Supporting Physics in Business
An exploratory study into the innovation-related business support needs of physics-based firms in England
The study team comprised Dr Kieron Flanagan, Dr John Rigby, Dr Ronnie Ramlogan and professors Philip Shapira and Jakob Edler. Coral Grainger managed and conducted the programme of telephone interviews with Dr Kieron Flanagan and Dr John Rigby. The report has been written by Dr Kieron Flanagan and Dr John Rigby with Dr Ronnie Ramlogan and support from Dr Jakob Edler and the rest of the team.

The authors would like to thank all of our respondents for agreeing to devote some of their valuable time to discussing these issues with us. We would also like to thank Alex Connor and John Brindley at the Institute of Physics for giving us the opportunity to conduct this study and for all of their support and encouragement. Finally, we would like to record our sincere appreciation to Coral Grainger, without whose research support this study could not have been completed.

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Executive summary

This document reports the findings of a study by the Manchester Institute of Innovation Research at Manchester Business School (University of Manchester) for the Institute of Physics on the innovation-related business support needs of “physics-based firms” in England. The Institute conducted a telephone survey of respondents in 16 small and larger firms across England, across a range of broadly “physics-based” sectors during October 2010. Respondents were asked about any public support for innovation that their firm had received over the previous five years. They were then asked for their views about likely needs for support in the next five years and their views on the needs of firms in their sector and region. They were asked for their views about the broader climate and “framework conditions” affecting innovation in England and the UK, and finally about their views of the most appropriate configuration of public support for innovation in the medium-term future.

Key findings
1. Our respondents tended to underestimate the support they have received unless it was explored systematically with them. Having said that, it seems remarkable that only two of our 16 respondents claimed to have received no public support for innovation whatsoever over the past five years (and one of those respondents still stressed the role of the public sector as a client in shaping their innovation).
2. Surprisingly, only one of our respondents specifically mentioned that the firm had received support from European programmes over this period.
3. Support for wider networking and collaboration was the most common form of support received, and sector-specific or local networks were frequently mentioned in this regard.
4. A small number of our respondents felt that support received had been unhelpful or welcome but not that important, but many others stressed the significance of the support they had received to their innovation over the five-year time period.
5. Many of our respondents did strongly stress the need for more focused and sector-aware or sector-specific support and, related to this, more scrutiny of the relevance of the knowledge and experience of those providing the support.
6. Most frequently rated as highly important or potentially critical to the innovation success of the firm for the next five years were support for specific research and development (R&D) projects, support for skills development, support for testing and proof of concept, and acquisition of external knowledge.
7. Skills development in particular seems to be a major concern for many firms, confirming the findings of previous studies. A number of respondents also strongly stressed the challenges of attracting highly skilled workers, whether due to barriers to relocation or due to the nature of employment and immigration regulations. These problems are severe for at least some physics-based firms.
8. Respondents strongly emphasised better understanding of sectoral and market needs as a crucial element in the design and delivery of innovation-related business support. For many this was a much more important factor than whether priorities were set or services delivered at a national, regional or local level.
9. A number of respondents stressed the importance of redressing the perceived “gap” in the provision of support between R&D and product or process introduction. Many noted the encouraging progress made in redressing this gap in recent years, with the establishment of the TSB and the development of centres such as the National Composites Centre at the University of Bristol and the Advanced Manufacturing Research Centre at Sheffield.
10. Respondents generally agreed that the broader
conditions and climate for innovation in England and the UK were good, if not by comparison with the US then at least by comparison with emerging economies in the Far East.

**Policy Implications**

11. Although respondents were generally relaxed about the reversion of policy-making about innovation support to the national level following the impending abolition of the Regional Development Agencies, geography is still an important consideration for innovation in that its activity has a clear spatial dimension and there will always be place-specific needs affecting innovation (e.g. the issues around attracting new workers into the congested and expensive Cambridge region).

12. The precise shape of the new arrangements is likely to have important implications for how effective innovation support is in the future. A particular issue is how the new national and local arrangements will relate to the existing sector-specific bodies and networks, which our respondents suggested have often been important. How will firms, the new Local Economic Partnerships, the Technology Strategy Board and the Department for Business, Innovation and Skills negotiate the process whereby sector-specific support is offered, and with what geographical implications?

13. A number of respondents stressed the importance of existing centres such as the National Composites Centre and the Advanced Manufacturing Research Centre. It seems sensible that any network of Technology and Innovation Centres should be built around the foundation of successful existing centres such as these.

14. Although respondents rarely mentioned EU funds, structural funds in particular have been an important resource mobilised by Regional Development Agencies in the recent past. It remains unclear how such funds will be managed in the future. In the short-term places in England may be at a comparative disadvantage in mobilising such funds in support of innovation infrastructure. More broadly these places will no longer have prominent regional agencies to promote their interests but will remain locked in competition for inward investment with other regions in Europe (and Scotland, Wales and Northern Ireland) that do retain strong and active regional agencies or governments.

15. Our respondents strongly stressed the need for informed, targeted and sector- or market-specific support. A number questioned the whole concept of generic business support, suggesting that such support added little or no value.

16. Not surprisingly, firms are not so interested in the specificities of governance arrangements – but complex or fuzzy arrangements may lead to gaps in provision of support. Unanswered questions remain about the extent to which the new Technology Strategy Board responsibilities represent an England-only role in the delivery of innovation support that is additional to the existing UK-wide one.
1: Background

1.1: Introduction
In the light of the forthcoming abolition of the English Regional Development Agencies, the formation of new Local Enterprise Partnerships (LEPS), and changes in the division of labour for business and innovation support between the national (Whitehall), regional and sub-regional/local levels, the Institute of Physics asked the Institute of Innovation Research at the University of Manchester to conduct a small study to explore the innovation-related business support needs of “physics-based firms” in England. To do this we have reviewed the literature on innovation policy support for firms, examined similar studies, and designed and conducted an exploratory telephone survey of respondents in 16 purposively sampled firms across England, across a range of broadly “physics-based” sectors. In the following sections we report on this work. In the remainder of this section we outline the changing arrangements for the provision of innovation support to English firms, which form the backdrop for the study.

1.2: Innovation policy in England
The UK has an asymmetric system of devolution, which affects the formulation and delivery of innovation policy as it does many other policy areas. Innovation policy can be considered to be at the confluence of traditional research policy, tertiary education and skills policy, and business or competitiveness policy. The division of labour is somewhat different for each.

Within England (which accounts for some 51 million of the UK population of 61 million) devolution has been administrative rather than political. In 1994 the government of John Major set up government offices (GOs) in nine English regions, including Greater London. These brought together the regional functions of a number of central government departments. Following the 1997 election, non-elected Regional Development Agencies (RDAs) were created in each of the English regions with the exception of London (which has its own arrangements). At the same time the Scottish Parliament and Welsh and Northern Irish Assemblies were established.

The primary role of the eight English RDAs has been to act as drivers of regional economic development. The philosophy behind regional development policy in England has been to increase productivity and promote growth in all regions and to reduce disparities between regions (although clearly there is a potential tension between these goals). Classified as non-departmental public bodies, the RDAs were established as non-profit-making companies, which would be “business-led”, each having a non-executive chairperson and a board of 15 people appointed by ministers.

A number of responsibilities for economic development were decentralised to the RDAs, principally around regeneration and competitiveness. Up until the formation of the Conservative-Liberal Democrat coalition government, the trend has been for the progressive decentralisation of responsibility to the RDAs in economic and competitiveness policy, including innovation policy. The introduction of the “single pot” model in 2002 (by which previously distinct, earmarked resource streams were merged) gave the RDAs substantial funding flexibility to respond to perceived regional needs, and subsequent increases in overall funding saw some elect to put significant sums of money into innovation and S&T related projects. RDAs were also given responsibility for the allocation of European Structural Funds, providing additional funds to complement the “single pot”. Responsibility for the “Business Link” business support service was also devolved to the RDAs alongside delivery of a whole package of other business support. So RDAs in England have increasingly taken responsibility for general business support and taken an interest in promoting innovation and entrepreneurship as drivers of economic growth and regeneration.

By contrast research and higher-education policies in England have more complex arrangements. Most government funding for research in English universities is directed from the Treasury through the Department for Business, Innovation and Skills (BIS), which channels it through two principal routes: first, via the (UK-wide) research councils, which primarily fund basic research through individual competitively awarded project grants and, second, via the Higher Education Funding Council for England (HEFCE), the university funding agency, which provides block teaching and research funding to higher-education institutions in England. In
Background

Scotland, Wales and Northern Ireland universities receive funding through their own funding councils but research projects are again funded by the UK-wide research councils.

The final element of this complex governance pattern was put in place with the creation of the Technology Strategy Board (TSB) in 2004. Initially an advisory board for R&D programmes within the then Department for Trade and Industry, in 2007 the TSB was reconfigured as a non-departmental public body. Although not classed as a research council, the TSB was established as a body incorporated by Royal Charter under the same legislation governing the creation of research councils and can be seen in some ways as a research council for applied research and technological development. The TSB took over responsibility for the long-standing R&D and knowledge-transfer programmes of the DTI/BIS and in addition has developed a series of new schemes. The TSB has a UK-wide responsibility to promote technology-driven innovation and has worked very closely with the UK-wide research councils, the devolved administrations of the UK and the English RDAs, in mobilising funding for innovation.

1.3: Recent developments

The current Conservative-Liberal Democrat coalition government has announced that all of the regional government offices in England will close and that the eight English RDAs outside London are to be wound down and will cease activity by March 2012.

“...The current coalition government has announced that all of the regional government offices in England will close and that the eight English RDAs outside London are to be wound down and will cease activity by March 2012.”...
2: Why intervene to promote innovation?

Innovation is commonly understood to refer to the introduction of new or significantly improved goods or services, or new or significantly improved methods for the production or supply of goods or services. Policy makers and economists agree that innovation is a major driver of economic growth. But the ways that economists have conceptualised that relationship, and the ways that policy makers have rationalised public policy interventions to promote innovation, have changed over time.

In the traditional framework of neo-classical economics, technological change is acknowledged as important but is excluded from the production function model of economic growth. It is treated as exogenous – something that comes from outside the economic system. Dissatisfaction with this treatment of technology as exogenous led some economists to modify the neo-classical framework. This modified framework treats scientific and technological knowledge as information. The process of producing and using science and technology information generates spill-overs due to the nature of science and technology. Private individuals face disincentives to invest in the production of science and technology information due to difficulties and uncertainties surrounding their ability to appropriate the returns from that investment. The result across the whole economy is a sub-optimal outcome as the market fails to allocate sufficient resources to innovation.

This modified neo-classical framework has been criticised on a number of grounds. It is felt to be unrealistic in treating science and technology as information, costlessly transmitted and difficult to protect. It neglects the tacit and human dimensions of science and technology knowledge (which tend to make knowledge “sticky”) and the consequently uneven real-world geography of science and technology. Various alternative approaches attempt at a more realistic synthesis, for instance by incorporating learning effects or by addressing the spatial distribution of spill-overs. In particular, scholars of the innovation process have progressively developed a loose conceptual framework in which the actors and institutional frameworks of a national economy that interact to shape the pace and direction of innovation processes are considered to operate as a “system”. These ideas are used to justify interventions around the promotion of system components (including “intermediating” actors) and interactive learning among actors in the innovation system. Meanwhile economic geographers have developed broadly similar concepts to understand the localised nature of innovation processes. These ideas are used to justify regional or local interventions to promote or strengthen industrial districts, clusters or “regional innovation systems” (Laranja et al. 2008).

In parallel with the evolution of these arguments, the emphasis on public policy to promote innovation has gradually shifted away from focusing on promoting the supply of scientific information, ensuring that sufficient scientists and technologists are produced and putting in place the infrastructure of research-performing organisations. While these things remain key concerns of policy-makers there is now a far greater emphasis on improving interactions and learning within a “system” and on the wider framework conditions and climate in which innovation takes place.
3: Framework conditions for innovation in the UK

3.1: Framework conditions

In work recently carried out by NESTA (NESTA 2009; Miles 2009), wider framework conditions are categorised under the following headings: public research, openness or information flow, entrepreneurship, demand, competition, access to finance and skills.

- **Public research.** This framework condition covers both the strength and depth of the UK’s public science base, including its higher-education institutions and research establishments.
- **Openness.** This refers to the circulation and use of information in an economy and can indicate “how quickly and effectively good ideas can diffuse and be absorbed” (NESTA 2009, p6). Openness is facilitated by technology factors, such as the availability of high-speed networks, but social factors can also play a role with societies that exhibited greater hierarchy are ones through which information passes more slowly.
- **Entrepreneurship.** This refers to the willingness of entrepreneurial talent to engage in business and take the risk of doing so, and the rate at which new businesses are created to exploit business opportunities.
- **Demand.** Demand is an important influence on innovation because demand for novelty generates innovation opportunities for firms. In recent years, the role of government as a purchaser or as a commissioner of public services has been promoted as an important policy tool for government to promote innovation (Edler 2005; Edler 2007), although questions about how realistic much of the policy discourse around procurement and innovation actually is remain (Uyarra and Flanagan 2010).
- **Competition.** Competition refers to the extent to which businesses in any area are competing with one another. There are two major dimensions to this, the extent to which businesses compete with each other within an area (internal competition) and the extent to which there is competition to own businesses within an area (external or foreign competition).
- **Access to finance.** This refers to the ease with which innovative firms can obtain finance for their activities. Sources and modes of credit availability vary considerably in most economies, but not to be overlooked in this framework condition is the presence of expertise and understanding among investors of the particular needs of innovative firms.
- **Skills.** This is a particularly difficult area in which to make policy, particularly as skills have a long lead time to develop, and the needs of innovating firms may change over time, often more quickly than the speed at which the skills supply can be changed. Innovative firms require a variety of skills, and skills mixes, with academic and technical knowledge being only one part of what is required to research, develop, integrate and market successful innovative products.

3.2: Framework conditions and support for innovation in firms

The NESTA report (2009) identifies three of these categories of framework conditions as problematic in the UK context, namely access to finance, demand and skills. International comparisons suggest that the UK does not have sufficient finance for small innovative companies, despite the fact that its capital markets are large, sophisticated and historically profitable. While the UK government has led international efforts to redesign public procurement so that it increases innovation, the UK’s consumer markets are held to be more averse to novelty than the average for the OECD. In the area of skills generally there is felt to be a chronic skills shortage, particularly at the tertiary skills level. The same research suggests that relatively small, science-based firms will have requirements for support in the following areas: a) access to finance; b) working with and exploiting the public science base; and c) obtaining the required skills level.

There is a voluminous literature on public support to promote innovation in firms, although much of this focuses on the specific needs of SMEs or “new technology-based firms”. In line with the dominant conceptual frameworks already mentioned, such studies tend to emphasise the impor-
tance of linkages and “connectivity” (e.g., Rickne 2006), the role of human capital (including the human capital of founders) and access to finance at key stages of development. Heydebreck et al. (2000) propose four “bundles” of support needs of new technology-based firms: around marketing, technology, financing and “soft” support (general support for strategic thinking, awareness-raising, relationship-building, etc). They make the important point that firms may have “unrealised needs”, needs that managers may underestimate or be unaware of. Tether and Storey (1998) attempt to classify innovation support measures to new technology-based firms in the European Union, identifying five broad areas in which support is offered: through infrastructures such as science or technology parks; through promotion of links with research or higher-education institutions; through direct financial support; and through advisory services. Finally, Bodas, Freitas and von Tunzlemann (2008) classify innovation support measures addressed to firms along a number of dimensions: measures can be vertical (focused on procuring new knowledge or in increasing business-to-business links) or horizontal (focused on awareness-raising and knowledge diffusion); they can aim to promote specific outcomes in a wide range of firms or can have a broad (generic) focus, which allows adaptation to firm specificities; and they can be implemented in a centralised (delivered by a national ministry or agency) or decentralised (delivered by local public or private actors) way.

“International comparisons suggest that the UK does not have sufficient finance for small innovative companies.”
Evidence from previous studies

4: Evidence from previous studies

4.1: Relevance of previous studies

Here we consider existing evidence in relation to public support for the innovation processes of firms. While there have been a large number of reviews of the operation of general business support to firms there are fewer comprehensive reviews of innovation support – although there are many evaluations of individual programmes or schemes. We consider those findings on general business support that are relevant to this study and then examine a recent EU-wide survey of the effectiveness of innovation support measures.

4.2: Usage and trends

Bennett and Robson (2003) considered the development of government support to small firms in the UK. Their study provides a number of insights on usage and penetration of the services into different sectors and notes differences in usage by sectors and company size. Their view was that over time, demand for support services might decline as the population of firms requiring assistance falls because of saturation. This view is rather static and simplistic. In reality entrepreneurs and managers retire, and firms go out of business or cease trading. New entrepreneurs, managers and firms will emerge to take their place. On a larger scale innovation will cause some markets to shrink or disappear while new ones will be created. A more dynamic view would imply a constant need for support services, although the details of the support needed might vary over time.

Bennett and Robson found that, over the period they observed, small firms tended to use these support services less, while larger firms tended to use them more. A plausible explanation for this trend, which has been evident over the last decade (Atherton 2010), is that larger firms are more likely to face challenges that require them to look outside for information while at the same time having sufficient resources to be able to seek help. Greater use by larger firms therefore reflects the more effective search strategies of such firms.

There appears to be evidence that usage of services is greater among smaller firms that are growing rapidly (Atherton 2010), a finding also supported by Johnson, Webber et al. (2007).

Mole, Hart et al. (2008) looked at the effects of Business Link support and advice. Their review suggested that support schemes did have some positive effect on employment and that larger firms with greater capabilities make better use of the help they receive. They note that it can be argued that support should be focused on “larger, more export-oriented businesses” (p315). Examin-
Evidence from previous studies

The ownership and operation of Business Link schemes, Bennett (2004) finds some evidence to suggest that such services perform better when owned by local chambers of commerce or private-sector organisations.

The studies mentioned above look at general business support measures. A recent study that has looked specifically at innovation support was conducted by the European Commission, as part of the “Pro Inno Europe” initiative, in 2009. This study used a “consultation” survey of companies to find out about the effectiveness of innovation support. Responses were invited from firms across the EU-27 and some 800 responded, with a heavy bias towards the old member states. The majority of respondents were small or micro companies. Although the results of such a survey cannot be considered representative, the findings are instructive for this review. As figure 1 illustrates, the survey suggested that respondent enterprises rate access to finance and the cost of innovation as the most significant barriers, and thus important potential targets for public intervention.

Figure 2 shows that, for the survey respondents, the most commonly received public support for innovation was support for financing R&D or innovation projects, followed by support for networking and collaboration, support for awareness-raising, and support for technology/knowledge transfer. The survey findings suggest that firms are far from happy with the support provided. Figure 3 shows that for each of the most commonly received types of support, a large proportion of respondents reported that their expectations from the support were not met at all, with this being true for almost half of all respondents who received support for financing innovation or R&D projects. In particular, respondents felt that innovation support measures should be much more customised to their specific needs.

Source: Making public support for innovation in the EU more effective, Pro Inno Europe Paper No. 13, 2009.

Figure 3: Degree to which expectations were met from public support received

5: Empirical findings

5.1: Research design

The aim of this study was to explore the innovation-related business support context in which “physics-based firms” operate in England by speaking to actual firms to draw conclusions about what innovation support needs might be required from any new arrangements. The research design and implementation strategy therefore involved two key elements: developing a classification of support types and developing a mechanism to identify suitable targets for inclusion in the study. The study is based on a telephone survey of respondents in 16 small and larger firms across England, across a range of sectors, conducted during October 2010. Semi-structured interviews were used to ask respondents about any public support for innovation that their firm had received over the previous five years and about likely needs for support over the next five years. We also asked about their views on the needs of firms in their sector and region. We asked them their views about the broader climate and “framework conditions” affecting innovation in England and the UK, and finally we asked about the most appropriate configuration of public support for innovation in the future. A detailed account of the research design and a copy of the interview guide are included in the appendices to this report. Tables 1 and 2 below provide a summary of the characteristics of the 16 firms from which our respondents came, and of the five broad sectors into which they fell. Details of how these five sectors were derived are also provided in the appendix.

5.2: Innovation support received over the past five years

Respondents were asked whether they had received any public support in relation to aspects of their innovation processes over the preceding five years. Importantly, although a number of respondents began by insisting that they had had no public support for innovation during that time, these respondents were often able to identify instances where they had indeed received such support. Public support is increasingly offered indirectly, sometimes through not-for-profit or for-profit private intermediaries at a local or sectoral level and the possibility remains that our respondents may still have systematically under-reported public support received because they did not recognise it as such. Having said that, only two out of our 16 respondents reported that their firm had received absolutely no public support relevant to innovation during the five-year period in question. A list of sources of support received by our respondents by type of support is provided in table 3. Surprisingly, only one respondent specifically mentioned having received European (Framework) programme support.

The most frequently mentioned category under which support was received was other networking and collaboration support. Sector- and/or technology-specific networking groups were most frequently mentioned here, followed by Knowledge Transfer Partnerships/Networks. Acquisition of external knowledge, support for testing or proof of concept, and financial support for specific R&D or innovation projects, support for skills development within the firm and help in identifying market opportunities or needs were also frequently mentioned.

Several respondents mentioned access to the “national” or “sectoral” testing facilities of public research organisations or quasi- or formerly public Research and Technology Organisations (such as the Building Research Establishment). Respondents from the electrical, electronics, instruments and telecoms sector, and the R&D, testing and other services sector also highlighted the role of other kinds of public investment – examples include launch aid in the aerospace sector, support for the development of superfast telecoms networks in that sector, RDA support to help with the construction of a new R&D facility, RDA promotion of carbon reduction and in the case of one contract research firm, the receipt of public funding to provide innovation-related services to other firms in the sector.

A small number of respondents felt that support received had been either unhelpful or welcome but not that important. Many others, however, stressed the significance of the support they had received, whether in relation to the funding of specific R&D projects (through grants from BIS, the TSB or an RDA, or through R&D tax credits) or in relation to skills development and networking.
Empirical findings

The category of support that was most often felt to have been highly important was other networking and collaboration support. Interestingly this seems to have been particularly the case for our respondents in the R&D, testing and other services sector. The other categories of support received most often rated as important, highly important or essential to the firm by our respondents were financial support for specific projects, skills development, other kinds of public investment and support for testing and proof of concept.

5.3: Likely future needs for innovation support

Firms were also asked about the extent to which public support of various kinds might contribute to their innovation processes over the next five years. The question was framed in terms of likely support needs that could be met through public support. Again respondents were asked to estimate how important such help might be to their ability to innovate. Identifying market opportunities and needs, acquisition of external knowledge and support for skills development within the firm were most frequently mentioned as categories where support would be important, very important or potentially crucially important – closely followed by financial support for specific R&D or innovation projects and support for testing and proof of concept.

Given that it had been mentioned so often in relation to past support, it is interesting to note that other networking and collaboration support was mentioned less often in answer to this question, and was not mentioned at all as being highly important or crucially important. Several respondents also mentioned support to exploit knowledge generated within the firm – but this was only rated as highly important or crucial by a single respondent. Most frequently rated as highly important/potentially crucial to the innovation success of the firm

Table 1: Broad physics-based sectors surveyed

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<tr>
<td>A</td>
<td>Energy and fuels</td>
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<tr>
<td>B</td>
<td>Machinery and materials</td>
</tr>
<tr>
<td>C</td>
<td>Electrical, electronics, instruments and telecoms</td>
</tr>
<tr>
<td>D</td>
<td>Architectural and other knowledge-based services</td>
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<td>E</td>
<td>R&amp;D, testing and other services</td>
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</tbody>
</table>

Table 2: Characteristics of respondent firms

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<th>Firm</th>
<th>Sector</th>
<th>Size</th>
<th>Location</th>
<th>Source</th>
<th>Notes</th>
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<tbody>
<tr>
<td>1</td>
<td>E</td>
<td>SME</td>
<td>North West</td>
<td>FAME</td>
<td>Formerly public RTO</td>
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<tr>
<td>2</td>
<td>A</td>
<td>Large</td>
<td>Yorkshire</td>
<td>FAME</td>
<td>Formerly public energy company</td>
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<td>3</td>
<td>E</td>
<td>SME</td>
<td>South East</td>
<td>FAME</td>
<td>CRO business and head office in the UK, R&amp;D and manufacturing in another EU member state</td>
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<td>4</td>
<td>B</td>
<td>Large</td>
<td>Multi-location</td>
<td>FAME</td>
<td>UK-originated global firm</td>
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<td>5</td>
<td>E</td>
<td>SME</td>
<td>East England</td>
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<td>6</td>
<td>C</td>
<td>SME</td>
<td>South East</td>
<td>FAME</td>
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<td>7</td>
<td>B</td>
<td>SME</td>
<td>South East</td>
<td>FAME</td>
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<td>8</td>
<td>C</td>
<td>Large</td>
<td>Multi-location</td>
<td>FAME</td>
<td>UK-originated global firm</td>
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<td>B</td>
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<td>Multi-location</td>
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<td>E</td>
<td>SME</td>
<td>East England</td>
<td>FAME</td>
<td>Business unit of Taiwanese firm</td>
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<td>11</td>
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<td>SME</td>
<td>North West</td>
<td>FAME</td>
<td>Business unit of Japanese firm</td>
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<td>12</td>
<td>D</td>
<td>SME</td>
<td>West Midlands</td>
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<td>FAME</td>
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<td>15</td>
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<td>Multi-location</td>
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<tr>
<td>16</td>
<td>C</td>
<td>SME</td>
<td>East Midlands</td>
<td>FAME</td>
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</tbody>
</table>
Empirical findings

were support for specific R&D projects, support for skills development, support for testing and proof of concept, and acquisition of external knowledge. Skills development in particular seems to be a major concern for many firms. Respondents often emphasised the very specific mixes of technical and problem-solving skills that they required, some of which may come with “fresh graduates” but some of which have to be developed through in-job training or by experience. One talked about the need to mix physics and engineering skills, while another suggested that (electrical) engineering programmes turned out broad engineering graduates rather than specialists in a particular technology.

Other forms of public investment were also felt likely to be highly or crucially important by a number of respondents. The kind of support envisaged here varies widely, not least according to the specific sector in question. In the aerospace sector “launch aid” is likely to remain important. In other sectors public support for infrastructure, such as data centres, was mentioned.

Support for identifying market opportunities was mentioned as potentially important by 10 respondents but as potentially highly or crucially important only by three. One respondent suggested that market intelligence needed to be better linked with technology intelligence. Several stressed that generic awareness-raising of market opportunities is not very helpful and that any support offered in this area in the future would need to be much more aware of sector specificities to be of any use, especially in helping smaller UK technology companies compete with larger global rivals with well developed sales and marketing networks. Finally, several respondents also stressed the role of the public sector in shaping market demand in some sectors, either directly, as a major potential client, or indirectly, through industry regulation.

Interestingly a number of respondents raised two additional categories here: three specifically mentioned the crucial need for support for the “transition” from R&D and design to manufacturing. Two independently used the concept of “technology readiness levels” (based on the US Department of Defense system for classifying technology maturity4, which has been adopted by many public and private technology organisations and which is also used in the Hauser Report to government, which recommended the creation of the new Technology and Innovation Centres) to describe where this gap is located. They placed it somewhere in the middle of the scale, between levels 4 and 6 (i.e. laboratory demonstration that the system works in principle through to prototyping and simulation). One respondent noted that this previously neglected area of support is now the responsibility of the Technology Strategy Board (with one respondent suggesting that the previous neglect may have been due to domestic interpretation of European State Aid rules).

Two other respondents specifically raised the issue of recruitment of highly skilled personnel (as opposed to skills development of existing personnel), indicating that this was an area where better support is crucially important. Both discussed immigration regulations and the problems of the work permit system. One stressed that their firm finds it almost impossible to recruit UK citizens with the skills they require and so has no choice but to look overseas. This respondent suggested that the problem is so severe it is actually slowing the

<table>
<thead>
<tr>
<th>Main area</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying market opportunities or needs</td>
<td>DTI/BIS, TSB, UK T&amp;I, Regional trade promotion bodies</td>
</tr>
<tr>
<td>Financial support for a specific R&amp;D or innovation project</td>
<td>BIS, TSB, RDAs, Research Council CASE awards, R&amp;D Tax Credits, EU Framework Programme</td>
</tr>
<tr>
<td>Support for testing or proof of concept</td>
<td>DTI/BIS, RTOs, Centres of Excellence</td>
</tr>
<tr>
<td>Acquisition of external knowledge</td>
<td>TSB, RDAs</td>
</tr>
<tr>
<td>Other networking and collaboration support</td>
<td>Sector specific networks, Technology specific networks, TSB, KTPs/KTNs, RTOs, RDAs, Engineering Council</td>
</tr>
<tr>
<td>Other investment</td>
<td>RDAs, DTI/BIS</td>
</tr>
<tr>
<td>Support for skills development within the firm</td>
<td>Train to Gain, Manufacturing Advisory Service, National Skills Academy, Sector-specific schemes</td>
</tr>
<tr>
<td>Support for management of the new product/process/service development process</td>
<td>MBA student projects</td>
</tr>
</tbody>
</table>

process of innovation within the firm. Finally, one respondent suggested that much better signposting and filtering of the help and support available is very much needed.

One respondent felt that the firm would require no support in the future, considering public support unimportant as a driver of innovation. One said “we would just get on with it” while another remarked that he couldn’t see “why public money should be used to help us” but nonetheless felt that if “competent” support were available then that could be useful – provided the transaction costs to the firm were not too high. In particular, project-based and knowledge or technology-intensive business services firms tend to see all aspects of their innovation process as being client-funded – although several also mentioned that clients often seem unwilling to pay a premium for “innovation”.

**Summary: Likely future support needs**
- Most frequently rated as important or potentially critical were support for specific R&D projects, support for skills development, support for testing and proof of concept, and acquisition of external knowledge.
- Skills development in particular seems to be a major concern for many firms (confirming the findings of previous studies).
- Respondents stressed the importance of redressing the perceived “gap” in the provision of support between R&D and product or process introduction.

### 5.4: Sector-specific issues

We observed few striking differences across the different broad sectors. It has already been mentioned that respondents in the R&D, testing and other services sector seemed particularly likely to have received support to networking and collaboration in the past five years, but interestingly respondents in this same broad sector did not feel that this category of support would be highly or vitally important to the success of their innovation processes in the future. Respondents in several sectors discussed the importance of sector-specific networks. Indeed there are no obvious sectoral differences in the responses concerning likely future support needs, with the partial exception of support in relation to regulation discussed below, and an even stronger emphasis on skills issues (both skills development within the firm and recruitment of highly skilled personnel into the firm) from respondents in the R&D, testing and other services sector.

Respondents were asked about the extent to which they felt their innovation-related business support needs were representative of their sector. Few firms felt that their needs differed markedly from those of other firms in their sector. Where potential differences were discussed these were generally due to differences in size or market position. Sector specificities of the aerospace industry were noted: the sector is both R&D intensive and characterised by long lead times and an unusual demand profile that is partly dominated (in the case of defence) by national governments. Demand is also powerfully shaped by government decisions in the energy sector. Aerospace, along with parts of the energy sector (notably nuclear), have traditionally had distinct support arrangements around innovation and broader technological and product development, and these were reflected in the responses we received. The importance of regulatory change as a central driver in the energy sector was also noted.

**Summary: Sectoral issues**
- Respondents strongly emphasised a better understanding of sectoral and market needs as a crucial element in the design and delivery of innovation-related business support.
Empirical findings

5.5: Geographical issues

We also asked respondents their views about any regional specificity in relation to firm innovation support needs. Some respondents worked in firms located in a single region, others in multi-site firms spread across several regions, with one very large firm with a presence throughout the UK.

A respondent from the North West discussed the particular need of the energy sector in that region, for instance the potential to replace the traditional petrochemical cluster at Ellesmere Port with a new “energy campus”. Another respondent from a firm based in a Northern region argued that most firms in the North would have different support needs from those in London and the South East and that these should be met in a different way. A respondent from the aerospace sector (a globally active firm based in one of two strong locations for aerospace in England) spoke of the importance of being located in a “cluster” where capability exists, and of the incentive for the firm to continue to invest in a place where they can develop centres of excellence and develop the talent pool. This respondent felt that such “clusters” should be respected and supported where they exist and warned of the dangers of “dilution” if support for a specific sector were to be spread too thinly across England.

Several respondent firms were located or had operations in and around Cambridge. Respondents talked of the benefits of being part of the Cambridge “cluster” but also the difficulties that this creates. One respondent suggested that it has been harder to receive local or regional funding for innovation in Cambridge than in, for instance, the North East of England. Another discussed the features of the Cambridge high-tech talent pool. The respondent suggested that all firms in the Cambridge area could use help to attract people into the area from other places because, paradoxically, the success of the “cluster” has led to a situation where the relocation costs are now so high that it is hard to attract new people into the talent pool. This respondent noted that the RDA had done some useful place marketing of the Cambridge area but could do little about this problem. A positive suggestion here was to raise or remove the current cap on non-taxable relocation expenses.

A respondent based in the South East of England made the similar point that high rents compare unfavourably with many places in competitor countries. A third based in Sussex contrasted the difficulty of attracting skilled people to work there in the absence of any “cluster” of related activity with the relative ease of hiring skilled workers in the West Midlands, where there is not only a much bigger talent pool but where there are plenty of other job opportunities in the same area, reducing the personal risk to the individual of relocating to that area. Other respondents raised broader skills issues, bemoaning a shortage of suitably qualified professional engineering staff across the country.

Summary: Geographical issues
- There will always be place-specific needs affecting innovation, not least in the distribution of highly skilled human capital. Successful “clusters” of innovative activity create their own problems, which must be tackled if they are not to constrain future growth.

5.6: Views on the general conditions and “climate” for innovation

We asked our respondents to comment on the broader conditions and climate affecting innovation in England. We asked them to comment on frameworks and conditions, such as the IPR regime, the education system, the science base, the tax regime, the availability of finance, and transport and other infrastructures, and to raise any other issues that they believed were important.

The IPR regime was not an issue for most
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respondents. Only one suggested any changes – this company, an RTO, wanted to see changes to allow the patenting or protection of business models and business processes.

A number of respondents focused on the supply of engineering skills and engineering talent. One argued that universities tend not to produce technology specialists (for instance they produce general electrical-engineering graduates rather than mobile-telecommunications graduates) so that firms have to provide the specialist training. For some this was an extreme concern. In the short term they see no choice but to access overseas talent and the broader regulatory framework needs to support their needs. In particular it was argued that the immigration/work-permit system should be simplified.

In contrast one respondent from a biomedical equipment/clinical trials firm argued that their recruitment picture was good because progressive job losses at big pharmaceutical firms are providing them with a larger pool of skilled people from which to recruit. One respondent, from the UK arm of an international company, argued that UK employment legislation is very complex and difficult to navigate, being based to a great extent on case law. This respondent argued that clearer employment law is a necessity. This respondent was not arguing that the balance should be shifted in favour of the employer, simply that the status quo may tend to lead foreign companies to make ultraconservative decisions and thus inhibit innovation.

Several respondents were concerned more generally about the state and status of engineering in the UK. One argued that for some years the government has appeared over-focused on services, and especially financial services. Another felt very strongly that the decision not to approve the loan to Sheffield Forgemasters sent the clear signal that the current coalition government is “not interested” in engineering.

Respondents were very favourable about the strength of the UK science base where they had experience of it. Several respondents expressed concerns, however, that this could be jeopardised by spending cuts and that the critical mass built up over a long time would subsequently prove difficult to rebuild.

Few respondents commented on the tax regime. One felt that taxes in general were too high. One stressed the importance of R&D tax credits. One respondent, concerned about recruiting talented workers, noted that stamp duty could be seen as a tax on internal mobility. Those who commented about transport and other infrastructure generally felt that this was adequate. One respondent doubted the transport problems experienced in the English region in which his firm is located were any worse than those that might be experienced in Shanghai.

Many of our respondents stressed that the overall climate for innovation was good or very good. One respondent made a favourable comparison with the Far East, suggesting that people in the UK are more innovative, better problem solvers. Other respondents made a less-favourable comparison with the US, which they felt to have a less risk averse, open and innovative business culture. One respondent suggested that the UK market is too price-driven and several suggested that clients are often unwilling to pay for innovation. Another suggested a combination of a cultural tendency towards risk aversion and a situation whereby talented people choose to move into large firms or large public-sector employers for an easier life. On finance, several respondents mentioned the relative weakness and greater risk aversion of venture capital in England compared with other countries.

Summary: Framework conditions and general climate for innovation
- Respondents generally agreed that the broader conditions and climate for innovation in England and the UK are good.

5.7: Views on most appropriate configuration for innovation support in the future

Finally, we asked our respondents about their views regarding the most appropriate future configuration of policy making and delivery of innovation-related business support in England.

First we asked at which level priorities for innovation-related support should best be set. Respondents were asked about the extent to which they agreed or disagreed with the principle that priorities are best set at the national, regional or local (county or city-region) level. Of those who answered the question, seven respondents agreed or strongly agreed that priorities are best set at the national level. Three disagreed, none strongly. Three respondents agreed that priorities are best set at the regional level, none strongly agreed. Five disagreed or strongly disagreed. Three respondents agreed or strongly agreed that priorities are
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best set at the local (county or city-regional) level, while six disagreed or strongly disagreed.

We then asked a second question, in the same form, this time about the delivery of innovation-related support. Six respondents agreed or strongly agreed that support should mainly be delivered at the national level. Five disagreed or strongly disagreed. Four agreed or strongly disagreed that support should mainly be delivered at the regional level, while five disagreed. Seven agreed that support should be delivered mainly at the local level, while four disagreed. The level of consensus is somewhat greater around local delivery than for any of the other options (figure 4).

One respondent specifically argued that delivery was needed at all levels. This respondent argued that the regional level is more accessible to smaller businesses and argued against the abolition of the RDAs, noting the work that RDAs did around attracting inward investment and pointing out that English regions will continue to have to compete for investment with other regions in Europe that retain strong regional support. Another argued that focusing innovation support too locally can restrict the way in which that support can be used (for instance schemes that promote collaboration only within a region or sub-region). This respondent felt that this is even a problem at the national level, and that innovation support in England could be better linked in with schemes in other EU member states so that funding for European collaboration becomes easier to access (the existing European schemes are felt to be poorly promoted and difficult to access). One respondent particularly stressed the importance of national-level priority setting, giving the example of sector road mapping done by the relevant BIS sectoral growth team.

A number of other respondents also stressed the need for the design and delivery of innovation-related business support to take into account sector specificities. They argued that sector knowledge and skills on the part of support providers are crucial and that policy-makers should encourage bottom-up development of networks by the sectors themselves. One respondent commented specifically on measuring the impact of innovation-related business support, suggesting that this should be measured on the basis of customer satisfaction rather than by the level of take-up or on the basis of anecdotal “success stories”. This respondent noted that the firm had never been asked about their satisfaction with innovation support measures until now. Several respondents actually declined to answer these questions on the grounds that the appropriate configuration for innovation-related support depends entirely on the needs of the sector/market. Finally, one suggested that delivery should be configured around whichever proves to be the most cost-effective model.

One [respondent] suggested that delivery should be configured around whichever proves to be the most cost-effective model.

Summary: Future configuration of innovation support

● Most respondents were relaxed about the reversion of policy-making about innovation support to the national level.
● There was some consensus that delivery should take into account local specificities.
● Respondents were very concerned that, whatever the arrangements, support was designed with sector and market specificities in mind, and that support providers had sufficient knowledge and understanding of these specificities.
6: Discussion

6.1: Context and scope of the data
This document reports the findings of a study by the Manchester Institute of Innovation Research at Manchester Business School (University of Manchester) for the Institute of Physics on the innovation-related business support needs of “physics-based firms” in England. We have reviewed the literature on innovation policy support for firms, looked at similar studies and, based on these starting points, delivered an exploratory telephone survey of respondents in 16 purposively sampled small and larger firms across England, across a range of broadly “physics-based” sectors.

We asked our respondents about any public support for innovation that their firm had received over the previous five years and about likely needs for support in the next five years. We asked them their views on the needs of firms in their sector and region. We asked them their views about the broader climate and “framework conditions” affecting innovation in England and the UK, and finally we asked their views about the most appropriate configuration of public support for innovation in the future.

6.2: Support received
Our respondents tended to underestimate the support they have received unless it is explored systematically with them. Even then, it is possible that they are still under-reporting the support received. Having said that, it seems remarkable that only two of our 16 respondents claimed to have received no public support for innovation whatsoever over the past five years (and one of those respondents still stressed the role of the public sector as a client in shaping their innovation). Surprisingly, only one of our respondents specifically mentioned that the firm had received support from European programmes over this period.

Support for wider networking and collaboration was the most common form of support received, and sector-specific or local networks were frequently mentioned in this regard. As noted earlier the literatures on innovation and economic geography often emphasise the role of such intermediaries or networks. Our findings regarding support received by respondent firms in the recent past seem broadly similar to those of the pan-EU “Pro Inno Europe” survey.

A small number of our respondents felt that support received had been unhelpful or welcome but not that important, but many others stressed the significance of the support they had received to their innovation over the five-year time period. Although we have a small sample, we do not detect the high level of concern over the effectiveness of the innovation support offered in recent years that was detected by the “Pro Inno Europe” survey. One respondent did raise the issue of bureaucracy and speed of payment in relation to public support but generally we did not encounter this as an issue. However, many of our respondents did strongly stress the need for more focused and sector-aware or sector-specific support and, related to this, more scrutiny of the relevance of the knowledge and experience of those providing the support. We did not find any evidence of demand for generic business advice, for instance of the kind that would likely be provided by the new web-based Business Link service. This could be an artefact of our sampling approach, however.

Most frequently rated as highly important or potentially critical to the innovation success of the firm for the next five years were support for specific R&D projects, support for skills development, support for testing and proof of concept, and acquisition of external knowledge. Skills development in particular seems to be a major concern for many firms, confirming the findings of previous studies. Respondents talked about the very specific mixes of technical and problem-solving skills that they required, some of which come with “fresh graduates” but some of which have to be developed through in-job training or by experience.

Respondents strongly emphasised better understanding of sectoral and market needs as a crucial element in the design and delivery of innovation-related business support. For many this was a much more important factor than whether priorities were set or services delivered at a national, regional or local level. Once more this seems in broad agreement with the findings of the “Pro Inno Europe” survey. There was little consensus among our respondents as to the best policy-making and delivery arrangements for innovation support with the exception that there seems to be a certain
“Respondents generally agreed that the broader conditions and climate for innovation in England and the UK was good.”

degree of consensus among respondents that delivery of innovation support measures would generally best be done on a local – that is sub-regional – basis.

Not only was skills development rated as a potentially crucial category of support needed in the future, but a number of respondents strongly stressed the challenges of attracting highly skilled workers, whether due to barriers to relocation or due to the nature of employment and immigration regulations. These problems are severe for at least some physics-based firms.

A number of respondents stressed the importance of redressing the perceived “gap” in the provision of support between R&D and product or process introduction. Several provided an analysis broadly similar to that used in the Hauser Report (which has recommended the creation of a new network of “elite” Technology and Innovation Centres to redress this gap), often using the same language of “technology readiness levels”. Many noted the encouraging progress made in redressing this gap in recent years, with the establishment of the TSB and the development of centres such as the National Composites Centre at the University of Bristol and the Advanced Manufacturing Research Centre at Sheffield.

Respondents generally agreed that the broader conditions and climate for innovation in England and the UK was good, if not in comparison with the US then at least in comparison with emerging economies in the Far East. One respondent strongly questioned the government’s commitment to technology and engineering. Another expressed serious concerns over the possible impacts of public spending cuts on the science and technology base.
7: Implications and recommendations

7.1: Coverage and limitations

The study was designed and executed over a short timescale with resources to allow only a small round of telephone interviews across a wide range of potentially “physics-based” sectors. A purposive sampling strategy was developed to ensure that our respondents were drawn widely from across England, across the broad sectors and across different sizes of firm. In aggregating some 35 “physics-based” sectors into five broader “sectors” for the purposes of sampling, our study would not expect to cover each of the original 35 individual sectors (something that would in any case be impossible with a programme of 15–20 interviews). A specific limitation is that we were only able to secure an interview with one firm from our broad “energy and fuels” sector. A further limitation, partly an effect of the selection mechanisms used, is that our sample does not contain any recently founded new technology-based firms. Such firms are highly likely to have different innovation-related business support needs from those articulated by our own respondents. The study must be regarded as exploratory and therefore not representative in the sense that the results cannot simply be extrapolated to the larger population of firms. We do believe that the results are illustrative of important and specific problems and that they show a high degree of consistency with the findings of previous studies.

7.2: Policy implications

Our study confirms that innovation-related support has been important to many of our respondent firms in the past. Our results also suggest that carefully focused innovation support will be vital to many firms in the future. Although respondents were generally relaxed about the reversion of policy-making about innovation support to the national level following the impending abolition of the RDAs, many were concerned that the delivery of support should have a strong sub-regional or city-regional component. Certainly geography is still an important consideration for innovation in that innovation activity has a clear spatial dimension and there will always be place-specific needs affecting innovation (e.g. the issues around attracting new workers into the congested and expensive Cambridge region). Certainly some sub/city regions intend innovation to be a strong component of their wider economic development strategy as witnessed by the inclusion of innovation as a topic in several LEP proposals.

The precise shape of the new arrangements is likely to have important implications for the effectiveness of innovation support in the future. Questions remain about the precise role of the TSB and what roles the LEPs will realistically be able to play. A particular issue is how the new national and local arrangements will relate to the existing sector-specific bodies and networks, which our respondents suggested have often been important. Many such sector-specific networks have received support from RDAs. Some have already closed and many more are threatened by the withdrawal of RDA funding. How will firms, LEPs, the TSB and BIS negotiate the process whereby sector-specific support is offered, and with what geography of implementation? There seems to be a tension here between the likely technological orientation of the TSB versus the sectoral orientation of BIS and the geographical concerns of specific LEPs. In particular, signals about the likely role and scope of the new Fraunhofer-style Technology and Innovation Centres are unclear in this regard. It seems that the ministers envisage TICs as having more of a sectoral or sectoral/spatial (“cluster”) focus than that of the Fraunhofer institutes, which tend to be organised around generic technological domains. A number of respondents stressed the importance of existing centres such as the National Composites Centre and the Advanced Manufacturing Research Centre. It seems sensible that the network of TICs should be built around the foundation of successful existing centres such as these.

It also remains unclear how European Structural Funds will be managed in the future. In the short-term, places in England may be at a comparative disadvantage in mobilising such funds in support of innovation infrastructure. More broadly, innovative places will no longer have prominent regional agencies to promote their interests but will remain locked in competition for inward investment with other regions in Europe (and Scotland, Wales and Northern Ireland) that do retain strong and active regional agencies or governments.
Implications and recommendations

Our respondents strongly stressed the need for informed, targeted and sector- or market-specific support. A number questioned the whole concept of generic business support, suggesting that such support added little or no value. This has implications for how support is delivered: delivery organisations seeking to maximise participation in the support schemes with which they are involved may do more harm than good by disbursing poor generic advice to firms with underlying problems in their market knowledge or business model. And generic business support or innovation advice of the kind likely to be offered by the new national Business Link service is unlikely to be useful to anything except fledgling firms. Of course, the more the advice and support provided is sector-specific, the higher the cost of providing that support and advice is likely to be.

Finally, and not surprisingly, firms are not so interested in the specificities of governance arrangements, but complex or fuzzy arrangements may lead to gaps in provision of support. As a result of the abolition of the RDAs, innovation policy in England will once again be the responsibility of BIS, a central (UK) government department acting in this instance for England. In turn BIS is likely to delegate most of this responsibility down to the (UK-wide) TSB. We seem to have seen the end of English Innovation policies even while the devolved administrations in Scotland, Wales and Northern Ireland retain their own ability to make and implement such policies.

“Firms are not so interested in the specificities of governance arrangements.”
Appendix 1: Bibliography

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A2.1: Study aims
The aim of this study was to explore the innovation-related business support context in which "physics-based firms" operate in England by speaking to actual firms to draw conclusions about what innovation support needs might be required from any new arrangements. The research design and implementation strategy therefore involved two key elements: developing a classification of support types and developing a mechanism to identify suitable targets for inclusion in the study.

A2.2: Classification of innovation-related business support measures
We were required to determine a suitable framework for the characterization of support for innovation to firms that was comprehensive and exhaustive, and fully covered the types of support given to firms and needs experienced by firms. A number of candidate frameworks were considered. The priority of the study team was for a characterisation that was comprehensive, relatively detailed and that could be recognised and understood by respondents. Additionally, it was also important that staff at the respondent firms could easily relate the framework/classification to the kinds of support that those firms had received and to the needs of their firms. Finally, we developed a classification drawing on our literature review and partially adopting and modifying the framework used in the Pro Inno Europe survey already mentioned. This was done both to allow some scope for comparison of findings and, crucially, to avoid the risk of using a wholly untested framework (as the timescale allowed no opportunity for pilot testing). The classification is reproduced below.

1. Identifying market opportunities or needs.
2. Financial support for a specific R&D or innovation project.
3. Support for testing or proof of concept.
4. Acquisition of external knowledge (e.g. licensing in, collaboration with HEIs or other partners to develop new knowledge or technology, bringing in new staff, contractors or students).
5. Other networking and collaboration support (partner identification, brokerage, facilitating links with HEIs and the science base, etc).
6. Support to exploit knowledge generated within the firm (e.g. IP protection and licensing, spin-outs).
7. Other investment (e.g. public-supported venture capital).
8. Support for skills development within the firm.
10. Other advice and business support relevant to innovation.

Prompts were used to communicate the modes of support: grants, loans, incentives, information, advice, access to equipment for research or testing, access to incubator space or other infrastructure.

A2.3: Selection process
The selection strategy to ensure that the sample of firms was representative of the industrial sectors was achieved by using, as the primary source, the FAME database of company reports. The precise sampling strategy was constrained by the time and resources available but the aim was to be as "representative" as possible in terms of geography (coverage of English regions) and firm size. Our approach to selection also included an attempt to complement the FAME database source by identifying English firms that have published research in physics journals or presented at physics-related conferences in the last three years. These additional firms were identified using the Web of Science and
### Table 7: The new aggregate classification, description and SIC 2003 codes

<table>
<thead>
<tr>
<th>New classification</th>
<th>Description</th>
<th>SIC 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Energy and fuels</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction of crude petroleum and natural gas</td>
<td></td>
<td>1110</td>
</tr>
<tr>
<td>Processing of nuclear fuel</td>
<td></td>
<td>2330</td>
</tr>
<tr>
<td>Production of electricity</td>
<td></td>
<td>4011</td>
</tr>
<tr>
<td>Transmission of electricity</td>
<td></td>
<td>4012</td>
</tr>
<tr>
<td>Distribution and trade in electricity</td>
<td></td>
<td>4013</td>
</tr>
<tr>
<td><strong>Machinery and materials</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of central heating radiators and boilers</td>
<td></td>
<td>2822</td>
</tr>
<tr>
<td>Manufacture of steam generators, except central heating hot water boilers</td>
<td></td>
<td>2830</td>
</tr>
<tr>
<td>Manufacture of engines and turbines, except aircraft, vehicle and cycle</td>
<td></td>
<td>2911</td>
</tr>
<tr>
<td>Manufacture of weapons and ammunition</td>
<td></td>
<td>2960</td>
</tr>
<tr>
<td>Manufacture of electric domestic appliances</td>
<td></td>
<td>2971</td>
</tr>
<tr>
<td>Manufacture of electric motors, generators and transformers</td>
<td></td>
<td>3110</td>
</tr>
<tr>
<td>Manufacture of electricity distribution and control apparatus</td>
<td></td>
<td>3120</td>
</tr>
<tr>
<td>Manufacture of insulated wire and cable</td>
<td></td>
<td>3130</td>
</tr>
<tr>
<td>Manufacture of accumulators, primary cells and primary batteries</td>
<td></td>
<td>3140</td>
</tr>
<tr>
<td>Manufacture of lighting equipment and electric lamps</td>
<td></td>
<td>3150</td>
</tr>
<tr>
<td>Manufacture of industrial process-control equipment</td>
<td></td>
<td>3330</td>
</tr>
<tr>
<td>Manufacture of motor vehicles</td>
<td></td>
<td>3410</td>
</tr>
<tr>
<td>Building and repair of ships</td>
<td></td>
<td>3511</td>
</tr>
<tr>
<td>Manufacture of railway and tramway locomotives and rolling stock</td>
<td></td>
<td>3520</td>
</tr>
<tr>
<td>Manufacture of aircraft and spacecraft</td>
<td></td>
<td>3530</td>
</tr>
<tr>
<td>Manufacture of motorcycles</td>
<td></td>
<td>3541</td>
</tr>
<tr>
<td>Space transport</td>
<td></td>
<td>6230</td>
</tr>
<tr>
<td><strong>Electrical, electronics, instruments and telecoms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacture of computers and other information processing equipment</td>
<td></td>
<td>3002</td>
</tr>
<tr>
<td>Manufacture of electrical equipment for engines and vehicles not elsewhere</td>
<td></td>
<td>3161</td>
</tr>
<tr>
<td>Manufacture of other electrical equipment not elsewhere classified</td>
<td></td>
<td>3162</td>
</tr>
<tr>
<td>Manufacture of electronic valves and tubes and other electrical components</td>
<td></td>
<td>3210</td>
</tr>
<tr>
<td>Manufacture of television and radio transmitters and apparatus for line</td>
<td></td>
<td>3220</td>
</tr>
<tr>
<td>Manufacture of television and radio receivers, sound or video recording</td>
<td></td>
<td>3230</td>
</tr>
<tr>
<td>Manufacture of medical and surgical equipment, and orthopaedic appliances</td>
<td></td>
<td>3310</td>
</tr>
<tr>
<td>Manufacture of instruments and appliances for measuring, checking, testing</td>
<td></td>
<td>3320</td>
</tr>
<tr>
<td>Manufacture of optical instruments and photographic equipment</td>
<td></td>
<td>3340</td>
</tr>
<tr>
<td>Telecommunications</td>
<td></td>
<td>6420</td>
</tr>
<tr>
<td>Manufacture of prepared unrecorded media</td>
<td></td>
<td>2465</td>
</tr>
<tr>
<td><strong>Architectural and other knowledge-based services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architectural and engineering activities, and related technical consultancy</td>
<td></td>
<td>7420</td>
</tr>
<tr>
<td><strong>R&amp;D, testing and other services</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research and experimental development on natural sciences</td>
<td></td>
<td>7310</td>
</tr>
<tr>
<td>Technical testing and analysis</td>
<td></td>
<td>7430</td>
</tr>
<tr>
<td>Defence activities</td>
<td></td>
<td>7522</td>
</tr>
</tbody>
</table>
5. In fact, only one firm selected via this secondary route was interviewed, the remaining 15 came from the FAME source.

6. A non-probability sample.

7. IOP (2007) identified 35 sectors at four-digit SIC codes (SIC 1992) as those that are physics-based. These are sectors in which there is a critical use of physics in terms of either technologies or expertise that require the application of physics. This definition primarily considers the use of physics rather than the educational background or training of a sector’s employees.

8. The EU uses a definition that includes both employment and turnover data. For our purposes the use of employment as a simple delimiting factor is unproblematic.

INSPEC databases and placed in a separate pool of candidate firms that could be used to “top up” the calling schedule based around the main sampling strategy.

A2.4: Characteristics of the respondent firms

Once a sample of firms that represented the industrial sectors had been obtained, this sample was divided into two further categories of interest to ensure that the firms that were interviewed reflected regional differences and differences in terms of company size. Firms were grouped according to postcode into firms in London and the South East, and firms outside this area. Firms were additionally divided into two groups: those that were large and those that were small or medium enterprise (SME) according to the number of employees. The small category was derived from grouping the firms from the following three categories: a) $1 \leq \text{micro} \leq 9$; b) $10 \leq \text{small} \leq 49$; and $50 \leq \text{medium} \leq 249$. Large firms were designated as those with equal to or greater than 250 employees.

The key objective was, through a method of purposive sampling (Patton 1990), to identify a small number of firms (15–20) that would provide good, if not necessarily representative, coverage of the population of broadly physics-based firms in England. While by definition purposive sampling results in a non-representative subset of a population, we nevertheless wanted a procedure that would deliver a cross-section of firms that were distributed by size, by region of operation and by sub-sector.

The first stage involved using the FAME database to identify all firms listing at least one of the SIC four-digit codes associated with the physics-based sector provided by the Institute of Physics (IOP 2007) as their primary activity. Data on firm size (employment and turnover), region (postcode) and key contacts were extracted to a separate database for subsequent analysis. At this stage the exercise yielded a primary data set of well over 50,000 firms.

In the second stage, we classified firms by size and region. We used postcode data to assign firms to broad regions and employment data to proxy for firm size. SMEs were defined as those with less than 250 employees. While most of the firm entries provided postcode information, only a small proportion (just under 10%) listed employment data. We therefore eliminated all firms without employment data and the few for which addresses were not in the database. This process substantially reduced the number of firms and yielded a potential target dataset of 4429. A cursory glance at the table suggests that London and the South East account for slightly more than half of all firms. We therefore further partitioned the dataset by two broad regions, aggregating London and the South East in one large group and all other regions into an “Other” group.

In the third stage we aggregated IOP SIC sectors into five broad categories. The Institute of Physics (2007) study identified 35 physics-based sub-sectors by SIC 1992 four-digit codes. However, the FAME database uses the SIC 2003 classification (among others). An examination of the correlation table between the SIC 1992 and SIC 2003 reveals that most of the categories are similar with the exception of SIC 40.10 (the production and distribution of electricity), which was subdivided in the later classification into three categories: SIC 40.11 (production of electricity), SIC 40.12 (transmission of electricity) and SIC 40.13 (distribution and trade in electricity).

This allowed the data to be organised into a $2 \times 2$ matrix along the dimensions of size and region, and further gave us scope for drawing a sample stratified by aggregate SIC classification from each cell. We believe that this procedure facilitated a sensitive distribution of firms in terms of their sub-sector of specialisation as well as by size and region of operation. 15 of the firms interviewed for this study were part of a sample of 320 generated by the above process. One was selected via the alternative selection method, drawing from a set of firms that had published in the physics literature. Characteristics of the firms are provided in table 2 in the main text.

Respondents were identified by calling up the main switchboard and explaining the purpose of the study. The initial request was to speak to the R&D director, director of technology, director of innovation, operations director or similar. A limitation with this study is that we have interviewed a single respondent only in each firm. The respondent may have only a partial recollection of support provided in the past, or may have had an atypical experience or strong views that colour the response. This limitation would also be true of questionnaire-based surveys targeting firms.

A2.5: The interview guide

A semi-structured interview guide was developed containing a mixture of open and closed questions around the categorisation of innovation-related
business support measures we had developed. We asked respondents about any public support for innovation that their firm had received over the previous five years. We then asked about likely needs for support in the next five years. We asked them their views on the needs of firms in their sector and region. We asked them their views about the broader climate and “framework conditions” affecting innovation in England and the UK, and finally we asked their views about the most appropriate configuration of public support for innovation in the future.
Appendix 3: Interview guide

Innovation-related business support needs of firms
The Institute of Physics has asked Manchester Business School’s Institute for Innovation Research to investigate the innovation-related business support needs of firms in a range of sectors.

The Institute seeks an evidence base about the kinds of innovation support that firms like yours will require in the coming years in order to help it respond to the government’s proposals about the future arrangements for innovation support to firms in England. Our findings will be used to inform the Institute of Physics’ response to the government’s proposals – it is important that this response is based on real-world business needs and experiences.

We are interviewing senior managers in a select number of firms across England. Our interview asks about what innovation support, if any, has been received by the firm in the past, what kinds of support firms might need in the future and about the broader climate for innovation. The interview should take no more than 20 minutes to complete.

Results and findings will be presented in an anonymised, aggregated form. We will not share the name of the firm or respondent without obtaining explicit permission to do so. We will provide a summary of the findings of the study on request.

Additional background

- The environment in which such firms innovate and compete over the next few years is likely to be very different from that of the past few years.
- In England, the coalition government has already announced the replacement of Regional Development Agencies with new Local Economic Partnerships and a new Regional Growth Fund.
- With the abolition of the RDAs, it is expected that support for the promotion of innovation will revert back to the national government level, although some proposed Local Economic Partnerships have also expressed an interest in promoting innovation in their specific areas.
- The government is due to publish detailed proposals explaining how the new arrangements will work to drive growth in a White Paper at the end of October.

Definition of “innovation”
New or significantly improved goods or services e.g. improvement in quality or distinct user benefits. (The innovation, although new to this business, does not need to be new to the market.)

Process innovations are all new or significantly improved methods for the production or supply of goods or services. (The innovation, although new to the business, does not need to be new to your industry.)

Definition of innovation-related business support measures
We are defining innovation-related business support measures as any support (grants, loans, incentives, information, assistance, advice, etc) offered by or on behalf of public authorities in relation to:

- Identifying market opportunities or needs.
- Financial support for a specific R&D or innovation project.
- Support for testing or proof of concept.
- Acquisition of external knowledge (e.g. licensing in, collaboration with HEIs or other partners to develop new knowledge or technology, bringing in new staff, contractors or students).
- Other networking and collaboration support (partner identification, brokerage, facilitating links with HEIs and the science base, etc).
- Support to exploit knowledge generated within the firm (e.g. IP protection and licensing, spin-outs).
- Other investment (e.g. public-supported venture capital).
- Support for skills development within the firm.
- Support for management of the new product/process/service development process.
- Other advice and business support relevant to innovation.
## Company details

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm name:</td>
<td></td>
</tr>
<tr>
<td>Contact person’s job title and role/responsibilities in connection with innovation:</td>
<td></td>
</tr>
<tr>
<td>Main sector in which the firm does business:</td>
<td></td>
</tr>
<tr>
<td>Location of business unit:</td>
<td></td>
</tr>
<tr>
<td>Ownership: (UK owned, UK business unit of foreign firm, etc)</td>
<td></td>
</tr>
</tbody>
</table>

## Your firm’s innovation-related business support received by the firm in the past five years

1. Has your firm received any public support in any of the following categories in the past five years?

<table>
<thead>
<tr>
<th></th>
<th>What kind of support was received?</th>
<th>How important was this support to your innovation process?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(name of programme, agency involved, mode of support – grants, loans, incentives, information, advice, access to equipment for res or testing, access to incubator space, etc)</td>
<td>(1 = unimportant to 5 = essential)</td>
</tr>
<tr>
<td>Identifying market opportunities or needs</td>
<td>[1]  [2]  [3]  [4]  [5]</td>
<td></td>
</tr>
<tr>
<td>Financial support for a specific R&amp;D or innovation project</td>
<td>[1]  [2]  [3]  [4]  [5]</td>
<td></td>
</tr>
<tr>
<td>Support for testing or proof of concept</td>
<td>[1]  [2]  [3]  [4]  [5]</td>
<td></td>
</tr>
<tr>
<td>Acquisition of external knowledge (e.g. licensing in, collaboration with HEIs or other partners to develop new knowledge or technology, bringing in new staff, contractors or students)</td>
<td>[1]  [2]  [3]  [4]  [5]</td>
<td></td>
</tr>
</tbody>
</table>
2. If you received innovation-related business support, what was the single most important support you received and why? (If not clear from Q1)

Your firm's innovation-related business support needs in the future

3. Which kinds of innovation-related business support needs do you expect to be important to your firm over the next five years?

| Financial Support for a Specific R&D or Innovation Project | [1] [2] [3] [4] [5] |

Degree of Importance
(1 = unimportant to 5 = essential)
Interview guide

4. Which form of support would you think would be most important and why? (If not clear from Q3)

<table>
<thead>
<tr>
<th>Innovation-related business support needs in your broader sector and local region</th>
</tr>
</thead>
<tbody>
<tr>
<td>5. To what extent do you think firms in your broad sector have support needs that may differ from the needs of firms in other sectors?</td>
</tr>
<tr>
<td>For example, in relation to:</td>
</tr>
<tr>
<td>● Identifying market opportunities or needs</td>
</tr>
<tr>
<td>● Financial support for a specific R&amp;D or innovation project</td>
</tr>
<tr>
<td>● Support for testing or proof of concept</td>
</tr>
<tr>
<td>● Acquisition of external knowledge (e.g. licensing in, collaboration with HEIs or other partners to develop new knowledge or technology, bringing in new staff, contractors or students)</td>
</tr>
<tr>
<td>● Other networking and collaboration support (partner identification, brokerage, facilitating links with HEIs and the science base, etc)</td>
</tr>
<tr>
<td>● Support to exploit knowledge generated within the firm (e.g. IP protection and licensing, spin-outs)</td>
</tr>
<tr>
<td>● Other investment (e.g. public supported venture capital)</td>
</tr>
<tr>
<td>● Support for skills development within the firm</td>
</tr>
<tr>
<td>● Support for management of the new product/process/service development process</td>
</tr>
<tr>
<td>● Other advice and business support relevant to innovation</td>
</tr>
</tbody>
</table>
6. Talking about technology-based firms more generally, to what extent do you think firms in your local, sub- or city-region have support needs that may differ from the needs of those in other regions?

For example, in relation to:
- Identifying market opportunities or needs
- Financial support for a specific R&D or innovation project
- Support for testing or proof of concept
- Acquisition of external knowledge (e.g. licensing in, collaboration with HEIs or other partners to develop new knowledge or technology, bringing in new staff, contractors or students)
- Other networking and collaboration support (partner identification, brokerage, facilitating links with HEIs and the science base, etc)
- Support to exploit knowledge generated within the firm (e.g. IP protection and licensing, spin-outs)
- Other investment (e.g. public supported venture capital)
- Support for skills development within the firm
- Support for management of the new product/process/service development process
- Other advice and business support relevant to innovation

Framework conditions and local economic development

7. To what extent are you happy with the broader environment/climate for innovation in England (prompt list: intellectual property regime, training/skills and education system, science base, tax regime, availability of finance, transport and other infrastructure, etc)?

8. Which, if any, aspects of this broader environment/climate most need improving? (max. 3)
9. To what extent would you agree with the following statements?

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Priorities for innovation-related business support are best set at the</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>national level</td>
<td></td>
</tr>
<tr>
<td>Priorities for innovation-related business support are best set at the</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>regional level</td>
<td></td>
</tr>
<tr>
<td>Priorities for innovation-related business support are best set at the</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>local (sub-regional) level</td>
<td></td>
</tr>
<tr>
<td>Innovation-related business support should mainly be delivered by national</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>government</td>
<td></td>
</tr>
<tr>
<td>Innovation-related business support should mainly be delivered by regional</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>agencies (i.e. government office regions: North West, North East, Yorkshire,</td>
<td></td>
</tr>
<tr>
<td>South East, London, etc)</td>
<td></td>
</tr>
<tr>
<td>Innovation-related business support should mainly be delivered at the</td>
<td>[1] [2] [3] [4] [5]</td>
</tr>
<tr>
<td>local (county or city-regional) level</td>
<td></td>
</tr>
</tbody>
</table>

10. Do you have any other comments with regard to innovation-related business support or the broader climate for innovation?

Thank you for your time.
Supporting Physics in Business
An exploratory study into the innovation-related business support needs of physics-based firms in England

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