Written evidence submitted by Nesta (GAP0017)

Executive summary

- This submission focuses on two aspects of the STEM skills debate - 1) data skills, incorporating mathematics, computing, statistics, problem solving and communication skills, and 2) the fusion of STEM and arts skills, and the positive impact this has on UK firm performance - suggesting that in closing the STEM skills gap government should look also be thinking about STEAM.

- **Data Skills:** Data is transforming the economy, increasing efficiency and creating new opportunities for innovation. To make effective use of data to drive decision making in UK companies, analytical skills are required - which the UK is currently lacking.

- **The Fusion Effect:** We find compelling evidence to suggest that firms combining STEM and arts skills are more likely to grow in the future, are more productive, and are more likely to produce radical innovations. Our findings support the hypothesis that the impact of arts skills in the UK economy extends beyond the creative industries, and should be seen as complementary to STEM skills.

Data skills

1. Data is transforming the economy, increasing efficiency and creating new opportunities for innovation. We are constantly generating data, from changes in how we shop, communicate and meet, to the clothes we wear and the gadgets we use, and businesses and government are becoming more adept at creating value from this.

2. The UK, referred to by some as ‘The Connected Kingdom’, is particularly well–placed to benefit. But if data is the new oil, logically, it won’t be useful to business until refined. That requires analytical skills - which the UK is currently lacking.

3. That much has been made clear in recent years by an extensive body of independent research by Nesta into the experience of the ‘datavores’ – those businesses that make heavy use of data for driving their business decisions – as well as the work of academics and other public bodies like the Tech Partnership. Such research shows a strong link between data, business innovation and productivity. Nesta’s recent report, *Skills of the Datavores*, finds that data–driven companies are over 10 per cent more productive than ‘dataphobes’ – firms that don’t exploit their data – controlling for other determinants of productivity.

4. However, the data–driven companies we have surveyed are struggling to find suitable talent. Two–thirds of datavores who tried to recruit analysts in the previous 12 months struggled to fill at least one vacancy. A recent employers survey by the Tech Partnership shows that big data analytics is the tech occupation with the biggest skills gaps. While data may be part of the answer to the UK’s productivity gap with other countries, it appears that barriers to accessing analytical talent are preventing businesses from fully harnessing its potential. By and large, the problem is finding people with the right mix of skills: the data scientists who combine technical skills,

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3 The Tech Partnership employer skills survey, 2015.
analytical and industry knowledge, and the business sense and soft skills to turn data into value for employers are very hard to find – so much so that some people refer to them as ‘unicorns’.4

5. In Skills of the Datavores5, we also found that there isn’t a one-size fit all to creating value from data. Our research reveals three types of ‘Data active’ businesses: Datavores who base their decisions on data and analysis, Data Builders working with big datasets, and Data Mixers who combine data from different sources. We also find 30% of ‘Dataphobe’ businesses who seem to have given the data revolution a pass - these companies tend to work with few, small datasets, and rarely use analysis to make decisions. We find all Data Groups present in all industries, consistent with the idea that data analytics has features of a General Purpose Technology, in that it drives innovation and growth in many different sectors.

6. Data-active companies are recruiting more analysts, and combining more disciplines to build a data science capability. But this isn’t proving easy, for instance, two thirds of Datavores struggled to fill at least one vacancy. 80% of them identified problems in at least one skills area. Data-active companies are particularly concerned about the lack of domain knowledge in analysts, the lack of people with the right mix of skills and the lack of experienced analysts. Technology is changing fast in the data space, so as well as recruiting, employers are keeping the skills of their data analysts fresh through a variety of approaches. 80% do internal training. Significant proportions (between a third and two thirds) are using innovative training methods like data competitions, online courses and meetups. But only a fifth use universities to train their staff.

7. In the absence of such unicorns, businesses are building their analytical capability through multidisciplinary teams. Members of a team may have a number of core skills in common, and individuals will have specialist skills developed within particular disciplines. This underscores the need not just for multidisciplinary working, but for data analysts with strong teamwork and communication skills.

8. The stakes for the UK economy cannot be understated. If, for example, in our sample of firms all the Dataphobes were to behave like Datavores, our results suggest this would be associated with an overall 3 per cent uplift in productivity. To put this into context, at the macroeconomic level a 3 per cent uplift could, according to OECD statistics,6 represent roughly one-fifth of the UK’s productivity gap with the rest of the G7.

9. In recognition of this skills shortage, Universities UK has undertaken research into how data skills are taught in undergraduate degrees across subject areas. We find that training in data analytics is found in most STEM and social science courses, but the extent of provision varies by institution and degree subject. To meet the current and future needs of the UK economy, we must do more to embed data skills as a core component of more degree programmes.

10. The recommendations in this submission span the whole analytical talent pipeline, including schools, colleges, universities and the labour market and industry. The recommendations aim to remedy skills shortages in the short term, while ensuring a sustainable supply of excellent analytical talent in the longer term. Additionally, the recommendations encourage cross-sector collaboration so that knowledge about how to create value from data and awareness of analytical skills shortages are not trapped in silos, but are widely shared.

11. The data revolution has implications not only for experts with advanced analytical skills (i.e. data scientists), but for the entire workforce. We all need to become more data literate to operate

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4 See: http://www.theguardian.com/media-network/2015/feb/12/data-scientists-as-rare-as-unicorns
6 This estimate is based on http://stats.oecd.org/Index.aspx?DataSetCode=PDB_LV
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successfully in increasingly ‘data–rich’ environments. This is a key lesson from Count Us In, the British Academy’s review of the UK landscape for quantitative skills.\(^7\) Our recommendations reflect the diversity of analytical skills levels which are needed, and also suggest creating early ‘touch points’ between young people and data, acknowledging that in some cases these will mark the beginning of a life–long analytical career, while in others it will involve raising awareness and confidence in using data, whatever the occupation.

12. Regarding the overall scope of our recommendations, our assessment of the current situation in the analytical talent pipeline is broadly optimistic. The data revolution has created analytical skills shortages, which are being particularly felt by those companies that are most innovative with their data, but there is a rapidly increasing awareness of those issues, and a willingness by educators and the government to act upon them. Much good work is already taking place in schools, universities and skills development agencies. The challenge therefore is to step up significantly the response so that it is commensurate with the scale of the opportunities.

The Fusion Effect\(^8\)

13. The ability of UK firms to access skills for growth has long been a national policy priority. Skills was one of the five cross-cutting themes of the 2014 UK industrial strategy, and consequently much policy effort has been dedicated to strengthening the UK skills base. It is likely that skills will form an important cross cutting theme in the government’s latest version of industrial strategy. While the importance of skills is widely studied in terms of the relationship between human capital, skills and performance, there is rather less work considering the combinations of skills used by firms and their implications for firm performance. Our research aims to address this by considering the relationship between science and arts skills and firm performance. One important and commonly discussed aspect of the UK’s skills base is science, technology, engineering and mathematics (STEM) skills.

14. STEM subjects are widely identified as key to UK national competitiveness, and consequently considerable investments have been made in promoting these topics at primary and secondary level and trying to ensure the financial feasibility of STEM teaching at the tertiary level. Consistent with this, recent research by one of the authors has also suggested that companies investing in STEM graduates outperform their rivals in terms of sales and employment growth and innovation.

15. Concurrent to this increased interest in STEM skills has been a challenging policy environment for arts education. On the one hand, arts graduates are popularly caricatured as doomed to poor earnings and underemployment. On the other hand, the importance of creative skills, of which arts skills are one (but not the only) component, have been widely recognised.

16. The ‘creative economy’, reflecting creative industries and those employed in creative occupations outside creative industries, has been widely hailed as a driver of jobs and economic growth. According to the latest official statistics, the creative economy employed 2.8 million people in 2014, including 1.8 million in creative industries and 0.9 million creative professionals working in other sectors. This was up from 2010, when the creative economy consisted of 2.2 million people, including 1.2 million in creative industries and 0.9 million in other sectors. Further, the GVA generated by the creative economy was £133 billion in 2014, up 25 per cent from 2011. At


the same time, there has been growing interest in power of interdisciplinary work as a driver for creativity.

17. Research in a number of fields has highlighted the benefits of different disciplinary, intellectual and personal backgrounds within groups on creativity at the personal, group and organisation level. This literature suggests that working with people from different backgrounds provides a range of distinct perspectives that broadens search, provides better identification of opportunities and gives unique ways of taking advantage of these opportunities.

18. In this paper, we explore the performance implications of the combination of STEM and arts skills. The growth of investment in STEM and increased awareness of the creative economy have generally been understood as separate phenomena. However, recently there has been an increasing level of research and policy interest in the complementary effects of STEM and arts skills. For instance, the two AHRC-funded Brighton Fuse projects identified possible dividends to bringing together creative and technical skills in one organisation, or even in individual self-employed workers. At the same time, Nesta, the Creative Industries Federation, the Cultural Learning Alliance, and others have joined to promote the integration of STEM and arts skills under a common STEAM (Science Technology Engineering Arts and Maths) framework.

19. This research aims to understand and further elucidate the complementarities that exist between arts skills and STEM skills. The purpose of our research is to measure the impact of these combined skills on firm growth and innovation performance throughout the economy. In doing this, we expand on previous findings from the Brighton Fuse project, extending and further exploring these findings using representative, official data covering a representative sample of UK firms with more than ten employees.

20. Our main research question therefore asked whether the combination of arts and science skills produces performance dividends in terms of growth and innovation. In doing so our aim was to explicitly identify the contribution of ‘fused’ firms to the economy and to generate evidence on their economic performance. While previous studies have highlighted effects at the cluster level, ours is the first to generate evidence of an arts and science ‘fusion’ effect at the national level.

21. This report highlighted important outcomes from the fusion of STEM and art skills in UK businesses:

- We estimate that these organisations employed over 3.5 million people and generated £500 billion turnover in 2011.
- Although STEAM firms only make up 11 per cent of the population of non-micro firms, we estimate that they generate 22 per cent of employment and 22 per cent of turnover.
- While fused firms are widely perceived to be present in ‘high-tech’ and creative industries, we find them to be common in ‘low-tech’ and ‘mid-tech’ industries too.

22. We find that firms combining arts and science skills, other things being equal, outperform those firms that utilise only arts skills or science skills:

- They show 6 per cent higher employment growth and 8 per cent higher sales growth than other firms.
- They are 3 per cent more likely to bring radical innovations to market.
- They are 10 per cent more productive than the average firm, though they are somewhat less productive than science skills-only firms.
- These positive effects hold across the entire economy, and are particularly strong for smaller firms.

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There is evidence that the broader the set of skills a firm uses, the higher its level of innovative performance and future growth.

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