of new technology rests in large part on management skills (Be the Business 2018; Round et al. 2020). A number of studies have identified key management competencies which underpin productivity: workforce management, technology implementation, investment in workforce skills, and business planning. Previous initiatives to ensure that the productivity benefits of new technology can be realised have sometimes floundered on the lack of these skills, suggesting a need for better management. Thus the lower quality of management in the UK means that UK firms have lower absorptive capacity to successfully introduce and utilise new developments, including technology (Keep, 2023).

2.4. Developing management skills to implement new technology

The relationship between technology and productivity is not straightforward (Tsou and Chen 2021). In 1987 Nobel Laurate Robert Solow famously quipped 'we see computers everywhere except in the productivity statistics'. Investment in and adoption of digital technologies has been increasing over the past decade when productivity levels in the largest economies have been sluggish or flat lining. The criticism is that too many businesses (and policymakers) have focused only on the potential of new technology and not its actual implementation and use within firms. The impact of new technology on productivity is greatly reduced if not accompanied by better management practices (Owalla 2022). Having the right management to lever the potential of technology therefore matters (OECD 2017).

Thus, a key component in getting the most out of capital (and human) resources is effective management. Good management underpins effective technology implementation and involves a combination of core and technology related management skills. Core management skills include: project management, human resource management and innovation. Technology related management skills include: sourcing, assessing and evaluating new technology; the strategic integration of new technology; and technology utilisation.

Managers need training and support in these skills in order to better ensure that new technology is implemented successfully. Be the Business (2018) found that businesses need the management skills to understand their technology requirements, source it and embed it in the organisation. Owalla et al. (2022) and HM Government (2019) show that improved management and technology investments need to progress 'hand in hand'. The interplay between good management and new technology implementation is likely to be that the latter's success requires changing business processes. Effectively changing those processes to accommodate and get the best out of new technology requires high level management practices (Burger et al. 2019).

In this respect, the findings echo the argument of the socio-technical school of thought that productivity gains from new technology require an integration of the technical and social aspects of any organisation (Trist and Murray 1993). It is noteworthy that this approach is

being advocated as crucial if the anticipated productivity gains are to be made from Industry 4.0 with its emphasis on the new digital technology (Avis 2018; Bednar and Welch 2020).

2.5. Delivering training and business support in managing new technologies

Integrating the management skills necessary for successful new technology implementation with broader management and business support is important (ERC 2021). A variety of public and private business support services exist, designed to provide consultation, advice, direct service, indirect services, etc. to firms seeking to grow their businesses, increase their productivity, or implement new processes.

SMEs generally lag behind larger organisations in adopting new technologies. SMEs are often a target for government funding for these services because SMEs are seen as requiring business support whilst having the least resources to access it without government backing.

Different approaches to delivering business support services have varying levels of influence or success. In the literature on best practice in pedagogical approaches, two broad themes emerge – the need for peer-to-peer learning opportunities and the need for bespoke support programmes.

Supporting businesses' technology implementation can only be effective if it acknowledges the specific management skills needed to manage new technology but within the context of core management skills. A number of studies identify the management skills useful for effectively adopting and utilising new technology. Managing digital technologies, particularly as part of Industry 4.0 will require the management of technical (the technology itself and its infrastructure) and social systems (such as, people, business culture and structures). Identifying these management skills provides a benchmark against which current education and training provision can be compared and forms the basis of a checklist by which to benchmark current management support across the West Midlands.

There is often a disconnect between management skills development through education and training provision, and that delivered through business support (Dickinson,2016 ; and see next section). Skills ecosystems help the coordination of the interactions and interconnectedness of the different actors and institutions locally with regard to the development, supply and demand for skills and can help improve how they operate (Anderson and Warhurst 2012). Skills ecosystems can evolve or be co-created, in the latter case by developing a network involving the main stakeholder groups who bring their experience and insights to address a particular issue (Warhurst and Findlay, 2012). Proof of concept comes from an EU-wide Mobility-Transport-Automotive skill ecosystem focused on workforce upskilling and reskilling. In this programme, the highest rate of change was amongst managers (Astarita, 2023). The developing West Midlands Local Skills Improvement Plan (LSIP) may provide a direction for how such an ecosystem might be developed as two of its three priorities relate to management and leadership, and digital skills (Coventry and Warwickshire Chamber of Commerce, 2023).

2.6. Conclusions

There are three components of productivity – capital, labour and TFP – and the UK underperforms on all them. A key to unlocking these components of productivity is the quality of management, management quality is linked to management training. Levels of both management quality and management training are lower in the UK than its main competitors.

Within OECD countries, high levels of investment in new technology have not brought about improvements in productivity. Researchers believe that this is because of the focus on new

technology rather than how it is selected and implemented within the context of the organisation. The proponents of this socio-technical viewpoint believe that the right management skills are required to generate business impacts. The literature identifies a number of management skills related to the effective implementation of new technology. Some management training and business support is available to inculcate these skills, but there is generally low take-up, especially amongst SMEs where the productivity gap is greatest.

The next section reports on a review of the education, training and business support in the management of technology across the West Midlands. It identifies whether training is available in the region to deliver and develop these managing technology competencies.

3. Review of current education and training provision

3.1. Introduction

The rapid evidence review found that productivity, management skills and technology implementation are interrelated. To be effective, new technology needs to be implemented within the context of the business organisation as opposed to a technology first approach. Key to this implementation are management skills to identify and implement new technologies. This section reports on whether management skills training in the region delivers these competencies.

The review identified a number of key management skills associated with the effective implementation of new technology, see Table 1 below.

Table 1: Key management skills related to new technology

Management Skill	Description
Strategic integration of new technology	Strategic role of technology in business, managing technology projects
Sourcing, assessing, and evaluating new technology	Selection of technology projects; timing of technology projects; evaluation of technology projects (e.g. Cost Benefit Analysis of digitization); technology sourcing and acquisition; technology financing
New product/service development	Management of research; new product/service development; technology innovation processes
Technology utilisation	Internal use of ICTs; internal use of manufacturing technology
HR - technology staff	Recruiting and retaining trained technology staff; employee technology skill development; overseeing technology team-based environments
HR - other staff	Communicating with employees; non-tech employee technology skill development; employees participating in decisions; overseeing team-based environments
Technology transfer	Transfer of technology between organizations; transfer of technology within organizations

Source: Rapid evidence review, Institute for Employment Research

A review of training provision across the West Midlands was undertaken to identify any programmes which currently existed providing training in the management of new technology, and if so, whether they included skills development in those areas outlined in Table 1.

An initial web search was undertaken of 84 providers:

- 73 currently contracted WMCA training providers, including 20 FE colleges, four HEIs, five local authorities and 44 ITPs;

- All other West Midlands HEIs not currently contracting with WMCA (this numbered ten providers); and,
- The Open University covering the West Midlands.

In addition, all 73 WMCA contracted training providers were sent a self-assessment checklist (see Appendix 3) which asked them to detail any management training or business support provision they delivered (to individual learners or employers) which included the introduction of new technology. New technology was defined primarily as digital technology that significantly alters the ways in which organisations produce goods, deliver service or perform business functions. This technology may be related to manufacturing, communication, sales, financial management and work organisation.[7] It could be stand-alone provision or part of a wider programme (e.g. management degrees). Providers were asked for details of the nature of provision, whether it led to a qualification, its funding and broad content.

Finally, as training can be delivered as business support as opposed to learning programmes, interviews were undertaken with representatives from the three WMCA Growth Hubs (Black Country, Greater Birmingham and Solihull, and Coventry and Warwickshire).

3.2.   Online review of provision

A web search was undertaken of the 84 providers. This included the 73 WMCA contracted providers (four HEIs, 20 FE colleges, 44 ITPs, and five local authority providers), nine other HEIs based in the West Midlands region, and the Open University.

Provider web pages (including online prospectuses), were searched for the terms "manage*", and "tech*"/"digital"/"IT". In addition, more detailed searches were undertaken within the content of specified management and digital/IT course descriptions. This search identified 155 potential courses of which further details were collected.

These courses were:

- delivered across most of the provider types but predominantly by HEIs. Four out of five HEIs (79%) delivered such courses compared to 29% of FE colleges and 5% of ITPs;
- at various levels but mostly higher level[8]. One in ten were at Levels 4 or 5, and 80% were at Levels 6-7. The only courses below Level 4 were short-term courses (10%).
- delivered on a full- or part-time basis (including apprenticeships and short courses). Most (37%) were delivered full-time only and 17% part-time only. However, one third (32%) were available on a full- or part-time basis. Just under one in ten (8%) were short courses, and 3% were apprenticeships.

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[7] The nature and content of training and support might cover the following: e-commerce; digital marketing; the human resource, and organisational implications of digital transformation; managing people in the digital environment; and Big Data analytics. In terms of specific technologies it includes managing the introduction and/or implementation of: AI, robotic or automated equipment to undertake a physical task, or a cognitive/non-physical task; Machine learning; Remote sensing or monitoring systems (e.g. smart detection systems, GPS); CAD software; IoT; AR and VR; Accounting or HR software; CRM systems; Video conferencing tools such as 'teams' or 'zoom'; and Cloud computing solutions.

[8] This is using the Regulated Qualificat8ions Framework (RQF) designation of course level. Bachelor degrees are Level 6, A Levels (grades A-E) and Advanced apprenticeships Level 3, and GCSEs (grades 9-4) and Intermediate apprenticeships Level 2.

- Two thirds of courses were within business/management departments or schools with 14% in engineering (or similarly named) departments. The remainder were in IT or arts departments, or there was no information.

- Courses included management, personnel, engineering, IT/computing, business support, e-commerce, innovation and design subject areas.

Of the 155 courses including management or technology, on more detailed inspection, around one third of these included both (48). So whilst there is management and technology provision across the West Midlands, only a minority of it includes the management of technology.

Of these 48 courses:

- Most of these courses were business or management HE courses with technology modules within them i.e. with technology as an optional component;

- The remainder were digital/technology-oriented management/business courses, such as an MSc Management in a Digital Economy.

- Most were delivered by HE providers (10) and three by FE colleges. Four of the region's HE providers did not deliver courses which included both management and technology.

- All but four of the courses were bachelor or masters degrees (including a degree apprenticeship). Of the remainder, three were short courses with no RQF level.

- Two out of five were offered as full time only, and a similar proportion were offered as either full- or part-time. Of the remainder 15% were short courses and 8% were part-time only.

Therefore, whilst there is seemingly an array of managing technology training provision available across the West Midlands much of it is full-time and degree focused. There appears to be little provision that is specifically employer focused delivered on a flexible basis.

3.3. Review of provision from the self-assessment checklist

The findings of the online review was confirmed by the self-assessment returns. All WMCA contracted providers were sent the self-assessment checklist and 14 responded, which is around one in five WMCA contracted providers. These returns comprised five FE colleges, two HEIs and seven ITPs.

The 14 providers who responded identified 44 separate courses. However, on closer inspection only six were in scope. Courses were excluded, for example, because they were primarily IT courses with no management content.

The remaining six courses were all short courses specifically targeted at employers. One course (delivered by FabLab in partnership with an FE college) was currently being piloted and five were new courses (delivered by one HEI) scheduled to start in late 2023. They were all day courses targeted at SMEs. The HEI courses covered all seven aspects of management skills identified in the rapid evidence review (see above) and received no public funding. Whilst the FE course covered four (not including the strategic integration or HR elements) and was funded through DfE monies. Such short courses can be used as first steps towards more substantial management skills development.

3.4. Business support programmes

The importance of supporting employers in the digital transition and human-centred technology adoption is recognised in WMCA's Digital Roadmap (WMCA, 2021). Interviews with the three WMCA Growth Hubs identified several programmes which supported firms' implementation of new technology. These programmes included Help to Grow Digital, Made Smarter and National Manufacturing Competitiveness Levels. These programmes supported some of the case study businesses reported in the next section. All receive public funding. However, some of these programmes tended to be short lived, for example Help to Grow Digital lasted for less than one year because it did not engage with a sufficient number of firms. Furthermore, many of these programmes are only available to manufacturing businesses and therefore exclude most of the region's businesses which are in the services and construction sectors.

The WMCA area contains three Catapults[9], of which two are High Value Manufacturing (HVM) Catapults: the Manufacturing Technology Centre (MTC) and Warwick Manufacturing Group (WMG), both based in Coventry. These Catapults provide technology and other support predominantly to manufacturing businesses.

Until recently there have been a number of time limited business support programmes funded through the European Regional Development Fund (ERDF). The ERDF ended when the UK left the EU and its funding has been replaced by the Shared Prosperity Fund (SPF) at a fraction of the monies, with funding limited to three instead of seven years.

There are a number of generic business support programmes to which Growth Hubs can signpost firms. These programmes can accommodate companies wanting to develop their business digitally or otherwise, for example the Goldman Sachs 10,000 Small Business programme, which provides development through learning, networking, peer learning and mentoring.

Finally, there are also a number of private consultancies which businesses can pay to receive support. Growth Hubs do not engage with this support because there are too many and Growth Hubs cannot quality assure them.

Interestingly, in the discussions with Growth Hub staff, the management education and training provision identified in previous sections was not mentioned suggesting a disconnect between business support, and management education and training provision.

Growth Hub respondents said that they often receive enquiries from businesses about the implementation of new technology. These are usually exploring whether financial support is available to help with a purchase, rather than assistance with implementing it. However, the timing of support is important. In most cases businesses request support after the decision on which technology to buy has been made.

Equipment and software manufacturers are often central to firms' decisions on which technology to implement, and also provide support and training on its implementation (see next section). However, Growth Hub respondents said this reliance on suppliers often put the choice of technology first, with implementation a secondary consideration (although suppliers do provide support in installation, see next section) whereas the introduction of technology should be a 'journey' placing the aims and needs of the business first, then its management,

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[9] Catapults are technology and innovation centres established by Innovate UK see https://catapult.org.uk/

and then the technology. Growth Hub respondents were positive about the Made Smarter programme because it took businesses on such a journey

The views of Growth Hub respondents on good practice in delivering business support for the implementation of new technology echoes the conclusions from the rapid evidence review. Business support should be: one-to-one; tailored to the needs of the business; focused on an identified issue; developed in the context of the geographical area (the importance of place); locally designed and delivered; and focused on business management rather than the technology.

3.5.   Conclusion

There are a number of management and technology related courses delivered across the West Midlands. However, very few concern the management of the introduction and implementation of new technology. Of those training programmes that do, many are degree level, full-time courses delivered by HEIs. Only a few short courses directly target businesses and are flexibly delivered.

Some publicly funded business support programmes focused on companies but most of these programmes are for manufacturing businesses only, and several have only lasted a few years.

Growth Hub respondents felt that too often businesses put the selection of technology first and foremost, rather than its implementation and utilisation. Effective business support programmes put the business strategy first with technology a means to an end of achieving the organisation's objectives. Support should be delivered one-to-one, tailored to the needs of the business, and locally designed and developed.

4. Employer case studies

4.1. Introduction

In-depth, qualitative interviews were undertaken with eleven businesses based in the West Midlands. The interviews covered: descriptions of the business (size, sector etc.); management skills development; new technology investments (choice, installation and implementation); and business support.

A case study approach was chosen in order to fully explore the complexity of the decision making process, the range of new technology investments and the workplace context of those investments, as well as the implementation process and its outcomes.

Organisations were identified through WMCA and the three WMCA Growth Hubs and included a wide range of organisations, as Table 2 shows. The businesses ranged from very large global service companies to small, regionally based manufacturers. The staff skills profiles also varied from highly skilled staff (e.g. degree level equivalent) to lower skilled staff (up to Level 2 equivalence) and those with a range of staff skill levels. All businesses had previously received business support, including several through the Made Smarter programme, and KTPs and which is why they were known to the Growth Hubs.

Table 2: Case study business profile

| Identifier	Sector	Site based	West Midlands employment	% of total	West Midlands staff skills profile	Total turnover
Business 1	Services	Global	500-999	4%	Mostly high skilled	>£1 billion
Business 2	Services	UK	100-249	13%	Mostly high skilled	>£1 billion
Business 3	Services	Global	100-249	1%	Mostly high skilled	>£1 billion
Business 4	Manufacturing	West Midlands	<25	100%	Mostly intermediate skilled	£1m-£5m
Business 5	Manufacturing	West Midlands	250-499	100%	Mostly lower skilled	£6m-£15m
Business 6	Manufacturing	West Midlands	500-999	100%	Range of skills	£50m-£100m
Business 7	Manufacturing	West Midlands	25-49	100%	Mostly lower skilled	£1m-£5m
Business 8	Manufacturing	West Midlands	25-49	100%	Mostly lower skilled	£1m-£5m
Business 9	Manufacturing	West Midlands	50-99	100%	Mostly intermediate skilled	£6m-£15m
Business 10	Manufacturing	West Midlands	100-249	100%	Mostly intermediate skilled	£6m-£15m
Business 11	Manufacturing	West Midlands	25-49	100%	Mostly lower skilled	£1m-£5m

Source: employer interviews, Institute for Employment Research

The next section presents findings on the decisions and approaches of these firms to new technology investments. The following section then reports their approaches to management skills development. Thes findings reveal these firms to have strategic and non-strategic approaches to both and can be typed on this basis.

4.2. Investing in new technology

For the regional manufacturers these investments were often related to their participation in the Made Smarter and similar programmes. Respondents were asked how much they had invested in new technology in the past five years. The large global/UK businesses could not put a figure on it as decisions were made at Head Office. They had no discretion within their regional offices as these investments were corporate decisions. The West Midlands regional manufacturers had complete control over the size and nature of the investments, and gave values ranging from £100,000 to £4m. Figure 1 shows that for most of these companies, their investment amounted to less 0.5% of their turnover. Three businesses invested 1-2% of their turnover on new technology. For one, it was 3%. The level of investments did not appear to be linked to whether the firms had strategic attitudes to new technology investments or management skills development.

Figure 1: **New technology investments in the past five years as a % of turnover**
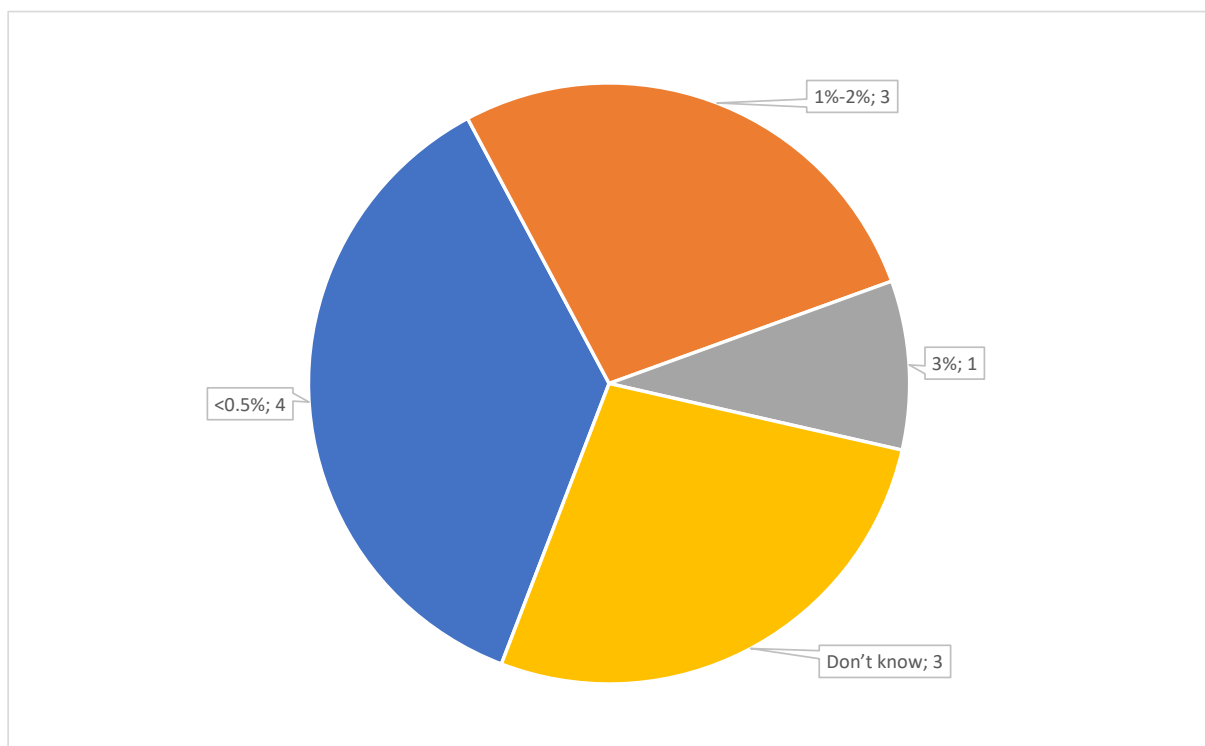
Source: employer interviews, Institute for Employment Research

Figure 2 shows that in the past five years all businesses had invested in the introduction or upgrading of cloud computing and video conferencing. All but one had invested in accounting or HR software, and CAD software.

By contrast, only a minority of businesses had invested in the IoT, machine learning, advanced materials, Big Data, AR and/or VR. On average, these businesses had invested in an average of 10 of these technologies, with the range being 6 to 14.

The range of new technology was not necessarily related to firm size. Whilst the large global/UK businesses had invested in ten or more of these technologies, three of the heaviest

investors in new technology (as a percentage of turnover and range of technologies) were the smallest firms in the sample.

Figure 2:   In the past five years have you introduced or upgraded any of the following?
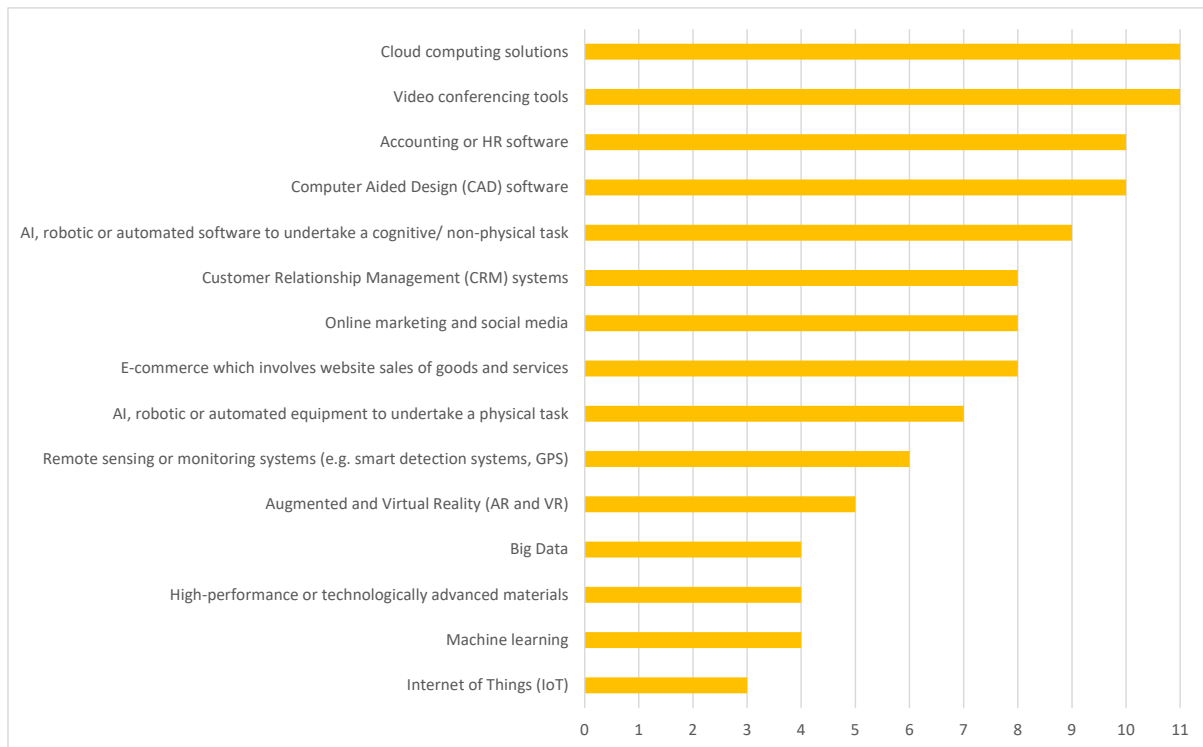
Source: employer interviews, Institute for Employment Research

All of the businesses had invested in new technology recently. Respondents were asked about their organisation's general approach to new technology investments. Most said that it was a fundamental or inherent part of their business strategy. In some cases being a technology leader was part of their service offer and so they needed to be at the forefront of technological developments:

> *"It is a fundamental aspect of the business. It is part of our business service offer as well as our operating business model. A couple of years ago we updated our mission statement to include digital innovation."* Large service company.

Others said they were always looking to reduce costs, and technology was a key (though not the only) aspect of this strategy. As a result, they were aware of technological developments:

> *"We are interested in increasing efficiency and reducing the number of hours workers had on a project. So we have looked at the possibility of digitalisation at both a business-wide scale and within individual areas."* Medium sized manufacturer.

The remaining respondents said that technological investments were more ad hoc, made when a business need (such as replacing older equipment) or an opportunity (e.g. having sufficient resources) arose:

> *"It is an ad hoc approach. We are not a cash rich company so we look at new technology when an opportunity arises or when there is a specific saving in efficiency that can be proven - then we will make that investment."* Small manufacturer.

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In two cases the Managing Directors were self-described technophiles and keen on keeping abreast of new technologies.

Respondents were asked why they had made their specific investments. They mentioned a number of drivers, see Table 3. Productivity was an imperative for all businesses, making the business more efficient, reducing costs and 'doing more for less'. Surprisingly, profitability was not a driver for many businesses, only two mentioned it. The next most significant driver was cyber security. In one case the organisation had suffered a serious cyber-attack which had taken enormous efforts to rectify. In some cases cyber security was a corollary or an added advantage of other technological investments in the business.

Production drivers were also important, especially production control.[10] Some businesses were in the process of replacing older equipment either due to it becoming inefficient or as a result of a fundamental change in the business model (see below). Two respondents mentioned skills shortages as a driver, that new machines could replace older staff who had or were retiring and which they could no longer replace. One business had instigated an apprenticeship programme to replace lost skills but was also introducing new machines to increase capacity.

Innovation was a driver for a number of companies. For the large service companies their business offer meant that they had to be seen to be at the cutting edge of technology or because they needed to be proactive in their business development. A number of the SME manufacturers had invested to develop new opportunities within their business. In some cases this also provided additional revenues to the business (e.g. new products or services) but was not what they had planned.

Table 3: Main drivers for investing in new technology

Broad driver	Specific driver	No. of responses
The bottom line	Productivity	11
	Profits	2
Risk	Cyber security	6
Production	Quality	2
	Production control	3
	Upgrading old equipment	3
	Skills shortages	2
Innovation	Future proofing	1
	Being an innovation leader	2
	New products/services	2
Customer focus	User experience	1
	Client expectations	3
Other	Sustainability	3
	Change in the business model	2

Source: employer interviews, Institute for Employment Research

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[10] This was mostly the introduction of Enterprise Resource Planning (ERP) and/or Materials Resource Planning (MRP) and often resulted from undertaking the Made Smarter programme.

Whilst respondents identified a number of drivers (four on average), those businesses with a more strategic approach to new technology investments and management skills development tended to have fewer drivers suggesting they were more focused in their reasons for investing.

Several case study businesses had recently engaged with their Growth Hub and/or the Made Smarter programme. Interviews suggest that through this engagement they had reviewed their business practices and identified that significant changes across a number of areas were required:

> *"The Growth Hub did an audit about our needs and what's available right now. They said robotics isn't there yet* [for what we make] *but we should look at ERP … At the moment we've got accounts, HR, Customer Relationship Management (CRM) software systems all separate, but the new ERP/MRP will bring it all into one place."* Small manufacturer.

For some companies there was realisation that systemic changes had to be made to the business. In some cases this realisation was due to having worked with a Growth Hub or Made Smarter programme.

> *"The company has been in existence for more than 50 years. They've done the same things for so long, then Covid crashed everything. After, they hoped things would pick up but it did not. So they brought me in to try and change things. Part of that is belief they must invest in new technology … rather than be stuck in the same way it's always been done."* Medium-sized manufacturer

This attitude contrasts with the approach of other regional manufacturers who had a more strategic and integral approach to new technology:

> *"It's done on an ongoing basis, we are constantly upgrading our equipment. But the main thing is to reduce costs, and new technology is one aspect of that."* Large manufacturer

Respondents were asked how they identified the potential utility of new technology to their organisation. A large number, particularly regional manufacturers, were signposted to particular technologies after working with Growth Hubs or the Made Smarter programme. In comparison, the large service companies had dedicated internal teams that could:" *assess, implement and strategically manage digital investments."*

For the regional manufacturers that were guided by working with a Growth Hub or Made Smarter programme, there was little discussion in the business, and few additional checks were made: *"We don't do a formal process. We don't have the time"* (Small manufacturer). However, several businesses would explore the technology further, for example, by seeing the equipment in use at trade shows, at the technology suppliers or in use by their own customers and/or suppliers.

The extent to which various business functions (production, R&D, purchasing, sales, HR, accounting and IT) were involved in the decision-making process depended on the nature of that technology. As one of the large service companies remarked: *"It depends on what we are doing. For example, some things wouldn't include HR but others would. So all of these* [departments] *would have been involved in tech developments over the past five years."*

In some of the smaller manufacturers, several business functions were involved simply because the Senior Management Team (SMT) is small with members having multiple

responsibilities. In some firms, certain business functions (such as HR and IT) are contracted out and so would not be involved. The cost of the investment determined the extent to which the MD or CEO was involved. Significant investments would need to be signed off by the highest decision-making level in the business.

4.3.   Approaches to skills development

Respondents were asked about their approaches to management skills development and whether this development relates to the implementation of new technology. Figure 3 shows that for most businesses in the sample, management skills development was regular and ongoing. Management skills development for the three large global and national service companies was centrally determined and systematically delivered, with little or no discretion at the regional level. This skills development included internally and externally delivered management training, and formal and informal provision including mentoring. There was also an expectation that managers would also 'self-develop' through a range of internally provided on-line development resources. All managers were qualified to at least degree level, and some of these businesses had company graduate management programmes.

Several of the regional manufacturing businesses also had regular and ongoing management skills development. This development was systematic whether stated or not in company training policy and was derived from the business strategy. In the case of these global and regional businesses, training needs were identified annually through personal development review processes (PDRs) and more frequently through regular management meetings.

For a minority of organisations management skills development was ad hoc and informal, and reactive to the needs of the business. In some cases management skills had been acquired whilst previous working for larger organisations, but for most of these companies it was 'learning by doing'. New technology developments in the sector or market were gleaned from a range of sources including: customers, suppliers, production managers, sales teams, equipment manufacturers and trade shows and as such was informal learning. One small manufacturer which had experienced significant recent growth commented:

> *"We fall down a little on this* [management training]. *Internal training is me learning it and passing it on. We learn about opportunities from our sales team who meet with clients who say, 'what about this' or 'what about that'".* Small manufacturer.

In some cases, there were internal barriers to management skills development, such as a past lack of encouragement for training

Figure 3:   Approaches to management skills development
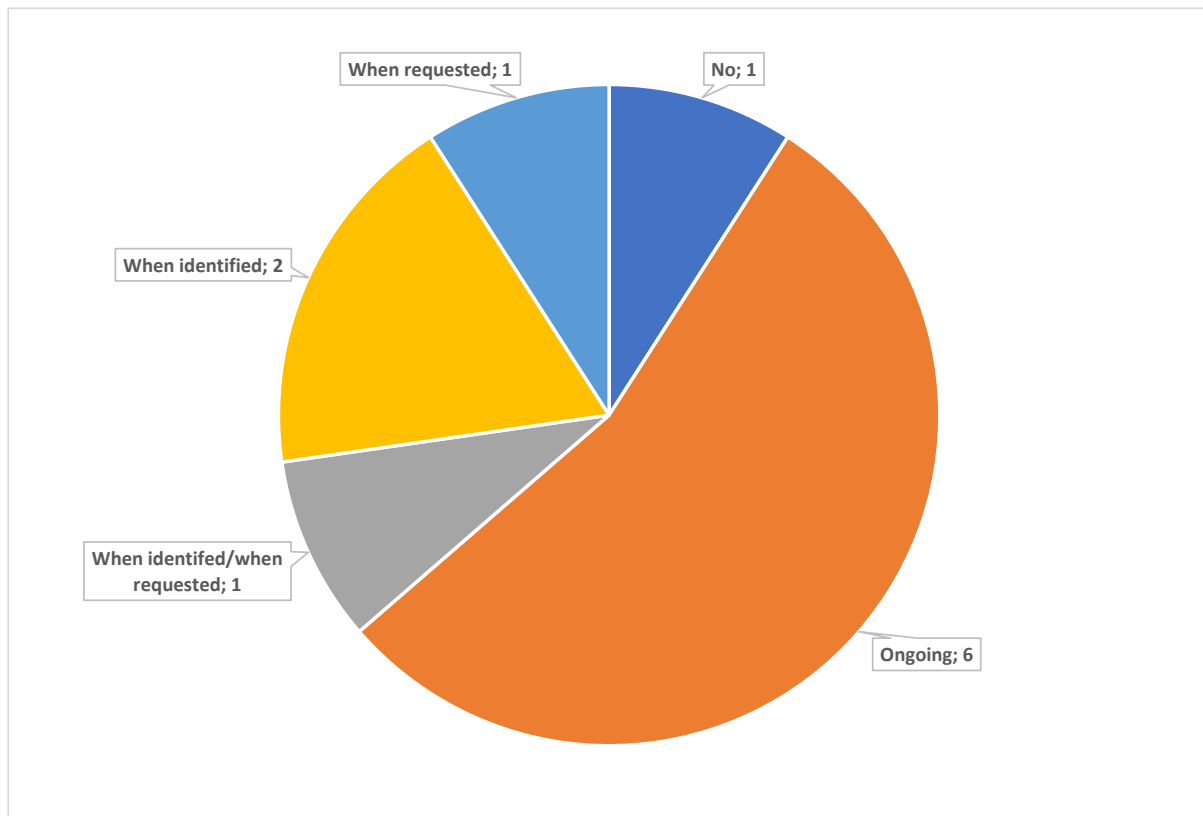
Source: employer interviews, Institute for Employment Research

Respondents were asked whether managers had received training in the acquisition and implementation of new technology. Those with an ad hoc approach to management skills development and an ad hoc view of new technology investments did not provide technology training to managers. Any training that does occur is neither systematic nor strategic:

> *"I've done a little bit of training. I went on the Help to Grow scheme. We talk with trade associations and learn about what other people are doing. Or its ad hoc and I Google to see what's going on. We are not cutting edge. We do management training usually out of necessity."* Small manufacturer

The five businesses which did provide new technology training to managers were asked whether it included certain types of training. The rapid evidence review identified requisite management skills for effective technology implementation. These skills are a combination of core management skills and other skills more specifically related to technology. Of the latter, there are seven broad technology-oriented skills associated with the effective acquisition and implementation of new technology (see Section 3.1).

Figure 4 shows that all but one of the companies which provide training to managers covered the topics of HR of technology staff, and the strategic integration of new technology. However, only two organisations trained managers in HR relating to non-technology staff.

All of the three large global/UK based organisations delivered on six or seven dimensions of management technology related training. Each had dedicated management resources focusing on technology acquisition and implementation as well as HR resources.

The final two businesses were regional manufacturers. One provided management skills development in the strategic integration of new technology, its utilisation and HR related to technology staff. Their approach was due to their participation in the Made Smarter programme which had resulted in them purchasing production planning software and needing to train people to implement and manage it. The other West Midland's manufacturer undertook such training only if it was identified and necessary. Theirs was a systematic, strategic but ultimately reactive approach. The two firms held regular management meetings which used analysis of systems data to identify and discuss training needs but only once the technology decision had been made.

Figure 4:   Management skills development in the acquisition and implementation of new technology
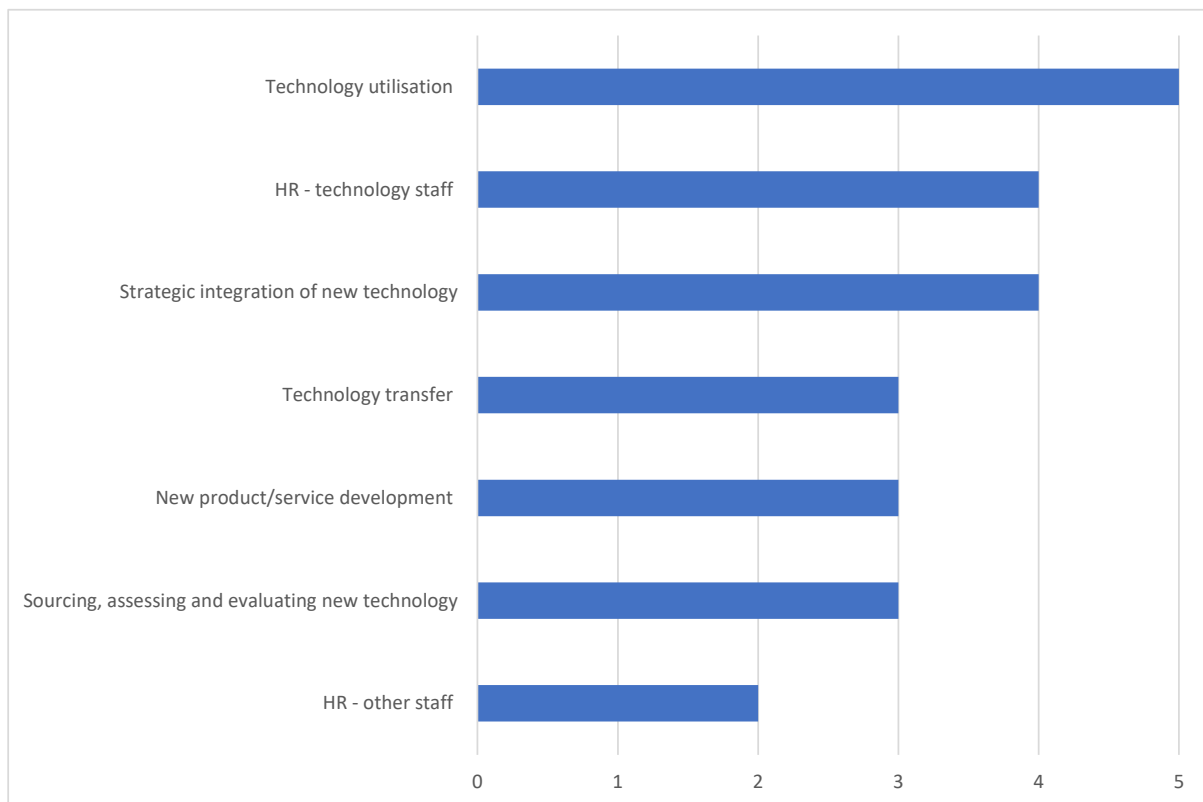
Source: employer interviews, Institute for Employment Research.

The findings reveal differing approaches to technology and management skills. The rapid evidence review found that a key reason why productivity gains have not resulted from such investments is that the focus has been primarily on the technology rather than how it might function within the business, and that particular management skills are needed to ensure successful implementation.

The 11 employer case studies divided into four clusters depending on whether they had a strategic approach to new technology investments and management skills. The first cluster has been further split into two groups because their resourcing was different due to their size:

- **Group A** companies (n=3) were the large service companies which had strategic approaches to both new technology and management skills development;

- **Group B** companies (n=3) were large and medium sized regional manufacturing companies which had strategic approaches to both new technology and management skills development;

- **Group C** companies (n=2) were small and medium sized regional manufacturing companies which had strategic approaches to new technology and but not management skills development;

- **Group D** companies (n=3) were small manufacturing companies which did not have strategic approaches to new technology nor management skills development.

Table 4 below summarises their approaches to investing in new technology.

4.3.1. Group A: strategic approach to both new technology and management skills development – large service companies

The first group of businesses were the three large service companies. Their investments in new technology, and management skills development, were derived from the business plan, they were continuous, and fundamental to the internal workings of the business and their service offer to clients:

> *"It is a cornerstone of the business. It is part of our business service offer and our operating business model. A couple of years ago we updated our purpose statement to include digital innovation."* Large service company

These organisations are technologically mature and have dedicated and well-resourced internal functions that lead and deliver on new technology investments and their relationship to other business functions, including and especially management and HR. Problems, issues and/or areas for investment are discussed at monthly management meetings and any skills and training needs would be discussed, including technology related.

Senior managers are recruited/promoted with high levels of management skills, for example, through graduate recruitment schemes. Managers receive further development that was ongoing, systematic, based on regular reviews and delivered in a variety of ways: in person, online, internal and external, self-progressed, tutor led, including mentoring.

Group A businesses had introduced or upgraded all of the 15 technologies identified in Figure 2. The main drivers were to: increase productivity; be an innovation leader; cyber security; and to deliver to their customers' expectations.

Their approach to new technology investments was derived from the business strategy and discussions of the future direction of the business at SMTs:

> *"It is part of our overall business strategy. We have an innovation hub where people identify and test ideas. As part of this we would run workshops across the business and ask people: what are our clients asking for? It is a structured approach – workshop, test things with clients, trials, engage with internal stakeholders."* Large service company

Table 4: Investing in new technology

	A – Strategic approach to management skills development and new technology	B - Strategic approach to management skills development and new technology	C - Strategic approach to new technology not management skills development	D – No strategic approach to new technology nor management skills development
Executive Team management training	Ongoing	Ongoing	When identified/ required/requested	When identified/ required/requested
Management training in technology	Ongoing	When identified	When identified	None
Technology drivers	Productivity; Innovation; Cyber security; Customer focus	Productivity; Production	Productivity; Production; External	Productivity; Innovation; Production; Cyber security; External
Technology investments (see Figure 2)	All of the 15 technologies listed	10 of the 15	8 of the 15	10 of the 15
Identifying potential of technology	Dedicated functions within the business	Monitor other businesses Trade shows; trade organisations Knowledge of CEO and production managers Links to HEIs	Monitor other businesses Trade shows; trade organisations Knowledge of CEO and production managers	Monitor other businesses Trade organisations Knowledge of CEO and production managers
Are employees consulted?	Yes	No	No	Yes
How are workforce implications assessed	Dedicated functions within the business	Through implementation Expect resistance	Through implementation Past experience Expect resistance	Inclusive approach Expect resistance
Process	Driven by business strategy SMT meetings Establish project board: consult, evaluate, identify and implement	Impetus from CEO/production managers Use Made Smarter/KTP Process driven: problem, solution Workforce involved in implementation	Impetus from CEO/production managers Use Made Smarter/KTP Work with supplier Workforce engagement to allay fears	Problem and purchase Use of Made Smarter Workforce engagement to get staff buy-in (older workers) Workforce engagement to allay fears
Support used	Dedicated functions within the business Suppliers	Made Smarter programme Suppliers KTP placement	Made Smarter programme Suppliers Customers KTP placement	Made Smarter programme Suppliers
Impacts	Innovation; Production; Customer focus	Production	Production	Production

Source: employer interviews, Institute for Employment Research

A task and finish project group would often be established to drive the technology investment. Workforce engagement would occur throughout this process via the project groups and would involve forums, workshops and/or user groups:

> *"There'd be forums and workshops, focus groups. It depends on the size of the investment and the nature of the tech. In the case of the* [XXXX]*, the idea was first mooted then there were focus group held with various people affected and they provided feedback, and then this fed into the implementation."* Large service company

In some cases, depending on the nature of the technology, external suppliers would be sought through a tendering process, and the supplier would be part of the implementation process, including staff training. Apart from these suppliers, no other external support was required.

Implementation ran smoothly and intended impacts were realised.

4.3.2. Group B: strategic approach to both new technology and management skills development – large and medium sized manufacturing companies

Three of the regional manufacturing companies also had strategic approaches to both new technology and management skills development. Two were medium sized and one was a large employer. Two organisations had undertaken the Made Smarter programme and two had been involved in a KTP and had good links with HEIs, including Catapults. Reducing costs was an ongoing priority.

Similar to the large service companies, they had an ongoing and business-wide approach to the implementation of new technology. The main technology drivers were increasing productivity, greater production control, to improve quality, and to replace older technology.

Management skills development was ongoing, systematic and based on regular reviews. Problems, issues and/or areas for investment are discussed at monthly management meetings and any skills and training needs would be discussed, including technology related.

The breadth of the decision-making process within the company depends on the nature of the technology. Unlike the large service companies, these manufacturers are much smaller and so have more concentrated management functions. Most business functions would be involved, primarily production, accounts and HR.

Staff are not consulted prior to implementation, although the workforce implications of technology investments are factored into the decision. The focus within the firms was on meeting the business objective rather than the technology:

> *"It's the process that's important rather than the kit. Too often there is too much focus on the capital side buying a new machine but not using it to the full capacity. You can buy new machines but don't have people to use it to the full capacity."* Medium sized manufacturer

The Made Smarter programme provided two of the organisations with a template for identifying and implementing new technology. Organisations used a variety of mechanisms for identifying the right solution: looking at what other businesses (competitors, customers and suppliers); attending trade shows; contacting trade associations; and drawing on the knowledge of directors and production managers.

Great reliance and trust is based on the technology suppliers as they also provided business support and training through the implementation process. Therefore securing the right supplier and developing good relationships with them are key factors in implementation.

Technical staff were involved in the technological aspects of implementation but other staff were also involved to promote the benefits of the investment, to allay any workforce fears and develop buy-in:

> *"It's a change and there is always resistance to change. But when everyone sees the benefit of the change, they get on board. Proper training is important to that, because once the training comes into existence, they really understand the benefit. Then everyone can see it and see how we are using it to make decisions. It motivates people."* Medium sized manufacturer

All three organisations reported significant impacts from their investments, including reduced costs, increased capacity (which led to new business); and better-quality products.

4.3.3. Group C: strategic approach to new technology but not management skills development –medium and small manufacturing companies

Two companies comprised this group, one medium and one small manufacturing businesses. Their approach to new technology was strategic and ongoing, driven by the business plan, including an aim of one company to be 'World Class'. However, their approach to management skill development was more ad hoc.

Between them, these two businesses had a wide range of drivers and expected a wide range of benefits from new technology investments. Both were making fundamental changes to their business models which involved significant technology investments. One respondent described themselves as a technophile who sees technology investments and their benefits as 'rewarding and exciting'. There was a similar approach in the second company, however, there had been a different approach to hardware and software:

> *"The MD is obsessed with tech and new machinery. Whenever he sees the opportunity he goes for it."* Small manufacturer

Whilst there was an ongoing awareness of technology developments and their application to the business, the approach to management skills development was unsystematic. The management team focused on the 'day-to-day running' of the business. They were not involved in future planning as that was the responsibility of the MD. The second company had just appointed a new Director who was developing a new business model for the organisation, including staff reviews and encouraging training.

Both businesses had received valuable support from HEIs. One organisation had invested in the Made Smarter programme, which had prompted them to invest in an ERP system. The second business had been involved in a KTP with a local HEI and had invested in a range of new equipment plus an ERP system. In this latter case, all technology decisions went through the MD.

The small manufacturing company had a new director driving changes and they want to introduce a more inclusive approach:

> *"Change is frightening. Especially when it's a small business. And now there's some new guy (me) bringing in new people, bringing IT systems. I think it's*

about the coaching and the presentation and the explanation of why you're making those changes. It's about having a different culture, having an open environment." Small manufacturer

As with Group B companies, staff were rarely consulted prior to new technology implementation. In one of the Group C companies staff reticence over the impact of new technology had to be addressed by stressing the benefits of the new IT system:

"If you go to a worker and ask them about an ERP system, they'll say what's an ERP system. It's the directors' responsibility to make decisions. It's then about how to implement which is why have meetings to get workers involved in the implementation phase. You start to explain the benefits, what it means to them, what it means to the business, what it means for wages and profitability." Small manufacturer

The medium sized company had very little staff involvement at any stage. The MD believed that past experiences of successfully implementing technology had created the buy-in of the workforce. New equipment is installed and workers receive training to use it, which is the extent of the workforce's involvement:

"I've got people who have been here for 30+ years. They've learned to trust me. Every year they get a rise and their work conditions improve. I've never told someone they don't have a job once we've got new tools. They get more pay. So there's not been any pushback." Small manufacturer

The significant technology investments identified by the two companies were still bedding in. But both felt that they will achieve the desired aims: for one to improve productivity and profitability; and for the other, to develop a more professional approach to managing the business and to improve productivity and turnover. However, there are significant risks in having management and technology decision making so concentrated in one person.

4.3.4. Group D: no strategic approach to new technology nor management skills development –small manufacturing companies

All three businesses in this group had an ad hoc approach to new technology investments and management skills development, although all three had been involved in the Made Smarter programme. Two of the businesses knew that change was needed. One respondent said, 'we are old fashioned but growing up'. Their decisions were, in part, driven by the returns from past investments.

Whilst these three firms were all small businesses, they had the highest level of investment in new technology. Two had a narrow set of drivers for investing in new technology: productivity, cyber security and innovation. One firm had several different drivers, in part because they had recently expanded and had moved to new premises where there was space for new machinery.

The approach to management skills development was ad hoc, although all three had participated in Made Smarter and two had undertaken the Help to Grow Programme. Very little additional management skills development is undertaken or training needs identified.

Two firms had invested in ERP/MRP software as a result of their involvement in Made Smarter, and the third had invested in other business control software. In addition, all of the firms had bought new computerised machinery.

As small firms, financing new technology was a major decision and achieving a return on these investments was critical. Even though the firms had participated in Made Smarter, there was no formal process for identifying and evaluating new technology.

All three firms encouraged workforce involvement in the decision-making process. In one firm this involvement was due to the MD's HR background. In another company the impetus was to allay workforce fears:

> *"Their first thought is 'oh I'm out of job', so we have to really talk it through. If we can, we take them to go see a demo at the manufacturers. The MRP/ERP supplier had a few meetings with people from different departments who could put their own questions in. It's change and people don't like change. We try to bring them in early rather than at the end saying, 'by the way here's a new thing'".* Small manufacturer

However, workforce engagement in technology implementation was not always successful. In one case it was difficult to engage an older workforce in the training. These workers preferred to learn by doing. As a result, implementation has been a challenge with some staff reverting to the older technology. In another instance, workforce engagement led to staff identifying a different solution, in part because staff needed training prior to participating in the engagement process, and their participation needed to be better facilitated:

> *"We did an engagement exercise to design the new workshop and workstations. But it was awful. It didn't lead to a sensible plan. But it then gave us a platform to explain why ours was not like theirs. They'd missed this, this and this. Once they learned why their plan didn't work, they had more buy in for the plan that was eventually produced."* Small manufacturer

Despite the challenges, all three companies reported positive impacts from their investments in terms of productivity gains, increased capacity, spin-off business lines, and better production controls.

4.4. Business support used and gaps

This section explores the extent to which businesses made use of publicly funded support available to them, either advice and signposting through a Growth Hub, or dedicated technology support through programmes such as Made Smarter, or available through HE providers.

The three large service providers (Group A) did not access publicly available support. Most of the business support they use was from internal dedicated business functions e.g. R&D and HR. If they do access external support it is from suppliers commissioned via a tendering process.

All of the regional manufacturing businesses had accessed business support through the three WMCA Growth Hubs, many had accessed the Made Smarter programme, a number had links with West Midlands HEIs (in some cases having a KTP placement), and participated in other support programmes, such as, Help to Grow. For many, the links with the Growth Hub and support programmes had helped them determine what technology they needed to invest in. In several cases this was ERP/MRP software which helped them monitor and manage the production process.

The Group B businesses were well associated with local business support and/or innovation networks. Two had participated in Made Smarter and, along with the training, had successfully applied for grant funding. In common with most of the manufacturing businesses, they received considerable support from suppliers with whom they had very good and trusted relationships. Group B companies were well served by their support networks, and derived significant benefits from them. Most could access all of the support they required. One firm mentioned a higher value productivity initiative they would like to access but it was too expensive. They suggested that they would like to see someone develop the programme for a consortium of SMEs in a supply chain, so funding could be pooled.

Group C businesses had more recently become aware of the range of business support available, and greatly benefited from it both in terms of training and grants. Both said that there was a lack of awareness in the past but now they knew where to go for assistance. One believed management skills development was the key as it gave a balanced view of technology across the business rather than seeing it as a solution in and of itself.

Group D businesses had recently contacted their local Growth Hub and were then signposted on to the Made Smarter programme. The programme had been instrumental in driving their recent technology investments providing advice, support, access to grant funding, help in identifying suppliers, and a structured process to implement their new investments. Respondents said they would like further support in: accessing finance, writing grant applications, links with FE institutions (for apprenticeships), and with HEIs for innovation. Some thought the region well served with business support but it is becoming aware and being able to access it.

Whilst several employer contacts came through the Growth Hubs, all of the regional manufacturers were aware, and made use of, publicly funded support programmes. Some (mostly Group B) were already in contact with Growth Hubs and HEIs and this provided a bridge into further provision. Others (Group C and D) were using their involvement in Made Smarter or similar programmes to act as a bridge into a wider range of provision. Group A employers did not need access public business support provision.

4.5. Conclusions

Case studies were undertaken with eleven businesses in the West Midlands. They were grouped according to whether they had strategic or ad hoc approaches to new technology investments and developing management skills. Resonating with the findings of the review, those businesses which did have a strategic approach to new technology investments and developing management skills were able to identify and implement new technologies more effectively. Having such a strategic approach resulted in managers receiving training in new technology, which was absent from organisations taking ad hoc approaches.

For businesses with a strategic approach to both technology and management training, new technologies were implemented in an organic way as part of a broader decision-making process within the organisation. By contrast, businesses taking an ad hoc approach introduced new technology in a more reactive way and encountered greater problems in implementation.

For the regional SMEs in the study, support from the Growth Hubs - and the programmes they were signposted - to were instrumental in the selection of new technology. All businesses received some support from suppliers of the technology.

5. Conclusions and Recommendations

5.1. Summary of findings

This study has been undertaken in partnership with WMCA in the context of the West Midlands wanting to improve its firms' productivity as digital technology increasingly pervades those firms. This research had two tasks. First, to identify the management skills that best support productivity gains from new technology. Second, the education and training available to businesses in the West Midlands to develop these skills.

The rapid evidence review found that new technology, productivity and management skills are interrelated. New technology has not achieved the anticipated productivity gains because there has been a focus on new technology itself rather than how it is selected and implemented within the context of the organisation. The proponents of this socio-technical viewpoint believe that the right management skills are required to generate business impacts. These skills are a combination of technology related skills such as the strategic integration of new technology, and sourcing, assessing and evaluating new technology, and core management skills, for example, project management and human resource management.

Some management training and business support is available to inculcate these skills, but there is generally low take-up, especially amongst SMEs where the productivity gap is greatest.

Based on a review of web-based information, a review of West Midlands education and training provision of these skills found that there were around 50 courses which covered both management and digital technology. These were mostly formal management degrees offered by universities. At the other extreme were a small number of employer-focused and accessible short course provision, often as 'taster sessions'. Some providers are developing employer focused management of technology provision, but with delivery scheduled for late 2023.

Between this formal degree and short programme provision were a number of publicly funded business support programmes. However, these support programmes tended to be primarily targeted at manufacturing businesses (and therefore a minority of West Midland's businesses). Moreover some of these programmes were short lived. West Midland service sector SMEs in particular do not seem to be well served with support for the development of management skills necessary to ensure successful adoption of new technology. When SMEs access publicly funded support to help them invest in new technology it is often after the decision is made, with businesses seeking grant funding to purchase the technology rather assistance with selecting and implementing it.

The review of provision suggests that there is a dividing line between new technology and management skills. On the one hand there is education and training for management skills development. On the other hand, there is business support for technology adoption. This distinction is not new (Dickinson, 2016) and cannot be helpful to meeting the needs of businesses. A bridge between the two needs to exist.

Case study interviews were undertaken with a range of businesses in the West Midlands. These interviews explored how these businesses identified and implemented new technology, undertook management training (in relation to this new technology), and any training and support they used or needed. The findings revealed that a first group (Group A) of businesses had a strategic approach to both the implementation of new technology and the management skills needed to underpin its success. These firms were large service sector companies who

were largely self-sufficient in their approaches to technology implementation and management skills development; they also had ongoing training in the management of new technology. The second group (Group B), also took a strategic approach to technology implementation and management development, these were medium sized regional manufacturers who accessed a range of publicly funded support. However, management training in technology was only undertaken when identified. A third group of businesses pursued a strategic approach to technology implementation and but an ad hoc approach to developing their management skills. These firms only undertook management training in technology was only undertaken when identified. A final group lacked a strategic approach to both technology implementation and management skills, and provided no management training in technology. However, these were the only manufacturing businesses that involved their employees in the introduction of new technology but this was not undertaken very effectively.

Significantly, as the first two groups included firms in both the service and manufacturing sectors and large and medium-sized firms, suggests that sector might not be a determining factor in whether a firm develops strategic approaches. Size however might be. While Group C included some medium-sized firms, there were also some small firms, however, small firms comprised all of Group D (the ad hoc group). Small firms in the West Midlands would appear to struggle to develop strategic approaches to the implementation of new technology and the requisite management skills. However, muddling through still led to positive productivity outcomes being reported by these firms.

Nonetheless, having a strategic approach to *both* new technology investments and management skills development resulted in more straightforward implementation. The reason is that these businesses were clearer about why they were making these investments (derived from their business strategies and plans) and there was an involvement of a broader range of business functions. Those firms taking a strategic approach to new technology investments *but not* management skills development ran into more challenges. The reason is because key investment decisions had limited management involvement and had a 'technology first' approach. Many of the SMEs, for example, often requested support from the Business Hub after the investment decision has been made.

Finally, companies without a strategic approach to new technology investments and management skills development faced the most challenges and/or risks. New technology investments tended to be 'one-offs' with little structured planning and involvement of wider business functions. Although they did not take a technology first approach, their investment decisions were the most reactive and disjointed and, moreover, faced most implementation challenges from employees. In short, the case study interviews confirmed what the literature suggests: to fully realize the productivity gains from new technology investments, management skills must be addressed. The case study findings thus support the socio-technical view that successfully investing in new technology requires the integration, primarily by management, of the technical and social aspects within any organisation.

5.2. Recommendations

These findings suggest a number of key recommendations. These recommendations are intended to address the weaknesses in current education and training provision for the management skills needed to successfully implement the new digital technology and thereby realise the potential productivity benefits for the West Midlands.

The WMCA has devolved responsibility for adult skills investments and business support. However, other organisations are also involved in and/or effect these policy areas. These recommendations are therefore relevant to a range of organisations including: the UK Government, local authorities, HEIs, business representative organisations, business support providers and employers.

Recommendation1: More and better provision of education and training to develop the management skills to implement new technology and reap the productivity rewards

The quality of UK management is generally lower than in competitor countries, in part due to relatively low management training (a key issue for SMEs). This produces weaker management skills and is seen as one reason why productivity gains are not being realised. The analysis of West Midlands management skills provision undertaken in this study reveals fragmentation and gaps in the education and training of the management of new technology. Firms need the management skills to be able to identify which technology is relevant to their business, how to acquire it, and how to implement it, most importantly, within the context of the business. There is currently little education and training provision in the West Midlands that does this, what is available tends to be through the business support route (e.g. the Made Smarter programme) and this is separate from management education and training that is predominantly delivered through HEIs and some FE providers. Building on WMCA's recognition of the need for greater upskilling of managers (WMCA, 2022), more provision needs to be available to engender technology implementation skills in the region's managers, but it needs to be integrated more within broader management education and training. As we have seen, the skills associated with effective technology investments are a mix of core management *and* managing technology skills.

Much of the business support provision is focused on SMEs, which is well targeted as SMEs tend to have lesser management skills. However, most managing technology programmes are for manufacturing SMEs, with few available to service businesses (which make up most businesses and employment in the West Midlands). Service sector SMEs should also be provided for, especially as many of the current trends in technology (such as, AI and Big Data) are likely to have greater impact on services.

Recommendation 2: The enhanced education and training provision for these skills needs to be demand responsive, tailored to varying firm needs

Firms are at varying starting points in their management of technology investments. At one end are the large businesses which have strategic approaches to both technology investment and its management. At the other end firms, usually, SMEs, which lack either such strategy. In between are firms that have a strategic approach to new technology but not the necessary management skills and managing technology skills. There ought to be education and training entry points from the day long 'taster' days through to more intensive skills development, and points in between. Taster days are currently offered by some FE colleges and intensive skills development by HEIs. A pipeline of provision could be created that incorporates such entry and progression opportunities. These opportunities would help firms engage at a number of different points relative to their needs and, having completed, easily move on to further development of their managing technology skills. The design of these entry and progression points should be co-created with firms so that they are both responsive to firm needs, i.e. provision when and how they need it, and are fit for purpose in terms of delivering the right

skills for that type of firm.[11] The WMCA might adopt an initial facilitating role in this co-creation, brokering between firms and education and training providers, and perhaps involving the Growth Hubs. In addition to formal provision, informal support can be better levered. Informal learning can occur through organisational engagement (especially technology suppliers) and networking relationships (e.g. trade associations). Such informal learning should be encouraged alongside formal provision as part of the pipeline of provision. Resources could be developed from 'how to' guides through to identifying recommending suppliers, networks and other 'informal' learning providers. WMCA could fund, and Growth Hubs deliver, learning brokerage functions.

Recommendation 3: WMCAs adult skills investments could be considered as a source of funding to develop this enhanced, firms-sensitive education and training provision

Many SMEs are reluctant to invest in skills training and often require financial incentives or subsidised provision. Resources will be needed to improve the education and training provision and development amongst managers of the skills needed to successfully manage new technology in the region. WMCA's devolved skills funding (the Adult Education Budget) is a potential source of funding. WMCA, through its management of both the adult skills investments and Growth Hubs, and links to HEIs and FE providers, is in a unique position to stimulate and finance the development of a coherent pipeline of managing technology skills, combining and/or linking core management and implementing technology skills.

There is currently a gap in managing technology skills provision, although it is partly filled by business support programmes. However, the two are often separate with a false dividing line between skills provision and business support. This is not a definitional issue. There should be more of an interplay between education and training provision and business support, where participants in either are made aware of the benefits of the other and how this impacts on business performance.

Recommendation 4: Firms need to be encouraged to adopt a business first, not technology first, approach to adopting new technology

There is a risk in assuming that the introduction of new technology alone will help raise productivity with firms. The evidence base – both from the literature review and the case studies – highlights that problems can arise within firms if that technology is not introduced as part of a wider business strategy and is appropriately managed. The findings reveal that a key reason why productivity gains have not resulted from new technology investments is that the focus has been primarily on the technology rather than how it might function within the business. A business first strategic approach to new technology investments and management skills development supports more effective technology implementation.

Recommendation 5: Business support programmes should use intelligence to inform and help motivate businesses to undertake the training needed to upskill staff to manage technologies.

Some publicly funded business support programmes do exist to support management skills in implementing new technology, however, most of these programmes are for manufacturing businesses only, and several have only lasted a few years. The evidence review identified those management skills required to effectively implement new technology. This wider evidence, and the findings from this study, should be summarised so that business support

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[11] See the suggestions by Grugulis (2023) about how the new Local Skills Improvement Plans (LSIPs) might be improved.

practitioners have a succinct and readily available evidence resource to present to employers, some of which engage with business support services as a means of boosting survival and growth prospects but may not be considering training as a means to these ends.

Recommendation 6: Consideration ought to be given to the development of a regional ecosystem approach to the management skills for implementing new technology

Gaps and weaknesses in the uptake of provision currently exist in part because greater coherence is needed. WMCA can take the lead in coordinating management skill demands and supply both immediate and longer term in order to boost uptake. Skill ecosystems help develop this coordination and coherence from both a user and provider perspective, and from different business starting points. The WMCA should adopt an enabling role in establishing such an ecosystem. As a first step, it should map the relevant regional key actors and institutions e.g. economic development agencies, business support organisations, companies, employer representative organisations, trades unions, consultancies, and education and training providers. Working with them it could co-create a protocol that outlines the relationships and responsibilities for what, when and how provision and support is delivered, and the resources required to initially boost both that provision and demand. Thereafter it is a basis for matching the demand and supply of management skills that lever productivity gains through new technology in the region.

These recommendations offer the WMCA the opportunity to co-develop interventions with firms as well education and training, and business support providers. The aim has to be to equip managers with the skills to successfully implement new technology in order to realise its potential productivity benefits. In doing so, there is opportunity to improve the provision of education and training for managers in the West Midlands, improve the quality of management in the region and future proof the performance of the region's firms, particularly SMEs, in an era of significant technological change.

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7. Appendix 1: Definitions

Productivity

Productivity is a key source of economic growth. It largely determines the long-term economic health of a nation and underpins raising living standards and the competitiveness of an economy (ONS 2020).

Productivity is the ratio of inputs to outputs. As there are a wide variety of inputs (i.e. various forms of labour, machines and other resources) methods for calculating productivity vary depending on which inputs are considered (Round et al. 2020).

As the major input into the production process is labour, many accounts of productivity calculate labour productivity, usually as the quantity of goods and services produced per unit of labour input per hour (Round et al. 2020). It is the indicator most used when comparing different geographical areas (e.g. regions and countries) and sectors.

Total Factor Productivity measures productivity that is unaccounted for by labour and capital inputs. It is usually interpreted as the contribution to production of the utilisation or deployment of labour and capital (e.g. organising people on production lines). TFP is also termed multi-factor productivity (MFP).

In this report, different definitions of productivity are used, to a large extent because use of the term productivity varies in the literature. The definition used will be specified where possible. Where productivity is used in a general sense, it refers to TFP.

New technology

New technology usually encompasses computers and information technology. However, more recently a range of new digital technologies have emerged, which include: Additive Manufacturing, artificial intelligence (AI), Big Data, machine learning, and simulation and other technologies. This bundle of new technologies effects the production of goods and services and is sometimes referred to as Industry 4.0 (Warhurst et al. 2020) and offers a future of increasingly autonomous and intelligent production systems (OECD 2017). In general, in this report, new technology refers to this digital technology.

SMEs

Whilst the project focuses on productivity across all employers, SMEs also feature. SMEs generally refer to companies with fewer than 250 employees.

SMEs are of particular interest primarily because they tend to be the main focus of economic development policies, programmes and funding which, in part, reflects their relative economic underperformance. Across the economy as a whole, SMEs have lower rates of productivity than larger organisations. Significantly, in most local economies, SMEs (as business units) account for almost all businesses. In WMCA 99.5% of all enterprises were SMEs (Inter Departmental Business Register, 2021). However, in employment terms SMEs account for around 40%-50% of jobs.

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8. Appendix 2: Managing technology skills - classification

Broad skill classification – new technology	Skill components
Strategic integration of new technology	Strategic role of technology in business, managing technology projects
Sourcing, assessing and evaluating new technology	Selection of technology projects; timing of technology projects; evaluation of technology projects (e.g. Cost Benefit Analysis of digitization); technology sourcing and acquisition; technology financing
New product/service development	Management of research; new product/service development; technology innovation processes
Technology utilisation	Internal use of ICTs; internal use of manufacturing technology
HR – technology	Recruiting and retaining trained technology staff; employee technology skill development; overseeing technology team-based environments
Technology transfer	Transfer of technology between organizations; transfer of technology within organizations
Broad skill classification – management	**Skill components**
HR – other employees	Communicating with employees; employee non-technology skill development; employees participating in decisions; overseeing team-based environments
Core management skills	Analytic skills; business administration; communication (written and oral); data-driven management; financing technical projects ; general business functions; management training; managing large, complex projects or systems; strategic management competencies
Management competencies	Attitude; creativity; entrepreneurship; leadership
Management knowledge	Environmental issues; ethical issues; influence of government policy; legal aspects; social issues

9. Appendix 3: Provider self-assessment checklist

1. Organisation's name

2. Title of course/programme

3. When did the course first start? (Enter month and year)

4. On average, how many hours does it take to complete?

5. Is it externally assessed?

6. Does it lead to a qualification?

7. Type of provision: Whole programme; Compulsory unit in a whole programme; Optional unit in a whole programme; Part of a unit; Other.

   If part of a wider course - what is the title of the managing technology module?

8. What is the main focus of this course? Business support; ICTs; Management training; Other technology

9. How is it delivered? Face-to-face instructor-led training; On-line instructor-led training; Mix of face-to-face and online tutoring; Coaching or Mentoring; Peer support; Webinars/podcasts; Other - please specify

10. What is the main funding source(s)? For example, DfE, WMCA, employers, individual, ESF etc.

11. Do you charge for this provision?

12. Does the course include any of the following?

    - Strategic integration of new technology

    - Sourcing, assessing and evaluating new technology

    - New product/service development

    - New technology utilisation

    - Managing technology staff

    - Managing staff who use new technology

    - Technology transfer

    - Other - please specify

13. Is the course targeted at:

    - specific sector(s)? If yes - please specify

    - size of business e.g. small and medium sized employers (SMEs)? If yes - please specify

    - businesses in a specific geographical location? If yes - please specify

    - businesses of different age/maturity e.g. start-ups? If yes - please specify

14. Do you plan any significant changes to this course in the next 12 months? If yes - please specify

15. Is there anything else you would like to add?