

White Paper

Leading through the Fourth Industrial Revolution Putting People at the Centre

In collaboration with Accenture

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Contents

Foreword	5
Executive summary	6
1. Rethinking responsible leadership in the Fourth Industrial Revolution	8
1.1 Looking at leadership through a new lens by putting people at the centre	8
1.2 Building transformational leadership behaviours	10
2. Leadership in advanced manufacturing and production	12
2.1 The changing role of leaders in manufacturing and production	12
2.2 Forging a multistakeholder compact for production workforce enablement	12
2.3 Challenging established paradigms about the production workforce	14
3. No. 1 job for production leaders: Enable workers	16
3.1 The changing nature of work in production	16
3.2 Attract, enable, involve and engage the production workforce	17
3.3 Reshape the broader enablement environment in production	19
4. Conclusion and next steps	21
Acknowledgements	22
Endnotes	23

Foreword



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The Fourth Industrial Revolution requires a new leadership paradigm. Turbulent times call for an approach that puts people at the centre of manufacturing and production. Leaders must transform their organizations to stay relevant and competitive amidst unprecedented change, but they must do so in a manner that guides the people in their workforce to opportunities and prosperity.

How is the leadership landscape shifting? What behaviours most effectively drive organizations and society to a more sustainable, inclusive future? Putting people at the centre means investing in the knowledge, skills and mindsets required to navigate the complexities of today and tomorrow.

The time to act is now. Leaders no longer have the luxury of preparing for the Fourth Industrial Revolution. Its disruptive forces can already be felt across all organizations as unprecedented technological advances drive seismic shifts. These are amplified by associated trends, such as protectionism and nationalism, increasing environmental constraints and rising inequality.

Can we adapt in time? In his article “Grappling with Globalization 4.0”, Klaus Schwab, Founder and Chairman of the World Economic Forum, states that the Fourth Industrial Revolution has introduced a new economy and new globalization that require innovative forms of governance to protect the public good. The human condition, he proposes, is in the hands of leaders from business, government, civil society and academia – and its future well-being depends on their timely adaptation to these changes.

Leaders across production value chains have the opportunity to drive transformation by elevating and enabling their workforces. Manufacturing has traditionally supported economic growth and prosperity in both developed and developing countries. By putting people at the centre, production leaders can catalyse the next wave of economic growth to the benefit of over 1 billion workers.

The path forward involves adopting key leadership behaviours. Crucial to this are new partnerships among businesses, governments, educational institutions and labour, and social partners, which help ensure positive outcomes for people while enabling production workers.

This White Paper explores these challenges and potential solutions. Leveraging the Forum’s platform, production leaders have an opportunity – indeed, an obligation – to work together in novel ways. A new, people-centred leadership paradigm can unlock the potential of the Fourth Industrial Revolution for businesses, individuals and communities.

Executive summary

Manufacturing propels the world

Manufacturing has long been a benchmark of economic vitality. An essential driver of economic growth, the sector accounts for 16% of global GDP today¹ and employs nearly one-quarter of the total global workforce (1.2 billion people).² It is projected to grow globally by 4% until 2030.³

Disruption and leadership

Disruption is under way and leadership is no exception. Fourth Industrial Revolution trends disrupt long-established business models. Consider the growing demand for customized products, shifts and skill mismatches in production value chains, and digitization across every dimension of manufacturing. Then add localized and consolidated production supply chains, protectionism and populism, and the concentration of product demand and labour supply across geographies.⁴ These trends are upheaving the production landscape – and its players – at breathtaking speed. Leadership is no exception. For organizations and individuals to thrive – indeed, even to survive – leaders must adopt new roles for themselves and their people.⁵

Leadership through a new lens that puts people at the centre

In 2017, the work of the World Economic Forum System Initiative on Shaping the Future of Advanced Manufacturing and Production and its [Future Production Workforce project](#) focused on how shifts in production value chains affect labour demand. Considering the critical role of leadership, the agenda for 2018 was twofold:

- To explore leaders' roles in elevating the production workforce to bring about positive outcomes for organizations, people and communities
- To apply that refreshed leadership lens to the biggest challenge (and opportunity) facing production organizations: worker enablement

The scale, complexity and urgency of today's challenges call for responsive and responsible leadership.⁶ Starting with the Forum's [Leadership in the Fourth Industrial Revolution Transformation Map](#), this White Paper assesses how the leadership landscape has changed across six dimensions: responsibility and accountability, systems leadership, technology leadership, entrepreneurial leadership, adaptive leadership and shaping societies.

The vast experience of constituents and partners in the field was examined to understand genuine Fourth Industrial Revolution leadership. One key theme and consensus

emerged: responsive and responsible leaders put their people at the centre.

Bob Chapman, Chief Executive Officer and Chairman of Barry-Wehmiller Companies and co-author of *Everybody Matters*, asserted that true leadership is the "...big difference between understanding the value of the people inside an organization and making decisions that consider their needs". This White Paper also explores key behaviours that can help leaders bridge the gap between "saying" and "doing", while confidently navigating today's disruption to ensure tomorrow's success – guided by the principle of putting people at the centre (Figure 1).

A new mindset and key behaviours aid in solving complex problems: how do leaders balance the delivery of short-term results with good stewardship of people and resources? What takes primacy: shareholder and market expectations, or long-term impact upon people, families and communities?

Forging a new multistakeholder compact

The complexity of the transformation under way demands new forms of multistakeholder collaboration. To drive the next wave of economic growth and promise for workers, leaders from business, government, labour unions and academia must forge a new compact.

Whether filling the talent pipeline, delivering a compelling employee value proposition or protecting workers' interests, each stakeholder group can contribute to building a robust and inclusive ecosystem.⁷

No. 1 job for leaders: Enabling workers

While it is tempting to point to technology as the key differentiator for organizations, people comprise the most important source of competitive strength.⁸ In their book, *Human+Machine: Reimagining Work in the Age of AI*, Paul Daugherty and James Wilson explain that "organizations are quickly realizing that humans are necessary to leverage the full potential of intelligence technologies."⁹

Thus, responsive and responsible leaders in production make enabling workers their top priority and, so doing, accelerate growth and value for their organization, individuals and communities.

If workforce enablement does not catch up with the rate of technological progress, G20 economies could lose up to \$11.5 trillion in cumulative GDP growth over the next 10 years. This is equivalent to more than an entire percentage point from the average growth rate every year during this period.¹⁰ Mauricio Macri, President of Argentina and host of the 2018 G20 Summit, put it simply, "The future of work will be a race between education and technology."

Figure 1: Leadership in the Fourth Industrial Revolution: Six dimensions of leadership and supporting behaviours



Source: World Economic Forum, Leadership in the Fourth Industrial Revolution Transformation Map

This White Paper recommends three questions for leaders to consider as they attempt to enable their workers in the Fourth Industrial Revolution:

1. Is the changing nature of work in production continuously being anticipated? *With skills now having a half-life of five years,¹¹ leaders must make proactive decisions about their workforce today.*
2. Is the ability to attract and engage the best talent by tailoring development initiatives for workers improving? *Global executives think only one-fourth of their workforce is ready to work with intelligent machines. Organizations increased spending on intelligent technology by over 60% in 2016-2017, yet only 3% planned to significantly increase the investment in training the following year.¹²*

3. Is the broader enablement environment and ecosystem being reshaped for the production workforce? *67% of people want business leaders to take the lead on policy change, instead of waiting for government.¹³*

The goal is to help production leaders make decisions that put people at the centre and enable their employees – in turn, unlocking new levels of organizational growth and individual prosperity.

1. Rethinking responsible leadership in the Fourth Industrial Revolution



The world is experiencing an economic and political upheaval that will continue for the foreseeable future. The forces of the Fourth Industrial Revolution have ushered in a new economy and a new form of globalization, both of which demand new forms of governance to safeguard the public good. Whether it will improve the human condition will depend on whether corporate, local, national, and international governance can adapt in time.



Klaus Schwab, Founder and Executive Chairman, World Economic Forum, “Globalization 4.0”¹⁴

Disruption and leadership

In the era of Globalization 4.0, the Fourth Industrial Revolution is coinciding with the re-emergence of protectionism and nationalism, increasing environmental constraints, the threat of massive workforce displacement and rising inequality.¹⁵ Organizations and nations are not immune to the disruptions brought about by these ongoing trends, and leadership is no exception.

Leaders face dual responsibilities in this context. They must navigate their own personal transformations in uncharted territories while guiding their people through uncertain paths into the future. Joseph Press, Global Innovator and Strategic Adviser at the Center for Creative Leadership, describes the challenge leaders face in the Fourth Industrial Revolution: “Business models that carried companies to the top of their industries are burning, set aflame by technology, demographic change, globalization, and other disruptive forces. For organizations to survive and thrive, their leaders must be adept at adopting new roles, crafting new identities, and finding new meaning for themselves and those they lead.”¹⁶

This is especially important for leaders in manufacturing, because it is the backbone of many economies. In the United States alone, for every \$1.00 spent in manufacturing, another \$1.89 is added to the economy, where it has the highest multiplier effect of any economic sector.¹⁷ Additionally, a new study published in the *Cambridge Journal of Economics* makes the case that manufacturing jobs precede prosperity. It notes how all rich countries today (other than oil producers and off-shore banking havens) have had, at some point, a large share of jobs in manufacturing – typically more than 18% of the workforce. The authors imply that, while it may be possible to achieve prosperity without a large number of factory jobs, no examples exist of large countries having done so.¹⁸

Therefore, leaders in manufacturing possess a unique opportunity to forge new social contracts through both global and local multistakeholder partnerships. These new social contracts will enable leaders to successfully navigate the Fourth Industrial Revolution to ensure an inclusive and just transition into the future for all.

But what type of leadership is required to elevate the workforce and influence positive outcomes for organizations, their people and broader communities?

1.1 Looking at leadership through a new lens by putting people at the centre

The [Leadership in the Fourth Industrial Revolution Transformation Map](#) was produced by the World Economic Forum in November 2017 as a dynamic knowledge tool. It was designed to help understand the issues and forces driving transformational change across economies and industries, as well as global issues and the Forum’s System Initiatives. It explored six dimensions, which remain highly relevant. However, given the increasing complexities leaders face today, the underlying narrative warrants a fresh look. Some expectations are shifting, and a bridge must be built to the more tangible behaviours leaders can apply to navigate the future.

Figure 2: Six dimensions of the changing leadership landscape

Leadership dimensions	How the leadership landscape is shifting
<p>1 Responsibility and accountability</p> <p>Responding to disruptive change must ensure a human-centred approach to the challenges of the Fourth Industrial Revolution.</p>	<p>As parts of jobs or, in some cases, entire jobs are made obsolete by technology, leaders will have a duty of care to their people to enable and elevate them rather than to replace them.¹⁹</p> <p>Values-based leadership (personal and organizational) is increasingly needed to help leaders navigate the complex issues populating the headlines today, including the responsible use of artificial intelligence;²⁰ the appropriate and ethical use of people’s data; an obligation to create a more diverse and inclusive workplace; gender parity; a commitment to sustainability and the larger community in which mankind works and lives; and the role of truth, trust and transparency in the workplace.</p>
<p>2 Systems leadership</p> <p>Leading in a situation where power is diffused reinforces the need for a shared vision and collaborative action across a highly interconnected world/ecosystem.</p>	<p>Hierarchical and command/control ways of leading may have been effective in the past, but organizations today are changing faster through networks of hidden influencers – people who enjoy informal authority because they have the trust and respect of their fellow co-workers (e.g. the “go-to” people on the shop floor – regardless of level).²¹</p> <p>The whole notion of collaboration across the ecosystem comes into play here – engaging partners outside the organization and pushing traditional boundaries beyond the typical ways stakeholders may have worked together in the past. (See section 2 for more information.)</p> <p>Bridging systems and technology leadership, Schwab recommends to “look beyond technologies as either simple tools or inevitable forces, by reflecting and amplifying human values as we make decisions around investment, design, adoption and reinvention”.²²</p>
<p>3 Technology leadership</p> <p>The unprecedented impact of emerging technologies calls for leaders to rethink their roles.</p>	<p>Googling the phrase “Every business is a digital business” reveals a list of today’s leaders attributed to that phrase. Yet, 44% of leaders say a lack of digital skills in their organization is delaying business transformation.²³ Executives believe only one-fourth of their workforce is ready to work with intelligent technology.²⁴ Less than half of executives believe they possess the skills and abilities to lead in the digital economy.²⁵</p> <p>In his book, <i>Dreams & Details</i>, Jim Hagemann Snabe, Chairman of Siemens, wrote: “The new digital reality requires a new kind of leadership, one that understands the rules of the digital season, reinvents business from a position of strength, thinks exponentially rather than linearly and develops people to unleash their full potential.”</p>
<p>4 Entrepreneurial leadership</p> <p>Leadership during the Fourth Industrial Revolution requires an entrepreneurial state of mind.</p>	<p>At the heart of entrepreneurship is innovation, and innovation is needed on two levels, according to the Center for Creative Leadership:²⁶</p> <ul style="list-style-type: none"> – Innovative leaders: This means bringing new thinking and different actions to how they lead, manage and go about their work. – Leadership for innovation: This means creating the environment and culture to unlock the innovation of others in the organization – fostering diversity of thought, giving freedom and autonomy to experiment, and tapping into people’s strengths and aspirations to do meaningful work.
<p>5 Adaptive leadership</p> <p>“Analyse, plan and implement” has given way to more adaptive leadership that relies on experimentation.</p>	<p>With the high speed of change, the challenge for leaders now is learning faster than the world around them changes. To ensure success, leaders may need to abandon old behaviours, habits and beliefs, only keeping those that best serve them and their people.</p> <p>When applying this adaptive approach with teams, experimentation is key. To keep up with high velocity change, leaders and teams should jettison a “pilot and perfect” model for one of “progress > perfection”, meaning they experiment rapidly and learn as they go, not delaying rollout until everything is perfect.²⁷</p>
<p>6 Shaping societies</p> <p>Non-traditional players are challenging existing social structures and creating a need for bold leadership.</p>	<p>Schwab emphasizes the importance of finding “ways to give the greatest number of people the ability to positively impact their families, organizations and communities by influencing and guiding the systems that surround us and shape our lives”.²⁸</p> <p>Shareholders, customers and employees expect leaders to proactively address rising concerns about inequality, social tensions, political fragmentation and the protection of the environment.</p>

Source: World Economic Forum, “Leadership in the Fourth Industrial Revolution - Transformation Map”, <https://toplink.weforum.org/knowledge/insight/a1G0X000004Q9aRUAS/explore/summary>.

Putting people at the centre

An overarching theme prevalent in conversations with World Economic Forum constituents is that people – their skills and mindset – are an organization’s strategic differentiator to unlock the promise of the Fourth Industrial Revolution. Whereas many point to technology as the driver of competitive advantage, the true accelerator is bringing together people with the right skills and mindsets. This is the key to maximizing the value generated by technology and innovation.

The New York Times columnist Thomas Friedman frequently writes about technology and its transformative impact. His remarks during a presentation at the Aspen Institute Conference in December 2016 underscore why humans, not machines, are central to an organization’s success: “All the things that are important today are the things you cannot download. It’s all the things you have to upload the old-fashioned way: one human being to another.” He stressed that to thrive in our rapidly changing world, we cannot replace human capabilities and interactions with all things digital.

In his recent book, Schwab emphasizes that one of three main challenges is to ensure “that the Fourth Industrial Revolution is human-led and human-centred. Human values must be respected in themselves, rather than weighted only in financial terms.”²⁹

To that end, in collaboration with Accenture and constituents engaged in the Shaping the Future of Advanced Manufacturing and Production initiative, the Forum explored the leadership behaviours most important for realizing a people-centric aspiration (Figure 1).

1.2 Building transformational leadership behaviours

The six dimensions outlined earlier contextualize the “why and the what” of modern leadership. But surveying the landscape is only part of the equation. Key behaviours help transformational leaders successfully put their people at the centre – elevating them and ensuring positive outcomes.

1. Inspire with empathy and vision – Transformations deal with complex and adaptive situations where the problem statement and the solution are often unclear. This requires creating a vision. Essential to this is empathy, which enables authentic connection with people. Such connection motivates them to believe and achieve the vision by connecting to their hearts before their heads. Gianpiero Petriglieri, Professor of Organizational Behaviour at INSEAD, shares how this comes to life in his definition of leadership: “Having the

courage, commitment, ability and the trust to articulate, embody and help realize the story of possibility – for a group of people at a point in time.”³⁰

- 2. Innovate with purpose** – The rapid pace of technology and business model innovation requires a culture of experimentation that tolerates failure and links innovation to a new purpose. The use of data provides a good example. The value of data is not merely quantitative. The integration of still more sensors into a smart product or production system offers little without commensurate capability and capacity to make sense of the vast amounts of data collected. Clarity of purpose minimizes wasted resources.
- 3. Advocate empathy, humanity, trust and transparency** – Even considering the automation of repetitive tasks, many activities across the production value chain will mostly be carried out by humans for the foreseeable future. The human role in ensuring artificial intelligence (AI) functionality, for example, remains critical. Many still consider humans the best, most adaptive and advanced “robots”, with unparalleled vision and sensing capabilities. An increased focus on humans and inspirational leadership that recognizes human contributions and aspirations becomes the key differentiator in helping organizations attract, inspire and retain the best talent.
- 4. Orchestrate for agility and growth** – Fourth Industrial Revolution leaders must sustainably transform their organizations while meeting today’s expectations. This generates constant tension between innovation itself and the existing revenue streams that drive future growth and make the innovation feasible. Likewise, leaders must have the courage to radically rethink and reorganize legacy businesses. This applies in contexts outside of business: labour unions, academic institutions and governments face similar trade-off challenges.
- 5. Collaborate across the ecosystem** – Teaming across organizational boundaries helps to continuously improve and fundamentally rethink established ways of working. Interaction among start-ups, small and medium-sized enterprises (SMEs), large corporations, academia, labour unions and policy-makers is not mere idealism; indeed, it is practical – no individual, organization, or nation will be able to deal with the challenges ahead alone. New solutions emerging from start-ups and universities should be tested and quickly scaled across the production value chain. Large corporations can involve SMEs in transformations by offering innovation partnerships that increase agility. Meanwhile, governments help create an environment in which the ecosystem can flourish. Labour unions should act as a

bridge – between workers and employers, or between the unemployed and the government and enterprises – through constructive social dialogue.

- 6. Embrace social responsibility** – While the conversation has started to shift from challenges to opportunities, there is still a long way to go before an inclusive future for all becomes broadly accepted as incremental to the success of the Fourth Industrial Revolution. A significant, committed, collaborative public-private effort is vital. Such an approach can address negative implications and unexpected consequences, such as the growing inequality between and within economies and the displacement of low-skilled workers. Likewise, it could facilitate the examination of, and adoption of, more sustainable approaches to production. This goes hand in hand with values-based, moral leadership.

The behaviours are connected by two underlying principles. The first refers to the leader's personal ability to adapt to a fast-changing environment; the second reflects the leader's ability to transform the organization.

Learn and adapt continuously – Ultimately, leaders need to change themselves faster than the environment around them changes. This requires tremendous curiosity and the desire to be voracious learners. This transcends tech-savviness and data-fluency, involving a much deeper understanding of how disruptive technologies, consumers, politics and new market players create new business opportunities by transforming traditional, established structures and assumptions.

Navigate the transformation – As with every transformation, bringing people along the journey is the major challenge. Leaders must guide their people through significant times of change with confidence and agility. Transforming organizations without paralysing them requires balancing conflicting needs and priorities. This demands focus, tailored communication and the ability to translate a compelling vision into something tangible and inspiring. Mental and physical stamina matter because, while leadership is always taxing, leading in complex times can be especially draining if approached incorrectly. Typical pitfalls include failure to launch, failure to scale or failure to sustain. Truly sustainable transformation demands persistence until desired mindsets and behaviours become habits.

2. Leadership in advanced manufacturing and production

2.1 The changing role of leaders in manufacturing and production

Because of manufacturing's important role in both developed and developing economies, leaders in production have a unique opportunity to become a new engine of economic growth and drive positive outcomes for people and communities. Looking through the lens of responsible leadership, the behaviours described in the previous section can accelerate progress on key priorities facing production leaders today – if they put people at the centre.

- 1. Anticipate and plan for change:** Do not wait for disruption when asking people to adapt. Agility is marked by proactiveness and the capacity to anticipate change and develop new solutions through multistakeholder collaborations that consider the broader socio-economic and environmental implications.
- 2. Break through the status-quo:** This can be accomplished by fundamentally rethinking historical roles as well as long-established mechanisms and approaches. Likewise, openness to fresh ideas, unbiased perspectives and new approaches can lead to sustainable, future-ready solutions.

- 3. Respond locally, connect globally:** Focusing on local challenges can yield relevant solutions that may be scalable at a global level. Simultaneously, however, looking beyond organizational, national or industry-sector boundaries can boost collaboration and inform broader thinking. This, in turn, allows local actors to contribute to unique global solutions that transform the broader production ecosystem.

The focus on connection and collaboration is particularly important as leaders consider how to engage all stakeholders to solve the challenge of workforce transition and enablement.

2.2 Forging a multistakeholder compact for production workforce enablement

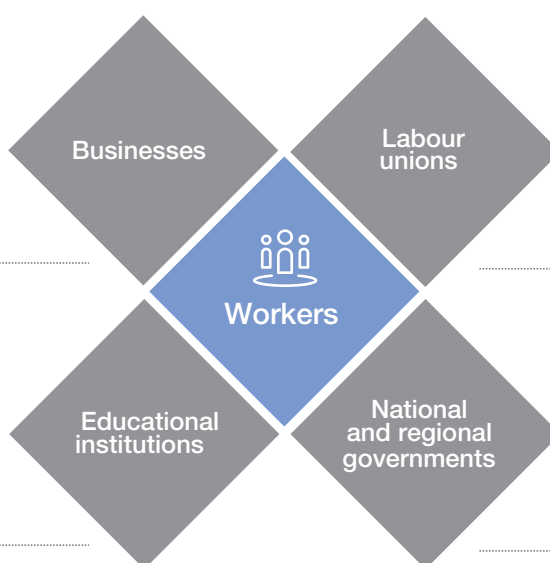
Putting people at the centre is highly dependent upon collaboration among multiple stakeholders – leaders from business, government, labour unions and academia – who are committed to forging a new compact. Global leaders have an opportunity – indeed, a moral obligation – to shape the production ecosystem through new partnerships. This should be undertaken in a manner that is neutral and apolitical, global and mission-oriented, highly connected and solution-driven, people-centred and sustainable (Figure 3).

Figure 3: Multistakeholder collaboration and the opportunities it creates

The path to true collaboration

Opportunity: Increase the chances of acquiring and retaining critical talent and enhancing the relevance and employability of the workforce to drive innovation and economic growth when competition is high

Opportunity: Bring the lifelong learning aspiration to reality for all, taking into consideration the uniqueness and diversity of workers' needs



Opportunity: Prioritize the longer-term protection of employment over the short-term protection of jobs, with mechanisms that support the right balance between flexibility and security

Opportunity: Accelerate economic growth and greater prosperity for citizens through lifelong learning, by connecting and collaborating across key education, work and social welfare systems

Source: World Economic Forum and Accenture

The path to successful collaboration

Successful collaboration can only be achieved if the Fourth Industrial Revolution's "Prisoner's Dilemma" is addressed, i.e. the challenge of extending cooperation beyond the boundaries of historically established norms and beliefs. For this to happen, leaders must honestly assess their roles, acknowledge and combat stereotypes, forge open dialogue within stakeholder groups, and create a shared view of the future that meets the needs of the people each leader represents.

Below is an outline of the opportunities and actions various stakeholder groups can take to transcend traditional boundaries of collaboration and establish a new generation of partnerships that put people at the centre.

Businesses

Opportunity: Improve acquiring and retaining critical talent and enhancing the relevance and employability of the workforce, driving innovation and economic growth when competition is high.

Actions:

- Be transparent about expected shifts in future demand for work and required skills, providing workers with enough lead time to develop the necessary new skills.
- Take some savings achieved through automation and reinvest it in training workers to take on higher value-adding roles.
- Make continuous investment in learning and training a core element of the employer value proposition to existing and future employees.
- Focus on the "greater good" for production workers by opening lines of communication and collaboration across manufacturing companies; this can provide greater clarity and transparency on what talent pipelines and future employment scenarios look like.

National and regional governments

Opportunity: Accelerate economic growth and greater prosperity for citizens through lifelong learning, by connecting and collaborating across key education, work and social welfare systems.

Actions:

- Proactively support and invest in the timely development of workers' skills rather than waiting for worker displacement and unemployment to occur.
- Help SMEs, through tailored support programmes in collaboration with companies, to level the playing field and compete with larger firms.

- Craft public policies that govern technology access and ensure all companies and individuals have easy and equal access to critical knowledge, information and education.
- Prepare government and public education institutions to respond to increasing needs for training and reskilling at scale – considering the shorter half-life of knowledge and the dynamic and sometimes unexpected shift in demand for labour.
- Consider dedicated development programmes for people that teach and coach others in collaboration with educational institutions and businesses, thus accelerating workforce enablement.

Labour unions

Opportunity: Prioritize the longer-term protection of employment over the short-term protection of jobs, with mechanisms that support the right balance between flexibility and security.

Actions:

- Focus on the long-term employability of the workforce rather than job security.
- Prioritize the reintegration of displaced workers by providing opportunities to learn on the job and on a continuous basis.
- Establish new or more flexible frameworks and supporting structures to ease workers' transition journeys by providing the right balance of security and flexibility.
- Help adjust established social protection mechanisms to enable faster and more context-specific adaptations.

Workers

Opportunity: Keep an open mind when confronted with changes and commit to continuous learning – to remain relevant and improve employability.

Actions:

- Hone not only functional skills, but also technology and distinctly human skills to smooth job and career transitions.
- Actively anticipate the changing nature of the job landscape and the required skill development to strengthen employability.
- Do not be afraid of new technologies; consider them opportunities to improve productivity and employability.

Educational institutions

Opportunity: Bring the lifelong learning aspiration to reality for all, taking into consideration the uniqueness and diversity of workers' needs.

Actions:

- Collaborate with employers to accelerate refreshing the learning content (balanced/functional/technical/social/human) and curricula in line with the changing needs of learners and employers.
- Strengthen the linkage between academic output and the concrete benefits for society and learners.
- Allow broader audiences to benefit from existing and future learning content by democratizing access and lowering the costs.

2.3 Challenging established paradigms about the production workforce

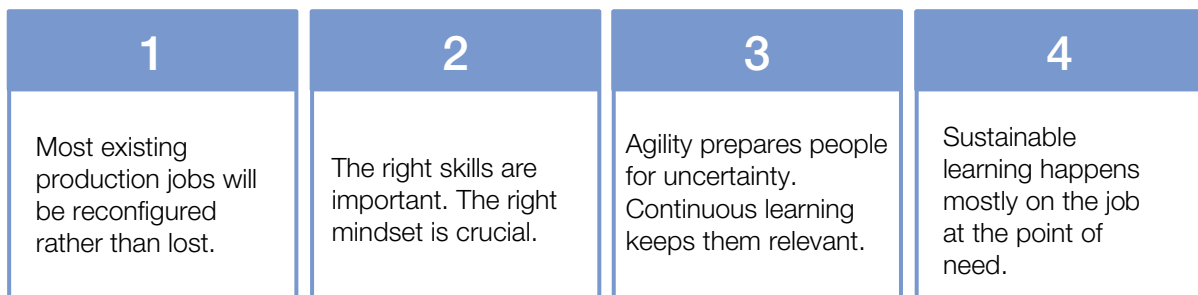
Along with consideration of the stakeholder landscape in manufacturing and the need to strengthen collaboration, it is also important for leaders to re-examine long-held beliefs about the workforce. This includes critical reflection on assumptions about technology's impact on jobs, the future skills required, what workforce agility entails, and effective approaches to continuous, sustainable learning (Figure 4).

- 1. Most existing production jobs will be reconfigured rather than lost.** The Organisation for Economic Co-operation and Development (OECD), in a March 2018 report to G20 finance ministers, stated that “automation has so far not created massive job losses, but does lead to reallocations of employment between tasks, sectors and regions”.³¹ However, there is no doubt that various jobs will disappear, causing worker displacement across segments of the value chain. A nuanced consideration of the changes is essential – including a distinction between existing jobs subject to gradual reconfiguration and those at risk of sudden disruption.

For example, when technologies such as generative design or additive manufacturing are introduced, they generally lead to new or different tasks within existing roles versus sudden displacement, leaving some workers with freed-up capacity. That capacity can be saved to increase productivity or assigned to new, higher-value work. The real challenge and opportunity for leaders is anticipating the changing nature of work and shifts in demand – and transitioning workers in a fair and just way.

- 2. The right skills are important. The right mindset is crucial.** Because most workers will change roles multiple times in their career,³² curiosity and openness to change are as important as having the right skills to maintain long-term employability. When disruptions

Figure 4: Key shifts in established workforce paradigms in the era of advanced manufacturing



Source: World Economic Forum and Accenture

lead to significant reconfiguration or even displacement, an open mindset, along with capability, enables the individual to switch gears, learn fast and make the pivot. According to Accenture Research, two out of three executives in the automotive and transportation industry sense their workforce believes intelligent technologies will make their jobs simpler and more interesting.³³ Another study found workers themselves are optimistic, with two-thirds believing intelligent technology will create more opportunities at work.³⁴ Responsible leaders will build on that optimism towards positive outcomes.

- 3. Agility prepares people for uncertainty. Continuous learning keeps them relevant.** True success lies in the right balance between organizational stability and agility. Hence, leaders must anticipate expected disruptive changes and proactively identify where agility is required in response. Likewise, they must ensure workers have resources to keep skills fresh in advance of disruptions.

- 4. Sustainable learning happens mostly on the job at the point of need.** Area9 Learning, which specializes in adaptive learning, asserts that 70% of training content in the United States is forgotten in 24 hours.³⁵ Recent advances in neuroscience offer insight into how adults learn best. Experiential learning done on the job, at the point of need, tops the list. Apprenticeships, such as Switzerland's Vocational Education and Training (VET), provide an experimental learning experience. These are widely considered the gold standard, as they allow future generations of workers to learn on the job rather than during time off. Simulation tools, virtual and augmented reality and AI also effectively blur the lines between learning and working.

These factors offer important insights to leaders as they tackle one of the most important issues facing production industries today – enabling workers.

3. No. 1 job for production leaders: Enable workers

“Well beyond today’s talent shortages, digital innovations will continually and rapidly alter the demand for skills in the future. Incremental changes to our education and corporate learning systems will not be sufficient.”

Pierre Nanterme, Chairman and Chief Executive Officer, Accenture, France

As leading economies struggle with low productivity increases and, in some cases, slow GDP growth, intelligent technologies promise efficiency gains and new growth opportunities. But traditional educational systems and learning approaches from the industrial age put these economic opportunities at risk. Continuous learning has become not only a key enabler for social inclusiveness and equality, but also a prerequisite for innovation and sustainable growth in production industries. The G20 economies could lose up to \$11.5 trillion in cumulative GDP growth in the next 10 years if workforce enablement does not catch up with the rate of technological progress.³⁶

In conversations with stakeholders and partners, the Forum discovered broad agreement that new, innovative approaches for attracting, engaging, enabling and involving the future production workforce are needed – right now. Given the average half-life for skills of five years, much of what workers learned 10 years ago is probably obsolete, and half of what they learned five years ago is irrelevant.³⁷

With so much at stake, enablement has become one of the top priorities for leaders in manufacturing. Three key

questions help leaders accelerate and scale the enablement of their production workforce (Figure 5). The next section examines their implications in detail.

3.1 The changing nature of work in production



Is the changing nature of work in production continuously being anticipated?

The skills of today are not the skills of tomorrow. This is true of *all* production workers, from the shop floor to the executive suite. Few jobs today are immune to disruption, but agility and a forward-looking mindset can help workers *proactively* transition to new roles.

Trends and the technology landscape

The demand for customized products and consumption-based business models is burgeoning. The rise of servitization has been enabled and unlocked by innovative technologies, such as robotic process automation, additive manufacturing, augmented and virtual reality, blockchain and AI. Entire smart factories, let alone smartened-up sectors, will be more complex and radically different from existing ones. Ultimately, ecosystems of production processes will be distributed, self-organizing, software-intelligent, highly automated, platform-based and demand-driven.³⁸

Recent research among chief corporate executives (CXOs) across different industry sectors reveals that three out of four executives from the automotive and software industry sector agree that their industry will be transformed beyond

Figure 5: Opportunities to accelerate and scale the enablement of the production workforce



Is the changing nature of work in production continuously being anticipated?



Is the ability to attract and engage the best talent by tailoring development initiatives for workers improving?



Is the broader enablement environment and ecosystem being reshaped for the production workforce?

Source: World Economic Forum and Accenture

all recognition by intelligent technologies within the next five years,³⁹ many of which are already undergoing pilot testing in lighthouse factories across the globe.⁴⁰ Most of these technologies will affect how products are designed, engineered, manufactured, transported and operated.

As technology advances at speed that continuously disrupts the global production landscape, the human production workforce is expected to adjust quickly. The changing nature of jobs can be felt across the entire production system. This trend will only accelerate, with demand for certain skills shifting drastically in the coming years.

Given this time of unprecedented, high-velocity change, it is the responsibility of production workforce leaders to develop mechanisms that enable organizations to do three things:

1. Anticipate how new technologies and other trends are affecting production processes – on an ongoing basis, rather than just occasionally
2. Determine which existing jobs are most likely being affected – how and when
3. Identify new jobs and emerging skill requirements – providing the insights to initiate rapid skill development

Task-based job analysis as a tool. The Forum’s research last year, carried out in collaboration with Accenture, indicated that automation and augmentation are likely to result in a significant reconfiguration and, in some case, displacement of production jobs.⁴¹ This year’s work continued with a task-based analysis of a representative group of manufacturing, warehousing and engineering jobs and provided a more accurate, although preliminary, view of the jobs most susceptible to automation or augmentation technologies. The study leveraged an advanced analytics engine using a combination of natural language processing, word embedding and recurrent neural network techniques to predict the automation and augmentation potential based on the nature of tasks within a job. It provided the following findings:

- Task-based analysis, complemented by additional information on the capacity allocated to each task, provided leaders with a more granular understanding of the potential impact of existing automation and augmentation technologies, along with the related risk of worker displacement.
- Leaders can make better and earlier decisions on how freed-up capacity can be reallocated to new, higher-value tasks once automation technology has been put in place.
- These insights empower leaders with lead time to make sound investment decisions regarding the transition of workers into new roles, retraining or sourcing new talent where required.

Leadership takeaways

1. Understanding the implications at task-level for specific production jobs provides sufficient granularity for leaders to identify tasks most likely to be affected by new technologies and changes in production processes.
2. Continuous capacity forecasting, scenario planning and demand simulation help to anticipate potential mismatches between the current workforce and future needs, from both the capacity and capability perspectives.
3. Identified automation and augmentation potential represents a possibility but is not a given. Further exploration is required, but this offers an initial indication of the most significant impact from a workforce perspective.
4. A common disposition is that proactive planning is a waste of time, given insufficient information about future changes and potential volatility. But this ignores the power of today’s analytics and simulation software, which can project historical trends into the future. While this may not provide a perfect target picture, the insights can steer organizations in the right direction.

The spirit behind the continuous anticipation of changing work is perhaps best summed up by Ylva Johansson, Swedish Minister for Employment and Integration: “In Sweden, if you ask a union leader, ‘Are you afraid of new technology?’ they will answer, ‘No, I’m afraid of old technology.’ The jobs disappear, and then we train people for new jobs. We won’t protect jobs. But we will protect workers.”⁴²

3.2 Attract, enable, involve and engage the production workforce



Is the ability to attract and engage the best talent by tailoring development initiatives for workers improving?

The career script has changed from “train and stay in a single career” to “learn, work, shift roles, repeat”. Therefore, learning must happen, and it must be timely, on the job and at the point of need. Global leaders in production have already identified the importance of retraining their workforce – only one-quarter think their workforce is ready to work with intelligent machines.⁴³ But while intelligent technology investments increased by 60% in 2016-2017, only 3% of leaders planned to significantly increase investment in the training of their people the following year.⁴⁴

What does successful continuous learning look like?

The Forum's analysis of ongoing collaborative production workforce training programmes suggests that traditional learning concepts should be broadened. Most production leaders with whom the Forum consulted consider vocational training programmes an ideal combination of practical experience and formal education. However, even they require constant updates to meet the changing needs of learners.

“Learning in the era of advanced manufacturing” also refers to opportunities intelligent technologies offer to enhance existing practices. Enabling workers to learn all the time, rather than take time off to do so, is the goal for leaders:

- 1. Shift to self-directed learning** – Many skill development initiatives and training programmes still follow a one-size-fits-all approach that addresses one skill gap with one specific learning intervention. Training programmes must be upgraded to enable self-directed education while providing new insights into how people learn. This further individualizes formats and curricula. Moving from a “push” to a “pull” approach provides easy, need-based access to relevant content. This empowers workers to individualize efforts based on the unique blend of skills needed at any given moment, in manners and formats most conducive to their learning styles. Many self-directed learning solutions are powered by digital technologies, formats and channels that function at lower cost, more effectively and more broadly.
- 2. Allow for experiential learning** – A growing body of research in neuroscience and behavioural sciences offers insights confirming that experiential learning through hands-on application is faster, deeper and more durable.⁴⁵ As Manolis Mavrikis, Director of Education and Technology MA, University College London, notes: “Technology is in that context a natural ally for experiential learning. It offers people ways to really experience what they are supposed to be learning about but in a safe and controlled environment.”
- 3. Navigate the learner journey** – Looking beyond individual learning interventions, guided paths are required to help workers navigate individual development journeys. This implies guidance on the continuous enhancement of skill sets, transitions between roles and accessing the most appropriate opportunities. “Empowering individuals to drive their own learning journey is great in theory,” says Kathleen Mullaney, Vice-President of Careers at Udacity, a leading Ed Tech provider, “but a big lesson for us was that learners also want and need guidance.”

Continuous learning in practice: Two examples from the field

Example: Co-designing data/insights into jobs

Tulip believes that people will always be the most valuable resource in manufacturing operations. Offering manufacturing's first platform-as-a-service, it brings people, machines and processes together to help production organizations involve their workers in the co-design and implementation of new technologies. The company provides tools that allow shop floor workers to optimize processes for which they are responsible by providing them with data and insights in real time, in the context of their normal work. Take for instance, their work with a high-end boat manufacturer: the paper-based assembly process did not allow for real-time visibility on parts as they moved from raw material to finished goods. Co-designed with other employees, a Senior Process Engineer created an easy-to-use app that provides full transparency of working times by piece and average cycle time.

Impact: The app provides workers with real-time data and insights in the context of the actual job task, helping them to learn and improve. It also gives leaders a clearer view into the learning requirements of workers, allowing them to customize operator training and coaching to match individual needs.

Example: Learning while you work

Upskill helps organizations to enable their production workforce by enhancing their capabilities using augmented reality technologies. At one of its clients, a high-tech electronic component manufacturer, a single technician is responsible for multiple highly automatized production lines. The breakdown of just one machine can shut down an entire line. The technician is equipped with smart glasses, using Upskill's Skylight Platform, which display an overview of key performance indicators for overall equipment efficiency from multiple production lines. Whenever machine outages occur, the technician receives an automated notification on the error and the affected production line segments. In case of complex issues, the technician can share his or her view with offsite experts using streaming technology to collaborate on a solution.

Impact: Enabling the technician with a smart glass solution blurs the lines between learning and working – it is simultaneous – resulting in increased machine uptime, shortened production cycles and reduced costs.

It is increasingly clear to leaders that long-term employability hinges on more than technology skills. In its recent report to G20 finance ministers, the OECD concluded “technological change shifts labour demand towards more cognitive skills for which many current workers are not adequately trained, contributing to the polarization of the labour market and the hollowing out of middle-skill jobs”.⁴⁶ To be truly successful in new roles, workers need unique “combinatorial skill sets” at the intersection of innately human skills, functional skills, know-how and experience, and technology skills. Leaders should underpin all skill-building efforts by fostering the right mindset elements, such as curiosity and openness to growth. This will best prepare workers for the future.

Leadership takeaways

1. Those entering the workforce today will likely have to learn more than five different jobs across their career. Success requires an increased emphasis on social competencies (e.g. team work and problem solving) and the right mindset (e.g. openness to change, willingness to learn and curiosity).
2. While workers’ know-how and experience remain valuable, an understanding of new technologies and how they affect established methods and processes is essential.
3. Existing training initiatives must be upgraded to enable self-assessment and self-directed learning by giving workers access to the right content and development opportunities.
4. Skill building must be accelerated while differentiating between developing job-relevant skills supported by innovative learning formats and leveraging intelligent technologies so workers have access to topical information and knowledge at their fingertips.

3.3 Reshape the broader enablement environment in production



Is the broader enablement environment and ecosystem being reshaped for the production workforce?

While 67% of people want business leaders to take the lead on policy change instead of waiting for governments to act,⁴⁷ the truth is that each institution – business, government, academia and labour organization – plays a vital role in elevating people and building sustainable economic growth.

New coalitions of governments, civil societies, academia and businesses are required to empower production workers with the capabilities to persist as value-adding

contributors in global production value chains. According to Schwab, “For policy-makers, reskilling and retraining the existing workforce are essential levers to fuel future economic growth, enhance societal resilience in the face of technological change and pave the way for future-ready education systems for the next generation of workers.”⁴⁸ Global leaders can transform their corporate and public production workforce training ecosystems, igniting new public-private partnerships for the continuous up- and reskilling of the production workforce around the world.

Singapore, for example, recently transformed its production workforce training ecosystem through the seamless collaboration of multiple stakeholders. Firstly, the government championed the development of industry transformation maps and skills framework. Then, academic institutions adapted and modularized their curricula to support the training needs of industry. Finally, labour unions galvanized the workforce, serving as an important bridge between government and industry to impress upon the workforce the importance of life-long learning.

Successful public-private partnerships

Based on the Forum’s research of public-private partnerships for production workforce enablement, the most successful initiatives have a specific local or industry focus. For instance, partnerships between regional governments, local businesses and nearby educational institutions foster greater ownership and increase the level of engagement of all the parties involved.

Another good example is the Experis Tech Academy in the Emilia Romagna region of northern Italy. For decades, many people found work in the textile industry, but as newer equipment was speeding production while cheaper imports were slowing demand for textiles made in Italy, workers were left without jobs. At the same time, high-end manufacturers of Italian luxury cars were struggling to find enough skilled workers who could use the advanced technology and materials required to fabricate the stronger, lighter-weight components used in their cars. In a multistakeholder approach that included local technical schools, universities and the government, a Labs and Academy Training Center was founded to re- and upskill the local labour force. Today the programme trains people to become carbon-fibre laminators, CAD designers, aerodynamics engineers, vehicle performance and data analysts, engine builders, programmers, project managers and IT specialists.⁴⁹

Another insight gained was that within each initiative, it is best if one of the parties involved takes the lead. The “leader” should not only contribute to the initiative, but also steer the collaborative effort. Based on a recent survey

among CXOs across production industries, employers and unions are considered necessary for maintaining the relevance of workforce skills.⁵⁰ In the German VET system, the role of the government is to set up a legal framework for regulation, grant open access to different stakeholders and develop the VET on institutionalized research.

All parties must play a unique role by contributing where they excel and ensuring their contributions are complementary. The UK's Advanced Manufacturing Training Centres, in the context of the Catapult Programme, requires employers to foresee and specify the skills required for their future manufacturing workforce. Participating employers are also required to communicate their demands to the educational institutes early in the process. Subsequently, they must provide insights on how to best design the training curricula and content based on their fields of expertise.

Leadership insights

1. Aspire to gold standards where possible, but be aware of differences and pitfalls. For example, in considering apprenticeships: some highly developed Western European countries like Switzerland or Germany spent decades developing sophisticated dual educational systems and vocational training programmes. These programmes work extremely well in specific national, cultural and economic contexts with historically developed supporting structures – but the same may not be true in different circumstances.
2. Public education systems must respond to the growing need for lifelong learning while broadening their focus beyond the development of functional expertise. Many truly human skills, cognitive abilities and social competencies are not optimally taught in a classroom or online course; rather, they are best garnered while learning and working with others, exploring new topics and experimenting together.
3. Greater focus is required upon providing learning guidance, incentives and flexible, free access to content. This content should be distributed through various channels that cater to the needs of certain workforce segments. This is particularly important for the less educated, less skilled and less digitally-literate workers, of whom many are vulnerable to technological disruption.

4. Conclusion and next steps

The world is at a point of fusion. Partnerships among people are key to every aspect of organizational and societal progress.⁵¹ Putting people at the centre is the mark of responsible leadership, because it will be the people who ultimately make the difference for organizations and communities across the globe.

Whatever made a company or an economy successful even a year ago will not guarantee its success in the future. No single leader, business or economy can provide sufficient answers and solutions regarding what lies ahead. But by adopting new leadership behaviours and working together, production leaders – global and local, from large and small businesses, start-ups, large corporates and labour unions in developing and developed countries – can co-create solutions and put people at the centre of the Fourth Industrial Revolution.

Opportunities to collaborate: propositions for production leaders to consider

To help leaders and workers in production across the globe reach tangible and impactful outcomes, constituents engaging in the World Economic Forum System Initiative on Shaping the Future of Advanced Manufacturing and Production and its Future Production Workforce project propose three collaborative, multistakeholder initiatives to be incubated in the Forum's platform. The initiatives build upon each other and can inform the work of the System Initiative and project for the year ahead.

1. A **Global Manufacturing Skills Council** will serve as a platform for designing a globally accepted, production-specific skills framework for certification, standards setting and training development. The council could also help elevate collaboration to a new level by converging stakeholders around shared goals.
2. An openly accessible **Future Production Workforce Insights Platform** will provide organizations and individual workers with access to the latest insights about the impact of technology on existing jobs. This will help to identify future job opportunities and associated skill requirements. It could also encompass a self-directed skill analysis with recommendations for learning in line with future skill requirements.
3. A **Manufacturing Education Index (ROI^{edu})** could be used as a vehicle to champion excellence in worker transition and proactive training by offering organizations the opportunity to highlight their investments in human resources, education and training. This would raise awareness of the return on investment in skill development and the societal value of such training. An index would provide shareholders, potential investors and employees an indication of an organization's commitment to investing in human capital.

The Fourth Industrial Revolution presents an unparalleled opportunity to develop a more interconnected, efficient and environmentally responsible global industry landscape. Remarkable innovations in technology and digitalization can yield amazing advances in manufacturing possibilities. At the core of this exciting era of transformation, however, lies the most important resource of all: people. Responsible leadership of the production workforce – now and in the future – is predicated upon a human-centric mindset. Unlocking the true potential of the Fourth Industrial Revolution depends on constantly recognizing human potential – and keeping people at the centre.

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