White Paper

Building the Workforce of the Future: The Current-to-Future State

Workforce of the Future Working Group Opinion Series, Part 1 – June 2020

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AMHUB: A Partnership Between the World Economic Forum and Automation Alley

The Workforce of the Future Opinion Series is based on the discussions, field interactions and ideations of the AMHUB Workforce of the Future Working Group, operating under the auspices of Automation Alley and The World Economic Forum. The purpose of the AMHUB Working Groups are to provide collaborative industry input on the evolving needs of the domestic manufacturing industry. The opinions, ideas and strategies herein are not necessarily the opinion or policies of the employers of the individual Working Group Members.

The Dynamic Current State

AV/CAV[i], Azure[ii], 4G/5G[iii], Rasberry P[iv], Tesla[v], Watson[vi], etc. These are all names of technologies, products, solution combinations or brands that have integrated into our industrial manufacturing industry vernacular. This is especially true if you are part of the Millennial or Z generations who have grown up in a digital age and have very different learning behaviors than other past generations[vii]. Yet, ten years ago, very few would have recognized these names, let alone understood what they did.

As predicted by Gordon Moore[viii], technology processing speeds continue to advance at not just an accelerated rate, but exponentially with shorter periods in between each advancement. This exponential development helps to enable the innovation of software solutions and client service models. Drastically changing the landscape for both consumers and providers. These changes are requiring a pivot to new education models for traditional schools, continuing education programs and in-house learning academies in order to equip and retain a talented workforce, all for our new connected world.

A side effect of this pace of change and rapid adoption of technology is that organizations are struggling to find qualified associates, let alone have the ability to retain them[ix]. It has become more important for organizations to adopt an on-going knowledge and learning culture; and embrace a larger viewpoint of how to provide such a culture. Companies are also dealing with the very real and very poignant general fear of many associates that their function may become obsolete[x] or replaced by a new technology—the fear of being expendable.

Although the fear is real, as Scott Erker of DDI noted in 2018, that "the current technological revolution need not become a race between humans and machines but rather an opportunity for work to truly become a channel through which people recognize their full potential.[xii]"

This is an opportunity for organizations to re-affirm their leadership role in life-long learning, attracting and retaining the best talent. "Industry 4.0 leaders must demand a radical shift in their hiring and promotion practices to focus less on skills and experience, and instead look for individuals who demonstrate strength in agility, continuous learning, interpersonal communication, and proactive problem-solving skills."[xiii]

Further, as articulated by Kevin Griffen with Falco Enterprises and former CIO of GE Capital, "learning cannot just be an afterthought — it must be a core focus of any strong organization[xiv]."

So how do we enable organizations to accomplish not only the needs of today, but to be oriented on the needs of the workforce of the future?

Public-Private Partnerships

In order to continue laying the foundations for a strong future, we should have a re- affirmation and re-engagement for a new level of public-private initiatives in the US focused on the skills and attributes that will be needed to maintain and create a relevant world-class workforce. As shared by the *European Commissions, Digital Transformation Monitor Report* (2017)[xv], it is through these types of relationships that we may seek to develop not only a culture of cross-industry collaboration that pulls ideas together, but we may also take the best of the best and utilize these tools to enhance the whole system.

Although an organization's leadership remains the directing force of those organizations participating, it is our position that the ones that stimulate and leverage this cross-collaborative process will be equipped to have the best chances of adaptation for success. Thus, future success will be directly tied to the strength of these partnerships for workforce development.

Existing Multi-leveled Engagement

As seen in the European Commission Report and reviewing the various existing arrangements made at the US state levels for public-private partnership initiatives and learning models, we first want to reflect, in general, on our current system, as it applies to the manufacturing industry. In the US, we have a diverse mix of approaches to develop and retain a competent workforce. With many education delivery mechanisms that cross over and repeat skills topics. That said, there are three primary ways that such is usually delivered:

First, we have **Traditional Schools**, whether they be technical schools, community colleges or universities. Each of them have the primary responsibility to develop the basic skills for the up-and-coming workforce, with their student focus tending to be the 18-25-year-old range (the traditional student). Each institution works to build on the basics that were to have been established through the public K-12 system and to impart some level of specialty knowledge so that the individuals may successfully transition into their first adult career focused employment role.

The second group are the **Continuing (Adult) Education Schools**, such as academies or knowledge-building organizations. These may include career professional programs, community college partnerships or continuing education offerings through various private companies. Regardless of the delivering entity, their focus is on advanced, enhanced and new skills development for the existing workforce, with their student focus tending to be adults under 60 years old[xvi].

The third group is the **In-house Learning Organizations** that have been established to typically serve larger organizations. They range from in-house apprentice programs, learning academies (career/leadership development) and a plethora of digital learning programs, with a focus on enhanced skills development for the existing and redeployed workforces. Most of these programs are either targeted for the 20-25 age range (apprentice programs) or they are targeted for the 25-50 year old age range (leadership development programs).

All three of these primary delivery models have been going through their own transformation journey. They also each offer learning models that are in-person and/or, virtual and/or some type of hybrid programs. In general, each has attempted to transform from the **Traditional Higher Education Model** to a **Modern Higher Education Model** (as seen in the graphic below) in order to not only be attractive to potential students (i.e. customers), but to adapt to the various learning styles[xvii] as embodied in the learning and life approaches of the Millennial and Z generations[xviii].

A comparative analysis between traditional and modern higher education[xix]

Traditional higher education	Modern higher education
• Teacher-centered • Stage on stage approach • One-way transfer • Passive Learning • Discipline specific knowledge • Low-order learning • Certification	• Learner-centered • Guide on side approach • Multi-way transfer • Active learning • Discipline specific & generic skills • Higher-order learning • Preparing post graduation life

In the end, this transformation has allowed forward-thinking organizations to be focused on methods of learning that meet the needs of the current diverse student base; striving for the adaptability and flexibility for the delivery of a truly personalized learning environment or experience. Further, they have been able to take full advantage of innovations in software and virtual-ware to leverage these new digital tools to deliver these personalized learning environments, yet meet the overall educational objectives of imparting relevant skills and knowledge, thus, maintaining their core mandates.

Required Workforce Skills for Industry 4.0 | Connected Industry

The workforce skills that are already required, and that will continue to be in high demand, are leading more and more employers to review what and how they approach their own initial associate recruitment, on-going career professional recruitment and associate retention. They must be able to grasp the differences seen across the generational divide and be dynamic in their approaches in associate skills investment(s). Without understanding the four primary generational workforce approaches to business: commitment, education and life in general[xx]; they may focus on the wrong skills or the wrong methods to upskill.

In taking a non-scientific level survey in 2019, by a team at Bosch Rexroth, at a variety of different manufacturing industry types (no official study or statistical analysis conducted); at approximately 15 companies spread across five states (Michigan, North Carolina, Pennsylvania, South Carolina and Tennessee); with varying capacity and product batch mixes; we can begin to see how the expectations of all parties have rapidly changed. We can observe the emergence of refined viewpoints on the different levels of skills that are needed in this new workforce of the future.

One of our main thought-provoking observations was that there are three maturity levels of **Business and Technical Skills development** that are being targeted and adopted across manufacturing industry segments: **Basic, On-going and Advanced**.

The most significant change seen here is not that there are multiple levels of associate (student) development that is emerging, but that the combination of Business + Technical Skills development are intermingled and **co-curricular**[xxi] in nature. It is no longer an "either or" decision, but an "and" decision to learning requirements. This balance between traditional business and interpersonal skills are going hand in hand with technical hardware and software-based skills.

To provide an example, below are three high-level perspective on each of these groups:

Working Group: Workforce[xxii]

Maturity Level 1	Maturity Level 2	Maturity Level 3
Basic Business Skills	**On-going Business Skills**	**Advanced Business Skills**
• Business writing • Inter-personnel communication • Presentation techniques • Time management	• 5S of Lean Manufacturing • Agile framework/methods • Kanban/Lean Basics • Project management basics	• Information flow mapping • Project leadership • Target Condition • Value stream mapping
Basic Technical Skills	**On-going Technical Skills**	**Advanced Technical Skills**
• Basic math (through Algebra) • Drawing reading (Mech/Elec) • Mechanical reasoning • Network connectivity • MS Windows basics	• Cloud access/storage • Database set up/usage • ERP/MES basics • Mechatronics configuration • OEE analytics	• Cobot programming • Cybersecurity tool sets • IEC61131/PLC open protocol • IT development tools (C++, Java, VBS, etc.)

Maturity Level 1 – Basic Business & Technical Skills | Summary

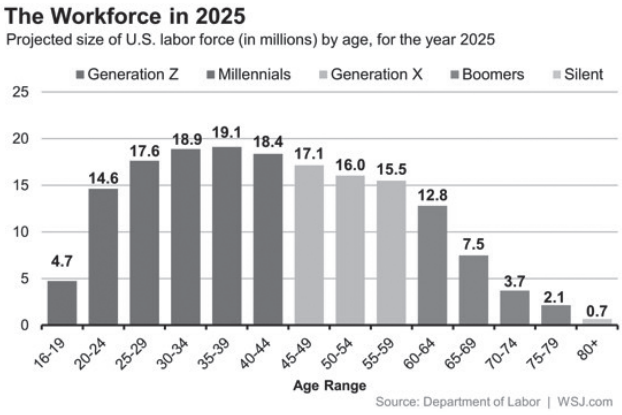
Maturity Level 1 includes many basic business skills that we expect new-to-the-workforce associates to both understand and practice, whether they are coming out of the K-12 system, an apprentice program or community college.

Although expected to present in new hires, common feed-back from companies surveyed is that these basic business skills are absent or not developed. Thus, they must have new hire training programs or some other type of mechanism in place by which to bring skills to an acceptable level.

The same level of expectations can be applied to the basic technical skills. The main difference here being that those new-to-the-workforce associates seem to have these competencies in place when recruited from apprentice programs or community college programs. There is a more scattered success ratio for those coming out of the K-12 system. Thus, the same training programs must also be made available, often utilizing third-party public or private partners, such as state-based apprenticeship[xxiii] programs or community college programs[xxiv] to bridge the gaps. Very few of the companies have all- inclusive technical training programs in-house and/or on-site.

The Workforce in 2025[xxvi]

Projected size of U.S. labor force i(n millions) by age

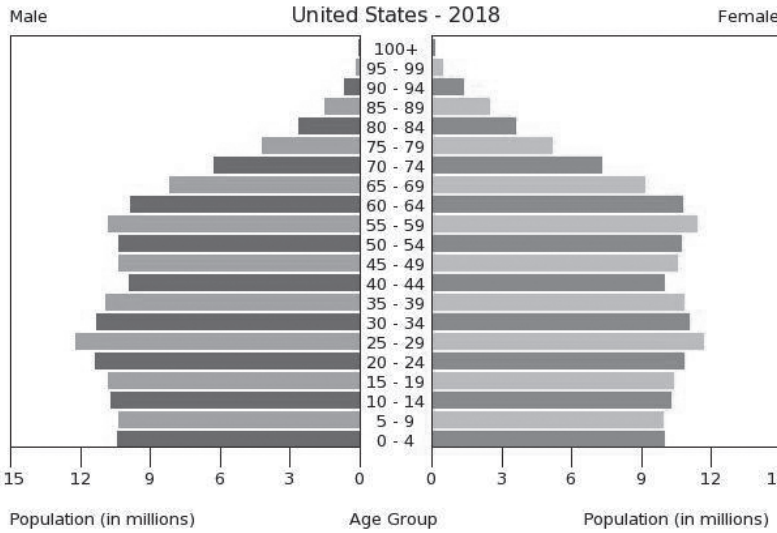


Maturity Level 2 – On-going Business & Technical Skills | Summary

When dealing with on-going associate development for the manufacturing industry, the focus on business and technical skills continues to grow. Every employer today is tied to a high mix of existing skill sets required to perform these jobs and competing needs for development. Because these associates are already employed; and/or experienced changing companies; and/or re-entering a profession and/or entering a new profession, they pose a development challenge. The generational range alone can be daunting with an age range about 20 to 65-plus years old and a complex mix of life experiences[xxv].

Despite the complexity of these associates, they also tend to be among the most valued because they come with a plethora of knowledge and/or experience being applied to real-world tasks that affect quality, cost, rates of production or any other key performance indicators. The financial cost of replacing such associates alone is enough to motivate most companies[xxviii]. They are the primary human assets that make up the innovation, practical talent and capabilities of any company, as well as having an impact on how companies are perceived[xxix].

United States - 2018[xxvii]



Thus, this level of maturity requires a fine balance between the business and technical skills for both employee attraction and retention[xxx]. This also requires more expert trainers/topic experts or access to qualified trainers/topic experts through one of the education delivery mechanisms outlined earlier. Especially in this new age of connected manufacturing where we are seeing a move away from silo role specialization[xxxi] and the merging of traditional IT[xxxii] and OT[xxxiii] responsibilities and skill sets, as well as the on-going search for the **IT-OT Unicorns**, or those associates who come with a balanced IT-OT package of skills and competencies that are exceedingly rare to find.

It is also in these associates that we need to expect the foundations of knowledge in **Lean Methods and Principles**; as well as an understanding **Continuous Improvement Processes (CIP)**[xxxv] and **Agile Manufacturing**[xxxvi] (aka Scrum Methods, Kanban, etc.)[xxxvii] for the achievement of real-world benefits and improvements to an operation, regardless of department, operation or functional role within a manufacturing operation. This includes general labor or line workers, maintenance staff, engineering, purchasing, human resources, finance and leadership.

Maturity Level 3 – Advanced Business & Technical Skills | Summary

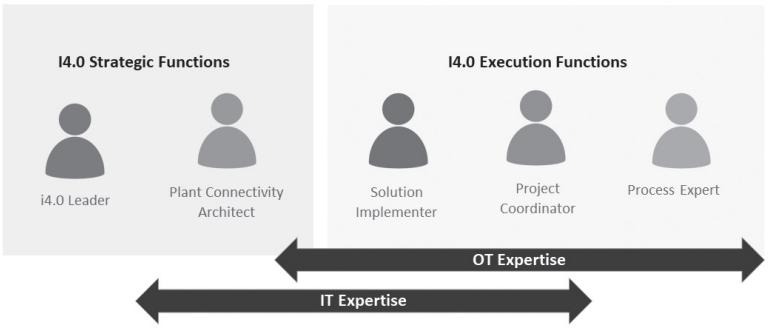
Advanced associate development creates the rarest breed of associate within an organization and is also the hardest to develop. In order to develop such an associate, there must be an extended commitment on the part of the employer, the associate and the co-curricular entity that provides the knowledge and skill training. In the new connected manufacturing reality, these are the associates that everyone seeks to attract and retain, but also compete fiercely with others to do so.

At this level of development, we expect not only a foundation in **Maturity Level 1** and **Level 2**, but we also need those who have mastered these most-needed skills or knowledge sets for the long-term success of our companies. In our **Maturity Level 3** descriptions from above, we outline additional business skills and technical skills that we expect to continue as high-value items. These mixtures of business and technical skills also present the challenge of associate development that can only be accomplished over time.

We expect that these associates have the potential to become the IT-OT Unicorns that we desire. They will be able to bridge the gap between the two silos and help us to accelerate our productivity or output, our key quality or value KPIs, and contribute to high levels of associate retention of the best and brightest.

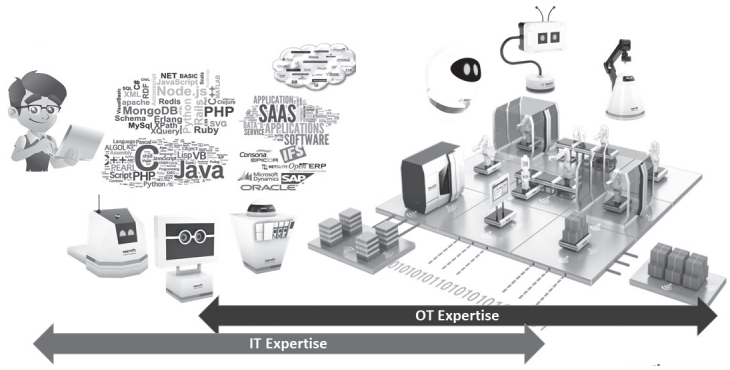
These associates will have the ability to adapt to a variety of roles, whether on the execution, planning or leadership levels. Those providers on skill and knowledge sets that can work collaboratively with industry to develop these associates will find not only strong partnerships, but will be able to enhance their own value to potential students. Real world needs, meeting real world skills and knowledge.

Connected Industry | Connected Manufacturing
People & Talent



Connected Industry Associates

- Solid Business Skills & Interpersonal Approaches
- Foundations in Agile, CIP &Lean Methods
- Knowledgeable in Process, Problem Solving & Collaboration
- Technology Savvy, Competent in Relevant Applications & Emerging Tools



Associates Leading Complexity

- Applying Business Tools, Communication, Collaboration & Technical Skills to solve & improve operations or eliminate obstacles
- Balanced in both Business & Technical Skills that are relevant to their industry
- Adaptable to Dynamic Needs and Change Management

Closing Comments

So, what should companies be doing now? The easy answer is actually more questions for reflection in two topical areas of Vision/Roadmap Plans and Organizational Self-Assessment. Without spending time on these two areas, setting training and development expectations lack the primary foundations required to communicate to training departments, agencies or partner institutions.

Connected Manufacturing Vision and Roadmap:

- What is the Connected Manufacturing Vision and Roadmap for our company? Do we have one?
- Does it include collaborative input from leadership, manufacturing, line workers, information technology, human resources, accounting, marketing and other critical departments?
- Is it a directive or is it a plan that has organizational buy-in?

Organizational Self-Assessment:

- When was the last time your organization did an organizational self-assessment of both new hire and on-going associate skills development curriculum? Was it a top to bottom review, or just a surface review? If not top to bottom, now is the time to undertake the task.
- Has your organization made changes to how you approach business and technical skills updating or upgrading? Have you adopted new tools such as collaborative web-based learning modules? Virtual training for distance learning? Pooling your resources with other manufacturers or partners (non-competitive of course) to bring classes to you?
- Are you still working with a master plan or curriculum that was put in place more than five years ago? If so, you are most likely out of date and need to update your requirements and curriculum.
- Does your company have a local (or national) network of training or education partners? When was the last time that this network of partners was reviewed top to bottom? It is important to insure current relevancy and impact.
- Have you clearly articulated to them what skills and knowledge disciplines are most important to your success?

Finally, we recommend that if you are not sure where to start, or that you feel that you lack the necessary internal qualifications to begin this process of Vision, Roadmap and Assessment, that you explore possible external partners that can help to guide your organization.

END NOTES / REFERNCE MATERIALS

[i]Self Driving Car Definition, (2020) https://en.wikipedia.org/wiki/Self-driving_car

[ii]Azure, (2020) https://azure.microsoft.com/en-us/

[iii]4G/5G Networks, Wikipedia (2020) https://en.wikipedia.org/wiki/4G

[iv]Rasperry Pi Devices, (2020) https://www.raspberrypi.org/

[v]Tesla Electric Cars, (2020) https://www.tesla.com/

[vi]IBM Watson, (2020) https://www.ibm.com/watson

[vii]'True Gen': Generation Z and its implications for companies, McKinsey Consulting (2018) https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/true-gen-generation-z-and-its- implications-for-companies

[viii]The Growth of Computer Processing Power, Off-Grid (2017) https://www.offgridweb.com/preparation/infographic-the-growth-of-computer-processing-power/

[ix]How to Improve Employee Retention, CIO.com (2019) https://www.cio.com/article/2868419/how-to-improve- employee-retention.html

[x]Industry 4.0 – It's all about the People, KPMG (2017) https://home.kpmg/xx/en/home/insights/2017/05/industry- 4-0-its-all-about-the-people.html

[xi]Robots will destroy our jobs…and we're not ready for it , The Guardian (2016) https://www.theguardian.com/technology/2017/jan/11/robots-jobs-employees-artificial-intelligence xii The Future of Jobs Employment, Skills and Workforce Strategy for the Fourth Industrial Revolution, weforum.org (2016) http://www3.weforum.org/docs/WEF_Future_of_Jobs.pdf

[xiii]4 Ways to Transform Your People, Industry Week Magazine, (2018) http://www.industryweek.com/leadership/4-ways-transform-your-people-strategy-industry-40

[xiv]How to Improve Employee Retention, CIO.com (2019) https://www.cio.com/article/2868419/how-to-improve- employee-retention.html

[xv]European Commissions, Digital Transformation Monitor Report, Europa.eu (2017) https://ec.europa.eu/growth/tools-databases/dem/monitor/content/welcome

[xvi]Profiles of the Adult Education Target Population, (2000, 2005) RTI International https://www2.ed.gov/about/offices/list/ovae/pi/AdultEd/census1.pdf

[xvii]The Murky Waters of Generational Learning Preferences, (2018) https://www.learningscientists.org/blog/2018/8/1-1

[xviii]Generational Differences Workplace, Getlighthouse (2017) https://getlighthouse.com/blog/generational-differences-workplace/

[xix]Does supply come on the heel of demand?, Deakin University (2014) http://dro.deakin.edu.au/view/DU:30072864

[xx]True Gen': Generation Z and its implications for companies, McKinsey Consulting (2018) https://www.mckinsey.com/industries/consumer-packaged-goods/our-insights/true-gen-generation-z-and-its- implications-for-companies

[xxi]https://www.edglossary.org/co-curricular/

[xxii]AMHUB Workforce of the Future Maturity Level Graphic (2019), Automation Alley & World Economic Forum Working Group

[xxiii]State of Michigan Registered Apprenticeship Programs, (2020) https://www.michigan.gov/leo/0,5863,7-336-78421_95539_73460---,00.html

[xxiv]Washtenaw Community College Apprenticeships Programs, Ann Arbor, MI (2020) https://www.wccnet.edu/learn/departments/apprenticeships/programs/

[xxv]Labor Force Statistics from the Current Population Survey, (2020) https://www.bls.gov/cps/cpsaat18b.htm xxvi How to Manage Generational Diversity in the Workplace, (2018) https://harver.com/blog/generational- diversity-in-the-workplace/

[xxvii]Demographics of the USA, (2019) https://en.wikipedia.org/wiki/Demographics_of_the_United_States xxviii This Fixable Problem Costs U.S. Businesses $1 Trillion, (2019) https://www.gallup.com/workplace/247391/fixable-problem-costs-businesses-trillion.aspx

[xxix]The Cost Of Turnover Can Kill Your Business And Make Things Less Fun, (2019) https://www.forbes.com/sites/johnhall/2019/05/09/the-cost-of-turnover-can-kill-your-business-and-make-things- less-fun/#32bbe9147943

[xxx]Managing for Employee Retention, (2019) https://www.shrm.org/resourcesandtools/tools-and- samples/toolkits/pages/managingforemployeeretention.aspx

[xxxi]How Manufacturers can get IT and OT to Work Together, (2018) https://www.forbes.com/sites/willemsundbladeurope/2018/12/05/how-manufacturers-can-get-it-and-ot-to- work-together/#4b95971369ff

[xxxii]Information Technology Definition, Wikipedia (2020) https://en.wikipedia.org/wiki/Information_technology

[xxxiii]Operational Technology Definition, Wikipedia (2020) https://en.wikipedia.org/wiki/Operational_Technology

[xxxiv]Unicorn Image, wikimedi.org (2019) https://commons.wikimedia.org/wiki/File:Unicorn_(PSF).png

[xxxv]Continuous Improvement Process (CIP) Definition, Wikipedia (2020) https://en.wikipedia.org/wiki/Continual_improvement_process

[xxxvi]Agile Manufacturing Definition, Wikipedia (2020) https://en.wikipedia.org/wiki/Agile_manufacturing

[xxxvii]Kanban Definition, Wikipedia (2020) https://en.wikipedia.org/wiki/Kanban