Technology-Induced Workplace Change

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Technology Remakes Work and Worker

By changing the way work is done, technology changes the worker. Workers not infrequently respond catastrophically to the introduction of new technology. Affected workers frequently develop anxiety states, depressive symptoms, and conversion syndromes. Job loss precipitated by technologically induced workplace change can emerge in two ways: as a result of planned replacement of human work with automated work or as a result of the workers psychological response to automation.

Job Elimination: Planned Replacement of Human Work with Automated Machines and Processes

Job elimination, frequently euphemized as "restructuring", is a common impact of technological innovation and is attributable to conscious planning on the part of employers. When technology is introduced into the workplace employees are not expected to learn how to use new technology but are instead expected to be replaced by it. Technologically-driven unemployment, like unemployment in general, tends to undermine the mental health of those affected by it. [1]

Adverse Reactions to Technologically Induced Workplace Change

Job loss can impact employees who retain their jobs after the introduction of a labor saving device. The key point to bear in mind when contemplating any technologically induced change in the work process is that the introduction of the technology doesn't just provide a substitute for some isolated component of a job. It not infrequently alters the character of the jobs that are left for the humans to perform, and impacts the roles, attitudes, and skills of the people who take part in it." [2]

Anxiety is very commonly observed among those faced with the introduction of new technology in the workplace. Even workers who initially exhibit an open and receptive attitude towards the new technology often find their ability to master it hampered by anxiety and/or frustration precipitated by its introduction. Their insecurity frequently results in a self-fulfilling prophecy wherein anxiety or frustration aroused by the new technology undermines their capacity for learning how to operate it effectively.

Anxiety and frustration among individual workers constitutes just one manifestation – albeit one that is frequently observed in a clinical context – of resistance that emerges in the affected workers. Regardless of the origin, content, or context of such resistance, employee response to the introduction of a new technology can negate benefits that management had hoped to accrue by implementing it. Objective problems that arise from the conception and/or implementation of a new technology – i.e., the so-called "technical problems" that limit the functionality of the new process – intensifies resistance among those whose work has been changed by it. If such resistance is not adequately addressed at both an occupational or organizational level, it may compromise the intellectual and/or emotional capacity of the workers to adequately adjust to the introduction of a new technology.

In both of the situations described above, job loss may cause more than a mere temporary setback as workers displaced by automation are at high risk for long-term unemployment. A significant percentage of newly unemployed individuals in both of the categories described here claim work incapacity as a means of insulating themselves from the economic impacts of unemployment. If workers fail to secure employment within six months of losing their job, they are at high risk for permanent separation from the workplace, in general, and permanent claims of work incapacity, in particular.

Exploring the Rational Basis for Technological Offloading

What drives an employer's decision to automate? In the private sector, decision-makers tend not to pose the question, insofar as the rationale seems self-evident: reduction in labor costs. Labor costs are assumed to decrease when tasks that are presently performed by human labor are "off-loaded" to non-human working devices. This inclination to "offload" mental or physical tasks from humans to computers is informed by the expectation that such offloading will free newly unencumbered minds and bodies to perform other, more creative, tasks. This assumption has been applied both to the individual worker and to those who labor more generally: technological innovation liberates not only the individual from highly routine tasks but also frees entire populations from tasks that can be offloaded to a computers or machines.

The premise that mandates offloading wherever and whenever possible was most famously articulated by twentieth century Physicist and Philosopher Alfred North Whitehead. By developing technological aides to offload tasks to computers and machines, innate and hitherto untapped human capacities, both in individuals and in society at large, could be tapped: "Civilization advances by extending the number of important operations which we can perform without thinking about them . . . (the notion that) we should cultivate the habit of thinking about what we are doing is profoundly erroneous." The more we can off load routine physical and mental chores to technological aids, the more physical and mental power we'll be able to store up for the deepest, most creative, or most complex tasks. [3]

Ironically, the rational basis for our predilection to use technology to "off load" tasks derives from our everyday awareness of a specifically human (i.e. not technological) process. The human capacity for "automaticity" refers to those mental operations that allow us to think of other things beyond putting ones foot in front of the other while walking, for example, or to focus our attention on the conversation over a meal rather than on how to transfer the food on our plate to our mouth. Automaticity – the internal/human analogue to automation – increases the number of important operations we can perform without thinking about them. Automaticity is intrinsic to normal human experience. Much of everyday human experience is contingent upon our innate capacity to learn to perform tasks without actively thinking about them.

At its best, technology allows us to not think about "mindless" tasks so that one can think about other, more complex or creative tasks. According to this criterion the pocket calculator exemplifies an optimal technological application, but only under specific circumstances. If we have mastered basic arithmetic through study and practice, for example, the calculator free up the user's conscious mind to consider the implications of the calculator's results. [4]

Technological Innovation Can Advance Human Capacities Only Under Specific Circumstances

> *What if the cost of machines that think is people who don't? (George Dyson, 2008)*

Although the premise that guides the inclination to "off load" work may seem rational, technology frequently does not induce development of those human capacities that employers most value.

In order to understand how technological innovation can hinder development of critical or valued capacities that are critical to the development of our work force we may wish to take a closer look at Whitehead's premise. Are there readily identifiable conditions under which automation would **not** increase the number of operations a worker can perform without thinking about them?

The aforementioned ability of a hand held calculator to "free up the mind" to perform other mathematical operations is contingent on its user's knowledge of mathematics. If the human user has not mastered basic arithmetic through study and practice, he/she will not have learned – and will not understand – the basic procedures that the calculator is conducting. Under such circumstances the calculator will not open up new intellectual opportunities to the user, won't help the user gain new mathematical skills, and won't help the user gather new knowledge. It will instead be used and experienced as a mysterious number producing machine. If the user has not learned the procedures that the calculator automates, then the machine – like any other tool that automates tasks that once required learning - becomes a barrier, rather than a stimulus, to human know-how.[5]

Automation Impedes Automization: Functional Impacts on the Work Force that Remains Employed After Technology has Changed the Workplace

The notion that it is economically advantageous to off load tasks to computers whenever and whenever possible is pervasive. Yet such a perspective fails to account for the full impact of automation. Mental impacts are often among those that receive insufficient consideration.

Whereas *automation* is a specific type of technological process that replaces human labor with a machine or computer, *automization* refers to a mental process that occur in humans individuals. *Automization* refers to the mental process by which we learn to perform tasks that we will ultimately learn to perform automatically, i.e., tasks that we do not need to "think about" in order to perform. Tying shoes, reading, riding a bicycle and driving a car are examples of tasks that are typically automatized. Such tasks involve a period of active learning followed by a prolonged period during which the pursuit of the activity becomes "automatic" in the sense that it does not require conscious thought. Automization also occurs in the context of prolonged and sustained exposure to highly complex tasks. The type of skills and capacities we value in "experts" in any occupation are those that are – at least partially - predicated on automization.

What we call "know-how" constitutes evidence of the mental "inscription" left in the wake of automization. [6] The "expert" in any field is the individual whose "know-how" has become embedded outside of her/his conscious awareness. The expert can immediately discern qualities in a given piece of fact, stimuli, or expression that a non-expert cannot. The process by which such expertise develops is called automaticity.

Since automation precludes automaticity, decision-making pertaining to technology and its applications should be informed by an awareness that the consequences of decisions to automate are frequently irreversible. The “no turning back” quality that inheres to such decisions relates to the inevitable loss of human capacities that will be precipitated by the technologically induced change in the workplace. With continuing automation, the human capacities required to perform the functions that have been automated will be lost. Future cognitive functions upon which automaticity depends must then also be automated as the human capacity to perform such functions will no longer exist.

Automization – and the production of experts in specific fields of human endeavor - can only occur where there is an opportunity to practice the task at hand. From both a developmental and functional standpoint the costs of automation are largely attributable to the fact that automation precludes automization. Whenever we automate – i.e., whenever we use computer software or a machine to off-load tasks that had previously been learned and performed by people – we eliminate the conditions upon which the development of a specific field of human knowledge and experience has been contingent.

In Our Preference for Ease over Effort, We Tend to Overestimate the Benefits of Automation

A pervasive tendency to value ease over effort reduces our capacity to think rationally about automation and its implications.

From the standpoint of mental health and human development, work's capacity to engage and challenge the worker is beneficial. When we refer to "therapeutic" aspects of work, we tend to refer not to those benefits that are extrinsic to work (i.e., the receipt of revenues that derive from engagement in labor), but rather to work's *intrinsic* rewards: the positive mental states that can be induced by work activity. Such mental states involve a subjective sense of "challenge" and "engagement".

The decision to automate typically derives from the presumed ability of automation to enhance speed and efficiency. Negative reactions (and the clinical manifestations of such reactions) arise from fact that automation changes the nature of the work that humans are left to perform. The tasks that humans are left to perform are often are less challenging or engaging.

In his book *The Glass Cage*, Nicholas Carr, (former editor of the Harvard Business Review) catalogues a consistent pattern of adverse impacts across fields of human endeavor as diverse as architecture, medicine, piloting, and law. Automation in these fields has created conditions that diminish the capacity of members of these professions to exercise expert judgment. Diminished "know-how" and diminished judgment result from our having off-loaded critically important tasks to computers. Automation can narrow people's responsibilities to the point that their jobs consist largely of monitoring a computer screen or entering data into prescribed fields. Even highly trained analysts and other so-called knowledge workers are seeing their work circumscribed by decision-support systems that turn the making of judgments into a data-processing routine. [7]

In Technology - as in Science (and Almost Everything Else) - Not Everything that Counts Can Be Counted, and Not Everything that Can Be Counted Counts[8]

While the costs implied by such trends are difficult to measure, they are real. How are the costs attributed to the following to be measured?

- erosion of worker effort and engagement;

- diminished sense of agency and autonomy on the part of workers;

- deterioration in worker skills.

Work designers assume that human beings are unreliable and inefficient and strive to give humans as small a role as possible in the operation of systems. Workers function as mere monitors, passive watchers of screens. Such human monitors are bored by their job, lack the capacity to sustain situational awareness, and become deskilled. The assumption that the human becomes the weakest link in the system thus turns into a self-fulfilling prophecy.

Although the Impact of Automation on Agency, Autonomy, and Skills are Difficult to Measure, Neurophysiologic Impacts of Work and Automation have been Measured

"Half of the neurons just shut up."
Mayank Mehta, Neurophysicist

A neurophysiologic basis for technogenic dimunition of brain-based capacities has been demonstrated in animals and humans.[9]

Use of the computer screen precludes development of senses such as touch, smell and taste and the brain-based substrate upon which senses depend. A study of rodents published in *Science* in 2013 indicates that the brain's place cells are 50% less active when animals make there way through computer-generated landscapes than when they navigate the real world.[10] The demonstrable and profound drop off among animals exposed to virtual reality (relative to those exposed to reality) most likely stems from the lack of “proximal cues”. A “proximal cue” refers to all the information about location that cannot be transmitted by virtual reality, i.e., the sounds, smells, and visceral feelings that one uses to determine where one is, where one has come from, and where one is going. Aspects of neuronal development that support non-visual learning and memory are foreclosed in the context of technological innovations that automate navigation.

The study reveals the profound changes that occur in brain development within the context of a simulated environment. We can reasonably infer that if we have no exposure to the natural world of real tasks, and operate instead in a “virtual world” full of “virtual tasks”, we will probably never develop those neurons that support non-visual learning and memory.

It would have been logical to anticipate these lab finding based on those articulated from the work-floor. James Bright was a well-known Harvard Business School researcher during the 1950’s. In the conclusions of his final report reflecting his extensive survey of the impacts of automation on American business, Bright noted:

> "…the more automatic the machine, the less the operator has to do….the progressive effect of automation is first to relieve the operator of manual effort and then to relieve him of the need to apply continuous mental effort." [11]

Bright was "startled to find that the upgrading effect (that he had expected to see) had not occurred to anywhere near the extent that is often assumed. On the contrary, there was more evidence that automation had *reduced* the skill requirements of the operating work force." [12] The lesson, he wrote, is that the "skill' can be built into the machine.

Real Knowledge Arises Through Confrontation with Real Things

We often distinguish between "mental" and "physical" types of work. More recently, we have come to see "knowledge" work as having replaced "manual" work as the primary type of work that engages most of the labor force. Twentieth century philosopher and educator Thomas Dewey noted that the "distinction between knowledge and manual labor is smug and frivolous." All work, he observed, is knowledge work: "The carpenter's mind is no less animated and engaged than the actuary's. To act is to think; to think is to act." [13] Real knowledge arises through confrontations with real things because labor is more than a way of getting things done: it's rather a form of contemplation, a way of seeing the world face to face rather than through a glass.[14] Action un-mediates perception. *Labor gets the worker "up close" to the thing itself.* [15]

We come to know what we are working upon through coming into contact with it. Whenever software is inserted between a call center operator and a customer, for example, or between a mechanic and the device she/he is using, or between a doctor and his/her patient, we place a medium/layer between the worker and that on which he/she is working.

If thought is bound up with action, then the task of getting an adequate grasp on the world – as reflected in the popular admonition "get a grip" - depends on our capacity to perform actions within it. [16] As Freud observed, the primary function of work resides in its capacity to bind workers to reality. [17] The deepest form of understanding is not mere perceptual cognition but a handling, using and taking care of things.[18]

Insofar as work increasingly involves the observation and manipulation of symbols on screens rather than attending to real things in real places, the question to be considered when reflecting upon technologically induced workplace change is: *How far from that which is worked upon do we want ourselves and our workers to retreat?*

The Boundary between Computer Work and Human Work has been Re-Set

In assessing the capacities of computers economists and psychologists have historically drawn upon the distinction between implicit knowledge and explicit knowledge. *Implicit* knowledge is used to catch a fly ball, ride a bike, or read a book. These skills have to be learned, but they can't be expressed as a simple recipe. The mental processes upon which such activities are based occur beyond conscious awareness. *Explicit* knowledge refers to mental processes that one person can explain to another, that can be broken down to well-defined steps through written or oral instruction. Examples of activities that can be driven by explicit knowledge include changing a flat tire or solving a mathematical problem.

The boundary between implicit and explicit knowledge has historically been used as a way of demarcating the limits of automation and computers and of marking out the exclusive precinct of human work. We have historically assumed that computers can replicate skills that depend on explicit knowledge but that computers cannot perform work that depends on skills that are contingent upon implicit knowledge.

Making a right turn while driving an automobile through a busy intersection requires skills that depend on the simultaneous working and coordination of numerous neurological and psychological functions. The skills necessary in such a case epitomize the type of skills that are based upon implicit knowledge. The Google car - a self-driving car - demonstrates that the computer's capacity to replace human workers is no longer limited to work that is based on explicit knowledge.

Transference to Technological Authority and Technological Solutionism

Problems are rarely, if ever, conceived of as essentially technogenic. They are seen instead as the result of an as yet incomplete or poorly coordinated application of technical expertise. Expectations of unrelenting technical progress are commonplace and typically remain unchanged even after the most profound and widely publicized technological failures. Such breakdowns only intensify the search for technologically-based solutions. The phenomenon we call "Technological Solutionism" is by no means new. The following description from Theodore Roszak (mid to late 20th century historian) can, in retrospect, seem prophetic:

> "When the internal combustion engine becomes an intolerable nuisance, the proposal will be that we retool and replace it with an electric motor…When public education collapses…the systems teams will step forward to propose that the schools invest in …computerized consoles….When … the air becomes unbreathable, we will be advised to cover the cities over with plastic domes and air condition them. Technological optimism (is the) snake oil (of the prevailing economic and social order) ... Each new application buys time, fast-shuffles the disasters, and rubs the addiction to artificiality deeper into the collective psyche." [19]

Whereas Roszak characterized the technological mystique that prevailed in the 1970's as "technological optimism", historians have more recently observed that contemporary manifestations of technological solutionism grow from less positive sentiments. Jill Lepore – Professor of American History at Harvard - concludes that the prevailing tendency to embrace the theory and ideology of "disruption" is predicated on fear and anxiety:

> "The eighteenth century embraced the idea of progress; the nineteenth century had growth and then innovation. Our era has disruption, which, despite its future, is atavistic. It's a theory of history founded on profound anxiety about financial collapse, an apocalyptic fear of global devastation, and shaky evidence… Most big ideas have loud critics. Not disruption. Disruptive innovation as the explanation for how change happens has been subject to little serious criticism, partly because it's headlong, while critical inquiry is unhurried; partly because disputers ridicule doubters by charging them with fogyism, as if to criticize a theory of change were identical to decrying change; and partly because, in its modern usage, innovation is the idea of progress jammed into a criticism-proof jack-in-the-box…The idea of

progress (is) the notion that human history is the history of human betterment…(by replacing)"progress" with "innovation" our age skirts the question of whether a novelty is an improvement: the world may not be getting better and better but our devices are getting newer and newer…The idea of innovation is the idea of progress stripped of the aspirations of the Enlightenment, scrubbed clean of the horrors of the twentieth century, and relieved of its critics. Disruptive innovation goes further, holding out the hope of salvation against the very damnation it describes: disrupt, and you will be saved." [20]

The Paradox of the Technological Mystique

> *"We have become so technologically musclebound in so many ways that the major preoccupation of our technics is no longer to conquer the now subservient natural world but to unscramble the chaos of its own making."* – Theodore Roszak [21]

Technological solutionism is one aspect of the technological mystique. Its paradoxical nature resides in the fact that it grows stronger by virtue of its chronic failures. While one might expect dysfunction in our technology to offer sufficient opportunity for disenchantment, the aggregate of such failures has the paradoxical effect of actually increasing our dependence on technological expertise. As Roszak observed as early as 1972:

> "After all, who is there better suited to repair the technology than the technicians? Where one technique has failed, another is called to its rescue. What choice have we? If modern society originally embraced (technology and automation) with hope and pride, we seem to have little alternative at this advanced stage but to cling on with desperation." [22]

Technological Innovation and Optimal Work Experience

In his study of automation, former Harvard Business Review Editor Carr offers an evocative description of "automaticity", namely "*the inscription that the world leaves on the active mind.*" Through repeated encounters with challenging aspects of reality, we develop and practice skills that render tasks "automatic", that is, ones that we perform without thinking. Many of the most significant implications of automation arise from the fact that the human capacity for automaticity is precluded by automation.

Focused attention and active engagement give rise to the "flow state", that is, the optimal response to workplace challenge from a phenomenological standpoint.[23] The state is typically accompanied by more elevated mood than that which prevails in a non-flow state. It also conduces to productivity and efficiency. "Flow" is not achieved upon a worker's initial exposure to the task at hand but only after the worker has "gotten the hang of it", and as her/his capacity to master the task becomes practically "automatic". The flow state – or, at very least, the capacity to experience the flow state - persists long after the acquired skills have become "automatic".

Efforts aimed at optimal work design should be informed by the recollection that the flow state is an *immersive* experience. If we value conditions that conduce to the production of immersive mental states in our workforce, then technological changes in the workplace must force the worker to actively generate knowledge rather than to passively take in information.

If we value positive mental states such as automaticity, generation, and flow, either on account of their intrinsic qualities or on account of the properties (e.g. productivity, creativity, intuition, know-how, and expertise) expected to issue from employees who experience these states, then we should consider decisions to implement technological change in the workplace with respect to the potential for achieving - or precluding - mental states characterized by automaticity, generation, and flow in employees.

Tools, Technology and Latitude

The term “technology” is not synonymous with “tool”. A “tool” is a device, often held in hand, that is used to carry out a *particular function* (a stethoscope, for example, might be considered the quintessential tool of the Physician). A "tool" also refers to a thing used in an occupation. "Technology" refers not to the tool, per se, but rather to the *application* of scientific knowledge for practical purposes. Whereas a tool performs a particular function, technology refers to the application of a particular branch of knowledge.

Technology invariably produces new tools. The tools the worker employs as he/she pursues a particular task can determine the range of freedom for thought and action scope (i.e., "latitude") allowed during the task at hand. Thinkers as diverse as Adam Smith, Karl Marx, Thomas Carlyle, John Ruskin, and William Morris were united in their belief that the quality of work experience was to a large extent dictated by the degree of latitude that the work process granted to the worker.

Yet it was Frederick Winslow Taylor's impact on work design that has probably exceeded all others. Taylor's theory of management ("Taylorism") held sway for much of the twentieth century and sought to diminish worker latitude as much as possible.[24]

Workers exposed to technology that undermines their latitude can succumb to negative mental states because their sense of autonomy is diminished. The mechanized factory, in which worker and machine merge into a tightly controlled perfectly productive unit, was seen as a triumph of engineering and efficiency. In the rapidly industrializing Europe of the 18th and 19th century, the loss of worker autonomy was not only an economic phenomenon (occurring when self employed craftsman disappeared as the economic and social forces unleashed by technology compelled those with skills to search for work in large factories for large employers) but also an existential one. As Hannah Arendt observed, unlike the tools of workmanship which remained the servants of the hand, the machines used in industrial production demanded that the laborer serve them, and that he adjust the natural rhythm of his body to their mechanical movement.[25]

A similar phenomenon was and continues to be observed in the 20th and 21st centuries. Software and automation, by definition, cede some portion of control of the work process to the computer. As functions that were previously mediated by humans are progressively "off loaded" onto computers, the autonomy of the working individual is diminishing. [26]

The "Creative" Worker

Considerations related to autonomy are particularly important because workers who are at the highest risk for responding negatively to technological innovations that decrease latitude at work may be among the most highly valued members of the work force. The most engaged workers – i.e., the so-called "creative class" - regard creativity as an intrinsic value and are most likely to react negatively to the introduction of any tool, computer, or device that constrains their latitude. Whereas tools such as the Carpenter's hammer, the Physician's stethoscope, or the Mechanics hydraulic lift increase the latitude of the worker who uses it, computer software has the potential to constrain worker latitude.

The Bond Between Work and that Which is Worked Upon

> *"We have made this flight across the ocean, not I or it"*
>
> \- Charles Lindbergh

There are two principal reasons why automation weakens the bond between worker and that which is worked upon:

1) the workings of computer-controlled systems are accessible only to the expert who has received special training relevant to the specific technology that is being applied. Information technology tends to hide its workings in a secret code.

2) the aim of most automation is to ask as little as possible of the human operator.

At its best, technology expands one's intellectual and emotional horizons. It opens up new possibilities to explore. Much as snow covered mountains extend an invitation to the ice climber or skier while withholding it from those who have never learned how to ski or ice climb, technology alters our perception of the world. For the biologist, the advent of the microscope radically altered both paradigm and practice, just as the telescope did for the astronomer, and just as the radiograph did for the Physician. Technology can become the primary means by which what is worked upon is experienced. Ideally, technological innovation (as is the case of the stethoscope, microscope, or telescope) provides the worker with tools that significantly enhance their grasp of what they are working upon. From a psychiatric perspective, the optimal tool is that which extends the productive capacities of the worker *without* circumscribing the individual's scope of action or perception.

Does the Proposed Technology Replace or Extend Human Functional Capacities?

Tools that increase our capacity for knowledge, skill, and awareness have given way to technologies that replace – rather than extend – our capacity. There is a risk that such tools will not extend our horizons or increase our engagement, but rather "anaesthetize" us. Such innovations can confer significant safety risks, insofar as it tends to produce disengaged workers who "press on the switch and follow the routine."

Technology, Economic Growth and Employment

> *"Sooner or Later We Will Run Out of Jobs"*
>
> *"(Due to technological unemployment) we shall have to change some of the fundamental assumptions upon which the world has been run ever since civilization began."*
>
> - Bertrand Russell, "Are Human Beings Necessary?", 1951.

Although we typically locate the thought of Adam Smith and Karl Marx on opposite ends of the ideological spectrum, both were united in their conclusion that human capacities diminished in the context of technological innovation at the workplace.

In his *Wealth of Nations*, Adam Smith famously observed that:

> "The man whose whole life is spent in performing a few simple operations, of which the effects too are, perhaps, always the same, or very nearly the same, has not occasion to exert his understanding, or to exercise his invention in finding out expedients for removing difficulties which never occur…He naturally loses, therefore, the habit of such exertion, and generally becomes as stupid and ignorant as it is possible for a human creature to become." [27]

Karl Marx's opus – *Das Kapital* – similarly focuses on the prospect that the forces unleashed by technology have run contrary to the intentions and interests of those who have created it. [28]

John Maynard Keynes (1930) also predicted that society of the near future society would face a terrible new "affliction": "We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come-namely *technological unemployment."* [29]

Political scientist Hannah Arendt similarly observed that automation confronts us with is the prospect of workers without work. Nothing could be worse, she claimed, than the "prospect of society of laborers without labor, that is, without the only activity left to them." Arendt wondered if our aptitude for technological innovation constituted a "cruel practical joke" perpetrated upon humankind. [30]

Up until recently, unemployment caused by technological disruption was deemed "cyclical", an unfortunate albeit inevitable function of the economic cycle. Accordingly, technology - it was believed - fueled gains in productivity that brought job and wage growth, and thereby "absorbed" those who have lost jobs due to technological off-loading. Job losses are unfortunate, the thinking goes, but they are a necessary evil on the path to greater productivity gains, economic growth, and the creation of other opportunities for employment.

Why might things be different now? For the first time in economic history growth and employment are diverging [31] due to

a) the rate at which manual jobs are being replaced by machines and robots, and

b) the replacement of white-collar jobs with computer networks.

Very few technological innovators concern themselves with social and economic dislocations that can arise as a result of technological innovation.

If they do, their anticipations typically ignore salient aspects of the human condition. Peter Thiel, the Silicon Valley entrepreneur and venture capitalist who co-founded PayPal, for example, glibly notes that "…a robotics revolution would basically have the effect of people losing their jobs." But, he hastens to add, "it would have the benefit of freeing people up to do many other things". Nicholas Carr trenchantly observes, "Being freed up sounds a lot more pleasant than being fired." [32] There is no stability in the division of work between human and computer. Prevailing methods ensure that the role of human workers will go on shrinking. As Carr concludes: "We've designed a system that discards us."

Is Human Judgment Dispensable?

> "*Society is reshaping itself to fit the contours of the computing infrastructure*".
>
> - Nicholas Carr

Writing in *Foreign Affairs*, the Princeton Economist

Alan Blinder considers the prospect of diminishing job security and wages for American workers in light of global competition. He writes that the critical divide in the future may be between the type of jobs that are easily deliverable through a wire (or wireless connections) and those that are not. Physicians who treat patients don't need to worry that their jobs will be sent offshore, for example, but Radiologists who examine images have already seen this happen, just as accountants and computer programmers have. Blinder predicts a massive economic disruption that is only just beginning, with 30 to 40 millions jobs ranging from those occupied by "scientists, mathematicians, and editors on the high end", to "telephone operators, clerks, and typists on the low end" potentially moving off-shore.[33]

This signifies the mass intrusion of computers and distant foreigners, whose work is conceived as computer-like and rule-bound way, into what was previously the domain of professional judgment. Under what circumstances does the human element remain indispensable, and why? Levy gestures towards an answer when he writes that "viewed from this rules-based perspective, creativity is knowing what to do when the rules run out or there are no rules in the first place. It is what the good auto mechanic does after his computerized test equipment says the car's transmission is fine but the transmission continues to shift at the wrong engine speed." [34]

When this happens, the mechanic is thrown back on himself and must make sense of the situation. In the real world, problems don't present themselves in a pre-digested way; usually there is too much information, and it is difficult to know what is pertinent and what is not. Knowing what kind of problem you have on hand means knowing what features of the situation can be ignored. Even the boundary of what counts as "the situation" can be ambiguous; making discriminations of pertinence cannot be achieved by the application of rules, and requires the kind of judgment that comes from experience. [35]

Conclusion: Decisions about Technology are Decisions about Values

According to Neuroscientist Susan Greenfield, the changes to our minds induced by technology and automation - diminished communication skills, reduced interpersonal empathy, externally constructed personal identities designed with the approval of an audience as priority, shorter attention spans, agile mental processing at the expense of deep knowledge and understanding - "amount to a phenomenon whose enormous size and impact make it comparable to climate change." "It just might be that the cyber-culture enables you to satisfy (the drive for status, to be accepted, and immediate gratification) … more fully and more easily in combination than at any other time in human history."[36]

Unlike concerns frequently articulated in the twentieth century –e.g. that technology will dehumanize us – cyber-culture, Greenfield concludes, poses exactly the *opposite* threat: "Some of the very worst aspects of being all too human - the desire for status irrespective of talent, mob mentality, and uncaring recklessness - are now being given free rein throughout the uncharted territory of cyberspace." [37]

But who is to say what are the worst - and best - aspects of being human? While the threat to the human mind and human work may prove as significant as that which is posed by climate change to the environment, the nature of the former threat is different insofar as there is no clearly identified end to our efforts. Whereas most people would prefer the planet not to overheat, and the collective desired end of efforts to prevent this from happening might be succinctly described as "damage limitation", the possible and desired outcome of changes to the mind induced by technology vary widely. In order to shape the future - instead of passively allowing the future to shape us - we must first decide on our priorities. While we cannot predict what new technologies will appear, nor even the developments and rate of advance of those already in existence, we can discern how humans adapt to technology. Such adaptations impact the knowledge, skills, capacities, and emotional experience of the worker. Ironically, any assessment of *technological* work mandates a re-assessment of the purposes and functions of *human* work. What knowledge, skills, capacities and emotional experiences are most worth retaining in our work force, and which should we discard?

What kind of individual traits do we value?

What kind of organization do we want to create?

What kind of society do we want to develop?

In this respect the questions raised by the prospect of technological innovation antecede those that arise in the context of the specific application contemplated, for such questions inevitably pertain to the ultimate purposes, functions, and ends of human work.

References, Notes, and Amplifications

1. Ginsburg, Sol Weiner. "What Unemployment Does to People". American Journal of Psychiatry, November, 1942, p 443.

"With the loss of job goes the great loss of prestige…No matter how humble the job, it had sufficed. In our civilization, work is what (we) live by. We work to earn the necessities of life, to secure its comforts, to provide as befits (our) families. It helps still the feelings of inferiority…it gains us parity with our fellow and the acceptance of the community. It dignifies our daily life, no matter how humble….For the unemployed…all this changed".

Reproduced in *In Job Loss-A Psychiatric Perspective*, Formulated by the Committee on Psychiatry in Industry, Group for the Advancement of Psychiatry, 1982.

2. Carr, Nicholas. *The Glass Cage: Automation and Us*. Norton & Company, 2014. Carr is former Senior Executive Editor of the Harvard Business Review.

3. Whitehead, Alfred North. *An Introduction to Mathematics*. Henry Hold, 1911.

4. See Carr, The Glass Cage, pages 65 – 85.

5. Ibid.

6. Ibid.

7. Ibid.

8. This aphorism has a history that is relevant to our subject. It is often erroneously attributed to Albert Einstein. It was most likely coined by William Bruce Cameron. In Cameron's 1963 text *Informal Sociology: A Casual Introduction to Sociological Thinking*, he wrote:

"It would be nice if all of the data which sociologists require could be enumerated because then we could

run them through IBM machines and draw charts as the economists do. However, not everything that can be counted counts, and not everything that counts can be counted."

9 &10. Ravassard Pascal, Kees Ashley, Willers Bernard, Ho David, Aharoni Daniel, Cushman Jesse, Aghajan Zahra M, Mehta Mayank R Multisensory control of hippocampal spatiotemporal selectivity. Science (New York, N.Y.). 2013; 340(6138): 1342-6.

Maguire, EA et al. "Navigation-related structural change in the hippocampi of taxi drivers". Proceedings of the National Academy of Sciences 97, no. 8 4398-4403.

11. Quoted in Carr, page 111.

12. Quoted in Carr, page 112.

13, 14, 15 & 16. See Crawford, Matthew. *Shop Class as Soulcraft: An Inquiry into the Value of Work,* 2009. Dr. Crawford is a Philosopher and a Mechanic. He received his PhD in Philosophy from

the University of Chicago and is presently fellow at the Institute for Advanced Studies in Culture at the University of Virginia.

See also *How to Read Heidegger.* Mark Wrathall. Norton, 2005.

See also Carr, Nicholas *The Glass Cage*.

17. Freud, Sigmund. *Civilization and its Discontents.*

18. See Crawford, Wrathall, and Carr (referenced above).

19. Roszak, Theodore. *Where the Wasteland Ends: Politics and Transcendence in Postindustrial Society*. 1972. Doubleday and Company. Roszak wrote extensively on late 20th century culture, and is perhaps best well-known for having coined the term "counterculture".

20. Lepore, Jill. "The Disruption Machine: Rethinking the Innovation Craze". *The New Yorker*. June 23, 2014. Pages 30 to 36. Dr. Lepor is the David Woods Kemer Professor of American History at Harvard University.

21. See reference 19.

22. Ibid.

23. See Mihaly Csikszentmihalyi's popular account in *Flow: The Psychology of Optimal Experience,* 1990. Harper & Row.

24. See Crawford's fascinating summary of Taylorism (reference 13, above).

25. Arendt, Hanna. *The Human Condition.* The University of Chicago Press, 1958.

26. See Carr, *The Glass Cage*.

27. See *The Cambridge Companion To Adam Smith,* Edited by Knud Haakonssen. Cambridge University Press, 2006. See also *The Theory of Moral Sentiments*, by Adam Smith. Dover, 2006.

28. *Capital*. Karl Marx. Excerpted in The Marx Engels Reader, edited by Robert Tucker. Norton. 1978.

See also *Marx's Das Kapital: A Biography,* by Francis Wheen. Grove Press, 2006. Wheen observes that Mary Shelley's *Frankenstein* was Marx's favorite novel, and that the prospect that technological innovation would lead to the undoing of the technology's creators remained a constant preoccupation for Marx throughout his career.

29. See *The Cambridge Companion to Keynes.* Edited by Roger Backhouse & Bradley Bateman. 2006.

30. See Reference 25.

31. See *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies.* Erik Brynjolfsson and Andrew McAfee. 2014. Norton. Brynjolfsson is Director of the MIT Center for Digital Business. McAfee us Principal Research Scientist at the MIT Center for Digital Business.

32. See Carr, *The Glass Cage*.

33. See Brynjolfsson and McAffee, 2014, *The Second Machine Age: Work, Progress, and Prosperity in a Time of Brilliant Technologies.*

34. See Crawford, Matthew, referenced above.

35. See both Crawford and Carr, referenced above.

36. Greenfield, Susan. *Mind Change: How Digital Technologies are Leaving Their Mark on Our Brains,* 2015. Random House. Dr. Greenfield is a Neuroscientist, honorary fellow of the Royal College of Physicians, and Senior Research Fellow at Lincoln College, Oxford University.

37. Ibid.