

# MANUFACTURING THE FUTURE WORKFORCE

VISIT REPORT: USA 



In partnership with

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<b>INTRODUCTION</b>	<b>2</b>
Structure of Report	2
Caveat	2
Visit Itinerary 4 <sup>th</sup> to 5 <sup>th</sup> June 2018	2
Visit Itinerary 6 <sup>th</sup> to 10 <sup>th</sup> August 2018	3
<b>MEETING REPORTS</b>	<b>4</b>
APLU-LIFT (NCMS Manufacturing Foresight) 'Work & Learn' Conference	4
Inter-Agency Group, Manufacturing USA Meeting	14
DMDII – The Digital Manufacturing and Design Innovation Institute	18
Harper College	21
LIFT - Lightweight Innovations for Tomorrow	23
SME (Previously Society of Manufacturing Engineers)	28
Lorain County Community College	30
America Makes	33
Manufacturing USA Workforce Development Leads	36
Community College of Allegheny County – CCAC	37
Department of Labor – Office of Workforce Investment	39
Jobs for the Future	41
Manufacturing USA Programme Leads	43
Whitehouse Office of Management and Budget	45
<b>GOOD PRACTICE – CORRELATED HIGHLIGHTS AND COMMENTARY</b>	<b>46</b>
Policy and Strategy	46
Education and Training Provision	47
Centres and Sources of Innovation	48

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## INTRODUCTION

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### STRUCTURE OF REPORT

Each meeting report summarises general discussions, additional observations and further background information provided by the hosts about their organisation and its involvement with wider vocational and professional education and training systems and Centres of Innovation.

Individual meeting reports also ‘highlight’ good practice and useful counsel captured during discussions then subsequently explored in delegate group de-briefs. These highlights are brought together using headings common with other visits in the closing section of this report to support further analysis and leading to recommended actions.

This document and its references are an appendix to the overall *Manufacturing the Future Workforce* report.

The full report is available to download at: [hvm.catapult.org.uk/mtfw](http://hvm.catapult.org.uk/mtfw)

### CAVEAT

This trip provided exposure to a fraction of the entire and complex USA system of innovation and workforce development. Furthermore, we interacted with only 3 of the 14 Manufacturing USA Institutes (all 3 are part of the Dept of Defense) and 3 of some 1,250 Community Colleges. As a result, this report should be read in relation to these organisations and not taken as a blanket view of the USA or as a view of Manufacturing USA as whole.

### VISIT ITINERARY 4<sup>TH</sup> TO 5<sup>TH</sup> JUNE 2018

1. APLU-LIFT Conference Washington DC
2. Manufacturing USA Inter-Agency Group Washington DC

### Delegates

Ian Collier – HVM Catapult

Paul Shakspeare – HVM Catapult

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## VISIT ITINERARY 6<sup>TH</sup> TO 10<sup>TH</sup> AUGUST 2018

3. [DMDII](#) Manufacturing USA Institute (DOD), Chicago IL
4. [Harper Community College](#) Palatine IL
5. [LIFT](#) Manufacturing USA Institute (DOD), Detroit MI
6. [SME](#) Professional Society for Manufacturing Engineers, Southfield MI
7. [Lorain County Community College](#) Elyria OH
8. [America Makes](#) Manufacturing USA Institute (DOD), Youngstown, OH
9. [Manufacturing USA Workforce Leads](#) Quarterly Meeting, Youngstown
10. [Community College of Allegheny County](#) Oakdale PA
11. [Office of Workforce Investment, Department of Labor](#) Washington DC
12. [Jobs for the Future](#) Washington DC
13. [Manufacturing USA Programme Leads](#) Pentagon, Washington DC
14. [Office of Management and Budget](#) Executive Office Building, White House DC

[Delegates](#) (\* for meetings on 10th – ref 12 to 14 above)

Chris Beck – TWI\*

Ian Collier – HVM Catapult \*

Tim Jones – National Physical Laboratory (NPL)

Paul Rowlett – Advanced Manufacturing Training Centre (AMTC)

Daniel Sandford Smith – Gatsby Foundation\*

Paul Shakspeare – HVM Catapult \*



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## MEETING REPORTS

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### APLU-LIFT (NCMS MANUFACTURING FORESIGHT) 'WORK & LEARN' CONFERENCE

4<sup>th</sup>-5<sup>th</sup> June 2018

APLU, 1307 New York Avenue, NW, Washington DC

#### Hosts

Emily DeRocco, Director Education and Workforce LIFT, Manufacturing USA Institute

Jim Woodell, APLU Vice President Economic Development and Community Engagement

c. 60 Delegates from APLU members, Manufacturing USA representatives and other manufacturing groups

#### Background

Calls with members of the Manufacturing USA programme team led to an invite to attend and participate in this workshop which was one of a sequence to cover a range of subjects related to the role of the Manufacturing Institutes and how they work with Industry, Colleges and Universities. 'Work and Learn' describes a variety of education and training approaches, primarily aimed at new entrants and including 'Apprenticeships'.

APLU is a representative body for over 230 mid-tier Universities in north America. Manufacturing USA details are provided at greater length in the report from the Inter-Agency group meeting. NCMS and Manufacturing Foresight were supporting the event.

HVM Catapult provided a presentation about Catapults, the UK workforce landscape and the Innovation and Workforce Study, then led a session when delegates provided responses to study questions.

Previous events have led to publication of conference findings at a later date.

#### Presentations and Discussion

##### *APLU*

APLU President Peter McPherson.

APLU has addressed improving access and is concentrating on completion, it now needs to secure employability (report 'Ready for Jobs. Careers and a Lifetime) where

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'qualifications are a clear route to employment by preparing for what they and their country will need'. Students work harder if they see employment opportunities.

The relationship with the Manufacturing USA Centres is an important link in delivering this goal in a systematic way. Clusters of Universities are working on delivery.

### *University-Industry Partnerships and Work-and-Learn*

Patrick Hillberg, Workforce Development and Academic Outreach, Siemens and Associate Prof at Oakland University.

Background of PLM, digitalisation, digital twin, data into knowledge. Opportunity to ship data not product (e.g. FedEx getting into part printing rather than shipping).

Need to tie demand and assets with educational needs and opportunities and make use of digital models as education and training tools with links to the real facilities. Intelligent products require cross-functional workers who are able to overcome problems with inter-disciplinary communication in teams from different educational backgrounds.

There is a workforce demand / supply gap with potentially already 3 million jobs going unfulfilled, partly due to industry dissatisfaction with poor work ready graduates.

Costs and payback for students: Oakland University at \$91k for 4 years compared with Community College at £17k over 2yrs). Cashflow comparison of future income shows it takes 23 years for the 4-year course to overtake 2 year and with a 53% drop out during the 4 year course.

Student Apprenticeship run by Siemens – salaried and Associate Degree based with greater social inclusion and leading to opportunity to return to higher education to gain further qualifications. Siemens promotion of these routes for their customers and supply chains is partly 'Corporate Social Responsibility' but also driven by customers needing the right skills and employees to 'buy my products'. (Manufacturing and IT skills combined is both rare and valuable)

Technology can outpace the customer's ability to absorb it which leaves space for the disruptors to grow, The same is happening in education where the mainstream are engaged in extending their qualification model without recognising changing employer demand, whilst disruptors are developing agile delivery to meet learners' and employers' needs – at significantly lower costs, more rapidly and in partnership with employers.

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Old World	Processes	Contracts	Planning	Outputs
New World	Interactions	Collaboration	Adaptation	Outcomes

- Use interactive creativity to improve products, processes and business models.
- Develop collaborative solutions through rapid prototyping and tight feedback loops.
- Place more value on adapting to change than sticking to a plan.
- Education to be accountable for outcomes (jobs, opportunities, ...), not outputs (graduates, publications, ...).

(Book: Disrupting Class, Clayton M. Christensen). Example of Steve Wozniak – WozU. Data Analytics for Professionals. Competency based project learning that will carry academic credit.

Continuous, collective learning should be replaced with recognition of changing customer demand, rapid pace of technology, knowledge obsolescence and resistance to change. This leads to more emphasis on employers taking on collective, lifelong learning (and the connection with Manufacturing USA Centres) to replace outsourcing the definition of the need to Universities. Some businesses already accept competency-based CVs in place of qualifications.

### *Aligning Technology and Talent Development: The LIFT-APLU-NCMS model*

Action is necessary to for industry and educators to understand skills needs ahead of technology deployment and for technologists to work with education. APLU and LIFT set up an ‘Expert Educator Panel’ drawn from selected universities to work with LIFT technology specialists to understand and to develop competence definitions for emerging technologies. The development process for the competences followed simple steps: Technical team presentations; Expert Educators’ discussions; Recommendations; Additional technical input; Outreach to providers. The technologies to be considered are selected at CEO and CTO level.

There are now three reports setting out competences at Community College (2-year degree) and University (4-year degree) levels:

1. Integrated Computational Materials; Metamorphic Manufacturing; Distortion Control; Thin Wall Aluminum Diecasting
2. Thin Wall Ductile Iron Castings, Powder Consolidations Processes; Agile Sheet Metal Fabrication; Nanoparticle Reinforced Aluminum
3. Refill Friction Stir Spot Welding; Joining Titanium to Steel; Inorganically Bonded Sand Molds; Friction Stir Extrusion

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These will now be followed by development of greater detail for each and to investigate how complementary skills (manufacturing fundamentals and business skills) are impacted by changes to the technology base and to detail resource needs for delivery. The LIFT Learning Hub provides an opportunity for trials.

The Expert Educator Team is developing a 'Think-Do' model (based on Bloom's taxonomy) to better interpret and visualise the nature of associated critical skill sets – modelling, process control, statistics, optimisation, design of experiments, etc.

### *Leveraging University-Industry Partnerships to Advance Work-and-Learn*

It is important to look at the quality of work assignments to ensure effective contribution to overall learning – not just time-based internships to optimize work and learn delivery.

The challenge of garbled employer demand signals requires more integration by faculties to work on this proactively during activities dealing with new technologies – there is both an external and an internal engagement gap.

Rebecca Taylor, NCMS

NCMS supports collaborative technology programmes. Member companies relate that education is not working for them, e.g. producing engineers who've never been on the shop floor. They are looking for people that 'can' instead of asking for a degree when hiring – technology is moving faster than students are being prepared for it – what competencies are students getting out of a degree?

Working with the Institutes is an opportunity for industry and educators to engage with the equipment that they can't access anywhere else. Some could be made available virtually.

Kelly Zeleznik, Lorain County Community College

(Community Colleges are completion funded.) Associate degrees (2 year) delivered by faculties that are well connected with local employers and can co-create courses to provide better learning and exposure to new technologies at an industrially relevant level. This knowledge returns to the classroom environment where students share experiences and helps the evolution of course content in response to industry feedback enabling agility of curriculum development.

State universities need to be better connected to colleges and to make their learning content available to greater numbers with students from both working together on shared equipment to reflect industry operation. This should extend to real projects carried out on behalf of companies.



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Great opportunity to connect with the Manufacturing USA institutes which are physical and virtual assets for workforce development. Colleges could also be used to link local companies that want to pair with the Institutes. Summer or ongoing student working in LIFT, other Institutes and related companies would bring back knowledge to faculties. They could also support teacher internships over several months to help them update curriculum and content.

Amy Clarke, Colorado School of Mines

There is a significant challenge and associated cost, to bring work and learn experiences to large numbers of students. Importance of role of professional societies to help teachers engage with students and to assist and invest in the development of curriculum and trainer capability as well as provide accreditation of learning.

LIFT should develop a model for access which other Institutes could follow.

*Keynote by William Bonvillian, Lecturer; former Director Washington Office, MIT*

Very parallel US analysis to that of UK manufacturing decline and view of consequences:

- Manufacturing job loss (down by 1/3) not automation driven, hollowed out and reduced supporting ecosystem, financing gap for scale-up, weak workforce training.
- Social disruption.
- De-linked innovation / production – but manufacturing is part of innovation system.
- Solve by adopting manufacturing innovation system model as well as continue research innovation.

2012/2014 Advanced Manufacturing Partnership Industry-University Reports recommended:

- Transformative technologies with strategies linked to R&D.
- Implementing Manufacturing Institutes and networking them.
- Demand driven workforce solutions.
- Technology scale-up / policy.

Clarity that there is no advanced manufacturing unless the engineering team fully understands and implements it and the workforce is educated and ready to implement it. This leads to a critical role for the Institutes and Universities. The Fraunhofer Academy provides best practice for a dissemination model of how manufacturing technologies get in to company plants. 'Learning walks on two feet, not through plans'.

Failed labour market system:

- US most de-centralised of all developed nations.
- Imperfect information (link of qualifications to jobs, lack of career guidance, only early stage job certification system, decline of unionisation).

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- Skills gaps of oncoming technologies are unknown.
  - Problems with existing workforce education system. Declining federal and state funds, existing programmes focus on those out of work not upskilling.
  - Apprenticeship programmes are declining and are limited to construction. Interest from larger employers despite expense and scope for poaching. Need to find pathways for lower end jobs to progress to higher skilled, better paying opportunities.
  - Current system doesn't respond to need for lifelong learning.

Higher Education and its slow approach to educational technology opportunities poses a major challenge to what has been seen as the key to middle class entry in the USA:

- Decline of business support because it is not getting work-ready employees and an increasingly partisan views on funding.
- Teaching of legacy subjects, not skills for the workplace (need to do both liberal arts as a foundation and prepare for short term job-readiness).
- Not adopting online and disruptive educational advances. New education technologies – VR/AR, gaming, digital tutors with educational gains from learning by doing without needing a factory.
- Inability to train at the necessary scale with existing institutions and mechanisms.

All lead to 'burning platform' for universities fuelled by the need for new technical skills, pressure from employers, political demands and the importance of new educational technologies.

The changing landscape for education where the importance of workforce in innovation needs to be recognised – 'can't just throw the workforce at new technologies'. The workforce must be designed in at the front as part of development or it won't work. Institutes that only do technology development without workforce will fail.

### *Small Group Ideation Session with presenters of Work & Learn education models*

#### New Jersey Institute of Technology

Public research university – 11,500 total students, 6,000 engineering, hence significant. Have recently commissioned a large co-operative Industrial Maker Space for students which is open to local schools and industry. Build and test excites learners with projects modelled on industry. Well developed 'Co-op' learning curriculum with 2nd and 5th year semesters in industry. These two factors led to revisions in school management to effectively integrate all of the elements for learners and the Institute.

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## University of Louisville

2,700 engineering students with a Co-op model of 3 semesters of work during the 4-year course. Students see themselves as problem solvers with access to a maker space to support joint learning and industry work by carrying out projects together. Industry sees the university as a resource (case study of GE appliances able to work at low volumes in agile environment to validate concepts). Now becoming evident how the right workforce is driving local investment. Students providing placement feedback from their coop experiences to refine curriculum.

## Ohio State University

Difficult to find the right people with the right mix of technical and business skills – a 'Liberal Doer' combining specific professional skills with a broad base and able to do as well as communicate. Things that have worked to address this:

- Materials Camps for Teachers - ASM foundation funded 40 hours hands-on instruction in materials science
- Multi-environment internships with dual status Co-ops
- E3 Program - Experiential Entrepreneurship Education (Use case and business modelling in collaboration)
- Teaching entrepreneurship 'mindset' – 'Effectuation'  
Knowledge + Skills + Experience = Student Readiness Level
- Contract research group delivering live fee-paying projects using students undertaking capstone units

## University of Mississippi

Has developed a new 12,000 sqft Maker Space to support delivery of manufacturing as a minor subject in wider qualifications. Aimed at improving analysis and decision making (Traffic light-controlled v roundabout junction philosophy).

## Kettering University

Originally the GM Institute. 2,200 students are on mandatory cooperative education programmes including 5 successful work terms (paid) mostly working with the same company throughout, accelerated to fit the teaching of 15-16 week semesters in 11 weeks. Co-ops improve learning outcomes and build the university's links with industry.

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### *International Models: UK-Role of Centers of Innovation in Technician Education and Workforce Development*

Ian Collier and Paul Shakspeare presentation content: UK Manufacturing and HVM Catapult; UK Workforce Landscape and Challenges; HVM Catapult Workforce Vision; Workforce and Innovation Study.

Delegate responses to questions provided a number of leads to good practice at a State level.

### *Research Universities & Manufacturing USA: The Education Opportunity*

Emily DeRocco, Education & Workforce Director, LIFT

Emily was able to secure funding to deliver workforce development activities at LIFT from the outset. This has not been the case across all of the other Institutes where it remains outside of budget allocations in some cases. There is a diverse approach across all Institutes related to ownership, technology and industry pressure. This is reflected by the varying nature of the workforce leads, some drawn from partners universities, some part-time.

The LIFT model is multi-dimensional and delivers at a number of skills levels based on competence frameworks and real-world problems at the Institute and across other centres.

Pam Carpenter, Director of Education and Workforce, PowerAmerica Institute

Power America and the Freedom Centre have brought workforce development activities together in two locations. The Institute offers work-based learning as on site capstone projects to support 2-year and 4-year degree programmes.

Rebecca Hartley, Director of Operations, Clemson University Center for Workforce Development; ARM Institute

ARM (located in Pittsburgh) coordinates a regional robotics innovation collaboration system and supports university and college-based demonstration centres – aiming to be a local facility with national reach and responsive to industry needs. Working with BMW at Greenville Technical College Centre for Manufacturing Innovation to provide vehicle assembly experience to enable Technicians to understand Engineers and vice versa.

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Philip Lippel, Assistant Director, MIT Washington Office; Representing AIM Photonics Institute

MIT operates AIM (photonics) and is a member at 10 of the 14 Manufacturing USA Institutes. The AIM Academy at MIT hosts and leads WFD and knowledge dissemination under a strategy that positions AIM as a certifier for industry. NIST funding is supporting road mapping for further AIM development of 'pathways', not 'pipelines'. Elite centres are equipped with high-end technology for research, supported by funding for education and SMEs which 'is always a good thing to seek funding for'.

### Panel Discussion

- There is a significant disconnect within universities between the research and teaching academics. Roadmapping involving universities would improve this.
- Need to develop an 'industry pays' model that supports more and better workforce development provision.
- Department for Education is still developing how to work with the Institutes and Manufacturing USA.
- Growing national view that work-based programmes are not working but are vital, hence the importance of Manufacturing USA involvement and improvements to work and learn strategies.
- A new 'Apprenticeship' model based on competency standards for multi-skilled environments is required.
- Some co-op programmes are too narrow and must become more integrated into academic programmes.
- Challenge of the forgotten workforce and the need for upskilling of incumbent workers.
- Manufacturing USA Institutes run project calls and can use funding for workforce projects.
- DOD is working to get a common narrative for their Institutes.

### APLU-LIFT Highlights

- Same industrial symptoms as UK, but perhaps more integrated planning of solutions – early stage. More about how to meet the manufacturing challenge, not why to.
- Stronger connections are necessary between Colleges and Universities as well as Institute – Expert Educators provides example to respond to technologies new to education.
- Real world problem-based learning is becoming embedded in curriculum and co-op models.



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- Acknowledged Manufacturing USA role to lead workforce development activities towards future technologies.
  - Diffusion of federal and state policy and funding. High levels of uncertainty.
  - Confusion over 'Apprenticeships', importance of employability.
  - 'Workforce is Innovation'.
  - Little on re/up-skilling or on higher levels – Masters, Doctorates.
  - Adoption of Maker-spaces and Micro-factories.
  - Importance of future skills in the workforce to support sales of future process, machines and engineering system (Siemens).

## APLU / LIFT Conference – Information and References

### APLU

<http://www.aplu.org>

### Manufacturing USA

[www.manufacturingusa.com](http://www.manufacturingusa.com)

### National Center for Manufacturing Sciences

<https://www.ncms.org>

### Alliance for Manufacturing Foresight

<http://mforesight.org>

### Ready for Jobs. Careers and a Lifetime – APLU

<http://www.aplu.org/library/ready-for-jobs-careers-and-a-lifetime/file>

### Disrupting Class, Clayton M. Christensen

<http://www.claytonchristensen.com/books/disrupting-class/>

### WozU

<https://woz-u.com>

### LIFT - New Competences

<http://www.aplu.org/projects-and-initiatives/economic-development-and-community-engagement/Aligning-Technology-and-Talent-Development/Index.html>

### Advanced Manufacturing - The New American Innovation Policies, Bonvillian and Singer

<https://www.bonvillian.org/advanced-manufacturing>

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## INTER-AGENCY GROUP, MANUFACTURING USA MEETING

6<sup>th</sup> June 2018

Department of Energy, 1000 Independence Ave, Washington, USA

### Hosts

Mary Ann Pacelli, NIST Manufacturing Extension Partnership Office,

Workforce Development Manager for Programs and Partnerships

Lisa Fronczek, NIST Office of Advanced Manufacturing, Competition Chair

Michael Britt-Crane, Dept of Defense, ManTech Education and Workforce Development Lead

Fatima Terry, Dept of Defense, ManTech Senior Workforce Specialist

Nebiat Solomon, Dept of Energy, Advanced Manufacturing Office, Senior Analyst

Abhai Kumar, ANSER, Principal Analyst

### Background

This group represent the interests of the three departments (Defense, Energy and Commerce) in the workforce development activities of their respective Manufacturing USA Centres. There isn't a direct comparison with a similar UK group since its involvement covers policy and funding of activities that contribute to education and training in the context of technology development programmes.

Calls with this group led to participation in the APLU / LIFT workshop on work and learn (4<sup>th</sup> and 5<sup>th</sup> June). This meeting was planned to develop understanding of the US landscape and to assist arrangements for the full Study group visit.

### Discussion

This relatively new group works to transfer learning between centres and to support the delivery of initiatives across wider education and training networks. It is seen as a 'Group Enterprise' working on common ground but with varying priorities from independent entities operating in a diffuse system of many actors at a federal and state level. Their purpose is to influence impact through established 'local' initiatives, not to create and impose new activities. Each Institute connects with its own workforce development networks and regularly reviews progress with this group to exchange and promote good practice.

The workforce mandate continues to evolve following the bipartisan Revitalize American Manufacturing and Innovation (RAMI) Act (Sept 2014) which set up the Manufacturing USA initiative with its embedded workforce objectives:

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- improve the competitiveness of U.S. manufacturing and increase production of goods manufactured predominately within the United States;
  - stimulate U.S. leadership in advanced manufacturing research, innovation, and technology;
  - accelerate the development of an advanced manufacturing workforce; and
  - create and preserve jobs.

Technologies at the outset were: nanotechnology, advanced ceramics, photonics and optics, composites, biobased and advanced materials, flexible hybrid technologies, and tool development for microelectronics.

The act directs that the National Institute of Standards and Technology (NIST) establishes the National Office of the Network for Manufacturing Innovation Program to: oversee the Program, develop and periodically update a strategic plan for the Program, establish a clearinghouse of public information related to Program activities, and act as a convener of the Network.

In the case of one of the older Centres – America Makes (Additive), the original proposal was made by the Manufacturing Extension Partnership (MEP), also a NIST programme with focus technology transfer to smaller businesses.

The Department of Labor sponsors the American Apprenticeship model which has historically been constrained by industrial relations issues, however only 50% of states report to the department resulting in a variety of approaches with states slow to adopt competency models (instead of time-served). Some of the Centres are looking at new forms of Apprenticeship to meet the needs of advanced manufacturing technologies.

Economically, unemployment is around 4% as a national average (significantly lower in some areas) with wages now starting to rise.

### *Activities*

The parent Agencies are not themselves responsible for workforce development. Funds are made available, either directly to fund activity at the Centres (e.g. LIFT) or in partner organisations (state level) which introduces the opportunity to mandate collaborative working.

Chief Workforce Officers at each Centre meet at least twice a year with other theme-based meetings as necessary.

Centres have varying approaches to workforce development, examples given at the meeting include: LIFT in-house offers, AM professional development, ARM - trying to create an incentive structure for Community Colleges to create curriculum and then provide credentials, Rapid working as part of the Professional Chemicals Association, IACMI and LIFT working together, Netflix developing a workforce pipeline.

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### *‘Credentialing’*

Is a process to approve elements of learning outside of formally accredited programmes and qualifications. It has value to individuals, employers and providers as an assured and transferrable recognition of small elements of competence, not simply acquired knowledge. Credentials are not a ‘license to practice’ but could provide evidence to inform license mechanisms.

In our terms, they relate to the changing emerging technology options within learning structures for new entrants and as CPD for the existing workforce and in principle should be ‘stackable’ to accumulate value. Work has started by the Manufacturing USA group to develop policy (DOD lead).

### *Funding and Purpose*

Each Centre was funded for a period of 5 years with renewals now due. HVM Catapult has previously engaged in dialogue about performance evaluation (how to measure economic impact) which is now part of ongoing funding decisions by parent agencies. Each Centre remains a small business within a variety of ownership structures (most are Universities). Projects continue through competitions run by the Centres as funding bodies, with obligations to collaborate and disseminate emerging knowledge.

Whilst the RAMI Act is explicit about workforce skills and jobs, the infrastructure to deliver policy seems ad-hoc, relying on other initiatives to make impact. It appears hard to influence Universities (including Manufacturing USA Partners) with greater success achieved by working with Community Colleges (2 year Associate Degrees). The Department of Labor ran a four-year programme with Community Colleges to establish shared learning resources (Skills Commons) although usage tracking data is not available (and thought to be poor).

MIT is working with 10 of the 14 Institutes and with a number of Community Colleges. It is also a major provider of on-line courses.

## **Manufacturing USA Highlights**

- RAMI Act – political mandate and economic solution with dual focus on technology and workforce development. Embeds the concept of a ‘Chief Workforce Officer’
- ‘Credentialing’ (Kitemarking/Recognition/Assurance) – with expiry dates within a risk based approach
- Knowledge becoming a borderless commodity, ability to apply is critical locally
- SME as workforce, not technology focus. Knowledge becomes commodity, emerging know-how is competitive advantage
- Limited HE influence on a national scale – scale and diffusion

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## Manufacturing USA – Information and References

NIST

<https://www.nist.gov>

ANSER

<https://www.anser.org/about/>

RAMI Act

<https://www.congress.gov/bill/113th-congress/house-bill/2996>

Manufacturing Extension Partnership

<https://www.nist.gov/mep/about-nist-mep>



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## DMDII – THE DIGITAL MANUFACTURING AND DESIGN INNOVATION INSTITUTE

(NOTE: NOW RENAMED MXD)

Monday 6<sup>th</sup> July 2019, 08:30 to 10:30

UI Labs, 1415 North Cherry Avenue, IL 60642

[www.uilabs.org/innovation-platforms/manufacturing/](http://www.uilabs.org/innovation-platforms/manufacturing/)

### Hosts

Kym Wehrle, Director of Operations

Rebekah Kowalski, Vice President, Client Workforce Solutions, Manpower Group

Jenny Kopach, Executive Director, Science Olympiad

Lizabeth Stuck, Workforce Development Lead

### Background

DMDII focus is on process, not product, using sensors and analytical methods to ‘make sure that each part is better than the last’ and to ‘de-mystify digital’. Founded in 2014 with 330 Members including 50 academic or non-profits with much collaboration between members. 1,500 people per month visit the centre ranging from CEOs to school pupils. Much of the equipment that has been donated requires expensive systems integration by the relatively small number of DMDII specialists. There are several examples of ‘Learning Factory’ set-ups, including an entirely manual assembly process fitted with AR and sensors to capture data and provide feedback and a McKinsey demonstration cell. Practical cyber applications are included.

DMDII currently have a total of 63 projects to a value of \$90m (some ongoing) at TRL 4-7 with a member driven quarterly process to determine future projects, typically funded @ \$1m matched by member contributions in kind. Universities access some machines for research work, some are used by companies for overflow work. The Centre seems to operate as a problem solving ‘Community Centre’ as well as a technology resource and knowledge transfer space. DMD ‘101 sessions’ are regularly provided.

Working with University of Buffalo, DMDII offer a 10-course series MOOC with each course taking between 2 – 15 hours. 50,000 students over 18 months, certification costs are \$100 per course.

DMDII will be offering the ‘Ignite – Master Manufacturing’, LIFT led initiative.

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## DMDII Discussion

### *Digital Manufacturing & Design Jobs Taxonomy and Success Profiles*

These were developed by DMDII and ManpowerGroup (a Member) with support from Microsoft, P&G, Caterpillar, Boeing and SMEs. Focused on Professional and Para-professional careers, including blue to grey collar progress. Three separate factors are now in play with significant effect:

1. Shortage of new talent
2. Demographics of current workforce
3. Rapid evolution of digitally founded technologies

The evolving, 'biological' change (mutation) of jobs and skills will occur at different paces and styles of disruption (chunky, lumpy, smooth) related to starting maturity of organisations and their technologies. It is happening now and expected to peak within 3 years.

The Taxonomy is intended as a 'roadmap' for jobs looking at 165 potential roles, with 20 subjects taken to deeper analysis. Both jobs and tasks will look different – changes will bring pressure to bear on the individual to up-skill, perhaps more than once, and to 'own' their career. (McKinsey figures are 45% jobs will change, 5% go – the 'noisy ones').

Underpinning concept of talent as a renewable resource which needs to be continually nurtured. Companies can't manage large scale singular changes by borrowing or buying talent at a premium, but business HR systems are currently often too rigid and inflexible to incorporate the changes foreseen.

Manufacturing has been seen as fundamentally unattractive for 2 generations; however parents are now beginning to recognise changes in the technology base and opportunities to aim for a job with lower levels of learning debt.

### *Science Olympiad*

As a Member of DMDII, Science Olympiad use the Institute as the 'Cake behind the glass' and to 'Light the pathway' to attract interest from school children and to use as a civic hub for activities with other members' involvement. Early stage education is key to successful change.

The State of Illinois has not updated its manufacturing curriculum for schools for more than 10 years.

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## DMDII Highlights

- Awareness raising and communication of I4.0 issues in a learning environment. DMD 101, 50,000 MOOC students over 18 months.
- Multiple Learning / Model Factories (McKinsey), including cyber training. Manual production model with process sensors and data analysis using AR instructions.
- Digital Taxonomy and implications for future jobs and skills. Digital change is variable and related to organisational and technology starting point.
- Talent is a renewable resource, hindrance of rigid HR systems.
- DMDII building is not a technology research centre – it operates more as a ‘community’ resource to service members’ and Civic needs. DMDII members (industry, academic, not-for-profits) execute the funded programmes with support from the small central team. Institute equipment is mostly for demonstration, knowledge transfer and learning purposes, not technology development.
- Much of the DMDII workforce development activity is not directly related to its apparent technology capability with much addressed at schools and existing Members’ skills concerns.
- The State of Illinois has a schools manufacturing curriculum – but not updated for 10 years – now sharing Ignite programme with other Manufacturing USA Centres.

## DMDII – Information and References

DMDII-Manpower digital jobs taxonomy

<https://www.uilabs.org/innovation-platforms/manufacturing/taxonomy>

DMDII MOOC Courses

[www.coursera.org/specializations/digital-manufacturing-design-technology](http://www.coursera.org/specializations/digital-manufacturing-design-technology)

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## HARPER COLLEGE

Monday 6<sup>th</sup> July 2018, 11:30 to 13:30

1200 West Algonquin Road Palatine, IL 60067

[www.harpercollege.edu/index.php](http://www.harpercollege.edu/index.php)

### Hosts

Rebecca Lake, Dean of Workforce and Economic Development

Mary Beth Ottinger, Dean, Career and Technical Programme

*Organised through Joshua Williams, UK Foreign and Commonwealth Office*

## Background

This visit was prompted by Harper College's previous leadership role with INAM (Illinois Network for Advanced Manufacturing) which was a state consortium of colleges and universities funded by the Department of Labor to develop and deliver collaboratively developed certificate programmes in advanced manufacturing (funding is now complete).

## Harper College Discussion

Harper College offer competency-based apprenticeship schemes to several sectors, including CNC manufacturing and maintenance programmes (3-year old scheme, instigated by Zurich Insurance at the outset and therefore influenced by Swiss apprenticeship model). These are approved at state level for standard of education and in most cases are paid for by small employers (fees of \$18,000 over 3 years). They are built on Associate (2 year) Degrees and are typically 50:50 time spent in college and employer. Elements of the manufacturing programmes are accredited to the requirements of the National Institute of Metalworking Skills (NIMS) and taught as part of larger groups of learners taking the same classes. INAMS supported the development of the apprentice programmes and their approval.

2018 Apprentice intake of 54 for manufacturing with 50% under 24 and 25% female. Each Apprentice employer is obliged to nominate a mentor who undergoes training in the role with monthly academic liaison meetings designed to bridge the industry to academic gap and avoid student difficulties during academic components.

The college have secured loan arrangements for advanced manufacturing equipment (laser cutters, CNC machines, etc.) which have included training of instructors and continued technical support. Continuing Technical Education (CTE), such as apprenticeships and workforce development specialist courses require some double shifting of delivery and enable

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mixed cohorts to improve learning. Community Colleges such as Harper, are distinguished from private training providers because they include credit transfer within their programmes.

The faculty is very time and resource constrained and would be challenged to respond to growth of demand without significant further investment in resources which might distract from current delivery.

## Harper College Highlights

- Collaborative, federal funding of new programmes through INAM continues to influence cooperation. Harper College indicate that they are happy to share programme standards and content with others.
- Local approach to apprenticeships tailored to local employer needs with state level approval. There are federal grants for post-secondary Community Colleges through WIOA (Workforce and Innovation Act which enables the Department of Labor to coordinate the activities of other Government Departments to deliver workforce programmes). Re-approval of the Carl Perkins act for CTE indicates further funding.
- Academic liaison and mentorship by host companies for apprenticeships is a key learning success factor.
- Associate degrees are becoming seen as new signal for employability.
- The Technology Faculty is operating at the limit of capacity and funding, hence the College is not driving new technologies, simply keeping up with current demand.
- Harper have few links with Manufacturing USA as a result of little apparent local employer demand for advanced technologies, despite Harper being located in the most concentrated US area for manufacturing.
- Harper is a leading member of the National Alliance of Community and Technical Colleges Convention (AOC).
- Useful return on investment calculator for employers.

## Harper College – Information and References

INAM

<http://www.inam.net>

Harper College training return on investment calculator

<http://www.costofahire.com/cost-hire>



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## LIFT – LIGHTWEIGHT INNOVATIONS FOR TOMORROW

Tuesday 7<sup>th</sup> July 2019, 09:00 to 15:00

1400 Rosa Parks Boulevard, MI 48216

[www.lift.technology](http://www.lift.technology)

### Hosts

Emily DeRocco, LIFT Workforce Development Director

Nigel Francis, LIFT CEO and Executive Director

Alan Taub, LIFT CTO

Martin Kinsella, Director Comau and Chair of LIFT Executive Advisory Education and Workforce Committee

Carrie Wilson, Executive Director ASM Materials Foundation

Roderick Brown, Executive Director, Development and Partnerships, Detroit Public Schools Community District

Jim Woodell, APLU

### Background

LIFT was one of the early Institutes to be formed and had comparatively well-funded and high-profile workforce development activity from the outset. Emily is a national thought leader with a significant track record in government. She had arranged a full agenda involving those listed above as well as other education partners.

LIFT has 20 Full time staff including administration operating in a 100,000sqft facility. The 'extended enterprise' comprises 750 people distributed amongst the 200 strong membership, 50% in academia. 200,000 teachers and students reached through 40+ education and workforce development initiatives (iceberg thinking). LIFT is primarily DOD / Navy funded to look at holistic, systematic lightweighting solutions, wider industrial funding is now sought.

### LIFT Discussion

Nigel Francis

Manufacturing success has three underpinning requirements: Technology, Talent and Capital – Talent being the primary constraint. However much this is apparent to everybody and although government is currently paying for early career aspects, no one seems prepared to pay in the longer term and industry will suffer from the 'missing-middle' that results.

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Aiming to revolutionise industry through lightweighting innovation and education at TRL 4 to 7 (development) and 7 to 10 (transition and where workforce is key factor).

(Comment that UK has placed a 'healthy bet' on powertrain and propulsion systems.)

#### Alan Taub

Technology projects include workforce and education plans and will focus on the development of practicing engineers and manufacturing technicians in the use of emerging methods using a combination of lectures on theory and practice as well as hands-on prototype manufacturing and experimentation. These materials will be archived, and lectures and slides will be available for asynchronous learning for members through the LIFT website.

Aiming to incorporate proper workforce activities in wider technology programmes – trying to be a US version of a Fraunhofer by special emphasis on workforce issues.

#### Emily DeRocco

Challenge of educating the educators? Who pays for building a skilled workforce? Continued challenge of integrating new technologies into academic / teaching systems. There is currently huge public investment but fragmented.

\$7m from LIFT budget for directly funding workforce activities and to identify further sources of funds cascading from federal sources into State and City workforce budgets. Focus on 'I75 Corridor' creating LIFT State teams at all levels of education using available evidence (Burning Glass, etc.) and build a political constituency placing LIFT at the centre of activity to provide 'blueprint' projects able to be scaled up without ongoing LIFT support and cost. The 2017 annual report shows a 16:41 ratio of workforce to technology projects.

Areas of workforce activity:

1. Addressing today's skills gaps – 2.5m to 3.5m jobs demand not filled, e.g. CNC, welding, maintenance.
2. Skills for the future – expert educator team to translate emerging technology needs into appropriate provision.
3. Deployment teams to take each workforce initiative forward with funding, resources to deliver value and impact that is replicable, scalable and sustainable.

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### *LIFT Teaching Lab*

Relatively small facility to be installed at mezzanine level in the High Bay at LIFT to provide practical learning facilities for local schools including robotics, fundamental skills, flexible learning and virtual learning resources. Set up is funded by Michigan Economic Development Board with an evolving business plan. It is seen as a model for wider take up and shared curriculum for teaching factories delivering advanced engineering curricula. ROI not only financial since the concept will indirectly impact LIFT members' recruitment locally. Costs for use will be recovered with self-sustaining income schedule by 3 years. National level philanthropy is anticipated.

Intend to build educational tools for robotics, digital twins, etc. that can be rolled out elsewhere. Specialist equipment will be 'entrusted' to the lab to include install, maintain and replace costs.

ASM will also have access to greater materials science resources nearby for educational purposes. Expansion of both labs is already anticipated with support from partners and equipment providers.

### *Ignite – Mastering Manufacturing*

This is a school level programme running over three years to completion of High School – Year 1 65 hours of materials science and 65 hours introduction to advanced manufacturing, Years 2 and 3 each 130 hours of advanced manufacturing systems. Ignite involves America Makes and DMDII as well as LIFT. It appears to relate to T-Levels, supported by Amatrol, provider of systems for technical education.

### *Expert Educators*

LIFT have pioneered work with APLU (Universities) to deploy academics as 'Expert Educators' working with technical specialists to develop competence structures for lightweighting technology areas.

Martin Kinsella, Comau Academy.

LIFT members vote on projects to be undertaken allowing smaller companies to suggest ideas. Workforce development often drives Member engagement. Projects are mostly led (delivered) by 'Gold / Silver members. LIFT as 'one-stop-shop' for innovation.

'Operation Next' to provide a 12 month pathway for VETs to enter manufacturing industry. Has been trialed at a local base and is now being made available to national bases (all of which operate independently for support to leavers).

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Carrie Wilson, ASM Materials Education Foundation

ASM operate materials 'boot-camps' for teachers (typically 500 a summer) and offer continued support. LIFT will support using extended learning facilities.

Rod Brown, Detroit Schools Board

Ex-GM Strategy Planner, now driving partnerships for Detroit public schools (1.8m population, 300k students). Aiming to get students work-ready with appropriate attributes and credentials – 'every school is a career pathway school'. Needs a systematic approach which includes project based and experiential learning to generate future innovation skills. Partnering with [United Way](#) (philanthropic / charitable trust) to create solutions and link learners for 9th to 12th grades.

LIFT Teaching Lab will only touch local need, scale up elsewhere.

Jim Woodell

Need to 'de-silo' technology and workforce issues and bring workforce upstream with greater agility.

APLU is delivering the 'Expert Educator' activity with academics from Kentucky, Colorado, Tennessee, Miami, Maine Universities and Edmund and Lorain Colleges. Working with LIFT members; technologists to understand learning needs of future technologies and capture requirements for delivery at Associate and Full Degree level. Greater detail is understood to be required – compare with MTC AM competence approach.

## LIFT Highlights

- Extended Enterprise reaches throughout membership, TRLs 7 to '10' transition is where workforce is key factor, hence technology projects include workforce thinking – LIFT is 'one-stop-shop'.
- 16:41 ratio of technology to workforce projects. Significant effort is required to generate and attract funds to deliver workforce impact from complex, multiple federal, state and city sources.
- Philanthropy remains important for funding community activity and helps resolve federal and state fragmentation for early stage workforce activities.

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- Investment in LIFT 'Teaching Lab' to support cultural and academic change in local schools.
  - Ignite High School offer in partnership with DMDII and America Makes. Extends beyond core Institute technologies to provide underpinning curriculum for advanced manufacturing.
  - Expert Educators are effective since working with relatively mature technologies.
  - Positive, proactive role of ASM with teachers. Granta (UK) resources used for materials teacher training.
  - 'Every school is a career pathway school' according to the Schools' board. The LIFT partnership with schools is a renewed local focus on advanced manufacturing curriculum and teaching.
  - LIFT is anticipating disruption in current learning processes, hence adoption of some on-line approaches. Has established a partnership with Amatrol for on-line learning content development and distribution.
  - Future industry recognised apprenticeships will be very different from traditional schemes.
  - Lack of short-term take-up for lightweighting short courses developed by Case Western.

## LIFT – Information and References

LIFT - New Competences (Expert Educator Reports)

<https://lift.technology/eet/>

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## SME (PREVIOUSLY SOCIETY OF MANUFACTURING ENGINEERS)

Tuesday 7<sup>th</sup> July 2018, 15:30 to 17:00

1000 Town Center, Suite 1910, Southfield, MI 48075

<http://www.sme.org>

### Host

Jeannine Kunz, Vice President, Director of Training and Development

## Background

SME is a not-for-profit professional society, funded through its membership and commercial activities, working mostly in the USA and Canada. The society was focused on personal membership but re-structured some 10 years ago to reflect downturns and structural changes and now has a mix of some 15% individuals, 20% education and 75% companies. This increased the level of workforce development services which are provided in parallel to SME's role as a Certifying Body for related professional qualifications.

The workforce team is some 90 people with a great 'pantry of stuff' including courses, books and videos and 500 e-learning courses under the Tooling-U brand available to members and commercially.

## SME Discussion

There are considerable challenges to get business of all sizes of to take up SME's training offers – the organisations may have capability but not capacity or may not have the systems to cope with workforce development. The demographic loss of older workforce reveals the lack of definition of long-held and evolved roles required to replace like with like. SME have 12 advisors working with members to offer advice and assessment of skills needs.

There is continuing demand for the 'basic stuff' to recover the basics and soft skills reflecting a failing education system. Current technical training demand trends are for machining, maintenance and welding with emerging needs for measurement and inspection, additive and automation, less for the connected factory. SME have launched an Additive qualification in partnership with America Makes.

SME partnering with industry and schools to respond to local needs (e.g. Honda PRIME project). Also identifying progressive high schools able to respond to needs.

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## SME Highlights

- Professional Society for individuals (historically) and now mainly companies and education. Continuing business need for skills basics – machining, maintenance, welding, emerging need for metrology, automation, additive, etc.
- SME are working out how they relate to the Institutes for workforce development – ideally SME should provide materials that react to the Institute’s definition of requirements, now working with technical specialists – including digital and additive manufacturing.
- Ill defined, long-held jobs which are now becoming vacant hinders recruitment and development.
- SME provides a single point of contact for workforce development for companies and is able to assist with ROI cases on training work. Innovation is outpacing workforce development provision, driving need to better understand ROI at all levels but companies will continue to be challenged by their absorptive capacity.
- Crucial role of machine tools suppliers in economy and workforce development driving their sales and future supply chain success.
- New report due - Workforce Challenges: State of Workforce and Pipeline Development.



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## LORAIN COUNTY COMMUNITY COLLEGE

Wednesday 8<sup>th</sup> July 2018, 09:00 to 11:00

1005 N Abbe Rd, OH 44035

<http://www.lorainccc.edu>

### Hosts

Terri Sandhu, Director of Talent and Business Innovation

Kelly Zelesnik, Dean Engineering, Business & Information Technologies Division

Michael Morgenstern, Director of Advancement and Institutional Development

Kasey Tamosiunas, Sales Manager Smart Microsystems

### Background

The USA Community Colleges programme was instigated by the GI Bill during WWII to provide education, training and opportunities for ex-servicemen. Lorain County Community College are among the top community colleges in the country (1250 in total) and 1st in the nation for student success. Lorain County has a population of 300k. Previous employment was 43% manufacturing which rapidly reduced to 13% during the 80s for similar value output but with 25% unemployment. Currently the now improved economy results in college enrolment going down because industry is tempting potential students directly to work.

The college mandate was amended in the 1980s to include a local economic development role as well as education, community and culture.

### Lorain Discussion

#### *Job Preparation*

College Credit Plus takes college learning back into High School increasing achievement and reducing learner's costs for Associate Degrees and using credit transfer to partner universities, for the cost of full Degrees awarded at an earlier age. From this scheme, about 1/3 go into work after graduating at Associate level. 34 High Schools are aligned to the programme. Project based learning is a central component.

LCCC ranks very low for student costs, high for value added and also very high for highest paid graduates. There are 11,000 Associate Degree students with some 3,200 at the higher level through partner universities.

Lorain systematically analyses 'talent demand' by working with employers to determine needs and credentials required. There has only been a small reduction of gender imbalance.

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### *Growing Jobs*

LCCC integrates both education and business support and funding activities and provides technology and incubation facilities on site together with connections to venture capital. 'Great business around great ideas' which has led to small spin outs on site, such as SMART Microsystems. Two investment funds operate state-wide, which in turn provide learning and employment opportunities for students.

Philanthropic investment has supported the development of new buildings and facilities on campus (Campana Centre and others) to provide specialised resources which in some cases are linked to the Manufacturing USA Institutes. Robotics, AR/VR and extensions to Additive Manufacturing are under development. This will attract companies to work with Lorain and connect to wider networks (although many smaller companies are not ready to step straight to I4.0). This will have a significant impact on the competence base of LCCC staff at the same time.

### *Advanced Manufacturing*

The Ohio Technical Network of some 18 Community Colleges, led by LCCC, receives capacity building grants fed from federal funds.

LCCC was a founding member of America Makes and works with DMDII, LIFT, ARM and Nextflex both directly with each for technology related issues and on shared workforce initiative such as 'Ignite' and 'Flexfactor'.

Previous federal investment of \$2bn in Skills Commons ([www.skillscommons.org](http://www.skillscommons.org)) made shared manufacturing learning content available to Community Colleges. The content is generally useful but requires improvements to the interface / access – being worked on at State level.

A digital manufacturing line is being installed to provide a shared 'learning factory resource' for industry and education. Based on Fanuc equipment, it will provide simulation of production processes for industry and enable Fanuc certified training delivery

### *Earn and Learn Programmes - Apprenticeships*

These need anchor-employers such as Ford or Honda but could also create anchors through the Manufacturing Institutes locally. Smaller employers need access to a wider skills base. Partners are necessary to host experiential learning elements often leading to employment on completion. LCCC can act as 'sponsor of record' to manage the bureaucracy and the combination of credit and non-credit components where companies undertake some of the training delivery and certification of practical elements.

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These have been piloted for Micro-electromechanical Systems (MEMS) integrating Flexfactor from Nextflex as a recruitment vehicle, with 99% retention on completion. This approach responds to acute industry needs ahead of I4.0 for smaller businesses and increases industry interest and commitment although high levels of marketing and promotion are proving necessary.

In UK terms the apprenticeship programmes might be seen more as ‘sandwich courses’ with internships in place of structured on the job learning and continued provider oversight.

### *Incumbent Workers*

Some of the above programmes are aimed at the current workforce undertaking natural progression. LCCC is aware of the acute needs of this group to react to the opportunities of new technology whilst balancing plans with the real needs of local employers, themselves stimulated by the wider economic activities of the College.

Programmes to transition mature students, especially women, with maths and interview support are proving successful.

### **Lorain Highlights**

- LCCC illustrates the potential that UK Institutes of Technology could fulfil with strong, visionary and shared leadership.
- Talent is number one challenge – the ‘Talent Development Model’ is vertically integrated for education and training, horizontally integrated for workforce development – systematic approach to workforce alignment and development to increase opportunity.
- Lots of state funding goes to Universities, far less to Community Colleges, hence concentration of investment through Lorain into local economy – including access to capital.
- Locally determined community-levy supports LCCC-delivered workforce success.
- College staff competence is raised by working with Institutes and new technology. Manufacturing USA workforce programmes Expert Educators are central to LCCC manufacturing skills strategy. (LCCC was a founding member of America Makes.)
- Manufacturing USA workforce programmes such as Ignite, Flexfactor and Expert Educators are central to LCCC manufacturing skills strategy.
- Working with LIFT on the multi Skilled Technician as an extension of the Manufacturing USA Institutes learning factories - companies coming here to do work that then allows the connection with students.
- Skills Commons could be effective with right model, portal and governance.
- I4.0 seen to be at ‘communications’ stage.

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## AMERICA MAKES

Wednesday 8<sup>th</sup> July 2018, 13:00 to 13:30

236 West Boardman Street, OH 44503

<http://www.americamakes.us>

### Hosts

Rob Gorham, Executive Director

Vicki Thompson, Workforce and Education Lead

### Background

America Makes has 221 members and cash contribution is not a requirement for membership. There is no direct asset base at the Institute (which is housed in Youngstown University buildings which also accommodate equipment owned by others as well as providing incubation facilities). AM are developing an asset map to identify what's available / accessible from others (only 30% is). Core activities are funding projects, creating partnerships and using leadership ('Authority') position to influence on behalf of technology sector using convene / co-ordinate / catalyse approach.

Working with members to define requirements and identifying funding projects to deliver an overall budget of \$120m which is now self-funding in terms of operating overhead contribution. Partners contributed \$60m via 50 MOUs in past 12 months, always looking for alternative sources of funding (Gov/State/Others – SEM – Somebody Else's Money).

Membership supported the creation of Technical and Workforce Roadmap. The current split of project activity by budget is 60% technical, 40% workforce, and now aiming at a more even balance with workforce offers essential to America Makes' survival, since it underpins the technology aspects of the business.

### America Makes Discussion

Additive Manufacturing – “lots of hammers looking for nails” and “random acts of excellence” increases importance of workforce elements to raise awareness and skills. Workforce development creates a marketplace for advanced technology solutions.

RG sees his role as the ‘conductor’ of funding flows and delivery looking for high impact, high value activities that move both technology and workforce agendas to meet the consensus of member views. The RAMI Act empowered this role from the outset to support reaching a sustainable model but no longer funds or drives it. America Makes has become the ‘Authority’, not in the sense of technical leadership, rather as the head of a growing

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community operating from a shared understanding of opportunity and challenge expressed in the Roadmap.

Much of the original mandate was to implement education programmes to deliver scale, not to develop technology methods. Roadmapping may therefore be a response to workforce pressures in the first instance and led by workforce specialists. Project proposals must relate to the common Roadmap.

This has produced a 'Swimlane' approach to workforce strategy and activity based on systems thinking. Delivery is through partners; however quality assurance and on-the-job training are challenging. Roadmapping uses the LUMA Institute 'Innovating for People' process (includes 'affinitization, impact/delivery matrix, concept posters, etc.).

An Additive Manufacturing Body of Knowledge – 'AMBOK' is being created which will relate to jobs and competencies. Also working with SME to develop on-line courses. Workforce shortage hot-spots are currently Design Engineer (e.g. AM and an appreciation of the potential of the technology) and the convergence of roles for the Technician (Apprentice/Journeyman/Master). Additive manufacturing technologies appear very accessible but are changing fast, hence AM is undertaking value-mapping on behalf of members and seeking to maximise use of available equipment for training purposes.

The America Makes 'ACADEMI' provides up-skilling learning with a route to future certification, classes are quarterly with practitioners' webinars freely available. Improvements are planned to rotational learning programmes which should provide academic and workplace learning opportunities.

Working with Lockheed Martin to generate a 'Supply Chain of People' – which highlights the need to educate the educators and setting up a Government Relations Advisory committee.

## America Makes Highlights

- Three legged-stool playback of a fragile eco-system necessary to anchor innovation.
- Essential nature of workforce activities to overall success. The RAMI Act empowered and instigated developments at the outset, now less relevant and avoids public funding models driving unsuitable behaviours.
- Workforce development creates a marketplace for advanced technology solutions – and therefore equipment, materials and machine tool suppliers.
- Roadmapping led by Workforce needs – Swimlanes. Value-maps support members and justify Institute sustainability.
- America Makes 'AMBOK' (AMTC competence structure comparison) and 'ACADEMI' (may lead to potential for membership through in-kind arrangement between AM and AMTC.).

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- Success measures hardening up from ‘good news’ to impact measuring KPIs – including Workforce.
  - Setting up a government relations advisory committee to create influence and a pipeline of opportunities.
  - America Makes is building local specialisms as well as supporting wider manufacturing interests.

## America Makes Group – Information and References

AM ACADEMI

<https://www.americamakes.us/academi>

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## MANUFACTURING USA WORKFORCE DEVELOPMENT LEADS

20 WFD leads attending from America Makes, NIMBL, BioFab, AIM Photonics, ARM, Dept of Labor and Rockwell.

### Main points of contact

Michael Britt-Crane, Education and Workforce Development Lead, DoD Manufacturing Technology Program Office)

Mary Ann Pacelli, Workforce Development, NIST Manufacturing Extension Partnership

Fatima Terry, OSD Senior Workforce Specialist

Lisa Fronczek, Dept of Commerce

## Manufacturing USA Workforce Group Highlights

- Appropriate workforce activity related to maturity of the technology and nature of workforce – hence little workforce activity from some Institutes to date.
- Institutes don't change the system, they connect the dots by identifying best practice across USA, raising visibility and looking for scaling.
- No substantive technology related Institute delivery in-house since funding dispersed to Members.
- Forecasting – ARM using Boston Consulting Group and Rand 900k new jobs for which there are no Job Descriptions written. Similar for NEXTFLEX.
- Credentialing report involved ANSI. Industrial Competence for manufacturing set by NIMS. (No digital badging discussed).
- National Coalition of Advanced Technology Colleges.
- Understanding of gaps in education system outputs is not central activity of Manufacturing USA – falls to DoL.
- New forms of Apprenticeships are a work in progress needing political statements hooked to funding.
- Opportunity for Transatlantic workforce partnership for Centres of Innovation?

## Manufacturing USA Workforce Group – Information and References

National Coalition of Advanced Technology Colleges

<https://ncatc.org>

ANSI

<https://www.ansi.org>

NIMS

<https://www.nims-skills.org/about-nims>



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## COMMUNITY COLLEGE OF ALLEGHENY COUNTY – CCAC

Thursday 9<sup>th</sup> July 2018, 10:00 to 12:00

West Hills Center, 1000 McKee Road, Oakdale PA 15071

[www.ccac.edu/about/](http://www.ccac.edu/about/)

### Hosts

Stuart Blacklaw, Provost, Executive Vice President for Academic and Student Affairs

Theresa Bryant, Vice President Workforce Development

Reginald Overton (Reggie) Director Workforce Development

Ronald Logreco (Ron) Assistant Dean

### Background

County based Community College, closely connected with ARM through Steve Catt (ARM WFD lead). CCAC is clearly structured into academic and workforce offers which have a strong local economic alignment.

CCAC deliver apprenticeships for 15 – 30 companies using generic programmes with additional emerging technology content.

### CCAC Discussion

80% of High School graduates enter 4 year college courses, 50% don't complete but carry debt. This leaves a void at 2 year high-skilled levels with low supply and high demand for recruits. The legacy of 'manufacturing' is unhelpful – re-brand as 'automation' based around mechatronics, all tied to NIMS certification to secure employability.

Local economic development schemes such as 'Wednet' use federal funds at state level to provide up-skilling programmes where employers are reimbursed once standards are achieved. Skills to HE coverage.

CCAC prefer multi-state consortia of colleges (avoiding local competition) to develop and share new curriculum.

Money follows students, grants encourage collaboration but often leads to competition.

Students can matriculate to gain credits after workforce courses – 'cross-walking', which can be based on 3rd party certification (stackable credentials). New units often start as workforce offers, then migrate into credit courses. Students need general education subjects to

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graduate. Credit side attracts students (transferability), Workforce side attracts business (competence, productivity).

The ARM relationship is seen as a means to understand future needs and to achieve change. Manufacturing USA relationship seen as constructive. ARM and members provide 'hot leads' able to be met by CACC. ARM inputs also include: workforce development group initiatives such as Ignite, certification of courses (kitemark), identifying 3rd party partners, curriculum development support. ARM is both a national and local resource.

Traditional apprenticeships take over 4 years with 4 weeks block release in each for sectors such as construction. Courses fees are paid for out of union dues and delivered by union training centres – highly regulated and bureaucratic. Re-constructed apprenticeships for automotive take place over 2 years with 40 weeks (student not paid and fees due) in school and 40 weeks on placement/co-op (student paid).

Risk of de-valuing 'Apprenticeships' without proper quality controls.

## CCAC Highlights

- 'Automation' not 'Manufacturing' to attract new students.
- Workforce to Credit flow introduces new content into academic portfolio.
- ARM Institute supports case for change and sources 'hot leads' through Member connections.
- ARM kitemarking of new content on behalf of Members'.

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## DEPARTMENT OF LABOR – OFFICE OF WORKFORCE INVESTMENT

Friday 10<sup>th</sup> July 2018, 09:00 to 10:30

DUS Conference room C4322, 200 Constitution Ave NW Washington, DC 20210

<http://www.dol.gov>

### Hosts

Kevin Thompson, Programme Analyst

Sara Hastings, Workforce Analyst

Kristin Sparding International Liaison

*Organised by Chelsea Dickson, UK SIN*

### Background

As with similar acts roughly every decade, the Workforce Innovation and Opportunity Act (WIOA) 2014 reaffirms the role of the public workforce system, and brings together and enhances several key employment, education, and training programs. This new law provides resources, services, and leadership tools for the public workforce system to help individuals find good jobs and stay employed and improves employer prospects for success in the global marketplace. *It ensures that the public workforce system operates as a comprehensive, integrated, and streamlined system to provide pathways to prosperity for those it serves and continuously improves the quality and performance of its services.*

As WIOA implementation progresses, success in accomplishing the purposes of WIOA at the state, local, and regional levels, will be determined by whether:

- One-stop centers are recognized as a valuable community resource and are known for high quality, comprehensive services for customers.
- The core programs and one-stop partners provide seamless, integrated customer service.
- Program performance, labor market, and related data drive policy and strategic decisions and inform customer choice.
- Youth programs reconnect out-of-school youth (OSY) to education and jobs.
- Job seekers access quality career services either online or in a one-stop center through a “common front door” that connects them to the right services.
- One-stop centers facilitate access to high quality, innovative education and training.
- Services to businesses are robust and effective, meeting businesses’ workforce needs across the business lifecycle.

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## DOL Discussion

WIOA promotes alignment of workforce development programs with regional economic development strategies to meet the needs of local and regional employers. Much of the delivery falls to local Workforce Investment Boards (525 nationally) these are legislated to comprise >51% business people who provide the Chair. The Boards have to provide 5-year sector based strategies – including future technologies (example of autonomous vehicles). Four mainstream funding streams: Adult dislocated, Youth into work, Adult education, Disabilities. Plus emergency funds related to disaster and innovation.

Skills Commons development funding (\$1.9bn to date) is a DoL initiative where Community Colleges are required to build materials (curriculum and resources) and make them available to all (American Association of Community Colleges).

## Department of Labor Highlights

- Recent Presidential Orders about expansion of ‘Apprenticeships’ and associated frameworks and the extension of the Perkins Act for Continuing Technical Education (CTE) continuing the norm of bi-partisan political support.
- WIOA brings workforce development strands together across departments and working under the recent legislation, this is creating significant change (= cross-departmental working + Lifelong Learning + Work-based learning).
- ONET provides rich data, but little capture of longitudinal data on post education outcomes.

## Department of Labor – Information and References

Presidential Order for Apprenticeships

<https://www.whitehouse.gov/presidential-actions/3245/>

Recognised Apprenticeships

[https://wdr.doleta.gov/directives/attach/TEN/TEN\\_3-18.pdf](https://wdr.doleta.gov/directives/attach/TEN/TEN_3-18.pdf)

Perkins Act for Continuing Education

<https://www.congress.gov/bill/115th-congress/house-bill/2353>

ONET Occupations

<https://www.onetonline.org/help/onet/database>

WIOA

<https://www.doleta.gov/WIOA/Overview>

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## JOBS FOR THE FUTURE – JFF

Friday 10th July 2018, 11:15 to 12:00  
122 C St NW SUITE 650, Washington, DC 20001  
<http://www.jff.org>

### Hosts

Eric Seleznow, Senior Advisor (previous Deputy Asst. Secretary, Department of Labor)  
Taylor Maag, Policy Manager

*Organised by Chelsea Dickson, UK SIN*

### Background

A national not-for-profit, JFF operates on 70% philanthropy, 30% DOL funding. Eric is a prime mover behind national apprenticeship strategy, working with government to develop policy (including with Rebecca Lake at Harper to deliver the Zurich Apprenticeship based on Swiss models). JFF is delivering big support programmes for DoL for Apprentices.

### JFF Discussion

Talent is a major concern for manufacturing given previous reductions and current demographics, hence much energy around the issue. Manufacturing apprenticeships were let go by the unions as downturn took place. *Nobody has figured out the answer.*

The Swiss have looked at US - trying to sell their apprenticeship system which includes company obligation to engage in schools - very different to US. Brazil - huge investment being driven into technology at all levels, including Apprenticeships.

Robert Lerman – American Institute for Innovative Apprenticeships. Intermediaries are the preferred way forward in USA (Australia model - ATA) but real risk of no jobs on completion.

Apprenticeship 2,000 in Charlotte – 8,000 hour training programme spanning four years during which time apprentices also earn an AAS degree in Mechatronics Engineering Technology from Central Piedmont Community College. Apprentices are also awarded a Journeyman's Card and Certificate by the State of North Carolina and a Certificate from the US Department of Labor.

KY FAME (The Kentucky Federation for Advanced Manufacturing Education) is a partnership of regional manufacturers whose purpose is to implement dual-track, apprenticeship-style training that will create a pipeline of highly skilled workers. The primary method to achieve this

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goal is through partnerships with local educational institutions to offer the Advanced Manufacturing Technician Program (AMT).

## JFF Highlights

- Lack of strong definition of 'Apprenticeship' beyond fundamental principles of formal learning and working requirement. Leads to regional Apprenticeship action
- Workforce development works best where there's an anchor player bringing in other industry and supply chain companies. Working to identify needs.
- Challenge of getting companies on board – some companies happy to pay, some not. Federal grants can cover the training cost but that's not consistent or guaranteed.
- Need next generation sector strategies to drive future programmes.

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## MANUFACTURING USA PROGRAMME LEADS

Friday 10<sup>th</sup> July 2018, 13:00 to 15:00

The Pentagon Washington, DC 22202

<http://www.manufacturingusa.com>

The three Manufacturing USA Institutes which were visited are all owned of the Dept of Defence (or one of the services). Others are owned by the Departments of Commerce or Energy

### Primary Hosts

Michael Molnar, Director Interagency Advanced Manufacturing National Program Office

Tracy Frost, Director of DOD Manufacturing Institutes

Phil Singerman, Associate Director for Innovation & Industry Services NIST

Other Attendees: Lisa Fronczek (DOC); Michael Britt-Crane, Fatima Terry (DOD); Mike Mickittrick, Peter Winter (DOE)

### Background

Multi – agency programme group, heavily DoD influenced. Phil S related unexpected and successful cross agency collaboration despite starting with a flawed and unsustainable model (with perverse incentives). Success is due in part from a focus on workforce issues to address stresses in USA manufacturing sector, being essentially non-competitive and able to deliver tangible and valuable outputs.

### Manufacturing USA Discussion

Urgency and diversity of workforce approach across all of the Institutes – see what works and fail fast approach.

Engineer – Design and build new systems (4yr Degree)

Engineer Technologist – Fabricate and operate new systems (2 yr Degree / Apprenticeship)

Trades – Build or repair existing systems / components

Draft of 2018-2020 strategy tabled, including clarity of 4 workforce pillars: *K-12, CTE, Higher Education, Current Workforce*. (Note, no 'FE'?). Strategies have common core themes to leverage current activity in new domains, develop Institute Learning Centres and expand curricula. Importance of cyber skills (DMDII leading).



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## Manufacturing USA Highlights

- Manufacturing USA Annual report due soon (published Oct 2018).
- Cyber skills necessary to protect supply chains.
- Common plans to leverage current activity in new domains, develop Institute Learning Centres and expand curricula.
- Desire for continued collaboration.
- William Bonvillian new book on Workforce in publication.
- 2017 – 200,000 people participated in workforce programmes (&X 2016), including 85,000 in Institute research and development projects, internships or training.

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## WHITEHOUSE OFFICE OF MANAGEMENT AND BUDGET

Friday 10<sup>th</sup> July 2018, 15:30 to 16:30

Eisenhower Executive Office Building, White House

<http://www.whitehouse.gov/omb/>

Host

David Weisshaar, plus others

### OMB Background and Discussion

To continue previous Gatsby discussions Including: Apprenticeships, Technical Education (sub-degree level). A late start curtailed discussions.

This was a group of policy makers working on Apprenticeships and related systems for the federal government. Much interest in the process of the UK systems with an underlying desire to maintain simplicity and reduce the overhead effort for participating employers.

### OMB Highlights

- Strength of Apprentice policy direction.
- Lack of real definition of new quality processes.

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## GOOD PRACTICE – CORRELATED HIGHLIGHTS AND COMMENTARY

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### RELATED TO VISIT REFERENCE (N)

#### POLICY AND STRATEGY

##### Apprenticeships (1, 4, 5, 7, 10, 11, 12, 14)

- Recent Presidential Orders for expansion of ‘Apprenticeships’ with a call for membership of a new Advisory Committee on Apprenticeships.
- Wide acceptance that the current highly variable definition of unregulated version of ‘Apprenticeship’ needs resolution with reference to international models (Swiss).
- Associate degree seen as new signal for employability.
- Academic liaison and mentorship by host companies is important for the success of the new apprenticeship models.

##### Labour Policy (1, 4, 5, 6, 7, 10, 11, 12)

- WIOA brings workforce development strands together across departments with historically high levels of bipartisan support for continued provision of Federal grants to enable the public workforce system to ‘operate as an integrated, streamlined system and continuously improve the quality and performance of its services’.
- Resolving current federal and state fragmentation for early stage workforce activities requires Local Industry Workforce Investment Boards to identify and acquire funds to deliver strategic change.
- Recent extension of the Perkins Act for Continuing Technical Education (CTE) combined with WIOA and apprenticeships initiatives is creating significant change (Cross-departmental working + Lifelong Learning + Work-based learning).
- ONET provides rich data on occupations.

##### Professional Societies (6)

- Professional Societies were historically for individuals but are now for companies and major education and training providers and advisors.

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## EDUCATION AND TRAINING PROVISION

### Digital / Model Learning Factories (1, 3, 5)

- Multiple Learning Factories at DMDII, including cyber skills and manual processes with sensors used for awareness raising and communication of I4.0 issues.
- Plans for teaching labs to support schools to take up new curriculum at LIFT.

### Community College Economic Role (1, 4, 7, 10, 11)

- LCCC typifies the potential for UK Institutes of Technology to be vertically integrated for education and training, and horizontally integrated for workforce development with a systematic approach to workforce planning and alignment.
- Concentration of investment through Lorain into local economy for a wide range of business support needs, including access to capital with well developed, strong and visionary leadership.
- Local electorally determined Levies increase capability of Community Colleges to service economic needs as well as support from local Philanthropy.
- Return on Investment Calculator for Apprenticeships has proved a useful means of overcoming resistance to investment in apprenticeships.

### Lifelong Upskilling (1, 4, 6, 7, 10, 11, 13)

- SME (Professional Society) provides a single point of contact for workforce development for companies and is able to assist with ROI on training work.
- Continued learning is implicit in the US credit and credentialing system. Impression that US learners better connect employability with investment of cash and time.
- Business will continue to need the basics – machining, maintenance, welding, emerging need for metrology, automation, additive, etc.
- Important role of machine tool and manufacturing systems suppliers in economy and workforce development driving their sales and future supply chain success.

### Collaborative Content Development (1, 2, 3, 4, 5, 7)

- INAMS funding was used to enable changes to delivery model and develop shared content (new apprenticeships).
- College staff competence is raised by working with Institutes and new technologies.
- Skills Commons for shared learning content is a good model, however updated governance and an intelligent portal is necessary.

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- Preference for geographically spread consortia for curriculum development to avoid local delivery competition.

## Emerging Technology Provision (1, 5, 6, 8, 9, 11, 13)

- Colleges may be operating at the limit of capacity and funding, hence not driving new technologies since challenged to keep up with current demand.
- Knowledge flows from short workforce training courses into credit bearing education course to update content into academic portfolio whilst meeting industry needs with accredited (credentialed) courses.
- Machine suppliers eager to influence curriculum.
- Manufacturing USA workforce programmes such as Ignite, Flexfactor and Expert Educators are central to LCCC manufacturing skills strategy. Kitemarking of workforce offers by ARM supports CCAC workforce offers.
- Growing importance of cyber skills.

## CENTRES AND SOURCES OF INNOVATION

### Roadmapping (3, 8, 9)

- Digital Taxonomy and implications for future jobs and skills indicates constant change and demand for flexible thinking for future workforce development.
- Forecasting and planning should be led by workforce needs where maturity and nature of technology indicates (e.g. AM).
- 'Swimlanes' approach to sequence and deliver knowledge and awareness, competency and skills, industry experience, individual advancement, scaling and diffusion.
- Workforce activities anchor innovation locally and create a market place for advanced manufacturing equipment and services.
- Talent is a renewable resource, subject to hindrance of rigid HR systems, ill defined, long-held jobs which are now becoming vacant hinders recruitment and development.

### Knowledge Capture / Transfer (5, 7, 8)

- Expert Educators role to interpret technology needs into curriculum able to be incorporated into existing academic offers. Likely to be more effective for relatively mature technologies.

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- A consequence of technology projects being undertaken by members is that new skills related to the technologies may be developed directly in industry.

## Mandate, Membership and Purpose (2, 3, 5, 9, 13)

- Institutes are seen to have 'authority' to exercise leadership and to convene Member and technology interests. This was enabled at the outset by the RAMI legislation but is becoming embedded in Institute value and sustainability models.
- The Institutes act as a catalyst for workforce development, connecting the needs and opportunities of their members. Workforce Development leads identify best practice across all of the Manufacturing USA Institutes, raising visibility and seeking scaling opportunities.
- High ratio of workforce to technology activities, both considered on an equal footing during project selection. TRLs 7 to '10' (transition) is where workforce is the key factor. Technology projects include workforce thinking to deliver 'one-stop-shop'. Departmental and funding bodies are moving toward much tighter evaluation models and will require suitable KPIs for workforce outputs.
- Institute facilities at DMDII and AM are not primarily research centres, operating more as a 'community' resource to service members' and Civic needs with problem solving and learning offers. LIFT has a growing suite of large equipment, some transplanted from other locations.
- Emerging approach of establishing government relationship committees to engage wider funding networks. Cross agency strategies have common core themes: leverage current activity in new domains, develop Institute based Learning Centres and expand curricula offer.
- A significant number of not-for-profit and ancillary business members widen impact of networks beyond technology matters into workforce activities.
- Institutes carry part of Innovate UK role to run competitive funding programmes through their membership hence there is an 'Extended Enterprise' of the members.
- Institute workforce activity funding coalesces federal, state and city opportunities to develop shared models which are locally funded for delivery to a common, national blueprint. Mainly for High School stage to date.

## Institute Training Offers (1, 3, 5, 8, 13)

- DMD 101, 50,000 MOOC students over 18 months (small fee).
- Amatrol partnership for on-line learning content. Granta resources used for materials training.
- America Makes 'AMBOK' (AMTC competence structure comparison) and 'ACADEMI'.

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- Military Veterans are a strategic source of skilled resources for industry and have a significant demand for up-skilling on leaving the service with soft and life skills content as well as technology.

### Institute Work with High Schools (3, 5, 7, 13)

- Related to everyday advanced manufacturing skills shortages (CNC, Maintenance, etc) whilst setting foundation knowledge fit for future technologies.
- Support existing state level curriculum in manufacturing.
- 'Every school is a career pathway school'.
- Ignite High School offer being made by LIFT, DMDII and America Makes. Curriculum extends beyond core Institute technologies and is targeted to provide underpinning learning for future advanced manufacturing.
- Nextflex Flexfactor provides hybrid electronics project-based learning.





## ABOUT THE HIGH VALUE MANUFACTURING CATAPULT

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The High Value Manufacturing Catapult creates the conditions for economic growth by enabling UK manufacturers to achieve significant improvements in their performance and productivity. We do this by providing open access to world-class innovation capability and technical expertise, enabling companies to embrace different ways of working, adopt new technologies and achieve step-change in their performance.

To find out more about the High Value Manufacturing Catapult, please visit:  
[hvm.catapult.org.uk](http://hvm.catapult.org.uk)

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## ABOUT THE GATSBY FOUNDATION

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Gatsby is a foundation set up by David Sainsbury to realise his charitable objectives. We focus our support on a limited number of areas: plant science research; neuroscience research; science and engineering education; economic development in Africa; public policy research and advice; the Arts.

To read more about its work in Education, please visit: [www.gatsby.org.uk/education](http://www.gatsby.org.uk/education)

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The full report is available to download at:  
[hvm.catapult.org.uk/mtfw](http://hvm.catapult.org.uk/mtfw)

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