

Skills 4.0

A skills model to drive
Scotland's future

Skills
Development
Scotland

Centre for
Work-based
Learning
in Scotland



Skills Development Scotland is the national skills body supporting the people and businesses of Scotland to develop and apply their skills.



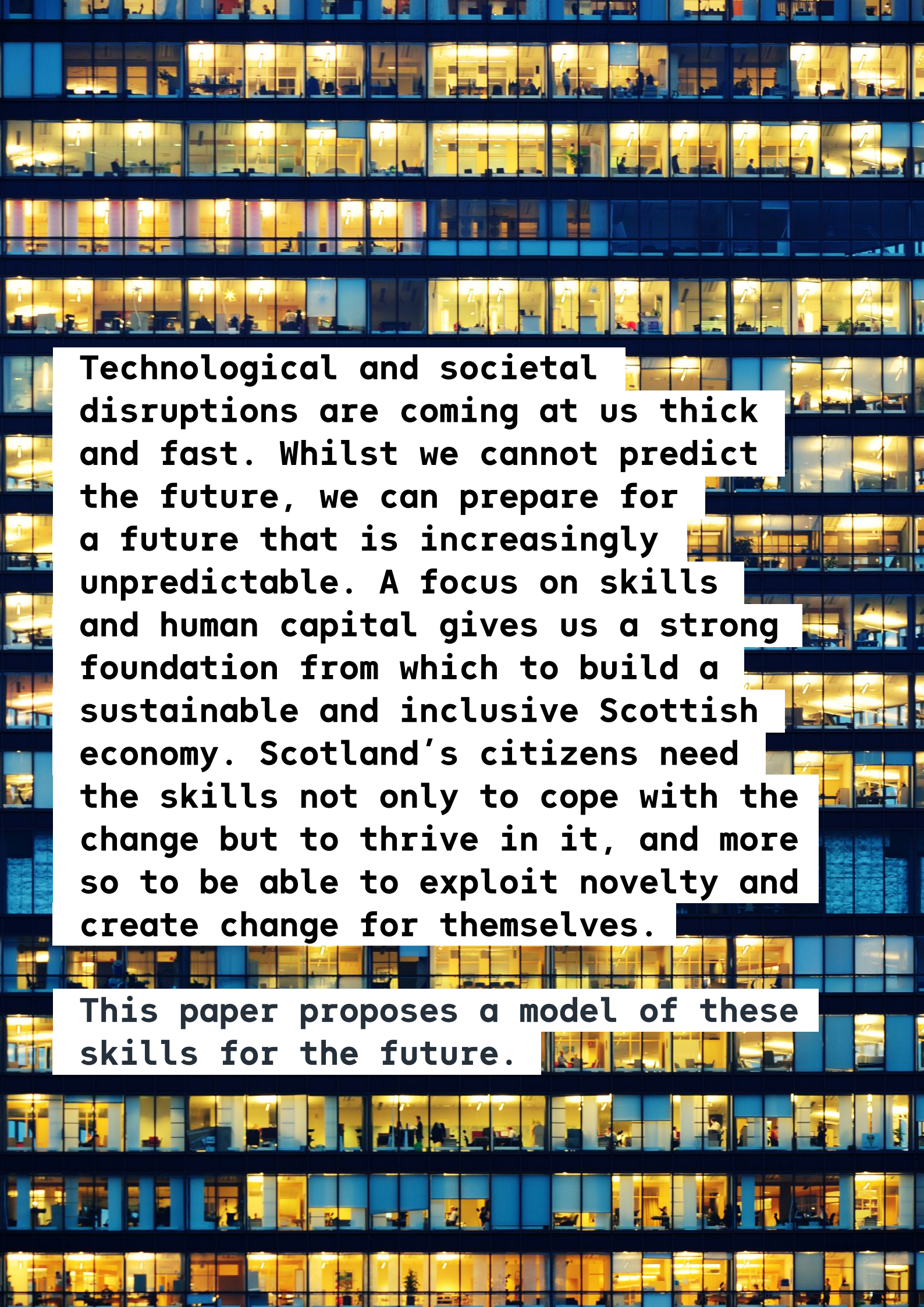
The Centre for Work-based Learning is a partnership between Skills Development Scotland, the University of Strathclyde, Heriot-Watt University and Robert Gordon University. Its vision is to establish the value of work-based learning in the Scottish education and training system.



© Skills Development Scotland, February 2018

This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License. To view a copy of this license, visit

<http://creativecommons.org/licenses/by-nc-sa/4.0/>



Technological and societal disruptions are coming at us thick and fast. Whilst we cannot predict the future, we can prepare for a future that is increasingly unpredictable. A focus on skills and human capital gives us a strong foundation from which to build a sustainable and inclusive Scottish economy. Scotland's citizens need the skills not only to cope with the change but to thrive in it, and more so to be able to exploit novelty and create change for themselves.

This paper proposes a model of these skills for the future.

Foreword

Skills serve as the bridge between knowledge and performance. In the emerging performance economy, this bridge is every learner's path to success. Skill is the mechanism by which we humans leverage our knowledge effectively to improve our individual and collective performance. To strengthen skills, we use the knowledge we already have and add to it; and then through lots of practice, we use this knowledge to strengthen our skills and ultimately perform better.

All around us today, we see signals that point to the growing value society places on performance. Witness the growth of platforms like TripAdvisor for rating hotels and attractions, or Yelp for rating restaurants, or Amazon's rating systems for both products and retailers. These signals turn our attention to real-time measures of performance often displacing historical markers of brand and trust.

Similar platforms are emerging to rate individual performance. On the Upwork platform, for example, employers rate individuals who provide online business services while TaskRabbit hosts a platform for rating adhoc support from tradespeople. Rate My Professors lets students review and rate their professor's ability to teach. So what are these platforms rating? Performance.

In this emerging economy, higher expectations of "peak performance" are fast becoming the new norm for work and living. To achieve peak performance, knowledge upgrades become critical survival tools for every person – as necessary as food and water. Vast stores of knowledge are ever more readily available as the costs of acquiring knowledge shrink and the paths for gathering it grow. Therefore, with an abundance of knowledge available anytime, anywhere, we humans are expected to learn and strengthen our skills of our own accord.

The result? The learning burden of both gathering knowledge and developing the skills that integrate that knowledge is quickly shifting to the individual. Peak performance (if not actual human survival) will depend more and more on the effective use of skills that bridge the distance between vast stores of knowledge and productive performance. In the quest for high performance, of course, we have to be careful to balance the value of immediately usable, practical skills with the importance of fundamentals derived through knowledge gathering. We need to better understand the relationship between the quality of knowledge and the productivity of skill.

This "Skills for the Future" paper, undertaken by Skills Development Scotland, in collaboration with the Centre for Work-based Learning, is precisely such an effort – an important and laudable step taken to ensure a solid future for the Scottish people.

Parminder K. Jassal PhD

Work + Learn Futures

Institute for the Future

Background

We are moving into a fourth industrial revolution, driven by technological disrupters. These disruptions are met by other large scale societal and demographic shifts such as further globalisation, an ageing population and increasing diversity within the workforce. There is an expectation that this period of change will be as disruptive as the original industrial revolution, if not more so. Organisations such as the World Economic Forum, the International Labour Organisation (ILO), McKinsey and Co and PwC, believe it will change the way we work and live, with implications for individuals, learning institutions and the skills system as a whole.

This fourth revolution is characterised by an exponential rate of change. Professor Sir Tom Devine believes that it could challenge our work and leisure lives, economic and political systems, societal structure, and even raise important questions about the nature of humanity itself.

Scotland's workforce needs constantly developing skills, knowledge and capabilities to thrive in this complex, ever-changing environment.

The Scottish Government has made a firm commitment to increase productivity, inclusive growth and fair work. We have an ambition to rank in the top quartile for productivity against its key trading partners in the Organisation for Economic Co-operation and Development (OECD).

This ambition for a fair and prosperous Scotland requires a high performing economy, driven by high performing individuals and businesses who are able to create and exploit new technologies and opportunities, rather than standing back and being swept along by the change.

Purpose

This paper presents a model of skills to enable individuals to excel in the future for consideration and use by policy makers, education and skills providers and bodies, employers and anyone with an interest in skills development. It hopes to:

- provoke thought on the value society places on these skills
- stimulate discussion on how these skills can be incorporated into learning programmes
- encourage testing and trialling of different ways of delivering and measuring these skills

There are a range of opportunities to enhance productivity and address potential labour market shortages by capitalising on automation. We do not attempt to cover all of these here, but to focus on human capability as a driver of change.

Approach

We have used a range of research methods to inform this work:

- ongoing review of literature on the subject of Industrie 4.0 and the future of work and skills
- primary research with leading thinkers on the subject
- a round table workshop held in February 2017 attended by representatives from the OECD, ILO, Gatsby Foundation, Bertelsmann Stiftung, Scottish Government, Strathclyde University and Robert Gordon University
- a review of related skills models and literature on the measurement of these types of skills

By definition, making projections about the future means that the majority of sources are the thoughts and opinions of others based on what we are experiencing now. The approach taken is an attempt to balance any conflicting views or biases and synthesise these from the perspective of the needs of the Scottish economy.

The future of work

Although we can anticipate a number of key trends (PwC, 2017) and their impact on the way we work and live, the only thing we can be certain about for the future is uncertainty itself.

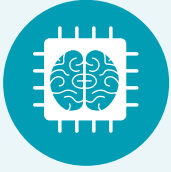
A number of predictions have been made of the impact of automation on work (Frey and Osborne, 2013, McKinsey 2017), using robust methodologies to demonstrate the potential of technology as it exists today. They provide useful recommendations that have influenced this paper. However, rather than consider predictions about the future based on existing technological capability, this paper focuses on the prospect of exponential change beyond what we already know.

Exponential change is something we rarely experience as humans and can be hard to even imagine. This increasing rate of change will make the world a more complex place to live and work in the future.

We can anticipate that:



- digital technology will permeate all places and forms of work (Deloitte, 2016)
- technology will continue to provide new ways of connecting and collaborating globally, making it easier to operate across wider and more disparate organisations and increasing market opportunities (Buchanan et al, 2016)
- the volume of information generated online will continue to increase exponentially, leading to a more complex information landscape (Marr, 2015)
- whilst it may be technically easier to collaborate globally, this creates increasing complexity for us as humans as we are required to develop relationships in new and different ways



- many jobs, or activities within these jobs, can and will be done by machines (McKinsey, 2013)
- technical skills and knowledge will be of a lower importance as machines learn to carry out technical tasks and artificial intelligence allows for knowledge to be shared globally (Deloitte 2016)
- humans will need to learn to work alongside these machines (Deloitte, 2016)
- machines will be able to carry out more and more routine tasks, both physical and mental; this leaves, for humans, tasks that are much harder for machines to carry out such as working with and supporting others and using creativity and drive to solve complex societal challenges (RSA, 2017)



- an ageing population will change the face of our workforce, leaving fewer people of working age and an increasing need for caring professions (World Economic Forum, 2017)
- climate change will continue to create an increasingly complex world as well as leading to new emerging sectors like the green economy (PwC, 2017)
- there will be more people working in less traditional employment contracts – self employment, contractors, zero hours (RSA, 2017)
- the boundaries between jobs and industries will continue to blur with jobs continuing to emerge and evolve (World Economic Forum, 2017)

...the collision of these changes will create a more complex world to work and live in (Friedman, 2016)

It is harder to predict:



- what this new technology will be
- how quickly new technology will be adopted
- what impact it will have on the job market
- what specific opportunities and challenges we will face in the future

Skills for the future: meta-skills

To ensure we thrive as individuals, businesses and on an economic and a societal level, we all need to develop new skills. These skills are not just to help us cope in this environment of ongoing change. They are skills to excel; to collaborate and empathise with others and to create our own futures.

We have termed these skills for the future 'meta-skills', and define them as timeless, higher order skills that create adaptive learners and promote success in whatever context the future brings. These are the skills that enable individuals to perform highly today; in a changed world of work they will be required by all of us.

These skills and capabilities themselves are not new. In fact, they are ancient human capabilities that have enabled people to succeed throughout history. They have been called many things and classified in a range of different ways across the globe. The difference now is the imperative for us to increase the value that society places on these skills, so that they are held by more people and in greater depth. Defining them more clearly supports this by increasing our awareness of how these skills are demonstrated, by helping us appreciate that they can be learned and by pointing to how we can go about doing this.

The skills have been classified under three headings:

- Self management: Manage the now
- Social intelligence: Connect with the world
- Innovation: Create our own change

The skills have been reviewed for their level of ease of automation (McKinsey) to verify their timeless nature (see appendix 3).

There are many interrelationships and dependencies between these skills as they each support the development of a range of other skills across the model. For example, you will need the capacity to **focus** on a challenge to allow for **creativity** and **innovation** in coming up with solutions and you will then need **initiative** to make these ideas become a reality. Concepts such as emotional intelligence, entrepreneurialism and confidence are made up of components that are represented across the model.

Self management	Social intelligence	Innovation
Focussing	Communicating	Curiosity
Integrity	Feeling	Creativity
Adapting	Collaborating	Sense making
Initiative	Leading	Critical thinking

Self management: manage the now



Self management is required to cope with this ongoing change and support wellbeing, growth and ultimately performance and productivity.

Scotland's learning system already has a good basis for this. The four capacities of the Curriculum for Excellence already specify the need for learners in the Scottish education system to be successful learners, confident individuals, responsible citizens and effective contributors (Education Scotland, 2017).

Focussing

Stimuli are presented to us all day, every day, from a variety of sources. We need to find ways of focussing and managing this cognitive load. This information overload has been shown to increase stress (Levitin, 2014) and mental health issues. The ability to effectively filter and sort information to maintain a sense of focus is essential in an age of information abundance and constant change. Honing this ability can have significant positive impact on wellbeing, enabling individuals to be more efficient and effective workers who will drive productivity (Levitin, 2014). Being able to focus will be of increasing importance as industrial boundaries are broken down (PwC, 2016) and our work has more complexity and interrelationships.

Imagine you are a statistician mining big and deep data sources to provide recommendations for a client's complex problem. As you are steeped in the mathematical detail of your analysis, you realise you are missing some information. You go online to search for the information and open an additional browser tab on top of the 10 you already have open. This reminds you that you didn't finish the shopping you started at lunch time. Then your smart watch goes off to let you know you have just received a new message and you remember an email you were meant to send. On your search for the information you notice an article that would be useful for another task. You find the information you need but as you close your browser you notice an email from the client that completely contradicts the advice you have been given by your line manager.

This is an environment many of us already work in and doesn't even take into account emergent technology and new ways of working that have the potential to add to this information overload. Strong focus is what makes a productive worker in this environment.

The ability to focus incorporates:

- | | |
|------------------|--|
| Sorting | The ability to sort information into categories and to understand the relationship between information |
| Attention | The ability to focus on the present and deflect/avoid distractions |
| Filtering | The ability to filter out non-essential information and focus on the essential problem at hand |

Integrity

At the core of self management is self awareness. This, coupled with a clear understanding of our personal values and a commitment to meeting these in our life and work, leads to integrity. This is important not only to support wellbeing but also as the basis for creating the future we want to see. The ongoing development of artificial intelligence and other new technologies could raise some questions about the nature of humanity. Integrity ensures we always take into account what we believe to be ethical and fair. Integrity is acting in an honest and consistent manner based on a strong sense of self and personal values.

It has been argued that a lack of personal integrity was a key contributing factor in the financial crisis that began in 2007 (Greycourt & Co. 2008). In order to avoid future crises and other major humanitarian issues caused by unethical behaviour, it is vital that, in any sector, we are able and empowered to act in accordance with ethical standards.

The ability to work with integrity incorporates:

Self awareness (reflexivity)	The ability to understand and manage emotions, strengths, belief systems and limitations, and the effects of these on behaviours and the way they impact on others
Ethics	Being aware of and acting upon personal values and principles
Self control	The ability to exercise control over your own impulses, emotions and desires

Adapting

If the only constant is change, it is imperative that we are all highly skilled learners. The fact that a job for life no longer exists is old news. However, where we used to talk about 4-5 careers in a lifetime, future generations are likely to find themselves in an even more fluid world of work. Technology will be ubiquitous and jobs will emerge, evolve and disappear and what we do in those jobs will also change – continuously. Being adaptive experts by seeing opportunities to learn new things, being comfortable with making mistakes and reflecting on all of this will be vital for success. Adapting is the ability and interest to continue to enlarge knowledge, understanding and skills in order to demonstrate resilience as circumstances change.

Learning is an extremely complex process. To be effective it includes having an open mind, being able to identify and solve problems, and being able to deal with new and under-developed concepts. It also requires the resilience to fail and the ability to restructure thoughts to accommodate new ideas and solutions.

Whilst educators are experts in facilitating learning in others, in the future they themselves will need to be able to adapt to rapid changes in the world outside of education. They will need to be future literate – to be able to imagine what life and work could look like for their students as significant changes could take place within a couple of years. They will also need to be highly developed learners so that they have current knowledge to pass on to their students.

The ability to adapt incorporates:

Openness	Being open to new ideas and approaches – having a growth mindset
Critical reflection	The ability to critically reflect on new knowledge and experiences in order to gain a deeper understanding, embed and extend learning
Adaptability	Flexibility when handling the unexpected, adapting to circumstances as they arise
Self-learning	The ability to self educate without the guidance of others
Resilience	Ability to respond positively and constructively to constantly evolving challenges and complexity

Initiative

Confidence has been acknowledged as a priority within Scotland for decades and it is no less important now. In this uncertain world we will need the courage and tenacity to take risks and try new things, enabling us to look into the future and see opportunities rather than fear change. Confidence leads to experimentation and can support the adoption of new technologies. As it becomes more common to be self employed and to work autonomously even within more traditional employment, independent thought, good judgement and effective decision-making will become increasingly important. Initiative is a readiness to get started and act on opportunities built on a foundation of self belief. It encompasses two of the four capacities of the Curriculum for Excellence: confident individuals and effective contributors.

This skill is already being required at new levels within emerging business and employment models within the care sector, such as Buurtzorg in the Netherlands and Cornerstone closer to home. These models give care staff the autonomy to manage their own work in order to provide the best quality of care to service users. With a focus on coaching and mentoring rather than management and supervision comes the need for workers to take responsibility and become effective decision makers to drive their own work (Cornerstone 2017).

The ability to take initiative incorporates:

Courage	The ability to manage and overcome fear in order to take action
Independent thinking	The ability to think for one's self and trust one's own judgement
Risk taking	Doing something that involves danger or risk in order to achieve a goal
Decision making	The act of making a considered choice after appropriately using intuition and careful thought
Self belief	A feeling of trust in one's abilities, qualities and judgement
Self motivation	The ability to act without influence or encouragement from others
Responsibility	The ability to follow through on commitments, be proactive and take responsibility
Enterprising	Willingness to take risks, show initiative and undertake new ventures

Social intelligence: connect with the world



Digital technology has allowed society to connect globally in new ways and will continue to make it easier to do so. It is also widely anticipated that existing sectoral and occupational boundaries will blur (Kelly, 2015) so the need to have skills to connect and collaborate with people from diverse backgrounds is critical. To make a positive change in the world, we recognise that we can do this more effectively with others, making use of different perspectives to reach the best possible outcome.

Communicating

Communication is a basic human skill that has been at the heart of our education system for generations. Often, however, with over-emphasis on one way communication, resulting in employers being dissatisfied with the level of communication skills that their employees are able to demonstrate (CBI, 2016). This need for effective communication in a range of media is likely to increase in the future. The difference may be the depth at which we communicate and a greater emphasis on listening and gaining real understanding. Sharing information effectively will also continue to be of utmost importance. In an increasingly complex future, where people have much more autonomy over the organisation of their work (CIPD 2008), clarity in communication will be vital – in all directions and at all levels. The ancient art of story telling is already being evidenced as a valuable method of communication (Monarth, 2014), and is likely to have increasing application as we look to influence others in the process of making change. Communication is the ability to openly and honestly share information in a way that creates mutual understanding about thoughts, intentions and ideas between all parties involved.

Within the accountancy profession it is recognised that skills like communication will be of increasing importance as a significant number of technical skills performed by the profession have the potential to be automated in the future (ACCA). While machines can produce detailed information, there is a potential for workers to take on the role of interpreting this, making use of effective communication skills and story telling to bring information to life.

The ability to communicate incorporates:

Receiving information	Understanding and mentally processing verbal or written communication
Listening	The ability to actively understand information provided by the speaker, and display interest in the topic discussed
Giving information	Giving written or verbal communication in a way that can be best understood by those receiving the communication
Storytelling	The ability to tell stories that persuade, motivate and/or inspire as well as bringing the sharing of knowledge to life through examples and illustrations

Feeling

For those who are looking to shape change, feeling ensures this change has a positive societal impact, rather than just being innovation for innovation's sake. Empathy has been identified as a key skill for the future by many (Parmar, 2017). Whether self employed, working for public services or even big business, really understanding customers' latent needs could ensure we solve problems and create solutions that matter to people. Empathy has been identified as a key differentiator for business success, with companies such as Facebook, Google and

Unilever being recognised as excelling in this area (Thomson, 2016). Even though empathy is recognised as a vital skill for the future, it has also been noted that empathy is an attribute that has been diminishing in individuals over the last 15 years (Konrath, O'Brien and Hsing, 2010). Feeling is considering our impact on other people by being able to take a range of different perspectives, thoughts and feelings into account.

IBM has embarked on a transformational programme of cultural change, investing more than \$100 million to embed design thinking across the whole organisation as a new way of working (Handa and Vashisht 2017 and Adobe Creative Cloud 2017). One of the key tenets of their design thinking approach is empathy and a focus on what users need. They recognise that an understanding of the perspectives of their customers is key to meeting customers' increasingly high expectations for digital experiences.

The ability to bring feeling to what we do incorporates:

- Empathy** The ability to take the perspective of others in order to understand their feelings and motivations
- Social conscience** A sense of responsibility and concern for wider society

Collaborating

Collaboration is not a new skill either but evidence suggests that its importance is increasing, with the majority of roles requiring collaboration at some level. The way we use technology for collaboration will undoubtedly continue to evolve so we will all need to be comfortable using new technology in this way. As this new technology removes distance as a barrier and we are able to work with others effectively across continents, cross cultural competence – being open to, understanding and working within alternative cultural norms – will be essential. Collaboration is working in coordination with others to convey information or tackle problems. These team working and relationship building skills should be built on a foundation of social perceptiveness to make us all truly effective collaborators.

Last year, Google and Levi's 'Project Jacquard' launched its first wearable technology product – a denim jacket that makes use of smart fabrics to allow you to do things like control music or get directions on the move (MIT Technology Review). A project like this takes real collaboration skills. It was not a co-branding exercise but a case of two teams with expertise in a specific area of design and production learning to work in new ways. To enable this to be an effective project the team members at both companies needed to have highly developed collaborative skills, but also to make use of other skills across the model such as adapting and curiosity.

The ability to collaborate incorporates:

- Relationship building** The ability to identify and initiate connections and to develop and maintain them in a way that is of mutual benefit to both one's self and others
- Teamworking and collaboration** Working with others toward shared goals. Creating group synergy in pursuing collective goals
- Social perceptiveness** Being aware of others' reactions and understanding why they react as they do
- Global and cross cultural competence** The ability to operate in different cultural settings

Leading

Working autonomously is likely to become a necessary requirement for the future workforce. This means we will need to be highly skilled leaders on a range of levels (Deloitte, 2014). Whether this means working for yourself, having more ownership over tasks within an organisation or setting the vision for your company, we will all need skills in influencing, motivating others and driving change. Management and leadership roles are also predicted to be of increasing demand in the future (Bakhshi, 2017). In addition to this, there may need to be broader responsibility for supporting others to develop and learn. For example, if more people work independently they will need support to continue to learn outside of traditional organisational structures. Leading is the ability to lead others by inspiring them with a clear vision and motivating them to realise this.

The concept of all workers being empowered as leaders has even been demonstrated in one of the most hierarchical environments we can imagine – the armed forces. David Marquet was a naval captain onboard an underperforming submarine when he started to treat his crew as leaders themselves, rather than followers and started giving fewer orders (Marquet). This shift was transformational, resulting in workers who were proactive, creative and able to take initiative.

The ability to lead incorporates:

Inspiring others	The ability to energise and create a sense of direction, purpose, excitement and momentum
Influencing	Working to gain the agreement of others to a particular course of action
Motivating others	Encouraging others to achieve goals, accomplish tasks, and complete objectives
Developing others	The ability to coach and constructively review the work of others to improve and advance their skills, knowledge and performance level
Change catalyst	Having the ability to ignite change

Innovation: Create our own change



We need to ensure that Scotland's citizens have the skills and capabilities to create change themselves, rather than letting change happen to them. Innovation can be demonstrated at a range of levels; from individuals having curious, open, creative mindsets that support their own learning, to businesses developing and making use of new technology to strengthen the Scottish economy, to international organisations solving global challenges.

Curiosity

To deliver real innovation we need to start by being curious. Curiosity is the desire to know or learn something in order to inspire new ideas and concepts. Using research skills like observation, questioning, information sourcing and problem recognition will support us to understand, break down and find the root cause of a problem or opportunity in order to identify alternative solutions. We are all born with this curiosity. As children we ask questions and see things from unconventional perspectives but through learning to 'fit in' we often lose this ability. If we can make use of what are conventionally seen as naive qualities and combine this with the wisdom of experience, we will have a good basis for solving problems well.

As smarter manufacturing enables routine tasks to be done by machines, workers on the shop floor will be expected to have higher levels of skills that support the ongoing improvement of processes and quality assurance. The Siemens Electronics factory in Amberg, Germany has pioneered this way of working where the plant has increased its production volume eightfold in the past 20 years (Webel 2016). The number of employees hasn't changed much but the expectations placed on them are greater. Workers have an overview of the entire production process and curiosity helps them find patterns in data to suggest new ideas that improve efficiency. At the Amberg factory employees are rewarded for their suggestions that account for 40% of annual productivity increases at the plant.

The ability to be curious incorporates:

Observation	The ability to notice behaviour or information and register it as being significant
Questioning	The ability to ask questions in order to increase understanding about a subject or experience
Information sourcing	The ability to filter resources and information to find information relevant to an issue or topic
Problem recognition	The acknowledgement and definition of a problem

Creativity

Creativity is the ability to imagine and think of new ways of addressing problems, answering questions or expressing meaning and is another quality we are born with (Meng, 2016). Within the Scottish education system, creativity has been seen as an added extra and is often boxed into subjects like art and music. In the future we will need to begin to see creativity in its broadest sense. Using our imagination and developing the ability to visualise alternative solutions or states of being, supports us to be more effective learners and workers (Jones, 2014) in any role. Its relevance will increase as we move away from the more routine tasks that typically don't require us to think differently or actively discourage creativity.

The emergence of new fintech startups like Monzo and disruptive technologies like Blockchain are shaking up the financial sector. These new way of banking are encroaching on the territories of the big banks. The financial sector will need to look to individuals who are highly creative to come up with the new ideas that will help them stay current and compete (PwC).

The ability to be creative incorporates:

- Imagination** The ability to explore ideas of things that are not in our present environment, or perhaps not even real
- Idea generation** Proficiency at thinking and coming up with solutions and responses beyond that which is rote or rule-based
- Visualising** Translating information and thought into accessible expressions, readable and recognisable images
- Maker mentality** The ability to explore, through tinkering and making, in order to arrive at new ideas and solutions

Sense making

In this increasingly complex world we need people who can make sense of the vast amount of information available to solve complex problems to the best of our ability. Sense making is also about making sense of complex situations and doing so in real time to enable an effective response. Some of the process driven elements of this could potentially be automated in the future but the ability to combine analytical skills with a broad strategic overview of a situation is a uniquely human ability and will be invaluable in the future. Sense making is the ability to determine the deeper meaning or significance of what is being expressed and to recognise wider themes and patterns in information and situations.

Social enterprise is a great example of this in action. Companies such as Social Bite and Terracycle, who team up with big corporations to recycle typically hard-to-recycle waste, have synthesised whole new business models from complex social problems by recognising commercial opportunities.

The ability to make sense of information incorporates:

- Pattern recognition** The process of classifying information into objects or classes based on key features
- Holistic thinking** The ability to see the big picture and understand subtle nuances of complex situations
- Synthesis** The process of organising, manipulating, pruning and filtering gathered data into cohesive structures for information building
- Opportunity recognition** The ability to identify areas of opportunity for innovation
- Analysis** A systematic examination and evaluation of data or information, by breaking it into its component parts to uncover their interrelationships

Critical thinking

With the abundance of information we now have available to us, being able to process, analyse and evaluate this in order to solve problems will be even more important. Weighing up conflicting arguments using logical thinking tools and being able to make use of these tools in a variety of contexts will enable us to do this in complex, ever changing environments. With the increasing volume of information available online from a variety of sources, critical thinking is also required at a more basic level to help us tell fact from fiction. Critical thinking is the ability to evaluate and draw conclusions from information in order to solve complex problems and make decisions.

Engineering presents an obvious environment where these skills are required but more and more of us, in a wide variety of roles, will need to be good critical thinkers to develop solutions to the challenges the future could hold. The ihub improvement programme run by Healthcare Improvement Scotland uses a model of local improvement that empowers health and care staff to run their own small tests of change. A recent programme on older people's acute care (Healthcare Improvement Scotland, 2016) supported nursing staff to develop logical and analytical thinking skills that enabled them to devise the tests, collect and interpret data and measure the effectiveness of the changes.

The ability to solve complex problems incorporates:

Deconstruction	Breaking down a complex problem or system into smaller, more manageable parts before developing a new way of addressing the problem
Logical thinking	The ability to identify, analyse and evaluate situations, ideas and information in order to formulate responses to problems
Judgement	The act or process of forming an opinion after careful thought
Computational thinking	The ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning

Universal skills

There are a number of other skills we see as being fundamental to success within the world of work in the future. These are core technical skills that are vital for success and include literacy, numeracy and digital intelligence. These skills are already well established as part of the Scottish curriculum and as such this paper only discusses the last of these, digital intelligence.

Digital intelligence: skills for the near future

It is without doubt that we will all need enhanced levels of digital ability in the future. There is already a significant push to deliver these skills as part of the digital learning and teaching strategy for Scotland (Scottish Government, 2016). The issue we see in such a strong focus on technical digital skills is the rate of technological change itself. For example, if we teach a student to use a piece of software or specific technology in their second year of higher education, by the time they have graduated that technology is likely to be outdated. The timeless nature of the meta-skills we have identified, such as adaptability, should support individuals to continue to learn how to make use of new technology on an ongoing basis.

There is an opportunity to focus the development of digital skills, less on the technicality of specific technologies and more on the higher level computational thinking skills that allow us to understand how machines work to enable us to both learn how to use them and design new ones.

Digital intelligence takes two forms – a confidence in using and exploiting technology and the ability to create new technology itself. The former should perhaps be seen as a priority for Scotland, as the ability to grasp new technology as it emerges and work alongside machines will be vital for all of us. Having an understanding of how technology works and the ability to spot opportunities for its use will be of benefit to most of the population and could speed up the adoption and potential productivity gains of better use of technology and automation. Whereas, the ability to create brand new technology may remain a relatively niche skill set.

This paper does not attempt to define these skills in any detail as this has been done well elsewhere. (See for instance, Jisc's six digital capabilities (Jisc, 2017))

The development of digital intelligence should be a priority, not only for the education system, but also for those who are already in the workforce. Digital intelligence should be seen as an essential skill alongside literacy and numeracy.

What this means for the learning system

Meta-skills and digital intelligence should be developed across the entire education and skills system in Scotland and maintained and further developed in the workplace. The Curriculum for Excellence and graduate attributes at universities are useful starting points, but given the composition of the skills that are needed, more radical change is required within the skills system to ensure individuals are highly skilled in these areas.

The skills are, however, not distributed evenly and individuals will naturally have strengths in certain areas based on their interests, abilities and the needs of their jobs. This may change throughout a person's working life and areas of strength are likely to be influenced by neurological differences. Our premise is that these skills are not for the select few and that they can be demonstrated at a range of levels.

These skills cannot be demonstrated outside of their context and therefore are most effectively learned and developed experientially in the workplace. This creates both an opportunity and a challenge for the learning system. There is an opportunity to engage more fully with employers and offer real work-based learning experiences that support the development of these skills in situ. There is a more particular challenge: where these meta-skills are developed alongside technical skills, it is much harder to measure and accredit the meta-skills than the technical skills. This is an area where further work is needed so that a clearer approach to the measurement of meta-skills can be set out and implemented.

The fact that we believe work-based learning is a key element in delivering these skills does not mean that it can do this on its own. We may need to consider a blended approach that combines the most effective attributes of work-based and academic learning.

We cannot assume that developing individuals to perform highly in these areas will lead us straight to a high performing economy. We also need to ensure that Scotland's workplaces are high performing, and that they allow workers to deploy and continue to develop these skills. For example, a highly creative, collaborative graduate could start working for a company that is extremely hierarchical, fears change and doesn't promote collaboration or ongoing learning and development. That individual will have the choice of either letting their skills atrophy or leaving the company. We need to ensure that Scottish employers embrace workplace practices that support the use of these skills so that we do not lose our talent to other countries that provide this space for growth. Practices such as openness to new ideas, supporting autonomous working and an emphasis on continuing professional development, will support this.

Any radical change in the skills system to deliver these meta-skills cannot be achieved by one organisation alone. It requires the development of a collaborative, industry focused, demand-led approach. Working together towards this common goal and ensuring the learning system contributes effectively to the development of these skills presents an opportunity for Scotland to lead the way. We should strive to develop a skills system that supports our citizens to meet their potential and be fully productive in work, driving a flourishing and sustainable Scottish economy.

Next steps

The development and implementation of this model is part of a wider programme of work within Skills Development Scotland in collaboration with our partners and the Centre for Work-based Learning. It will test approaches to embedding the delivery of these skills within work-based learning in order to make sure these concepts are adopted.

We hope that others in the Scottish skills and learning system will consider embedding the development of these skills in learning programmes. Given that we see the workplace as the ideal environment to develop these skills, this also includes employers.

Skills Development Scotland's intention is to further define these skills as measurable and observable standards that will make their adoption in learning programmes straightforward. The implementation of this will be tested through the development of new Graduate Apprenticeship programmes, with the aim of expanding into other work-based learning products.

The learning from this will put us in a better position to influence the wider learning and skills system to incorporate these skills.



References

- ACCA. Professional accountants – the future: drivers of change and future skills. Available at <http://www.accaglobal.com/uk/en/technical-activities/technical-resources-search/2016/june/professional-accountants-the-future-report.html>
- Adobe Creative Cloud (2017). From THINK to FEEL: The Design transformation of IBM Available at: https://theblog.adobe.com/from-think-to-feel-the-design-transformation-of-ibm/#_edn1 [Accessed 10 January 2018]
- Airbnb, Inc. <https://press.atairbnb.com/about-us/>
- Auguste, B., Lund, S., Manyika, J., & Ramaswamy, S. (2012) Help wanted: The future of work in advanced economies. [online] McKinsey Global Institute. Available at: <https://www.mckinsey.com/global-themes/employment-and-growth/future-of-work-in-advanced-economies> [Accessed: 1 June 2016]
- Bakhshi, H, et al. (2017). The Future of Skills: Employment in 2030 [online] Nesta. Available at: <https://www.nesta.org.uk/publications/future-skills-employment-2030> [Accessed: 8 February 2018]
- Buchanan, J., Kelley, B., & Hatch, A. (2016) Digital workplace and culture. [online] Deloitte. Available at: <https://www2.deloitte.com/us/en/pages/human-capital/articles/digital-workplace-and-culture.html> [Accessed 19 October 2017]
- Buurtzorg. <http://www.buurtzorgnederland.com/>
- CBI (2016). The Right Combination: CBI/Pearson Education and Skills Survey 2016. [online] CBI. Available at: <http://www.cbi.org.uk/news/the-right-combination-on-skills/> [Accessed 27 Jul. 2017]
- CIPD (2008). Smart working: the impact of work organisation and job design.
- Cornerstone (2017). Strategic plan 2017 – 2020. Available at https://www.cornerstone.org.uk/uploaded_files/Strategic%20Plan%202017-2020%20updated2intranet.pdf [Accessed: 10 January 2018]
- Deloitte (2014). Leaders at all levels: Close the gap between hype and readiness. Global Human Capital Trends 2014: Engaging the 21st-century workforce [online]. Available at: <https://www2.deloitte.com/global/en/pages/human-capital/articles/leaders-at-all-levels.html> [Accessed: 7 November 2017]
- Deloitte (2016), Talent for survival: Essential skills for humans working in the machine age [online] Deloitte. Available at: <https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Growth/deloitte-uk-talent-for-survival-report.pdf> [Accessed: 9 November 2017]
- Dellot, B. & Wallace-Stephens, F. (2017) The Age of Automation [online] RSA. Available at: https://www.thersa.org/globalassets/pdfs/reports/rsa_the-age-of-automation-report.pdf [Accessed: 13 October 2017]
- Devine, TM. (2017). Interview with Skills Development Scotland <http://www.skillsdevelopmentscotland.co.uk/news-events/2017/october/thriving-in-the-workplace-of-the-future/>
- Education Scotland (2017) What is Curriculum for Excellence? [online] Education Scotland. Available at: [https://education.gov.scot/scottish-education-system/policy-for-scottish-education/policy-drivers/cfe-\(building-from-the-statement-appendix-incl-btc1-5\)/What%20is%20Curriculum%20for%20Excellence?](https://education.gov.scot/scottish-education-system/policy-for-scottish-education/policy-drivers/cfe-(building-from-the-statement-appendix-incl-btc1-5)/What%20is%20Curriculum%20for%20Excellence?) [Accessed: 23 October 2017]
- Fair Work Convention (2015) What we do [online] Fair Work Convention. Available at: http://www.fairworkconvention.scot/theconvention_whatwedo.html [Accessed 14 December 2017]

- Frey, C.B. and Osborne, M. (2013) The future of employment : How susceptible are jobs to computerisation? [online] University of Oxford. Available at: <https://www.oxfordmartin.ox.ac.uk/publications/view/1314> [Accessed: 17 October 2017]
- Friedman, T.L. (2016) Thank you for being late. New York: Penguin Books.
- Greycourt & Co (2008) White Paper No. 44: The Financial Crisis and the Collapse of Ethical Behavior [online] Greycourt & Co. Available at: https://icma.org/sites/default/files/301680_WhitePaper044-FinancialCrisis.pdf [Accessed: 12 January 2018]
- Handa, A and Vashisht, K (2017) How IBM Is Embracing the Future Through Design. [online] UX Matters. Available at: <https://www.uxmatters.com/mt/archives/2017/02/how-ibm-is-embracing-the-future-through-design.php> [Accessed 10 January 2018]
- Healthcare Improvement Scotland (2016) Improving Older People's Acute Care: Learning from a Blended Local Collaborative Approach 2015-2016 Available at: http://ihub.scot/media/1183/opac-blended-report_dec2016_web.pdf
- Industrie 4.0 Working Group (2013) Recommendations for implementing the strategic initiative Industrie 4.0. [online] Acatech. Available at: <http://www.acatech.de/de/publikationen/stellungnahmen/kooperationen/detail/artikel/recommendations-for-implementing-the-strategic-initiative-industrie-40-final-report-of-the-industr.html> [Accessed: 7 June 2016]
- Institute for the Future (2011) Future Work Skills 2020. [online] Institute for the future. Available at: <http://www.iftf.org/futureworkskills/> [Accessed: 1 June 2016]
- International Labour Organisation (2017) The future of work. [online] ILO. Available at: <http://www.ilo.org/global/topics/future-of-work/lang--en/index.htm> [Accessed: 19 October 2017]
- Jisc (2017). Building digital capabilities: The six elements defined [online] Jisc. Available at: <https://digitalcapability.jiscinvolve.org/wp/2017/03/09/digital-capabilities-framework-an-update/> [Accessed: 17 October 2017]
- Jones, B. (2017). 5 Ways Creativity Leads to Productivity. [online] Entrepreneur. Available at: <https://www.entrepreneur.com/article/234997> [Accessed: 27 Jul. 2017]
- Kelly, E (2015). Blurring boundaries, uncharted frontiers [online] Deloitte Insights. Available at: <https://dupress.deloitte.com/dup-us-en/focus/business-trends/2015/business-ecosystems-boundaries-business-trends.html> [Accessed: 10 November 2017]
- Kelly, K. (2016). The inevitable: understanding the 12 technological forces that will shape our future. New York: Viking.
- Konrath, S., O'Brien, E. & Hsing, C. (2010). Changes in Dispositional Empathy in American College Students Over Time: A Meta-Analysis. *Personality and Social Psychology Review*, 15(2), pp.180-198.
- Levitin, D. (2014). The organized mind: thinking straight in the age of information overload. New York: Dutton Books.
- Manyika, J. et al (2017) Harnessing automation for a future that works. [online] McKinsey Global Institute. Available at: <https://www.mckinsey.com/global-themes/digital-disruption/harnessing-automation-for-a-future-that-works> [Accessed: 16 August 2017]
- Marr, B. (2016) Big Data: 20 Mindboggling Facts Everyone Must Read. [online] Forbes. Available at: <https://www.forbes.com/sites/bernardmarr/2015/09/30/big-data-20-mind-boggling-facts-everyone-must-read/#40358a2117b1> [Accessed: 9 November 2017]
- Marquet, D. Our Story [online] <https://www.davidmarquet.com/our-story/> [Accessed: 9 January 2017]

Meng, T.K. (2016). Everyone is born creative, but it is educated out of us at school [online] The Guardian. Available at: <https://www.theguardian.com/media-network/2016/may/18/born-creative-educated-out-of-us-school-business> [Accessed: 27 July 2017]

Metz, R (2016). Here's Why Google and Levi's Are Working Together to Make a Jean Jacket [online] MIT Technology Review. Available at: <https://www.technologyreview.com/s/601564/heres-why-google-and-levis-are-working-together-to-make-a-jean-jacket/#comments> [Accessed 10 January 2018]

Monarth, H. (2014). The Irresistible Power of Storytelling as a Strategic Business Tool [online] Harvard Business Review. Available at: <https://hbr.org/2014/03/the-irresistible-power-of-storytelling-as-a-strategic-business-tool> [Accessed: 23 October 2017]

Monzo Bank Limited. <https://monzo.com/about/> [Accessed: 12 January 2018]

Neumeier, M (2013). Metaskills: Five Talents for the Robotic Age. San Francisco: New Riders.

Pantic, I. (2014). Online Social Networking and Mental Health. *Cyberpsychology, Behavior, and Social Networking*, 17(10), pp.652-657.

Parmar, B. (2017). The one crucial skill our education system is missing [online] World Economic Forum. Available at: <https://www.weforum.org/agenda/2017/04/one-crucial-skill/> [Accessed: 27 July 2017]

PwC. (2016) Financial Services Technology 2020 and Beyond: Embracing disruption [online] PwC. Available at: <https://www.pwc.com/gx/en/industries/financial-services/publications/financial-services-technology-2020-and-beyond-embracing-disruption.html> [Accessed: 12 January 2018]

PwC (2016) The future of industries: Bringing down the walls [online] PwC. Available at: <https://www.pwc.com/gx/en/industries/industrial-manufacturing/publications/pwc-cips-future-of-industries.pdf> [Accessed 10 November 2017]

PwC (2014) The future of work: A journey to 2022 [online] PwC. Available at: <http://www.pwc.co.uk/services/human-resource-services/insights/the-future-of-work-a-journey-to-2022.html> [Accessed: 1 June 2016]

PwC (2017) Workforce of the future: The competing forces shaping 2030 [online] PwC. Available at: <https://www.pwc.com/gx/en/services/people-organisation/publications/workforce-of-the-future.html> [Accessed: 10 October 2017]

Scottish Government (2015) Scotland's Economic Strategy. Available at: <http://www.gov.scot/Topics/Economy/EconomicStrategy>

Scottish Government (2016) Enhancing Learning and Teaching Through the Use of Digital Technology: A Digital Learning and Teaching Strategy for Scotland [online] Scottish Government. Available at: <http://www.gov.scot/Publications/2016/09/9494> [Accessed: 12 January 2018]

Scottish Government (2017) Technical Note: Productivity [online] Scottish Government. Available at: <http://www.gov.scot/About/Performance/scotPerforms/TechNotes/productivity> [Accessed: 14 December 2017]

Smil, V (2012) The Last Eighty Years: Continuities and Change. Available at: <http://vaclavsmil.com/wp-content/uploads/smil-article-20130204.pdf>

Taylor, M. (2017) Good Work: The Taylor Review of Modern Work Practices [online] Gov. uk. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/627671/good-work-taylor-review-modern-working-practices-rg.pdf [Accessed: 13 July 2017]

Thomson, S. (2016). 10 companies that are great at empathy [online] World Economic Forum. Available at: <https://www.weforum.org/agenda/2016/11/empathy-index-business/> [Accessed: 27 July 2017]

Uber Technologies Inc. <https://www.uber.com/en-GB/newsroom/company-info/>

UK Commission for Employment and Skills (2014) The future of work: Jobs and skills in 2030 [online] Gov.uk Available at: <https://www.gov.uk/government/publications/jobs-and-skills-in-2030> [Accessed: 1 June 2016]

Webel, S. (2016) "Industrie 4.0": Seven Facts to Know about the Future of Manufacturing [online] Siemens. Available at: <https://www.siemens.com/innovation/en/home/pictures-of-the-future/industry-and-automation/digital-factory-trends-industrie-4-0.html> [accessed 12 January 2018]

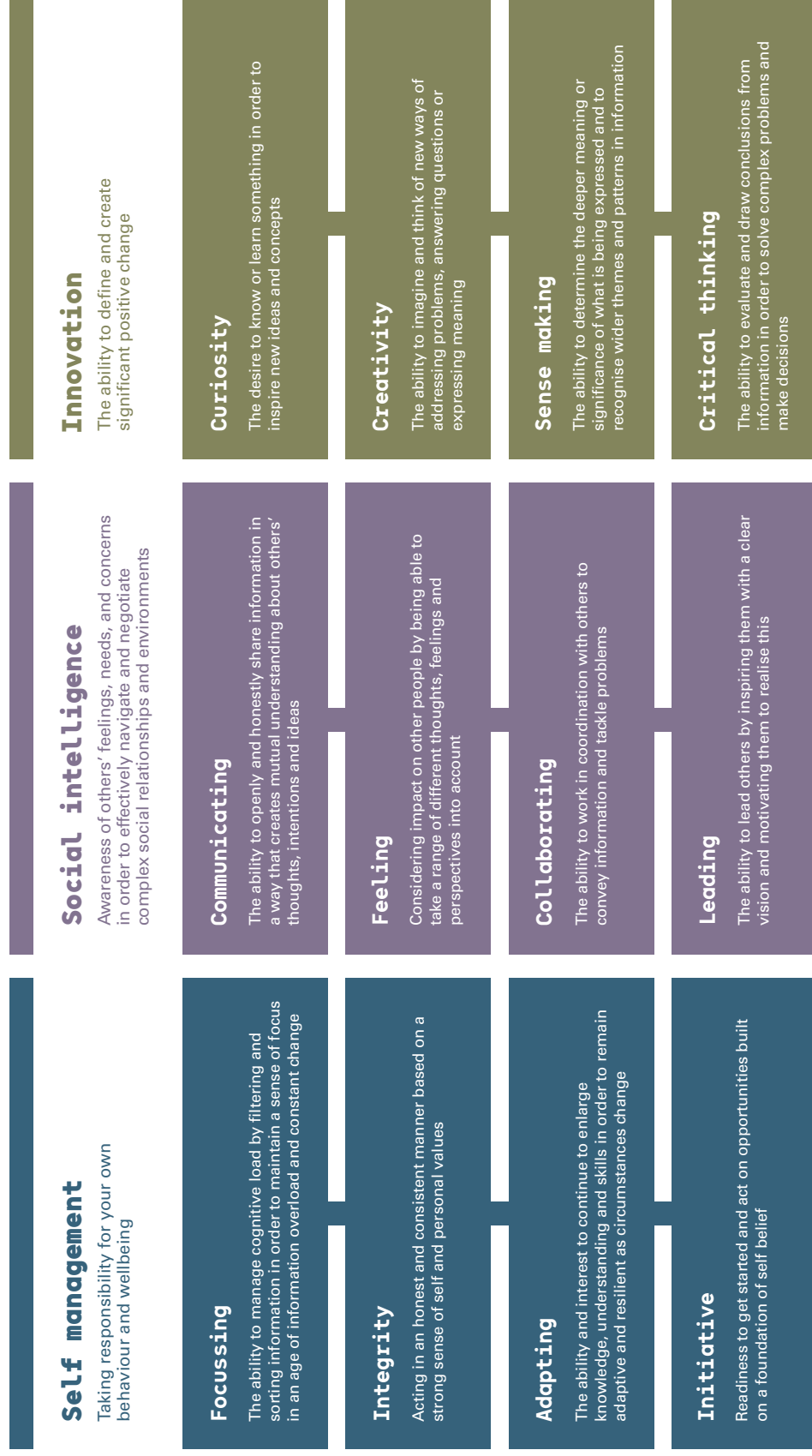
World Economic Forum (2017) Realizing Human Potential in the Fourth Industrial Revolution: An Agenda for Leaders to Shape the Future of Education, Gender and Work [online] World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_EGW_Whitepaper.pdf [Accessed: 4 January 2017]

World Economic Forum (2016) The Future of Jobs: Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution [online] World Economic Forum. Available at: http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf [Accessed: 1 June 2016]

Appendix 1: Meta-skills model

Skills for the future: Meta-skills

Timeless, higher order skills that support the development of additional skills and promote success in whatever context the future brings



Appendix 2: Meta-skills model expanded

Skills for the future: Meta-skills

Timeless, higher order skills that support the development of additional skills and promote success in whatever context the future brings

<p>Self management</p> <p>Taking responsibility for your own behaviour and wellbeing</p>	<p>Social intelligence</p> <p>Awareness of others' feelings, needs, and concerns in order to effectively navigate and negotiate complex social relationships and environments</p>	<p>Innovation</p> <p>The ability to define and create significant positive change</p>
<p>Focussing</p> <p>The ability to manage cognitive load by filtering and sorting information in order to maintain a sense of focus in an age of information overload and constant change</p> <ul style="list-style-type: none"> — Sorting — Attention — Filtering 	<p>Communicating</p> <p>The ability to openly and honestly share information in a way that creates mutual understanding about others' thoughts, intentions and ideas</p> <ul style="list-style-type: none"> — Receiving information — Listening — Giving information — Storytelling 	<p>Curiosity</p> <p>The desire to know or learn something in order to inspire new ideas and concepts</p> <ul style="list-style-type: none"> — Observation — Questioning — Information sourcing — Problem recognition
<p>Integrity</p> <p>Acting in an honest and consistent manner based on a strong sense of self and personal values</p> <ul style="list-style-type: none"> — Self awareness — Ethics — Self control 	<p>Feeling</p> <p>Considering impact on other people by being able to take a range of different thoughts, feelings and perspectives into account</p> <ul style="list-style-type: none"> — Empathy — Social conscience 	<p>Creativity</p> <p>The ability to imagine and think of new ways of addressing problems, answering questions or expressing meaning</p> <ul style="list-style-type: none"> — Imagination — Idea generation — Visualising — Maker mentality
<p>Adapting</p> <p>The ability and interest to continue to enlarge knowledge, understanding and skills in order to remain adaptive and resilient as circumstances change</p> <ul style="list-style-type: none"> — Openness — Critical reflection — Adaptability — Self-learning — Resilience 	<p>Collaborating</p> <p>The ability to work in coordination with others to convey information and tackle problems</p> <ul style="list-style-type: none"> — Relationship building — Teamworking & collaboration — Social perceptiveness — Global & cross-cultural competence 	<p>Sense making</p> <p>The ability to determine the deeper meaning or significance of what is being expressed and to recognise wider themes and patterns in information</p> <ul style="list-style-type: none"> — Pattern recognition — Holistic thinking — Synthesis — Opportunity recognition — Analysis
<p>Initiative</p> <p>Readiness to get started and act on opportunities built on a foundation of self belief</p> <ul style="list-style-type: none"> — Courage — Independent thinking — Risk taking — Decision making — Self belief — Self motivation — Responsibility — Enterprising 	<p>Leading</p> <p>The ability to lead others by inspiring them with a clear vision and motivating them to realise this</p> <ul style="list-style-type: none"> — Inspiring others — Influencing — Motivating others — Developing others — Change catalyst 	<p>Critical thinking</p> <p>The ability to evaluate and draw conclusions from information in order to solve complex problems and make decisions</p> <ul style="list-style-type: none"> — Deconstruction — Logical thinking — Judgement — Computational thinking

©©© Created by Skills Development Scotland, 2018.
 This work is licensed under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.
 To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc-sa/4.0/>.

Appendix 3: Automation potential of skills mapped to meta-skills model

