Future of Work

In a number of our 2017 blogs we examined ideas and thinking about the future of work and the issues involved with automation.

Melding machine learning and participatory foresight

Last year SAMI colleagues assisted in beta-testing a workshop process design which was used in a project looking at the skills that may be required in the future and is the subject of the following article.

Occupations, Tasks, Skills: what might we need most in the future?

What do ***you*** want to be when you grow up?

Are you thinking about choosing a new career? Worried about the jobs available for your children, and what skills they might need to succeed in the future? Pearson, the world's largest education company, has sponsored Nesta UK and the University of Oxford in forecasting future jobs availability and skills requirements.

The resulting project, "**Employment in 2030: Skills, Competencies, and the Implications for Learning**," explored which occupations may disappear in the future, and which may be in greater demand. Robots and smart things everywhere are supplanting human labour —how many occupations are actually in jeopardy?

Official government occupational lists from the UK and the USA provided the starting point for the project. Each occupation's description includes a list of typical tasks and the skills they require. Consequently, forecasting the potential for growth or decline of a specific occupation also indicated the potential for growth or decline in demand for specific skills: will we still need chefs in the future?

Or will nimble robots assemble raw ingredients into gourmet meals in gleaming restaurant kitchens? Does that only mean that restaurants no longer require line cooks, and that the chef's key tasks—of designing the dishes and curating the meals, calculating the ingredients required and their most efficient use—and related skills will still be in high demand?

Understanding what skills future occupations will require helps educators understand what the critical educational needs of the future might be. What do people really need to know to thrive in the transformed economy of the future?

How can experts work together to help train an algorithm about occupational futures?

Pearson, Nesta and the University of Oxford set out to explore these questions with a unique futures approach: a dialogue between human experts and an active learning algorithm. The array of methods available to foresight researchers and forecasters splits across Snow's two cultures: the highly data-driven and quantitative vs the data-informed, intuitive and qualitative. This project sought consciously to bridge the two.

It's a tricky bridge to build. Nesta invited world class thinkers to discuss emerging changes and their potential effects on occupations to one workshop in Boston, and another in London. I should also declare an interest at this point: I was commissioned to design and facilitate the workshops that elicited the expert opinion that informed the algorithms.

The workshop attendees were looking forward to a stimulating conversation and discussion about transformations in jobs and labour. The active learning algorithm that we needed to feed, on the other hand, simply wanted those experts to rate possible growth or decline in 30 occupations—not a very interactive task. Our goal was to design a process that supported wide-ranging thinking about change, stimulated discussions across the expert perspectives in the room—and paused periodically to inform the algorithm, via a simple web-based input form.

How did we do it? The most critical part of the process design was explaining clearly what we were asking participants to do, and why: the introductions to the project goals (understanding what skills the future will require), the overview of machine learning (introducing them to the algorithm they'd be training), and their role in sharing data and contributing insights. Second, while many of the experts had deep understanding of one sector of change, we wanted everyone to have a shared baseline of changes across multiple sectors of changes that might affect the future of occupations. Thus a key component of the project was extensive research into critical trends, and summarising them as a trends deck for discussion.

The workshop live

What, then, did we actually do on the day? Each workshop began with a round of introductions that included—as an icebreaker and a way to frame discussions —the

question, “When you were ten, what did you want to be when you grew up?” It turns out that even economists, social scientists, and technology experts wanted to be astronauts or soccer stars when they were ten!

The project team then galloped rather rapidly through the extensive map of trends and emerging issues affecting economic activity and potentially transforming occupations over the next twenty years. After listening to a data-dense presentation for thirty minutes, participants deserved an opportunity to process the information and its implications, and to discuss the trends amongst themselves. We wanted them to think about how those impacts might affect all the different activities in the economic landscape. We also wanted to switch thinking modes from listening (verbal) to mapping impacts and interconnections (visual).

To spur that conversation and encourage that thinking mode, we printed out a table-sized cartoon of a city landscape (office buildings, retail space, government buildings, arts and leisure, manufacturing facilities, transport infrastructure, agriculture, suburbs, etc.), and a deck featuring each of the key trends and emerging changes, summarized in a phrase. Participants worked in pairs to cluster the trends they thought reinforced and amplified each other, and then placed each change or change cluster on the map where they thought it would have the greatest impacts.

If they thought the change affected more than one economic activity, they could use coloured tape to connect their chosen change to other activities. We then asked them to summarise by suggesting two occupations that, as a result, would increase in future, and two that would decrease.

After stretching their mental muscles with that exercise, we moved on to labelling specific occupations with directional forecasts—“will this occupation increase or decrease in the next twenty years?”—an activity that was assisted by fact sheets that included a definition of the occupation, its specified tasks and required skills, and historical trend data summarizing its growth in the economy. We instantly displayed the forecast output to the group, so they could discuss the range of answers, explore the different assumptions each of them used to arrive at their forecasts, and potentially amend their initial judgments. Participants could refer to the trend deck for change ‘evidence’ to support their assumptions and forecasts. To provide the algorithm with its required base of thirty occupation evaluations, we repeated this process two more times.

Giving the participants discussion space during the occupation forecast labelling gave them an opportunity for unconstrained and exploratory thinking, in contrast to the very constrained mental process of assigning ‘increase or decrease’ labels to 30 different occupations. But it didn’t provide space for another obvious potential output from combining emerging changes, forecasts of impacts on current occupations, and human creativity: brainstorming entirely novel occupations, or radical transformations in current occupations. To capture those creative insights, participants ended the day by pairing up again and scrawling their wild and divergent extrapolations of the occupations of the future on a wall mural with the key change clusters already posted.

Emergent forecasting… watch this space

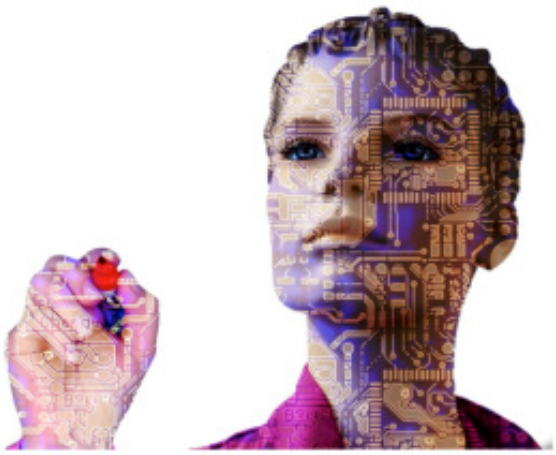
The research team has mapped the interesting changes, the experts have discussed the possible impacts, and the algorithm is computing. We are looking forward to the output: forecasts of potential future growth—and decline—in specific occupations in the UK and the USA and, more importantly, in the range of critical tasks and skills that may be required of the next generation of workers.

Web pundits trumpet the erosion of employment due to increasing roboticisation and the emerging ecology of 'smart everything' (cities, factories, cars, toasters, you name it). Nesta has just demonstrated at least one instance where human intuition and machine learning can work hand in hand. Maybe that's the best future we could hope for.

*Written by Wendy Schultz, SAMI Principal, published March 1 2017. A version of this article was previously published in the January 2017 edition of Compass, the newsletter of the Association of Professional Futurists, and is republished with their permission under a Creative Commons licence. There is more information, and project reports, **at Nesta UK**.*

Work Automation

*This is the first of three blogs leading up to **a forum on the future of work in health**. IN this first blog, David Smith, Chief Executive of Global Futures and Foresight, looks at the wider context of automation in the workplace and its impact*



The rate of change is such that by 2027, **75 percent of the companies in the S&P 500 are predicted to be companies that are not in the index today**. Adapting to the underlying economic, technological and social changes that are reshaping the world of work will be critical for incumbents wishing to survive and thrive.

One major area of change obviously lies with technology; not so much with the technology per se but in what it enables organisations to do. Many of the technologies underpinning digital transformation are relatively prosaic yet nine in ten organisations in 2016 still reported the implementation of digital transformation as a significant challenge, **with 70 percent of these citing internal complexity as an inhibiting factor** .In addition, a wide range of ostensibly differing industries and professions possess a common set of characteristics that are open to codification and thus automation. How such organisations can successfully merge artificial intelligence (AI) and humans to work together remains an infinitely bigger task than the digital changes made thus far, and one that few seem prepared for.

The organisational and leadership implications of artificial intelligence are enormous. Jobs, processes, the relationship with consumers, patients, citizens and organisational models will all be reworked by artificial intelligence. Indeed, **PwC says 64 percent of CEOs believe that robotics will bring new innovations to their business models**. Crafting models that enable a given organisation to frame these challenges as opportunities – and then to capitalise on them – will be a huge task, requiring multidisciplinary thought and genuine innovation.

Such changes may in fact be necessary for the organisation to evolve at the same rate as its wider environment. The rate at which **medical knowledge is being generated is estimated to be doubling every 18 months**. This gives practitioners little chance to stay abreast of all developments, even within their field of expertise. Even medical students stand little chance in the current educational set-up, since the time from

acceptance in a program to graduation is likely to see a doubling of medical knowledge twice over. The ability of algorithms to help deliver the most relevant details and updates to doctors (as well as for students), on-demand and on a case-by-case basis holds great potential.

There is also the possibility, that, along with other trends, emerging AI will open new possibilities in future medical business and organisational models. AI capability is advancing at such a rate that as many as 47 percent of jobs (or at least the tasks within them) **will be highly susceptible to automation over the next two decades**. In 2016, an **autonomous robot surgeon bested human doctors** in stitching up pig intestine. In addition, haptically enabled robots, able to touch and feel, have **enabled remote diagnosis and abdominal ultrasound imaging**. Alone these developments are not enough to constitute an immediate threat to the current model. It is, however, worth recounting that in their seminal study, Osbourne and Frey suggested s**urgeons and physicians were amongst the** *least* **likely of all professions to be automated**, at 0.42 percent. This clearly suggests that even within those jobs unlikely to be fully automated, automation is likely to feature alongside the human worker.

Automation is likely to contribute to a quickening 'skills turnover' in the coming years. A Deloitte survey found that 75 percent of executives believe that automation will require new skills over the next several years. The ability for the organisation at large to change successfully is questionable however, much as it is with the related digital transformation process. Only 13 percent of executives believe their organisation's capabilities to redesign work done by computers to complement talent are excellent. By contrast, **34 percent see them as weak**. The friction, between what is needed and what is organisationally possible will account for much turbulence.

As a result, '…in the Next Economy, companies (will) use technology to augment workers, not just to replace them, so that they can do **things that were previously impossible,' says Tim O'Reilly**. Given that flatter and even decentralized work structures are better equipped to cope with ambiguity, speed and evolving digital norms, it is quite likely that much work will occur within team units. Bain predicts that '…by 2027, **most work will be project-based, with agile teams (internal and external) the dominant unit**.' Designing for this will be key, with GE Healthcare's Chief Patent Officer Greg Petroff, noting that design thinking should be used '…to have multidisciplinary teams frame the problem space more accurately. **It's a great process for stakeholder alignment,' he suggests**. Healthcare is set for radical change, and carefully planned and implemented AI solutions may be key to a successful transformation.

In the next two blogs we will look at the social, technological and environmental changes that will drive change in health care; and then look at specific potential impacts on the work that professionals and others do in health and social care.

Written by David Smith, Chief Executive, Global Futures and Foresight, published March 15, 2017

The Future of Work in Health – Part 2

This is the second of three blogs leading up to a forum on the future of work in health. In this one, David Lye, Director and Fellow of SAMI, and a former Senior NHS Manager and Department of Health official, looks at the trends and factors that will drive change in the way that health and social care will need to work.

The story so far…

In **his blog, David Smith, CEO of Global Futures and Foresight,** put the world of health into the wider context of applied technology across the wider corporate world. He highlighted the rapid and accelerating changes taking place – noting the prediction that in ten years' time, 75% of companies in the S&P 500 in will be ones that are not there now. More specifically to health, he noted the observation by Professor Nick Jennings of Imperial College that the rate at which medical knowledge is being generated is doubling every 18 months.

The STEEP Drivers of Change

Looking forward over the next 15-20 years, it is clear that rapid technological advances will drive significant change in the way that health and care services need to operate – and therefore the way that people work within those services, but there is more than technology at play here. Taking the STEEP (social, technological, environmental, economic and political) headings as a primer, we can see key drivers of change across all the headings.

Social

According to the Office for National Statistics, the **population of the UK will grow from 64.6m in 2014 to 73.9m in 2039**. The median age will rise from 40 to 43. One in 12 of the population will be aged 80 or over.

By 2040 we should be well on the way to being a "post-smoking" society, but there is rising incidence of obesity and its associated illnesses, such as diabetes. An aging population will have a range of different conditions (comorbidities). The over-80s will have a rising demand for social care among the ageing baby-boomers (of whom this author is one). Baby-boomers will be more vocal and demanding service users than their parents' generation have been.

If there is great instability in the world of work, and greater job insecurity, we can expect a rise in the incidence of mental illness.

Generations X and Y will become the leaders of health care. Last year's junior doctors' strikes indicated they may bring a different attitude to their employment. And if Brexit leads to reductions in immigration, this will potentially affect the available pool of NHS and social care staffing. Currently the UK is neither self-sufficient in doctors or nurses. The UK needs 11,000 new doctors each year. UK medical schools train just 7,500.

Technological

Technological change is accelerating. In modern health care the pharmaceutical industry, and the suppliers of medical devices and equipment are joined by Google, whose Deep Mind is being piloted at Moorfields Eye Hospital in London and elsewhere, IBM, whose Watson is being piloted in healthcare around the world, including Alder Hey Children's Hospital, and many other smaller innovators in IT and artificial intelligence.

Technology will allow quicker and more accurate diagnoses, more thorough scanning for potential drug interactions – important in a population with more comorbidities – and do the routine work of trawling through medical records and test results, quickly and effectively. In the private sector, Babylon is offering AI-based online consultations.

Alongside artificial intelligence, big data is getting bigger – the digital universe is doubling every two years. The ability to hold more data adds to the need for AI machines to mine it.

Robots are being deployed as care and nursing assistants in Japan, as porters in hospitals, and have been piloted within UK hospital pharmacies as far back as 2010.

These technologies empower the patient too. Implants and wearables – such as 24/7 blood sugar screening for people with diabetes, allow people to become partners in their own health care, rather than passive recipients of care. Not all will choose to do so, but the uptake of apps, fitbits etc suggests that most will.

Genetic advances have allowed personalised medicine, pre-diagnosis, targeted treatments for cancer, and gene splicing to address hereditary conditions. Nanotech will allow micro-invasive techniques for screening, diagnosis and treatment. Biotech is opening up the possibility of much-needed new anti-microbial treatments. And 3-D printing and robotics together are beginning to open up the prospect of exoskeletons. There is a constant wow factor on medical websites today as we look forward to a world in which the blind will see and the lame will walk.

Environmental

Advances in technology will change the way in which services can be delivered. People will welcome the chance to access services digitally.

More generally, the change in the infrastructure of urban and rural Britain will impact on health care. If drones can deliver pizzas and shoes, then why can't they also deliver prescriptions? Will advances in renewable energy lead to better air quality – and thus improve the health of children and other vulnerable people?

On a global scale, might there be major effects of climate change that trigger major migrations? The continent with the fastest population growth in this century will be Africa. Mass-migrations are likely to be towards Europe. This would change the UK's population figures, add to the pool of younger working-age people, and change the health profile of the population.

Economic

Aside from the economic news of today – Brexit, Trump, a growing sentiment against globalisation – the wider impact of the so-called 4th Industrial Revolution will be felt more and more. We have seen a shift in the balance between capital and labour, favouring "the few" relative to "the many".

Whilst the changing demography of the UK will drive up demand for health and social care, the availability of public funding lies with the politicians. In this they will be influenced by tax revenues, which are in part, down to the state of the national economy, but also to the ability of the government to collect taxes.

The pressures are real, but the economic outlook is uncertain.

Political

Many of the pressures and drivers above will depend in part on political responses. For example the post-Brexit policy on immigration will affect the availability of staff, or force an increased investment in recruitment and education & training among UK citizens. Government will determine how much money it can afford to invest in health and social care, and the relative priority against other demands for public spending.

Government will use its influence to drive the pace of investment in new technologies and determine the legal framework in which new technologies, such as genetic sciences, are able to operate.

The Government should also recognise the potential strength of the UK as a clinical science and research base, which will be enhanced by the application of AI and big data to the national hospital episode statistical data – which is a unique global resource.

This very brief and high-level overview illustrates how much change is going to have an impact on the health care services that we know. In the final blog, we will start to identify some possible areas in which the world of work will change.

Written by David Lye, SAMI Fellow, published March 29, 2017

The Future of Work in Health – Part 3

*This is the last of three blogs leading up to **a forum on the future of work in health**. In this one, David Lye, Director and Fellow of SAMI, and a former Senior NHS Manager and Department of Health official, identifies a few key questions posed by changes in society, technology and other dynamics.*

The story so far…

In his **blog**, David Smith, CEO of Global Futures and Foresight, highlighted the rapid and accelerating changes taking place in the world of work and technology. In the **second blog**, I identified a number of the key factors that will drive change in health care – social, technological environmental, economic and political.

The Overriding Question … "So What?"

We know that the world of work is changing, and we know that there are currents of change that will affect the worlds of health and social care. These factors lead us inevitably to the question of how they will change the world we know.

What We know

We can probably be sure of some things. The ageing population will drive up demand for health care. More people living with comorbidities; more people living alone; more people living with dementia.

The march of technology will drive up the number of new treatments some will be incremental improvements on current options, whilst some – genetech, biotech and nanotech, for example, will seem like miracle cures. This flood of innovation will add a further cost pressure to the pressure of the ageing population.

There is no immediate prospect of a windfall of extra funding to help the NHS to absorb these pressures, although no doubt battles will be fought in the trenches of UK politics. NHS England's publication,**"Next Steps on the NHS Five Year Forward View"**, published last week, recognises the need for the NHS to change, and to look again at its priorities.

So we face the likelihood of a world of rising demand, new opportunities (at a cost) and little prospect of a financial windfall.

What We Don't Know

The future health of our health system will therefore depend on how it can adapt to these challenges, making use of the opportunities of new technology to provide services in ways that are better and more efficient. Here are some of the questions to which we don't know the answer, but which will determine how successful we are in the future.

The Patient of the Future

The market is awash with apps and wearables that claim to help us to keep a closer watch on our vital signs, diet, exercise, sleep patterns etc. How far will this lead to a change in lifestyles? And what proportion of the population will refuse to engage in proactive management of their health? How can health services best encourage and support the willing, and try to convert the unwilling?

The Clinician of the Future

Given the ability of artificial intelligence to absorb entire libraries of information and to diagnose more quickly and accurately than humans, what will change in terms of what clinicians need to do, and need to know? Will significant areas of the current professional training curricula become redundant? What new skills will be needed? How will boundaries between different professions change?

Will the current boundaries between primary, secondary, tertiary and social care need to shift? For example, will primary care become accessible from the patient's home – or wherever they happen to be? Will traditional secondary care services, such as diagnostics, be centralised? Will advances in AI and robotics mean that some services will become less labour-intensive (the NHS paybill is over £45 billion)?

Research in the Future

How to ensure that different technologies and strands of research can join up and allow cross-fertilisation? And how to ensure a safe and efficacious transfer from the laboratory to the clinic? How will funding streams and licensing/regulatory systems need to change? How do undergraduate and graduate syllabuses need to adapt to produce the researchers of the future?

Managing for the Future

The NHS and social care have been very resistant to radical change. How to ensure that change can be adopted more quickly, without compromising safety and efficacy? How to persuade the public and the staff who work in health and social care to support changes to the status quo? How to prioritise the massive change agenda facing services?

As John Maynard Keynes exclaimed:

"The difficulty lies not so much in developing new ideas as in escaping from old ones'

The workshop on 6 April will begin to address how we can distance ourselves from the bondage of established dogma and start to explore the questions posed above. We will report on the outcome in a future blog. But undoubtedly there will need to be a lot more concentrated and continuing thought, and we will be looking for ways to foster and contribute to that debate.

Written by David Lye, SAMI Fellow, published April 4, 2017

The future of work in health – preliminary observations for pharma/life-sciences

The mega trends affecting the healthcare sector are well-documented: ageing populations; longevity increasing the prevalence of chronic disease; more knowledgeable and assertive patients; public policy challenges in funding and resource-allocation against a background of seemingly inexorable increasing demand and scientific opportunities.

Technological developments of many kinds offer opportunities for transforming the way healthcare is delivered, bearing particularly on the relationships between professionals and patients. Virtual consultations; home-based monitoring; implant drug-delivery – all tend to obviate the need for the time-consuming surgery visits. It puts the patient at the centre of the healthcare system; traditionally, the system has been largely designed around the professional service suppliers. This is predicated on patients being willing and able to take the primary interest in their own health and health outcomes. While much evidence confirm such trends, it remains unclear whether individuals will seek to practise a healthier lifestyle; or, alternatively to look to pharmaceutical intervention to nullify the effects of an unhealthier hedonistic lifestyle. There are policy – and cost – implications from such human choices.

Much of the transformative drive in the healthcare sector will come – as in so many sectors – from enhanced data and analytics. Big data analytics applied dynamically to patient records can be harnessed to assess, monitor and, through artificial intelligence protocols, intervene to effect outcomes. It can equally be applied to another revolutionary development in the area of genetics, where understanding of which population sub-types respond to which therapies can transform the nature of diagnosis and therapy. This will also tend to put the focus more on the individual patient; and while it is unrealistic to conceive of an individualised medicine, it is feasible for patients to be grouped into a number of sub-types for which effective therapies can be identified and administered.

For such visions to be realised requires a range of hurdles to be overcome, not all of which relate strictly to the pace of scientific development. They also include the concerns of the public in relation to the sharing of individual medical and genetic data, which could have profound implications for individuals and families. There are also wider issues involving population-wide genetics and the need for ‘bio-banks’ to analyse and determine the sub-types predisposed to specific diseases.

The consequences of a more patient-focussed system on financing are yet to be resolved in relation to whether future funding of healthcare will be more-or-less public, or more-or-less private. For the pharma/life-sciences industry, it will be highly important to understand the nature of which type of demand it will need to meet: a consumer market or an industrial market: the key success factors will be distinctly different, especially in relation to the types of products demanded and the willingness to pay. One feature that will be common to both, nevertheless, will be the emphasis on evidence-based value propositions relating to health outcomes of alternative therapies – a field relying heavily on data analytics.

In a world where public funding predominates, pharma/life-science organisations would negotiate contracts with payers based on *ex-post* treatment outcomes, rather than the

flawed system of *ex-ante* outcomes from limited clinical trial data. Research would have a new impetus – more selective and less serendipitous – but the industry would also be more conscious of the need to ensure an end-market for the product through close liaison with payers. It is also possible that the nature of product design and development would change from one where companies offer products of their own conception to more of a defence-type procurement system, in which payers set out what products they want and are prepared to pay for. The traditional mind set among public funders to see therapeutic breakthroughs as a cost threat rather than a benefit opportunity might well still prevail. Hence the pharma/life-science industry would need deeper skills to link up with patient groups, who would wish to take advantage of the new therapeutic opportunities and act as a joint lobbying force on public funders.

Alternatively, in a world where private funding predominates, with private sector being encouraged, most likely through a thriving private insurance sector. Individuals would take responsibility for managing their risk profiles through lifestyle and behaviour. There would be a strong focus on the development and supply of medicinal therapies for specific population genotypes. Such developments might well blur the difference between different types of healthcare, such as prevention, genetic screening, genetic counselling, lifestyle management, diagnostics and therapeutic options. The pharma/life-science sector can either be a marginal provider or a big orchestrator of a whole well-being programme in partnership with other specialist functions. This distinction might be a big differentiator.

In any event, the future is likely to encompass a sea-change in the operating model of the pharma/life-science industry and in its relationships with its key constituents – payers, healthcare professionals and patients. A very different range of skills will be required for the industry.

Written by Mike Owen, SAMI Fellow and Chairman, published June 21 2017

Key trends and drivers of change in information and communication technologies and work location

As part of our work with the European Agency for Safety and Health at work (EU-OSHA), on their project 'Foresight on new and emerging occupational safety and health risks associated with information and communication technologies and work location by 2025'. we produced a report on the key trends and drivers in ICT and work location. This report is now available via our website **here**.

Trends and key drivers of change were identified in a three-stage process: horizon scanning, consultation with experts through phone interviews and a Delphi-like survey and then a mini-workshop. The report lists and describes these important trends and drivers, which are organised by STEEP (Societal, Technological, Economic, Environmental and Political) category.

From demographic changes to technological innovations, these are the factors that will decide what occupational safety and health (OSH) challenges, associated with the digitalisation of work faces Europe in 2025.

Naturally, we found both potential benefits and risks for OSH. The main benefits included:

- Removing people from hazardous environments through the use of robotics
- Providing new means of promoting good OSH practice.

Risks were primarily psycho-social, relating to issues arising from work-related stress, 24/7 working practices and the loss of hierarchy and interaction at work, and ergonomic, through the use of mobile devices and novel human-machine interfaces.

Some 17 key drivers and trends were identified.

1. Virtual and flexible working, including zero-hours contracts and platform working
2. Changes in supply chains, with more sub-contracting and an increase in e-commerce
3. The rise of small/micro- businesses, with opportunities for entrepreneurs but also pseudo self-employment
4. The European Single Market, and the effectiveness of regulation
5. Challenges of the economic environment – rates of growth, globalisation or its converse, and levels of investment
6. Gaps in ICT skills and the need for frequent re-training
7. Attitudes to online privacy, online bullying and ethics
8. The scope for collective action, perhaps through social media
9. The economic value of data and the rise of the knowledge economy
10. Population demographics: the ageing population, migration, generational differences and the proportion of women in the workforce
11. Built-in OSH, through user-centred design
12. Robotics, AI and autonomous vehicles
13. Internet of Things and big data
14. Cybersecurity

15. Virtual reality and augmented reality
16. Growth of communications networks
17. Man-machine interfaces, including direct computer/brain interfaces.

Later parts of the project convert these drivers into scenarios and then policies are tested against each. Further reports will also become publicly available in due course.

Written by Huw Williams, SAMI Principal, published August 2, 2017