THE FUTURE OF WORK

REPORT FROM THE UNIVERSITY OF KANSAS
LISTENING SESSION ON OCTOBER 17, 2019

KU

Future of Work: KU Event Report

The fifth UIDP Future of Work Listening Session was held at the University of Kansas on October 17, 2019. The Future of Work is a defining Grand Challenge of our time. NSF describes it as the Human-Technology Frontier with the potential to impact all sectors of society. UIDP organized the series of Listening Sessions to gather academic and corporate input on this timely issue and inform the development of federal research programs. More than 75 participants convened at the Kansas Union to consider research topics and identify areas where university-industry-government collaborations would yield the most meaningful results. Attendees came from regional industry, municipal government and economic development organizations, federal agencies, and regional universities.

This session was hosted by the University Kansas Office of Research, the College of Liberal Arts and Sciences, Institute for Policy & Social Research, and the University Industry Demonstration Partnership.

Agenda

Session	Title	Presenters
Keynotes	The History of Work: Lessons for the Future	Dr. Joshua Rosenbloom Iowa State University
	An Ongoing Transition to Automated Manufacturing	Dr. Brian McClendon University of Kansas (KU)
Panels	Human-Technology Partnerships	Moderator: Hyunjin Seo, KU Tim Pleskac, KU Ryan Spaulding, KU Medical Center Chris Harper, KU Health System Nate Kelly, Cerner Corporation
	Perspectives on Lifelong Learning	Moderator: Leigh Anne Taylor-Knight, The DeBruce Foundation Donna Ginther, KU Sharon Graham, KU Edwards Tyler Nottberg, US Engineering Col. David Parkes, National Simulation Center, Combined Arms Center
Breakouts	Four concurrent small-group sessions	Two facilitators per group

Keynote Session

The keynote session speakers presented the historical context of the interaction between labor and technology as well as perspectives on how the future of work is evolving. Joshua Rosenbloom opened with the observation that the process of labor displacement by technology has been a constant theme for the last 250 years. However, while jobs are displaced, the application of technology has created new employment and increased the overall standard of living (measured by GDP per capita). Examples included agriculture

Joshua Rosenbloom

Brian McClendon

and manufacturing. It is oversimplifying to just look at labor displacement from a single current industry sector. For example, as technology displaces labor and drives down prices of goods, it creates new demand (more jobs) and new labor tasks (new jobs). Dr. Rosenbloom suggested that the more relevant question, beyond simple labor displacement, is the distribution of total income within an economy. Labor's share of total income has dropped significantly. How can society divide the gains of the future of work? How will society assist or support the "losers" in a putatively free-market economy?

Brian McLendon described the real-world experience of the Future of Work with examples from Google. While digital technology created new services like online maps and location-based apps, those "goods" were initially heavily dependent on human labor to deal with tasks the technology couldn't handle (data management, image classification). As technology has evolved and new ways of providing the services have been developed (crowd-sourcing image classification, for example), the digital tech labor force has been re-deployed to new challenges. Dr. McLendon went on to identify two of the key drivers affecting the evolution of work. First, sectors that are fundamentally inefficient, such as personal transportation, are prime candidates for technology solutions and labor displacement. Second, as labor becomes less of an input to a sector, other factors such as distribution and energy drive decisions about manufacturing location. The Future of Work is potentially a counter to some of the effects of globalization.

Questions and discussion:

- Is the historical trend of labor-technology-GDP a valid model for the future?
- Is there a difference between labor displacement and workforce transition/mobility?
- Is the evolution of ubiquitous and homogeneous technology creating new vulnerabilities for society?
- We should be defining infrastructure broadly to include networking, energy, natural resources, and spatial factors.
- How can university-industry partnerships address the challenges of Future of Work?

Panel #1: Human-Technology Partnerships

The common sector focus of much of this discussion was healthcare. Digital technology is overwhelming the sector. While innovations like electronic health records have created incredible new opportunities, the ability of the workforce to use the tech to actually create better healthcare outcomes remains a challenge. When we allocate functional tasks to people or technology, where do we place decision-making? Research suggests people may not make better decisions than tech (AI), but people often prefer a human as the decider. More work needs to be done on human-machine teaming to understand how/when people will cede decision-making to the machine. There is an important need for human-human contact at the point

service delivery. Social sciences are critical to exploring the implications of the Future of Work. Panelists also noted that the workforce is changing in tandem with technology. Workers' expectations of labor structures, work-life balance, and autonomy have evolved. We need to understand the evolution of the workforce as much as the evolution of technology. Members of the new workforce must be trained as problem-solvers rather than fact-recallers. Connecting to the keynote presentations, it was noted that healthcare is an inefficient sector — 95% of ER care does not need to happen in the ER. An important role for university research will be to develop evidence-based assessments of technology to help understand where new technology actually improves outcomes.

Questions and discussion:

- Should the adoption of new technology by the workforce be voluntary or compelled?
- Will human intelligence evolve as technology takes over more functions? The autopilot problem: Will humans be prepared or able to take over a task if they don't regularly perform it?
- Digital tech is excellent at many memory/cognitive functions. How does offloading that affect people?

Panelists, from left, Chris Harper (KU Medical Center), Nate Kelly (Cerner Corporation), Tim Pleskac (KU), and Ryan Spaulding (KU Medical Center) discuss the human-technology partnerships with moderator Hyunjin Seo (KU).

Panel #2: Perspectives on Lifelong Learning

The panel presented a broad perspective on the topic, including observations from the construction industry, defense, academia, and professional development and continuing education. Every organization, regardless of sector, must be a learning center. The labor-management contract is a joint commitment to learn and to provide learning. Industry is investing at least $300 billion per year in training. The demand for lifelong learning is disruptive — the need for workforce development happens quickly, and the technology for delivering knowledge changes faster than our institutional structures for learning. Traditional models of degrees and a single transition from education to work are obsolete. Traditional models of the industry-university partnership are also changing. Instead of industry recruiting and hiring the products of higher education, industry is becoming more integrated in the educational process before hiring. Lifelong learning is not just about workplace learning; it must also consider/address the preparation that occurs in early childhood experience.

Moderator Leigh Anne Taylor-Knight (The DeBruce Foundation) engages panelists Donna Ginther (KU), Tyler Nottberg (US Engineering), Col. David Parkes (National Simulation Center, Combined Arms Center), and Sharon Graham (KU Edwards Campus) in a conversation about lifelong learning.

Questions and discussion:

- Learning is cumulative. How do we address the built-in social disparities that stem from inequalities in foundational education?
- Given existing questions about the effectiveness of reskilling, how can education prepare workers better for the flexibility required for future reskilling?
- In a Future of Work scenario, are there still high-skill and low-skill jobs? Can we identify/sort labor into these tracks? Is it reasonable to expect that reskilling can turn a low-skill worker into a high-skill worker?
- What are the core educational needs for lifelong learning? Knowledge, creativity, problem-solving?
- Does lifelong learning devalue single-interest people, such as the highly skilled specialist?
- We need to study the economic impacts of lifelong learning.
- Key development need is to train the workforce on interpersonal skills (the difficult conversation).
- Jobs with judging/estimating and serving/caring are on the rise. Are we preparing for that?

Breakout Sessions

Participants were assigned to one of four small-group breakout sessions to respond to the keynote and panels discussions. Each group (15-20 people) had a balance of academic-external participants. Breakout sessions followed a structured format that flowed through identifying disruptive technologies, considering specific sectors that will be affected, and brainstorming research needs and partnerships that will be required. Groups also processed their conversation to highlight key takeaway concepts.

1. What disruptive technologies are going to have the greatest impact?

Participants were asked to consider technologies affecting their sectors or technologies that they saw as major disrupters of the wider world of work. See the individual group notes for details. Some common, high-priority disruptive technologies include:

- **Artificial intelligence:** including specific applications like language or image processing
- **Human-machine interfaces:** AR/VR, and the way these affect people (neurological, psychological)
- **Digital connectedness:** networking, 5G, IoT, tech like hyperledgers
- **Autonomous systems:** robotics, one group specifically identified home and care-giving robotics
- **Biotechnology:** manipulation/engineering of biology, new food production
- **Business organization:** gig/sharing economy

2. What sectors of the economy will be affected by the top disrupters?

Every group quickly rolled out a lengthy list of sectors affected by disruption. Two points emerged. First, there are a lot of places where the nature of work will be directly impacted by emerging tech. However, the discussions also highlighted the complex interrelationships in the economy. For example, tech changing the way goods are distributed affects the logistics/transportation sector. That, in turn will affect the design of infrastructure and vehicles, urban planning, finance, insurance, and more. This highlights the need for systems-level approaches to studying the FoW. See the group notes for details.

3. What are critical research questions or needs?

This question was given the largest block of the small-group time. The keynote sessions and panels clearly created a good foundation to brainstorm questions. See the group notes for verbatim details. Some examples of common themes include:

- What is the effect of digital technology on people? Mostly focusing on digital dependency, social skills, human ability to function when technology fails
- What happens to low-skill and mid-skill workers? Does reskilling work? Will new jobs exacerbate disparities?
- What role does society have in controlling the FoW? Regulation, distribution of wealth, acceptance.
- How should we redesign education from childhood through career for the FoW?

4. Who needs to be involved in research and finding solutions?

Every group identified the need to involve industry, government, and academia in research projects. A common theme was the need to ensure that research is grounded in real-world applications. Discussants also noted the need to engage a range of stakeholders — from labor unions to community organizations — to ensure that research questions reflect the concerns of all affected people. Additionally, groups identified policymakers and regulatory bodies that will use the results of research to implement new laws, regulations, and standards as important participants in FoW conversations.

5. Key takeaway concepts

This question was a chance for everyone to process five hours of discussion and attempt to capture the big ideas that "stuck." See the group notes for details. Some common ideas emerged:

- We need to know a lot more about how people are impacted, e.g. digital effects, learning, psychosocial. Research needs to define the effects, risks, and potential costs/impacts of the FoW.
- Multi-disciplinary and systems-level research approaches are needed to make sure that we address the complex interactions of technology, people, and work.
- Similarly, this Grand Challenge clearly requires new models of collaboration between industry and academia to address research questions.

- Technology is already driving change. There is a sense of urgency to expand the scientific base and get rigorous answers. This may also call for new approaches to scientific discovery to ensure that science keeps up with the pace of change.
- We need to know a lot more about labor mobility and technological change. There is a need for economic assessments of the distribution of wealth with labor displacement. Our economy is not a pure free market, and equitable wealth distribution is not a guarantee.
- Education/learning is central to human adaptation to the FoW. We need to understand how the needs of FoW will drive education. At the same time, the education sector is ripe for technological disruption.

Detailed Group Notes

Breakout Group #1 | Facilitators: Mindie Paget (KU) and Tim Pleskac (KU)

What disruptive technologies are going to have the greatest impact? Which are the top 3?

- Autonomous systems
- Remote sensing, space-based systems
- Object recognition, OCR
- Ability to manipulate biological information (e.g., artificial food)
- Genetic engineering
- Online interactions changing relationships
- Smart homes
- Social media
- Internet of things
- Blockchain/virtual currency
- Natural language processing
- Customer service
- Augmented reality/virtual reality
- Neuroscience (human brain evolving differently because of interactions with tech)
- Artificial intelligence
- Climate change

Three biggest disrupters will be artificial intelligence, distributed medicine, and energy.

Focus on AI

This includes: natural language processing, virtual/augmented reality, internet of things, autonomous systems, image analysis, robots

Affected sectors

Manufacturing, education, transportation, health, pharmaceutical, commerce, service, media, arts and entertainment, sports organizations, law and policy, labor unions, research universities, industry, federal agencies, NGOs, military, foundations, human resources

Research questions

- What are the requirements to augment human performance for manufacturing?
- What kinds of skills do we want to maintain? (Kids are starting to treat adults like machines whose purpose is to meet their on-demand needs.)
- What are the social-technical implications of artificial intelligence?
- What is critical knowledge preservation in the face of automation?
- What are the physical and cognitive augmentations required to address workforce needs?

- Will we need an external hard drive for our memories?
- What are we doing about data privacy? What are the consequences of collecting massive amounts of personal data? (Commercial agenda not necessarily aligned with what customer wants. Defaults play a big role in decision-making.)
- Regulatory implications?
- Research on getting to common ground about acceptable ethical standards. With tech moving forward, how do we create boundaries?
- Research about collective choice and governance? (Effect on social media of politicians being able to speak directly with the public. Invisible complex systems that make lights turn on when you flip a switch.)
- How do you combine human and AI capabilities to get the best of both? (e.g. pilots, autopilots, prevent something like the Boeing failure)
- How does manufacturing adapt to augmentations in human performance?
- Side note: Universities with science and engineering departments can support growth of knowledge. Industry: One of largest aerospace producing states in country is Kansas/Wichita (Boeing, Airbus, Cessna, Beechcraft, U.S. Air Force base)

Focus on Distributed Medicine

This includes: rural medicine, telemedicine, e-medicine, DIY medicine

Affected sectors

Patients, rural areas of Kansas where doctors are in short supply, care providers, insurance, hospitals, communications, infrastructure/logistics, pharmaceutical, VA, education/outreach, research universities, federal agencies, foundations, human resources

Research questions

- What technology will tell patients what's going on with them? Communicate that to doctor? (sending tech, chip technology, device apps that feed data)
- Does the doctor have to be human at all? Place technology locally so "tele" infrastructure is not even required. (e.g. automated stretchers in military that have everything embedded. AEDs can already be operated by pedestrians with a high degree of success).
- Are people willing to adopt these technologies? Trusting machines on both sides? Behavioral research? Decision sciences?
- If person has to make diagnosis, how do you walk them through those decisions?
- What tech is necessary to make a decision about when to intervene in health care? When is a human necessary versus tech sufficient?
- What is the effect of insurance/legal issues on this process?
- Where is the decision being made and what information is necessary to make that decision? Insurance level? Patient level? How much information do they need to make decision that is in their best interest?
- Can you design an instructional video that does nearly as well to educate an uninformed person to provide medical care as a trained professional? Can do it in virtual reality. What level of procedure?
- Where is the threshold for accepting technological advances?

Focus on Energy

This includes: renewable energy; energy production, storage and transmission; education

Affected sectors

Carbon-based energy interests, workers, education, research universities, agriculture, transportation, environment (unforeseen consequences), industry, state government, utilities, federal agencies, foundations

Research questions

- How do we convince people to shift to renewable energy?
- How do you retrofit individual homes to generate/store energy?
- What are the storage technologies necessary to address energy needs? Scale?
- Is the current energy transmission infrastructure sufficient to support renewable energy and storage? Are there regulatory/legislative engagements to be made?
- How do we incentivize people — financially or otherwise — to want to retrain for new skills? (e.g. incentives to move into renewable when resistance to giving up jobs in coal or steel)

Key Takeaway Concepts

- Human acceptance of whatever dimension of change we're talking about. What are barriers of human willingness to do this? What determines whether we're willing to trust autopilot, distributed medicine, renewable energy advances?
- Human augmentation performance: What are the requirements to increase human performance in manufacturing that are necessary to increase productivity?
- What policy or regulatory changes are required to implement any of these?
- Who are the winners and losers? People? Sectors? From an ethical framework? In distributed medicine, e.g., people will be left behind because they lack tech resources.
- What are the implications of insurance companies (for-profit) deciding on course of medical care and how that affects care for people in different socioeconomic classes?
- Does a physician need to be human and, if so, why?
- What are the best teams that you can create with human/AI components?
- Can we predict where people who are displaced by technology will be displaced to? What effects does automation have on society as people become obsolete?
- How do we form education and education policy to lower barriers for further training when people are displace by technology?
- What is the best way of influencing people to accept new technologies?
- With acceleration of disruption, what policies would make education and training accessible and affordable for everyone? Our policies haven't kept pace with disruptive technologies.

Breakout Group #2 | Facilitators: Carolyn McKnight (KU Edwards Campus) and Michael Branicky (KU)

What disruptive technologies are going to have the greatest impact? Which are the top 3?

- The sharing/gig economy and disruptive business models
- AR/VR and other human-computer interfaces
- IoT/5G networked world that supports distributed activity like Bitcoin

What sectors of the economy will be affected by the top disrupters?

- Everything. Any tasks/functions/jobs that are highly repetitive
- Transportation, banking, retail and service
- The disruptive tech in human-computer interaction will change the way people work everywhere.

What are critical research questions or needs?

- What defines an employee with job-switchers, side-hustlers, job-sharers?
- What new sectors will emerge with new tech?
- What are the risk/benefits/costs of self-training, reskilling, and other forms of skill credentialing? What role do "guilds" have in future workforce development?
- What are the long-term effects of tech on people — memory, decision-making, curiosity, socialization, resilience, problem-solving?
- How can we teach/train the ability to work in degraded environments? If the tech can't function, can we?

Who needs to be involved in research and finding solutions?

- Government, industry, academia, international collaborators, nonprofits/foundations.
- Stakeholders and advocacy groups
- Need a framework for collaboration with roles, goals, data-sharing

Key Takeaway Concepts

- Must avoid a siloed approach
- Need a systems-level view: Are we solving the right problems? Are we building the right systems? Will they work for society broadly? Watch out for the digital divide.
- There needs to be a sense of urgency given the pace of technical change.

Breakout Group #3 | Facilitators: Kara Lowe (KC Tech Council) and Aaron Deacon (KC Digital Drive)

What disruptive technologies are going to have the greatest impact? Which are the top 3?

- AR/VR
- Robotics
- Artificial intelligence

What sectors of the economy will be affected by the top disrupters?

- Everything: manufacturing, finance, healthcare, retail, transportation, government, energy, entertainment, arts, education, services, legal, media, human resources

What are critical research questions or needs?

- Training AI for new situations (rather than just prediction of the past)
- How do we avoid replicating entrenched systemic inequity with tasks that learn from these systems?
- How do we staff healthcare? (gap between provider and patient created by technology advancements)
- How do we balance humility versus expertise in prestige incentive for certain professions?
- Foundation of skills (e.g. third-grade math/reading, college algebra) still needed for reskilling? How do we orient the system? How do we educate in the age of AI?
- How do we measure, incentivize, reward and coach creativity?
- How do we teach skills to entry-level/growth employees when those tasks are automated? (e.g., legal, finance)
- What is the point of education?
- Futurecast/replicate human creativity
- Neural network improvement for novel thought, not just pattern recognition
- What future role can industry-sector accrediting associations (e.g., ABET) play in the modality of continued skill-building to bolster traditional education?
- Does standardization of education curriculum help or hurt?
- How do we bridge the gap between "ivory tower" professors and community of practitioners?

Who needs to be involved in research and finding solutions?

- Can accrediting organizations partner with higher ed? Foundational knowledge (70%) in higher ed with accrediting organizations playing an agile, modal role in continued learning (last 30%) to align with emerging technologies?
- Government: funding tuition-reimbursement credits for individuals or companies to engage in retraining opportunities that exist outside of a traditional two-, four-, or six-year program.
- What role do the corporate learning and development groups play?

Key Takeaway Concepts

- Industry should lead, fund, and play a significant role in the modality of continued learning programs.
- Government, systems, and institutions are not incentivized to respond to the pace of change and the perspective/capacity of long-term thinking.
- Impact for corporate leadership and development?
- Incentivizing creativity in education. Is there a relation to IP laws, especially in a global environment, and how the university system interacts with them?

Breakout Group #4 | Facilitators: Emily Wilder (KU) and Bob Rummer (KU)

What disruptive technologies are going to have the greatest impact? Which are the top 3?

- Streaming services/media/networking
- Autonomous vehicles for personal mobility
- Computing, particularly the potential for quantum computing
- Identities/biometrics and assured transactions, hyperledgers
- Additive manufacturing
- VR/AR simulated environments for entertainment, training,
- New business models (sharing/gig, ownership structures, just-in-time everything)
- Renewable energy
- Biotechnological ways to manipulate living systems (CRISPR)
- IoT/IIoT
- Robotics, particularly robots in the home (manufacturing robots are old news)

What sectors of the economy will be affected by the top disrupters?

- Everything: agriculture, personal transportation, healthcare/long-term care, financial/insurance/legal, manufacturing and construction, urban real estate and municipal services, hospitality/entertainment, childcare, higher education and training

What are critical research questions or needs?

- What is the effect of tech on people? Psychology and social science
- Where will mid- and low-skill workers migrate? Better understand labor mobility
- What are the life cycle effects of rapidly changing tech?
- Ethical and philosophical implications like machine rights, liability for actions. Do we need more Laws of Robotics?
- How do political and regulatory structures need to evolve?
- Forecasting effects of quantum computing: What will break? What will be created?
- Better understand the distribution of wealth with FoW
- What is human tolerance/acceptance for more engagement with tech?
- What are generational differences in training/workforce expectations?

Who needs to be involved in research and finding solutions?

- Business/industry practitioners
- Ethicists, philosophers and other social sciences
- Education from pre-K to workforce lifelong learning
- Standard-setting and regulatory organizations, policymakers
- Labor (unions) need to participate in retraining/reskilling
- Social advocates on issues of disparities, distribution of wealth
- Economists
- National security/DoD with global impacts of FoW on social stability, conflict, trade

Key Takeaway Concepts

- Critical gap of understanding the effects of tech on people — AI, robots, IoT — needs a strong multidisciplinary program of research.
- Acceleration/pace of change is a challenge. Typical research cycle is too long.
- How confident are we in the validity of machine intelligence? If machine learning is based on correlation, it may not actually be "thinking."
- Challenge of talent development. What is the future workforce need? Worker bees? Or deciders?
- Challenge of knowledge management when so much depends on data that is transient.

Participant Organizations

- Agelix Consulting LLC
- Army University Press
- Atonix Digital
- Bioscience & Technology Business Center
- Blue Valley Center for Advanced Professional Studies (CAPS)
- Boeing Company
- Cerner Corporation
- City of Kansas City, Missouri
- City of Lawrence, Kansas
- Edward Jones
- Elsevier
- Federal Reserve Bank of Kansas City
- Hallmark Cards Inc.
- Honeywell National Security Campus
- Grandstand
- Initiatives Inc.
- Iowa State University
- Kansas State University Technology Development Institute
- Kansas Board of Regents
- Kansas Department of Commerce
- Kansas State University
- KC Digital Drive
- KC Social Innovation Center
- KC Tech Council
- MRIGlobal
- Nokia
- Pollen Inc.
- Spirit AeroSystems
- Sprint
- The DeBruce Foundation
- The STEM Broker
- U.S. Engineering Company Holdings
- University of Kansas
- University of Kansas Health System
- University of Kansas Medical Center
- Urban Education Research Center
- U.S. Army Command & General Staff College
- U.S. Army National Simulation Center
- Unified School District 497
- Workforce Partnership