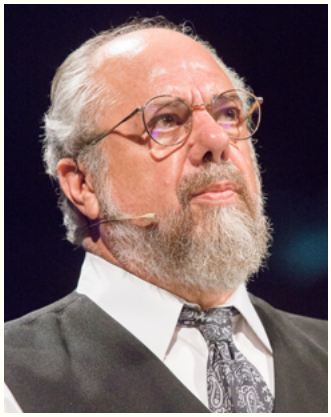

THE IMPACT OF TECHNOLOGY ON WORK AND THE WORKFORCE

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The global economic and health impact of technology, such as automation, artificial intelligence (AI), and robotics on work and the workforce is increasingly being considered by commentators, but in widely divergent ways. One view is that technology will bring less work, make workers redundant or end work by replacing workers. The other major view is that technology will create abundant opportunities for workers and boost economies. Historically, as technology has changed the way work is done, the number of jobs created has outstripped the number of jobs eliminated.

There is concern that although history may be correct, the future may reverse history, and worker displacement and unemployment due to automation, AI, and robotics will be widespread (Ford 2015). However, future forecasting is difficult and complicated. If analysts in 1870 in the United States had been informed that agriculture sector employment would go from almost 50% of the workforce to less than 2% in 2018, they also would be hard-pressed to foretell a burgeoning health care sector, software, and services as major sources of employment (Autor 2018; Daly 1981; Segal 2018).

Still, with current evidence of technological displacement, there is a growing preponderance of analysis and commentary supporting the occurrence of technologically induced unemployment (Brynjolfsson and McAfee 2014; Frey and Osborne 2013). In many cases this displacement is the result of increased productivity which is responsible for reduction in labor demand and wages in some sectors (Acemoglu and Restrepo 2018). International trade, such as trade with China, has been mentioned as a contributing cause of job displacement, but competition from China may explain only a fourth of the decline in manufacturing during the 2000s (Autor et al, 2015). The view that technology is a prime cause of job displacement is bolstered by the concern that some technologies such as AI have the ability to replace something previously exclusive to humans: intelligence (EOP 2016). Cognitive capacity, including machine learning and decision making, will rapidly scale across all sectors and be as pervasive as electricity (Ford 2015).

The impact of technology on employment is real and pervasive and likely to relentlessly affect developed and developing countries.

Estimates of impact vary. One high estimate is that globally approximately 400 million jobs will be displaced (MGI 2017. However, the historic lesson that the introduction of new technology ultimately creates new jobs should not be ignored; the dichotomous "jobs or no jobs" assessment is too simplistic and, in short, a "false dichotomy" (Acemoglu and Restrepo 2018).

Rather than thinking about entire occupations being eliminated (that is, technology as a substitute for human labor), there is value in addressing the issue in terms of specific tasks within occupations being automated (that is, technology as a complement to human labor). Tasks should be considered in terms of the range and the extent to which they can be automated. Technology then is conceptualized as replacing human labor in tasks used to perform it even in jobs with higher educated people (Acemoglu and Restrepo 2018).

Task-based analyses provide a more detailed level of information than occupational analyses do. Technology can eliminate jobs, but it does not eliminate work (Autor 2015); it aims at automating specific tasks rather than whole occupations (Autor 2015, Arntz et al. 2016). Consequently, certain tasks rather than occupations may be displaced. However, there are various countervailing effects of technology that boost employment, in terms of increased capital accumulation, and the creation of new tasks in which labor has a comparative advantage relative to machines (Acemoglu and Restrepo 2018; Besson 2017).

Another way that the impact of technology on work is misconstrued is the impression that all workers in a specific occupation or sector will suffer unemployment in the same way and at the same time. This projection uses a low-power focus to view a time-dependent complex process. Some work will be highly resistant to the technological induced changes in jobs or tasks. Non-routine physical and cognitive work fits in this category. The issue of comparative advantage of labor for various tasks also plays out when the cost of producing a subset of tasks is reduced; automation generally increases the demand for labor in non-automated tasks (Acemoglu and Restrepo 2018).

Nonetheless, there is the strong possibility of a mismatch between technology and skills (capabilities)—between the requirements of new technologies and tasks and the skills of the available workforce. Already in many countries there is evidence that such a mismatch has resulted in millions of jobs going unfilled because there are not enough skilled workers. However, the issue of a "skills gap" is controversial and still requires analysis to clarify exactly what the true state of skills of the labor force and job opportunities will be (Cappelli 2015). A strong, proactive worker training and re-training effort is immediately necessary to address the issue, as are considerations of policy issues attendant to nonstandard present and future work arrangements (ILO, 2019;Karacay 2018). Work, now and even more in the future, will be a mosaic of standard and nonstandard work arrangements (Howard 2017). The social protection of workers with inadequate skills or inadequate nonstandard work arrangements and the maintenance of 'decent work' will be important and difficult problems to address.

The impact of technology on work and workers is multifaceted and complex. Technology is not homogenous and at least should be thought of in terms of enabling and replacement technologies: the former complementing the productivity of workers and the latter taking away the need for workers

(Acemoglu and Restrepo 2017). In addition to technology's impact, workers and the workforce also will be affected by the policies and governance of societies regarding the needs of impacted workers. Clearly, inequalities and wage polarization will arise and need societal response (ILO 2019).

The impact of technology on work and workers also should be considered as a process that occurs over time. Hence, it appears important to understand the extent of the process according to specific times. The speed at which technology is modifying work is believed to be increasing, although it will not happen everywhere all at the same time. There will be differential transitions by country, region, sector, occupation, task, and type of technology. While yielding positive benefits to some parts of the workforce each transition process is likely to create negative physical and psychosocial impacts in the workforce due to the precariousness of work and the perception of a potential lack of opportunity for workers to evolve with a job or be positioned for a new one (Leso et al. 2018; Stacey et al. 2018).

Currently, the anxieties resulting from the skills gap and anticipation of a future lack of opportunity may be contributing to a public health crisis in some countries.

In recent years, some regions and subpopulations in the United States have experienced an alarming increase in suicide rates; abuse of opioids, other drugs, and alcohol; and poorer physical and mental health. These can be traced in part to unemployment, underemployment, and the compromised quality of working lives (Case and Deaton 2017; McGee et al. 2015, Hollingsworth et al. 2017). The lack of skills and opportunities and an increase in hopelessness and despair may play a role in the drastic increase in mortality arising among middle-aged white Americans (Case and Deaton 2017), increased depression among young adults (McGee et al. 2015), and increased likelihood of unemployment and

health problems among African Americans (McGee et al. 2015). The absence of employment in good paying jobs contributes to these "deaths of despair" (Case and Deaton 2017; Sirviö et al. 2012, László et al. 2010, Hollingsworth et al. 2017). Future work also could be a source of adverse health effects due to work intensification, altered organization of work, impaired coping, sedentary postures, impaired work-life balance, physical trauma, and psychosocial stress (Leso et al. 2018; Murashov et al. 2016).

The future of work and the workforce will need to be seen against the backdrop of technological change and working life, not just at the level of a single job or task.

Technological change will continue to impact all work and nonwork periods over the working life. Hence, the occupational safety and health (OSH) field should extend its focus and needs to be longitudinal over time and working life (Schulte et al. 2017). OSH and other public policies should address not only hazards in a single job but also hazards along the whole working-life continuum. This means addressing the precarious nature of work and attendant stresses and anxieties, as well as the times between jobs, where unemployment and underemployment can cause significant health problems. It also means immediately focusing on the lack of appropriate skills of present and future workers. These conditions are "occupational health hazards" as well (Schulte et al 2017).

Clearly, a broader focus of OSH requires the consideration and application of new skill sets in the field. These include more emphasis on psychosocial factors, human capital, organizational dynamics, education and life-long learning theory, human development, and economic disciplines.

Ultimately, not only will a new focus be necessary for OSH practice but also technology may drastically transform the OSH profession in terms of the role of human experts (Susskind and Susskind 2015). Still, there is the need for proactive risk assessment and management of new technologies (Murashov et al. 2016) and the promotion of worker participation in design of technological and organizational innovation (Oeij et al 2017). Protecting the workforce of today and the future, as new technologies are applied, requires taking a holistic view of the hazards they experience and the range of adverse effects that may result.

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