# THE FUTURE OF WORK

Report from the UIDP Workshop
University of Massachusetts Listening Session at Bose
Framingham, MA
November 13, 2009



Panel discussion at the Future of Work Listening Session, Bose and
University of Massachusetts, November 13, 2019

**INTRODUCTION**

This listening session brought together representatives from the prior events to discuss their findings and observations from participants attending this event.

The event host, Chris Miller of Bose, welcomed everyone to the company site and presented a YouTube video, "Dream and Reach," which followed the founding of Bose. The video included a piece of advice: Patents are of great value; do not let them slip through your fingers.

**FUTURE OF WORK OPENING SESSION - Skills, Workforce, and the Academy**
**Dr. Robert E. Johnson; Chancellor for UMass Dartmouth**
- Reviewed drivers for changes to the future of work.
- Resource development success
  - Fast-track infrastructure.
  - Machines developed for anything which can be reduced to a routine, predictable algorithm.
  - It took 100 years to go from steam to combustion engine. Since 2007, the internet has been a game changer, creating paradigm shifts in the workplace; we don't have 3.5 generations to adjust. We have to adjust in real time.
- Nature of work
  - Millennials stay in jobs on average about 1.8 years.
  - 5% of future jobs do not even exist, don't even have a name.
  - 47% of jobs will be automated by 2033.
  - Only 27% of workers today are working in a job related to their majors. Why do we need majors?
  - Social responsibility is also becoming more important.
- Still require "agile mindset" of workers
  - Value creation: We need to reinvent our own skills and current work to be ready for the next thing.
  - Socio-emotional intelligence: We are more commonly working collaboratively in teams to solve problems.
  - Divergent thinking is needed.
  - Empathy: Understanding human needs and wants is also important. Priorities are marketplace demand/drive profits/make world a better place.
  - We need to think critically and solve problems, but also seek ways to add and create new value.
- The traditional academic approach is a strong liberal arts education with value creation skills; now we must think differently.
  - Learn, unlearn, relearn.
  - Expand capabilities in all we do, daily (life-long learning).
  - Academy must think differently (lifelong).

- o Focus on uniquely human skills and tech literacy and ways to create value.
- o Not about chasing skills but building agency and mindsets.
- o Start with why and/or purpose.
- o Skillset and mindset with a sense of humanity.
- Civil discourse: agree to disagree to get to better solutions.
- Who determines what is "relevant knowledge?"

## NSF CONVERGENCE ACCELERATOR and THE FUTURE OF WORK

**Douglas Maughan, NSF**

The National Science Foundation (NSF) recently launched the NSF Convergence Accelerator – a new organizational structure to accelerate the transition of use-inspired convergence research into practice areas of national importance (Note: this program provided the funding for this project). The guiding rationale of the NSF Convergence Accelerator is that to deliver progress on scientific and societal challenges, it is necessary to take an approach at the highest level of interdisciplinarity and to involve multiple kinds of partnerships and stakeholders, including researchers and the ultimate users of research products. NSF is repositioning to take basic research and turn it into practice.

In the future, nothing will be done within a single discipline; there will be more merging of ideas and background will drive the topics. The program is looking to move late-stage basic research down the field – not necessarily toward commercialization, but that could be the result. The C-Accel program is intended to solve large national and global problems and *requires* participation from industry. Projects will be milestone, deliverable-driven. (See also NSF Dear Colleague letter from March 2019).

Convergence Accelerator progress to date:

- Pilot cohort requirements
  - o Management driven
  - o 43 out of 50 applications were selected for funding
  - o Pitches in December 2019
  - o 5 projects to be selected at $5M each
- Three tracks:
  - o A1: Open knowledge and networks (Siri and Alexa are knowledge networks, but not open). Knowledge graphs and data; make openly available using U.S. government data – don't rely on a single vendor.
  - o B1: Employees of the Future: Capabilities future workers need to have
  - o B2: Employers of the Future: How to best upskill and reskill/provide the resources needed for employers to upscale employees.

- 2020 Solicitation will be based upon community input; $60M to be awarded:
  - Looking for 75 responses, 3 from MA, holding 9 workshops.
  - Looking for companies to co-invest – 5 teams at $10M each; additional monies for companies to co-invest.

**UCF Future of Work Listening Session Takeaways**
**Debra Reinhart, University of Central Florida**

A recap of the September 24, 2019 workshop was presented.  The event was co-hosted by Microsoft. See white paper submitted by the University of Central Florida for details. Key highlights:

- Trust in computers and big data applications varies by generation.
- A university degree is a good foundation for work, but certification of other skills to meet industry needs go to lifelong learning.
- Curricula should be aligned with industry needs.
- We will see more augmented reality and virtual reality applications in everyday life, in the home and in the workplace.
- Technology adoption does not correlate to developmental phase of a nation (i.e., smartphones).

**HUMAN TECHNOLOGY PARTNERSHIPS: ROBOTICS**
**Moderator: Tom Ryden, Mass Robotics**
**Holly Yanco, UMass Lowell**
**Sundar Krishnamurty, UMass Amherst**

Trust will become a big factor as humans and robots begin to intermix.  What will be normalized over the next decade? Key takeaways about working in the robotics sector:

1. This is a young sector (startups often are begun by those in their 20s).
2. Data and knowledge are not the same. Both are dependent upon an expert to input the information.
3. The UMass Robotics Center is agile and dynamic and responsive without putting the onus on faculty or students for maintenance and upgrades. Producing functional parts.
4. A T-shaped professional profile is needed:  Disciplinary depth, but breadth in interdisciplinary capacities.
5. There are new concerns about ethics for the future of work; as we start offloading tasks to robots, what happens to muscles over time?  Robots should help us, not replace us.
6. NIST  is creating create ways to measure what forces are exerted on workers and developing standards to test robot systems.

7. Retraining human users is the hardest gap to bridge.
8. There is a need for people to build, train, and maintain robots. Jobs are not going away; they are just changing.


**REALWEAR: COMPANY SPOTLIGHT PRESENTATION**
**Chris Parkinson, RealWear Inc.**

- RealWear is a private company headquartered in Vancouver, WA.
- Real-world experience about connecting real workers with tech.
- The RealWear headset is designed for safety and productivity.  Wearable/handsfree, use with an Android tablet.
- "Information snacking" concept means the worker gets information and gets back to the task; not meant to read a book, etc.
- Digital workflow: It's a stand-alone device without connectivity required (no cloud/security concerns).


**CWRU FUTURE OF WORK LISTENING SESSION TAKEAWAYS**
**Nick Barendt, Case Western Reserve University**

- There are tremendous opportunities in the future of work and human performance arena, but policy frameworks need to be addressed.
  - Downside risks to sensors; need for ethical training (ethics should be woven in throughout curricula)
  - Worker autonomy and privacy
  - Location divide – some communities do not have connectivity or digital literacy access
  - Routine skills less valuable – creativity, empathy, critical thinking more valuable
  - Reliance on technology may require skills to prevent atrophy
- Healthcare will be impacted, but human touch will remain critical in health care.
- Both critical thinking and ethical thinking are key strengths needed to resolve challenges.


**DARTMOUTH FUTURE OF WORK LISTENING SESSION TAKEAWAYS**
**Kate Norton, Dartmouth College**

- There's an important nexus of conversation to be built between universities and industry.
- AI and robotics' role in economic and societal development was discussed.
- Memory and learning cognition studies can play a key role in understanding learning.

- There is a critical need for ongoing learning and consideration for non-desk workers and an aging workforce.

**AUGMENTING HUMAN PERFORMANCE: FIELD WORKERS AND WORKER SAFETY**
**Moderator: Chris Miller, Bose**
**Ilissa Bruser, Bose**
**Deepak Ganesan, UMass Amherst**
**Tom Juravich, UMass Amherst**
**Laura Punnett, UMass Lowell**

This session focused on opportunities to enhance safety, productivity and continuous learning of field workers and other non-desk workers, and how we can add technology that workers and their employers will value. Key takeaways:

- Sleep, circadian rhythms affect work performance.
- Wearable devices can measure in real time stress and fatigue.
- Textile-based sensors can measure much more – sweat, etc.
- In some ways robots can be a hazard rather than collaborative. How we can predict those hazards is area of current research.
- Discussion of Healthy Work (book) and how jobs are affected by technology change:
    - New bad jobs:  Workers' minutest actions are prescribed and monitored; new technologies restricted to rigid, unmodified format.
    - New good jobs: Machine interfaces allow workers to assume control.
- Decision latitude and job controlling – there is well-documented phenomena affecting heart health related to these characteristics.
- All-day wearables, that are affordable and deployed at scale allow workers to keep their heads up, hands free, and eyes free.
- Not a competitive, but complimentary, approach
- Workers' knowledge is more complex, multi-dimensional, and nuanced than conventionally conceived. This complex knowledge base is unrecognized and underutilized. What's needed is a  fundamental bridge in human-computer interaction.
    - What's needed: Have the conceivers and the doers discuss the way work is done to make sure conception matches reality.
    - Polanyi and Bourdieu's Corrective – knowledge of riding a bike within us (tacit/habitus, embodied knowledge).  Skilled workers *and* line workers have habitus.
    - Technology must be effective *and* embraced by workers.
    - Any technology must acknowledge and make integral a place for the deep habitus and tacit knowledge of field workers.
- Join productivity with pride and dignity.  Those at the bottom of the socioeconomic ladder have tacit experiences that the conceivers who may be more educated do not.

**ILLUMINATING THE SOCIO-TECH LANDSCAPE**

**Liz Altman, UMass Lowell**
**Tony Boccanfuso, UIDP (Moderator & Contributor)**

Work is increasingly becoming remote and digitally collaborative. This session focused on ways that industries like Bose and IBM and others are thinking about the impacts of this trend and how to grow into a better organization as a result.

- Innovation:
    - Enables others to build complementary products or services.
    - Leverages external ecosystems.
    - Is heavily technology strategy related.
    - Is multi-sided (a platform business).
    - Is NOT a product-based structure.

- Network effects
    - Direct, e.g., Facebook: More people like me on the platform, so we can share.
    - Indirect, e.g., Amazon offers other company's products in one place.

- There is tension between data as a proprietary asset vs. open for public good. Businesses must think carefully about responsible stewardship of data.


**FUTURE OF WORK: ETHICS AND EQUITY**
**Seyram Avle, UMass Amherst**
**Shannon Roberts, UMass Amherst**
**Beth Humberd, UMass Lowell**
**Monica Galizzi, UMass Lowell (Moderator & Contributor)**

Leading voices from three different vocations discussed ethics and issues of equality as we venture deeper into a tech-based workplace.

- We need to better understand what to tell workers about how to translate their value to different job.
    - Example: Job re-training from Plymouth Nuclear Power Plant. Issues raised included:
        - Biased data
        - Data privacy and security
        - "Moral" AI
        - Trustworthy AI
        - Questions around who benefits and who will be negatively impacted
        - Worker protections in the gig economy
        - Robot tax
        - Universal basic income

- - Concentration of economic power
- Recruitment and support of a diverse workforce
  - Equal access discussion should include age and socioeconomic diversity. Those later in their careers who won't go back to college for a degree may consider certificate-based programs.
  - There's a digital divide in terms of access to resources and training.
- There's a need to acknowledge the differences between self-interest, societal interest and organizational interests.
- Amazon and others are bringing job retraining in-house. There's a need to examine the role of academia in this.
- Effect of automation, racial equality, and the future of work
  - Automation will increase jobs, eliminate jobs, transform jobs, and introduce new tasks within a job.
  - Automation only affects certain types of jobs and automation only benefits certain types of people.
  - Jobs that are at high risk of being automated have high concentrations of racial minorities.
  - Social and computational scientists must work together for fuller understanding of the challenges.
  - We are in between in the partial automation transition. There will be a different feel to co-working with tech and complete automation.
  - Knowing which jobs will be automated will impact who lives in a region and who will benefit from technology.
- AI can provide racial equity, but there are biases in AI systems. We don't yet know the effects of these biases.
- Driving and automation: Racial minorities consider trucking a job that can be a pathway to a better life. When trucking is eliminated with automation, it eliminates a career pathway.
- The economist's viewpoint:
  - Efficiency vs. equity – this is a natural tension that needs to be acknowledged
  - There are different models regarding equity. We need a true lens to examine this.
  - In terms of retraining approaches, academia can provide modeling rather than leave this issue completely to companies.
  - Earnings is only one element of worker wellbeing. Health and personal life are others. There is a blurring of work and family, which increases stress.
- It takes a systems and interdisciplinary approach to study all the different components.
- The pace of change is accelerating so quickly that we are not keeping pace in addressing social implications.
- Solutions will be web- or interconnection-based.

**RESKILLING THE WORKPLACE**
**Beverly Woolf, UMass Amherst**
**Dan Berlowitz, UMass Lowell**
**Lynne Gauthier, UMass Lowell**
**Scott Latham, UMass Lowell (Moderator & Contributor)**

Work is changing and in some ways is it becoming more accessible and easier to work a longer career and in other ways it is more challenging. Key takeaways:

- Adaptability is key. We're heading toward a "Reskilling Revolution." According to research from the World Economic Forum and the U.S. Bureau of Labor Statistics:
    - 5 million people will be displaced or unemployed.
    - 85% of professional jobs a decade from now are not yet created.
    - The average college student by age of 40 will have had 10 unique jobs.
- NSF funded 40 teams to work on this challenge. Activities include:
    - Training – framework for diagnosis, recommendation, and training in continuous workforce development.
    - Software to handle continuous skilling and upskilling to keep those with habitus and provide technology training.
- Soft skills are transferable and adaptive: creative problem solving, critical thinking, cooperation, collaboration. Universities and traditional classrooms are not yet teaching these skills.
- Working with a disability: According to UN statistics, 46% of the workforce over age 60 have some disability, and more are becoming disabled at a younger age.
    - Return-to-work potential for those with disabilities is dependent on brain health.
    - Physical disability does not limit white collar job return-to-work capability.
- Future of prevention and adaptation
    - Cognitive flexibility to learn is extremely important.
    - Labor jobs that exist now may not in the future.
    - Prevention includes diet and avoiding substance abuse.
    - Studies show a sedentary lifestyle has the same health impact of smoking a pack of cigarettes a day.
    - The onus is put on the worker to solve the problem.
    - Brain injury – adaptation through technology for return-to-work capability.

**MODERATED DISCUSSION – HOW CAN COMPANIES AND UNIVERSITIES PARTNER TO ADDRESS THE CHALLENGES AND OPPORTUNITIES PRESENTED BY THE FUTURE OF WORK**
**Anthony Boccanfuso, UIDP**
**Doug Maughan, NSF Convergence Accelerator**

Key takeaways:

- The NSF Convergence Accelerator is intended to be a program for later-stage research. Teams are free to add and subtract people up until the time of the pitch.
- The core of C-Accel is partnerships between industry and academia. The pain points come from industry, and the talent to do research comes from universities. It is important to understand that accepted projects must have an industry business case component.

**CONCLUSION**

The day's wrap up emphasized the need to strike a balance between efficiency (with technology support) and the human factors of equity, worker wellbeing, and the real need to continuously provide retraining opportunities for displaced workers. Because many jobs that we will see a decade from now have not yet been created, adaptability is intrinsically tied to the successful worker. Characteristics of the future workforce, and therefore academic preparation, should emphasize transferrable soft skills (creative problem solving, critical thinking, and collaboration), and acknowledgement of the need for lifelong learning. Because of the gap between the skills that industry needs now and current academic curricula, collaboration and cooperation between universities and industry is key to better structure traditional degree programs and specialty certifications.