ROYAL ACADEMY OF ENGINEERING

Business, Innovation and Skills Committee Inquiry on Industrial Strategy

Response to the inquiry, 27 September 2016

The Royal Academy of Engineering welcomes the opportunity to submit evidence to the House of Commons BIS Committee. As the UK's national academy for engineering, we bring together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering.

The Academy has, over many years, been an active proponent of the UK developing and delivering a modern industrial strategy. The views described in this response have been developed through consultation with our Fellows from industry and academia as well as with a range of industry partners and others in our network.

Our key messages are as follows:

Industrial strategy and the UK's exit from the EU: Following the result of the EU referendum, an industrial strategy becomes all the more important in providing a vision and roadmap for how the UK can strengthen and grow as a technologically advanced, globally engaged and competitive economy. An industrial strategy, deployed successfully, will help the UK to exploit the opportunities and mitigate many of the risks that face the economy as a consequence of exiting the EU.

Providing the confidence to invest: Industrial strategy sends a strong signal that government regards industry as a major part of a modern, well-balanced economy and gives businesses the confidence to develop long-term strategic ambitions and make decisions on investment. Government needs to set out early high-level details of the UK's industrial strategy, as well as drawing up a robust and coherent plan for communicating both nationally and internationally.

Consistency of support across government and a systems approach*:* An industrial strategy will take many years to deliver and will need to be delivered across multiple parliaments. Consistency and continuity of support across government and within and across political parties is needed. Senior-level support from ministers and departments across government is essential for ensuring alignment between industrial strategy and other policies. A systems approach is needed to policymaking, so that other policies and industrial strategy are mutually reinforcing.

Industrial strategy, education and skills: The skills pipeline remains a fundamental challenge both within and across sectors. Industrial strategy must influence the education system at all stages in order to inspire young people and families and to ensure that young people have access to the qualifications, skills and careers that the nation requires to develop and grow. Education – and STEM in particular – needs to be a long-term priority with sustained government support.

Infrastructure and industrial strategy: Provision of a sound infrastructure that provides capacity for growth and is fit for the future must be an integral part of the strategy. Infrastructure investment also has a positive impact on the skills base and technology development beyond delivering infrastructure and providing connectivity. Alignment of the strategy with the work of the National Infrastructure Commission is needed.

The broader benefits of industrial strategy: An industrial strategy has broader social benefits through its potential to create jobs and to deliver improvements to the quality of life for people by enabling advances in transportation, health, energy and housing, for example.

Key components of an industrial strategy:

- increasing productivity is a vital part of industrial strategy. Skills, investment and innovation are important components of achieving productivity gains
- strong partnerships between government, business and academia are key to successful collaboration and catalysing joint action. It will also be necessary to build support for the strategy from trade unions
- an industrial strategy must combine horizontal, cross-cutting policies with support for all sectors. Prioritisation of support for specific sectors should target sectors where there is greatest potential for growth and the UK can be a market leader. How best to nurture technologies that cut across sectors, such as digital technologies, also needs to be considered
- industrial strategy must be strongly aligned with policies on science and innovation as innovation and R&D are critical components of industrial strategy. A shared commitment by business, government and academia to investment in innovation and R&D is important and could be a condition of government support for sectors
- the commercialisation of ideas generated in the UK would be better supported if regulation, planning, licensing and other government-led processes are enabling, easy and quick
- a focus on UK supply chains and small businesses is an important part of an industrial strategy. Lessons must be learned from sectors such as aerospace, defence and automotive which have helped to drive up-skilling and investment in the supply chain.

Foreign ownership and industrial strategy: While the issue of ownership of production capability is complex, there needs to be caution about government intervention in the foreign acquisition of UK companies to avoid creating a culture of protectionism and a loss of commercial edge, while ensuring that genuine national interests are recognised and considered. It is important that the UK is seen as an attractive place to do business by UK and overseas owned companies alike.

Opportunities afforded by devolution: Industrial strategy must build on the opportunities afforded by devolution in order to develop national, regional and local strengths. Strong strategies and plans created by Local Enterprise Partnerships or their equivalents are needed but working together in a clear strategic framework from central government, with an effective mechanism for coordination to ensure that their activities are mutually reinforcing rather than competing.

Evaluating the success of industrial strategy: Industrial strategy will need to be evaluated to ensure the appropriate drivers are in place and that it can deliver at the required scale and pace. Measurable change may take 10 years to realise, although it is possible to employ softer measures or monitor incremental gains in the short term. An early benchmarking exercise will be needed at the outset.

Introduction

1. We very much welcome the government's commitment to an industrial strategy, given its critical role in creating economic benefit for the UK. High-level support for an industrial strategy across government will be crucial to its success; we welcome the creation of the Economy and Industrial Strategy Committee chaired by the Prime Minister and involving secretaries of state from 11 departments.

2. The UK's natural strengths in engineering, science and innovation – across academia and industry – are the foundation on which to build an industrial strategy that will in turn deliver outcomes such as stimulating economic growth, achieving higher productivity and contributing to regional development. These strengths may underpin specific sectors such as the aerospace and automotive sectors, or may be cross-cutting, such as digital technologies and data analytics, advanced materials and biological sciences.

Question 1: What does the Government mean by industrial strategy, and what does the private sector want from one?

3. In a speech at the Royal Society on 28 July 2016[1], BEIS Secretary of State Greg Clark conveyed his preliminary thoughts on the nature of a future industrial strategy underpinned by excellence, agility, collaboration, the importance of place, openness and internationalism. On 27 September 2016, he spoke about the importance of industrial strategy and the need for a long-term, sustainable strategy to achieve stability and predictability[2]. The Academy welcomes this early direction of travel.

Why is an industrial strategy needed?

4. In a business, a well-defined strategic framework pulls through the right leadership, skills training, product and service development and other critical components of the business. A national industrial strategy provides a link between macro-economic policies and business-level strategies and needs to address issues such as customer requirements, market structures, product and service development, manufacturing and distribution, availability of financial and human resources, use of global science and technology, competition and regulation.

5. Industrial strategy gives a strong signal that government sees competitive industrial activity as a crucial part of the nation's growth strategy. It signals to society that industrial activity – the development of high-value, technologically-advanced industries – is important and provides a rewarding career choice for young people. The education system can help to communicate career options and prospects and to inspire young people and families.

6. An industrial strategy provides a crucial message to business – both domestic and global – that the government is committed to providing a stable policy framework for key sectors and technologies, enabling business to have confidence in developing long-term plans and

[1] Department for Business, Energy & Industrial Strategy and The Rt Hon Greg Clark MP, July 2016, *New ministerial team to develop industrial strategy: Greg Clark introduces his new ministerial team at the Department for Business, Energy and Industrial Strategy*, Speech at the Royal Society https://www.gov.uk/government/speeches/new-ministerial-team-to-develop-industrial-strategy

[2] Department for Business, Energy & Industrial Strategy and The Rt Hon Greg Clark MP, September 2016, The importance of industrial strategy: Speech by Greg Clark to the Institute of Directors annual conference 2016 https://www.gov.uk/government/speeches/the-importance-of-industrial-strategy

ambitions and make the appropriate long-term investments. It demonstrates where the UK's industrial strengths lie or where it wishes to grow these based on UK research strengths. The UK has to compete with other countries for investment and the choice of where to develop and manufacture products and base the provision of services is strategically and commercially very important to investors. The development of an overarching industrial strategy will positively influence the desire to invest in the UK. It is important that the UK's excellent track record in attracting high levels of foreign direct investment from overseas companies is maintained[3,4]. There are some indications that investor confidence may have been shaken by concern over the UK's future access to the European market[5].

7. An industrial strategy has broader social benefits through its potential to create jobs with the required skills at all levels. It can also deliver improvements to the quality of life for everyone in the UK through enabling advances in transportation, health, environment, energy and housing, for example.

8. North-east Asian countries such as China[6] and South Korea, and other countries, have ambitious five-year plans or industrial strategies that support key growth areas, link industry, science and education to national priorities and focus on the role of innovation in economic growth. The UK needs to learn from the intensity of these ambitions.

What are the key components of an industrial strategy?

9. A successful industrial strategy needs a long-term vision. It must be sensitive to changing economic conditions and the emergence of new technologies, industries and sectors, and catalyse growth at a scale and pace that allows the UK to improve its competitiveness.

10. An industrial strategy must create strong partnerships between industry, government, business and academia. It requires in addition:
    - a cross-government approach that ensures that policies across government are aligned with the strategy and support is at the highest level
    - horizontal policies on issues that cut across all sectors such as skills, access to finance, exports, standards and regulations, and the development of strong supply chains, to support fundamental elements that underpin the success of industrial strategy
    - support for current and emerging sectors, with priority for sectors where there is potential for the UK to be market leaders and to create growth

[3] Foreign direct investment has a significant impact on job creation. 345,537 new jobs were estimated to have been created between the 2011 to 2012 tax year and the 2015 to 2016 tax year as a result of foreign direct investment, Department for International Trade, August 2016, *Foreign direct investment (FDI) projects by UK region*

[4] The UK's R&D In 2012, 20% of the UK's R&D investment came from overseas in 2012, compared to 4% for Germany and the United States and 1% for China. Economic Insight, BIS, 2015: *What is the relationship between public and private investment in science, research and innovation?*

[5] EY UK Attractiveness Survey 2016, http://www.ey.com/uk/en/issues/business-environment/ey-attractiveness-survey-2016-uk

[6] APCO Worldwide, November 2015, *The 13th Five-Year Plan: Xi Jinping Reiterates his Vision for China* A major tenet of the plan is innovation, primarily as a driver of economic development and to shift China's economic structure into a higher-quality growth pattern.

- strategically targeted investment in innovation that helps catalyse increases in economic growth and productivity[7]. The amount of investment, its type and how it is applied are all important.

11. Sound infrastructure – both physical and digital – is of fundamental importance. Infrastructure capacity and fitness for the future must be an integral part of the industrial strategy. This should include secure, affordable energy, ubiquitous high-speed broadband, and adequate transport infrastructure for land, sea and air. Infrastructure investment also has a strong effect on the skills base, job creation and technology development beyond delivering infrastructure and providing connectivity. Government decisions on infrastructure have an impact on organisations considering investing in the UK, and therefore need to be made quickly and communicated clearly to reduce investor uncertainty[8]. Alignment of industrial strategy with the work of the National Infrastructure Commission will be essential.

12. An industrial strategy will take many years to deliver and will need to be delivered across multiple parliaments. A key to continued success of any future strategy will therefore be the continuity and consistency of support from current and future governments, particularly during a time of uncertainty such as the UK's exit from the European Union, or if there is a change in government or of secretary of state. For this, the strategy needs to have support within and across political parties. Measureable change may take 10 or more years to realise.

13. It would be beneficial if government sets out early the high-level details of the strategy as this will help in negotiations with others, at all levels, and will also give industries with long lead times on major equipment an early steer, as well as providing early confidence in infrastructure investment.

Industrial strategy and productivity

14. An industrial strategy is a vital part of improving productivity. Key components include skills, investment and innovation[9]. The report by the Business, Innovation and Skills Committee on its productivity plan inquiry also highlighted the need to prioritise these areas in response to evidence from a number of sources, including this Academy[10].

15. For innovation to have an impact on productivity, companies need 'absorptive capacity': the ability to recognise the value of new, external information, assimilate it and apply it to commercial ends. This requires people with the right skills, and government can play a part via the education system and by providing incentives and investment for companies to

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[7] Royal Academy of Engineering, September 2015, *Investing in innovation*, http://www.raeng.org.uk/publications/reports/investing-in-innovation. This report demonstrates the importance of government support for innovation and the role of innovation in delivering economic and productivity benefits.

[8] For example, the Energy and Climate Change Committee recently highlighted the negative impact that sudden changes to policy have on investor confidence, Report by the House of Commons Energy and Climate Change Committee, 23 February 2016, *Investor confidence in the energy sector*, http://www.publications.parliament.uk/pa/cm201516/cmselect/cmenergy/542/542.pdf

[9] Engineering the Future response to the government's *Productivity Plan*, Business, Innovation and Skills Select Committee, September 2015, http://www.raeng.org.uk/publications/responses/etf-response-to-the-government-s-productivity-plan.

[10] House of Commons Business, Innovation and Skills Committee, *The Government's Productivity Plan*, Second Report of Session 2015–16, 26 January 2016, http://www.publications.parliament.uk/pa/cm201516/cmselect/cmbis/466/466.pdf

train their existing workforce[11]. It also requires access to appropriate finance[12]. Furthermore, companies need to adopt a customer-focused approach to new product and service development and utilise the creativity of their employees to pull through a mix of both existing technologies as well as leading-edge ideas from wherever they are globally into value-adding offerings.

Aligning industrial strategy with science and research

16. Close collaboration between the research base and businesses is required to reap the benefits of the UK's research investment. The UK innovation system must be able to support productive collaborations between universities and businesses. Government needs to ensure that the tax system effectively encourages collaborative research[13]. The Dowling Review discusses the benefits of business-university research collaborations and provides detailed recommendations on how they can be better supported[14].

17. It is important that government and business engage with universities in developing industrial strategy and other long-term sectoral strategies.

18. It is essential that the UK's industrial strategy and policies on science and innovation are coordinated effectively. Strategically-targeted investments made through the sector strategies in skills, R&D and innovation have in the past been substantial and provided real opportunities for UK researchers and innovators to achieve leading positions in the global market[15]. These must be improved on for the long term and an explicit intention to do this is important for building confidence.

19. A well-balanced research portfolio is vital: an industrial strategy needs to be underpinned by world class research in science and engineering, including both long-term, curiosity-led research and research with a more immediate focus on addressing industry challenges. In the latter case, there is an opportunity for research councils to put greater emphasis on developments that have an impact on government policy delivery such as healthcare, environment and energy. Long-term support is particularly important for long lifecycle technologies in sectors such as aerospace and defence, energy, construction and transport; start-stop funding threatens innovative developments and the maintenance of the UK's skills base. It should be noted that EU research and innovation programmes, including Horizon 2020, provide stable long-term funding in cycles longer than the UK's national programmes tend to provide.

20. The creation of UK Research and Innovation (UKRI) offers the opportunity for an agile research and innovation system that invests strategically in areas of future growth and brings greater coherence to research and innovation funding. To ensure that UKRI fulfils its potential of facilitating, supporting and promoting innovation, it will be essential that support for innovation is embedded throughout UKRI. UKRI will need to ensure that the

[11] Royal Academy of Engineering response to the *National Innovation Plan – Call for Ideas*, May 2016, http://www.raeng.org.uk/publications/responses/national-innovation-plan-%E2%80%93-call-for-ideas

[12] Royal Academy of Engineering response to the *Access to Finance* inquiry, House of Commons Select Committee on Business, Innovation and Skills, February 2016, http://www.raeng.org.uk/publications/responses/access-to-finance-inquiry

[13] Ibid.

[14] *The Dowling Review of Business-University Research Collaborations*, July 2015, http://www.raeng.org.uk/policy/dowling-review

[15] Royal Academy of Engineering, contribution to the development of the *Science and Innovation Strategy*, July 2014, http://www.raeng.org.uk/publications/responses/science-and-innovation-strategy-submission

question of how technologies contribute to increased productivity and broader economic and social benefits is addressed with informed stakeholders.

Focusing on UK supply chains

21. Large companies have an important role to play in supporting their supply chains. Supply chains are often global: the UK cannot retain every single sector of the supply chain. An industrial strategy should identify those elements of supply chains where the UK is strong and intends to be competitive and also any significant gaps in the UK supply chain for key sectors that need to be closed. Opportunities to grow existing primes or to attract new primes in key areas also should be identified.

Question 2: How interventionist in the free market should Government be in implementing an industrial strategy, for example in preventing foreign takeovers of UK companies?

Manufacturing capability and ownership

22. Manufacturing is often described as a sector when it is in fact a capability that crosses sectors and industries. Advanced production capability will be critical to the development of emerging industries such as synthetic biology and the newer frontiers of quantum technologies. Existing manufacturing process knowledge can be widely applied in these new industries if recognition is given to this underpinning capability.

23. The issue of ownership of production capability is complex. There are some strategic sectors where UK ownership matters and where there is a clear interest in preserving ownership for the UK economy and security. However, there needs to be caution about government intervention to avoid creating a culture of protectionism and a loss of commercial edge. Generally speaking, the responsibility for the preservation of UK ownership of a company should lie with company boards, rather than government. Moreover, some highly successful UK-based companies are thriving as a direct result of being bought by investors from abroad.

24. Nevertheless, the recent ARM sale to Japan's SoftBank has shown that there are some strong concerns about the consequences of selling UK companies to overseas companies or investors, particularly in regard to the ability of the government to ensure that the assurances given by the purchaser – such as maintaining employment and the location of headquarters in the UK – are met[16].

25. There are also international examples where government support for emerging industries has been important for enabling leading positions to be reached, such as liquid crystal display production in South Korea. The UK approach needs to be fully debated as part of industrial strategy and policy on exiting the European Union.

Capitalising on UK intellectual property and knowledge

26. A more pressing issue is to ensure that we optimise the exploitation of UK-generated intellectual property. There are many examples of good ideas being commercialised overseas - from breakthrough technologies such as plastic electronics delivering substantial

[16] House of Commons Library, September 2016, Briefing Paper Number 05374, *Mergers & takeovers : the public interest test*, http://researchbriefings.files.parliament.uk/documents/SN05374/SN05374.pdf

profits to foreign-owned firms, to the more recent exploitation of the UK's vibrant creative sector by foreign intermediaries[17].

27. Government-led processes such as regulation, licensing and planning need to be enabling, easy and quick to ensure that, as far as possible, the value generated from good ideas emerging from UK universities and businesses accrues to the UK.

28. Notwithstanding, exploitation of UK-generated knowledge and insights by foreign firms should be welcomed, especially where those firms have UK-based development and manufacturing operations[18]. It is also essential that the UK possesses the ability to capture value from its own investments in research and from research undertaken overseas.

Growing businesses to scale

29. Industrial strategy could play an important role in helping businesses grow to scale. There is a perception that, in the UK, the further a company wishes to progress along the investment spectrum, the harder it becomes to access finance, particularly at the growth and large scale-up stages, resulting in the relocation of companies abroad, although it is difficult to quantify this. Greater access to long-term, patient capital would help more UK companies grow to scale[19]. The challenge of growing the customer base for new products and services requires a focus on user needs, commercialisation and business models, as well as international market awareness and access. The Department for International Trade must support UK businesses in understanding how to trade successfully in international markets, and to access the support available, such as UK Export Finance[20].

Question 3: What lessons can be learnt from:

- **Previous governments' industrial strategies?**
- **Other countries' attempts to develop industrial strategies?**

30. A roundtable chaired by Professor Dame Ann Dowling OM DBE FREng FRS and involving Fellows of Royal Academy of Engineering took place in March 2015 at the request of the then Department for Business, Innovation and Skills. The purpose of the roundtable was to discuss progress on the industrial strategy established by the coalition government[21]. The following section is based on this discussion and other sources.

A brand for the industrial strategy

31. There is a perception that the concept of 'eight great technologies' had a resonance that was successful in raising the profile of UK industrial activity and attracting inward investment. Germany's use of Industrie 4.0 to promote the merits of German industry is another example of successful branding. The new industrial strategy needs to be deployed as a brand to communicate through UK agencies such as the Department for International

[17] NESTA (2012), *Plan I The Case for Innovation-Led Growth*; House of Commons Innovation, Universities, Science and Skills Committee, *Engineering: turning ideas into reality*, 2009

[18] Royal Academy of Engineering, 2015, *Investing in Innovation*

[19] Royal Academy of Engineering response to the *Access to Finance* inquiry, House of Commons Select Committee on Business, Innovation and Skills, February 2016

[20] UK Export Finance assumes financial risks associated with exporting on behalf of British businesses, including through the provision of insurance, loans or loan guarantees for commercial banks.

[21] Department for Business, Innovation and Skills, *Industrial strategy: government and industry in partnership*, first published 6 August 2013 https://www.gov.uk/government/collections/industrial-strategy-government-and-industry-in-partnership

Trade the various strengths of UK industrial activity and the government's determination to use it to drive policy decisions.

Assessing the impact of an industrial strategy

32. Government will need to create a clear narrative about the impact of its industrial strategy; the long-term nature of accrued benefits will need to be recognised. In the short term, hard measures of success might not be identifiable and it might be sensible to adopt softer measures or monitor incremental gains. Longer term key performance indicators could include attracting investment, better access to finance, the availability of skills, more business-university collaboration, a strong supply chain and changes in the structure of UK industry. A benchmarking exercise at the outset would enable changes to be measured, as well as adjustements to the strategy at an earlier stage if needed.

33. The scale and pace of delivery of industrial strategy will also need be evaluated to ensure that the appropriate drivers are in place and that the UK is performing to the same level as its international competitors. Many Academy Fellows have an international perspective and could play a part in this process.

Strong partnerships

34. Industrial strategy has been effective in bringing together previously fragmented sectors with resulting benefits. For example, robotics was a fragmented community of university groups and SMEs but has now made real progress in building an innovation pipeline of spin-out companies that are connecting to large companies through strengthened supply chains. Initiatives such as the Royal Academy's Enterprise Hub can help to accelerate enterprise development; in this case, the Hub supports engineering entrepreneurs with funding and bespoke mentoring and training from Academy Fellows[22].

35. In any future industrial strategy, there is scope to bring sectors together to maximise opportunities to develop cross-sectorial capabilities. For example, the digital and manufacturing communities currently do not understand each other's technologies well. There could be a role for national academies in bringing together sectors to catalyse joint action.

36. Pre-competitive research, involving collaboration between multiple industry partners across a sector, can raise standards by offering insights into new techniques and potential efficiencies, as businesses work together towards common goals, often for societal benefit[23]. An industrial strategy could include mechanisms for businesses to engage with each other. This kind of support is of particular importance given that many such activities have historically been funded by EU sources, for example the Clean Sky aeronautical research programme[24].

Strengthening supply chains and small businesses

37. There is a need for better mechanisms for partnerships between OEM companies and SMEs. The international nature of the supply chain is a challenge; there have been serious

[22] Royal Academy of Engineering, Enterprise Hub, http://enterprisehub.raeng.org.uk/

[23] Royal Academy of Engineering response to the *National Innovation Plan – Call for Ideas*, May 2016

[24] The Relationship between EU Membership and the Effectiveness of Science, Research and Innovation in the UK, House of Lords Select Committee on Science and Technology, Submission from the Royal Academy of Engineering, 27 November 2015 http://www.raeng.org.uk/publications/responses/relationship-between-eu-membership-and-uk-science

concerns about deskilling and offshoring of the supply chain. Locking SMEs into the supply chain as part of delivery frameworks is a difficult but important challenge.

38. The aerospace and automotive industries provide excellent examples of what can be achieved through effective sector leadership councils with strong political and industry buy-in, creating business confidence and a clear vision for the sector. In these sectors, dominant OEMs actively encourage innovative supply networks to form and help drive upskilling in the supply chain, in the knowledge that a quality supply network is a competitive advantage for the business.

Business support

39. Across all types of business, there is a clear need to simplify publicly-funded schemes to support innovation, many of which are targeted at specific industry sectors or location. As detailed in the Dowling Review[25], businesses, especially SMEs, can be deterred from applying for support due to the sheer complexity of the funding and support landscape. Consequently, it will be important that any new mechanisms of support are easy to access, navigate and understand.

Catapults

40. The Catapults represent an important mechanism for supporting collaborations involving multiple institutions and companies, including SMEs. Catapults have been helpful in reducing investment capital requirements for companies entering key markets by offering open access prototyping, scale up and demonstration facilities. While the older organisations such as Sheffield AMRC and Warwick Manufacturing Group that have been brought under the Catapult umbrella are demonstrating their worth, the new Catapults need to continue to receive appropriate government support to enable their potential to be realised.

Skills

41. The skills pipeline is a fundamental issue both within and across sectors. There is a risk that, if there is a shortage of skills and expertise, companies will need either to import skilled people from overseas or export the work. The UK therefore risks giving away massive value in the form of skilled jobs for young people and technology-led growth in the economy. The UK will also need to move rapidly to address the need for completely new skills resulting from rapid developments in technologies such as robotics, autonomous systems and artificial intelligence. There is evidence of acute pressure on the supply of people with certain specialist skills and expertise[26].

42. Education – and STEM in particular – needs to be a long-term priority with sustained government support. More unified engagement and career support is needed in schools and higher education to attract young people into STEM subjects and guide them through to the workplace. The Royal Academy of Engineering's *Engineering Talent Project*[27] aims to address the engineering skills pipeline by scaling up engagement with schools, working with industry and government to remove barriers, establishing and showcasing optimum

[25] *The Dowling Review of Business-University Research Collaborations*, July 2015

[26] The Department for Business, Innovation and Skills, November 2013, Professor John Perkins' Review of Engineering Skills https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254885/bis-13-1269-professor-john-perkins-review-of-engineering-skills.pdf

[27] Royal Academy of Engineering, *Engineering Talent Project*, http://www.raeng.org.uk/education/engineering-talent-project

workplace culture and employment to attract and retain engineering talent, and campaigning to change perceptions and promote opportunities.

The role of leadership councils

43. Leadership councils provide a vitally important convening role, bringing together industrial communities where there is otherwise no forum for this. One size does not fit all leadership councils. However, some degree of consistency will assist policymakers with the prioritisation of investment, policies and regulations. Leadership councils need to focus on the question of markets and whether there might be regulations or policies missing that would create markets, and to anticipate changes to markets. Many sectors now have plausible roadmaps, but it is now important for councils to identify and address the barriers to delivering the roadmaps.

Access to finance

44. The Academy has set out detailed recommendations on improving access to finance in its submission to the inquiry by the House of Commons Select Committee on Business, Innovation and Skills[28]. Access to finance in the UK is an area where more needs to be done. Fiscal policy in the UK tends instead to incentivise financing debt rather than investment in equity. Furthermore, the way the Regional Growth Fund (RGF) is being administered – the length of time taken and the overheads it incurs – is tarnishing investor perceptions. This is especially true in the automotive sector.

45. State Aid Rules have not helped on numerous occasions in public-private partnerships, in particular where there is a prospect of profit. Any changes to State Aid Rules following the UK's exit from the European Union should be examined in the context of their potential to support the industrial strategy.

46. More investment funding for start-up businesses is required. The British Business Bank's minimum turnover requirement of £2m could be reduced to help start-ups rather than more established businesses.

47. A shortage of long-term patient capital has been identified by many experts as a barrier to the ability of UK companies to innovate[29]. The creation of the independent Business Growth Fund (BGF) in 2011 demonstrates that the UK has potential investees with sufficient ambition to warrant the provision of long-term patient capital. It also demonstrates the enabling influence of government if it articulates effectively the case for investment. Consideration should be given to increasing collaborative working between the government and existing financial institutions, as is already done by the British Business Bank, to expand the portfolio of incentives to increase long-term investment by the private sector[30].

Government procurement

48. Procurement is a powerful lever available to government to stimulate innovation. The US Small Business Innovation Research (SBIR) procurement model provides one route to promoting collaboration within a supply chain and has been perceived to be far more successful than the UK Small Business Research Initiative (SBRI). SBRI is far too limited in scope, only applying to departmental research spend, and is very small in comparison to

[28] Royal Academy of Engineering response to the *Access to Finance* inquiry, House of Commons Select Committee on Business, Innovation and Skills, February 2016

[29] Royal Academy of Engineering response to the *National Innovation Plan – Call for Ideas*, May 2016

[30] Ibid.

the overall public procurement spend. There is a widespread perception that procurement in UK government departments and other public bodies still tends to favour 'faster and cheaper' over 'smarter and better value': too often, the outcome is neither faster nor cheaper. This may be due to government's tendency to be risk averse due to the perception that failure will negatively influence political and public views. Establishing and accepting an appropriate level of risk is essential if the opportunities to stimulate innovation provided by procurement are to be exploited[31]. Visible support from a ministerial champion and departmental champions tasked with promoting the benefits of SBRI would be helpful, and best practice should be shared.

49. Publishing government contracts alone will not drive businesses to invest in training and capacity-building unless they see more security in the pipeline of opportunities. There is a challenge in turning the publication of procurement opportunities into more secure business opportunities to enable businesses to invest in upskilling. The biggest spends on public procurement relate to construction, healthcare and education and these represent major opportunities for public procurement as part of industrial strategy and other policies following the UK's exit from the EU.

50. There is a need for government to make tendering for projects simpler and cheaper and to consider more collaborative frameworks. Investment in the capacity of civil service is needed to ensure it can act as an intelligent customer.

Question 4: What tensions exist between the objectives of an industrial strategy and the objectives of other policies, and how should the Government address these tensions?

A systems approach to policy making

51. A systems approach must be taken to policy making. This involves taking a holistic view of policies to identify where interdependencies exist and how policies can be aligned so that they positively reinforce each other.

52. The strategy needs to connect with relevant policy areas and departments across government. There are important interfaces with policies on exiting the European Union, trade, infrastructure, the digital economy, education and skills, immigration, procurement, and tax, for example. If the support of other government departments could be secured, the potential impact of the strategy would be amplified significantly[32]. Another important consideration is building support for and active engagement in the strategy from the trade unions.

53. As part of industrial strategy, the role of the defence industry in the wider economy should be considered particularly given its weakening position as a major exporter of defence equipment. Alignment will be needed between industrial strategy and the Ministry of Defence's industrial and procurement policy.

Tensions between an industrial strategy and the UK's exit from the European Union

54. The result of the EU referendum presents challenges to maintaining the UK's excellence in engineering, but with it come opportunities. Industrial strategy must allow the UK to grasp

[31] Royal Academy of Engineering response to the *National Innovation Plan – Call for Ideas*, May 2016

[32] Royal Academy of Engineering, contribution to the development of the Science and Innovation Strategy, July 2014

the opportunities afforded by exiting the European Union, including those around international trade.

55. International companies have in the past chosen to locate and invest in the UK because of the opportunities afforded by access to the Single Market. This has also attracted investors in start-ups. Freedom of movement and a skilled and experienced workforce have also influenced investment, both of which will be affected by the UK's exit from the European Union. Government must look for ways to anchor key companies in the UK in order to offset this effect – for example, in healthcare, the close proximity of research and teaching hospitals and a more enlightened clinical trials regime could be attractive to pharma companies. The UK is a valued part of European and global research and innovation networks, and its continued participation in these is important in maintaining its science and engineering strengths, as well as its attractiveness to investors.

56. In order not to lose out on the contribution that EU research and innovation programmes have made to the UK's productive research and innovation base, the government needs to create the closest possible association with EU research programmes[33]. If the UK was to establish replacement research and innovation funds, these should replicate the successful and unique aspects of EU programmes, specifically support for international and industrial collaboration, collaboration between SMEs, larger companies and universities in a single project and long-term visibility of themes and subject areas.

57. There may be a need for new financial instruments to ensure continuity of funding along the innovation cycle from research to commercialisation. There may also be potential to redirect funding that previously went to the European Union into big nationally strategic projects.

58. The UK faces an engineering skills crisis and engineering firms are highly dependent on non-UK nationals to sustain their business[34]. University engineering departments are also very reliant on international students for their continued financial stability as it is necessarily costly to teach engineering students and equip them with the necessary practical and computer modelling expertise demanded by industry.

59. The result of the EU referendum presents an opportunity to refocus efforts on boosting the supply of UK home-grown talent to tackle the skills crisis. Nevertheless, inward migration to the UK of talented individuals who can contribute to filling the skills gap will be essential for the foreseeable future. The UK government must ensure that any changes resulting from the referendum vote do not impede the ability of UK institutions to attract world-class talent to academia and industry.

60. As a result of the UK's exit from the European Union, there may be opportunities to simplify fiscal and regulatory frameworks, and to deploy policy levers that help to enable delivery of the industrial strategy. For example, changes to procurement rules such as State Aid may be possible.

61. The Royal Academy of Engineering is coordinating a project on behalf of the 38 professional engineering organisations, with the aim of providing evidence-based advice to government

[33] UK National Academies, July 2016, Research and Innovation: After the EU Referendum, http://www.raeng.org.uk/news/news-releases/2016/july/seven-national-academies-publish-joint-statement-o
[34] The Department for Business, Innovation and Skills, November 2013, *Professor John Perkins' Review of Engineering Skills*

on the opportunities and risks presented by the outcome of the EU referendum. This will include advice relating to industrial strategy and will be published in the autumn of 2016. In September 2016, the Academy also provided a response to the House of Commons Science and Technology Select Committee inquiry on *Leaving the EU: Implications and opportunities for science and research*[35].

Question 5: What are the pros and cons of an industrial strategy adopting a sectoral approach?

- **Should the Government proactively seek to 'pick winners'?**
- **What criteria should be used to identify which sectors are supported?**
- **Should the Government prop up traditional industries that it considers to be in the national interest?**
- **If not a sectoral approach, should the industrial strategy have a broader objective, such as improving productivity?**

Combining a horizontal approach with support for sectors

62. An industrial strategy should combine sectoral support with horizontal policies that cut across sectors. The argument for a sectoral approach, that there is a need for government support for sectors experiencing knowledge and innovation market failures – or other types of market failure – was made by BIS in 2012[36] and this broadly still holds true. The balance between a sectoral and horizontal focus, however, and the sectors that should be prioritised, needs to be reassessed in the new political and economic environment. The skills pipeline remains a fundamental issue both within and across sectors and requires a combination of coordinated approaches, both horizontal and sector-specific.

63. There is a need for the strategy to maintain clarity about what is sector-specific and what applies across sectors. There is an opportunity for leadership councils to identify between themselves where there are common agendas and to encourage concerted, coordinated effort – for example, in the area of education and skills.

Heterogeneity of sectors

64. The UK has sectors with heterogenous characteristics:
    - strong sectors (such as energy, aerospace, automotive) that the UK wants to grow
    - new sectors that are not in the position to act collectively and need to be supported
    - critical underpinning sectors, such as construction, that create large numbers of jobs and deliver the infrastructure that underpins productivity, but may not have the ear of government.

    Sectors vary widely, depending on the life cycle for introducing new products and processes, capital intensity and the barriers they face. Therefore, a sectoral approach should be tailored to each sector's specific issues but within a stable policy environment that provides support across sectors. It is much easier for government to deal with existing sectors because they have existing structures; but there are new and emerging sectors that will create new jobs and growth in the future.

[35] Royal Academy of Engineering response to the House of Commons Select Committee inquiry on *Leaving the EU: implications and opportunities for science and research*, September 2016 http://www.raeng.org.uk/publications/responses/leaving-the-eu-implications-and-opportunities-for

[36] BIS Economics Paper No. 18 (2012), *Industrial strategy – sector analysis,* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/34607/12-1140-industrial-strategy-uk-sector-analysis.pdf

Criteria for identifying sectors to support

65. The criteria that government and business should use in identifying which sectors to support include:
    - the potential for high-tech, high-added value business
    - a very large, potential multi-billion dollar market that provides a sufficient scale of opportunity
    - an existing UK lead in research or industry
    - products already in the market but with a need to expand the customer base
    - the potential within five years to expand internationally
    - room for emerging industries to spin out.

    The potential scale of the market needs to matched by a sufficient scale of activity around research, innovation and collaboration. International collaboration is necessary for achieving scale.

66. Government has an opportunity to use industrial sectors and key technologies as levers to encourage greater business investment in innovation and R&D and to involve companies of all sizes through the supply chain. There needs to be a shared commitment by government and business to invest in innovation, R&D and business models, and indeed, this could be a condition for providing support for a particular sector[37]. There is an opportunity to capture greater value from multinational companies investing in the UK's world-leading science base by incentivising them to site R&D facilities in the UK.

67. Identifying clean interface opportunities allows a separation between design and manufacture such that design can be done in one country and manufacture in another. One such example is ARM in Cambridge which licenses manufacture of its semiconductor designs to overseas manufacturers. An industrial strategy needs to be alive to future clean interface potential where the UK can be world-class.

An approach to cross-cutting technologies

68. The structure of the strategy, the councils and the connections that it seeks to foster and maintain should be dynamic, responding to opportunities and new linkages. The strategy needs to be alive to the implications of different cross-cutting technologies and put in place the right structures to represent them, along with mechanisms for building the bridges between sectors. Digital technologies are so significantly cross-cutting that the UK cannot afford not to be a leader in this area.

Question 6: Should the industrial strategy have a geographical emphasis?

- **How should an industrial strategy link with devolution initiatives aimed at devolving taxation and decision making away from Westminster?**
- **What examples are there of interventions from central Government that have successfully supported economic growth away from London and the South East of England?**
- **How should the industrial strategy work with local authorities and Local Economic Partnerships, reconciling a U.K.-wide strategy and local, regional and devolved nations' priorities?**

[37] *The Dowling Review of Business-University Research Collaborations*, July 2015

Capitalising on the benefits of regional specialisation

69. Regional specialisation, such as clusters, can generate powerful positive benefits. These arise from the spatial concentration and the agglomeration of activities that allow for greater labour market pooling and knowledge sharing[38]. While some sectors such as construction and retail are spread fairly evenly across the country, others such as aerospace and financial services are geographically localised.

70. Capitalising on the opportunities afforded by clusters requires a local approach that builds on the strengths of places and communities, and recognises local drivers and barriers to growth. There is a need for regional and local organisations to collaborate and coordinate more to build a stronger economy overall and to ensure that their activities are mutually reinforcing rather than competing. This will require them to work flexibly and independently, but as part of a coherent national strategy. Science and innovation audits have the potential to gather detailed local information and to assist with coordination; however, it is not yet clear how these will be integrated to provide a collective view.

71. There is value and importance of locality in the skills agenda – providing a locality where people can see and experience innovation and engineering heritage. The Royal Academy of Engineering runs education programmes to encourage young people in economically deprived areas to become engineers and technicians, and to improve skills levels by providing opportunities to take part in authentic engineering projects and building links with local authorities. For example, the Barrow Engineering Project has provided over 25,000 STEM learning opportunities for local students and involved 31 local employers[39]. There is growing evidence that it is having a positive effect on educational attainment more generally and this in turn will have a positive effect on the local economy.

The role of Local Enterprise Partnerships

72. In England, government has given Local Enterprise Partnerships (LEPs) a remit to support innovation within the local areas but, while there are examples of excellent practice, their performance to date has been patchy and there is a need to set a clear national direction and provide stronger support to enable them to fulfil this role[40]. There appears to be significant variation in capability, activity and engagement with the public and private sectors and academia amongst LEPs and their role in stimulating innovation remains largely unproven. This may in part be because of the relatively low level of funding compared, for example, to that received by Regional Development Agencies. The quality of staff in LEPs and Growth Hubs is likely to be a key determinant of success and there may be a role for central government in supporting capacity development within the LEP teams.

73. By strengthening the role of LEPs in innovation, establishing rich networks between organisations and ensuring their work is coordinated, the potential to capitalise on regional strengths will be optimised.

The Academy would be very happy to discuss further the points made in this submission with the Committee.

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[38] BIS Economics Paper No. 18: Industrial strategy – sector analysis, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/34607/12-1140-industrial-strategy-uk-sector-analysis.pdf

[39] Royal Academy of Engineering, Barrow Engineering Project, http://www.raeng.org.uk/education/schools/education-programmes-list/barrow-engineering-project

[40] *The Dowling Review of Business-University Research Collaborations*, July 2015