Chapter 1
Automation and Augmentation:
Human Labor as Essential Complement to Machines

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ABSTRACT

This chapter examines the nature of work where human labor is a complement to machines and considers its import for social wellbeing. While dominant portrayals about the effects of work automation are often characterized by discourses of fear and hype, these have limited utility. The chapter proposes moving beyond fear and hype to consider the ways in which automation alters the organization of work and the human role. It asserts that, although essential, the human role in automation is often obscured. Drawing on the concepts of "fauxtomation," "heteromation," and human infrastructures, the chapter makes visible hidden forms of human labor in automated work and maintains that a positive strategy for social well-being is the recognition and revaluation of human work in automated processes.

INTRODUCTION

In his influential essay, "Economic Possibilities for our Grandchildren," penned in the midst of the Great Depression, the economist John Maynard Keynes (1930) observed: "the increase of technical efficiency has been taking place faster than we can deal with the problem of labor absorption. . .we are being afflicted with

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a new disease—namely, technological unemployment" (p. 3). Keynes's words parallel today's concerns about the effects of technology to augment and automate the work practices from which many people derive meaning, identity, and agency. Historically, technology applied to work has reduced human labor. In the eighteenth and nineteenth centuries, mechanical systems displaced manual labor jobs. In the twentieth century, robots and other forms of automation diminished the need for human labor in manufacturing and service work. Today, networked computers coupled with big data, artificial intelligence, robotic automation, scanners, and computing power (Gerrish, 2018; Sejnowski, 2018) augment and automate the social organization of work in new ways.

Augmentation and automation typically refer to a range of advanced developments in information technology and computing that are applied to work and make a device, process, or system function on its own. Robotics, artificial intelligence, and other technologically-driven forms of augmentation and automation displace both low-skilled work and knowledge work. Concerns about the effects focus on possible increases in unemployment for low-skilled labor and deskilling of professional work in healthcare, education, law, finance, accounting, and journalism (Acemoglu & Restrepo, 2018; Aghion, Jones, & Jones, 2017; Benzes, Kotlikoff, LaGarda, & Sachs, 2019; Kan, 2019). In radiology, for example, "there are currently machines reading more scans than a radiologist will see in their entire life" (Chui, Manyika, & Miremadi, 2016). In journalism, Open AI's GPT-2 can "produce [human–like] text for articles and social media posts of 'unprecedented quality' by simply giving it a writing prompt" (Kan, 2019). Given these developments, what is the nature of human work in an increasingly augmented and automated landscape?

Chapter Preview

This chapter explores the nature of work where human labor is a complement to machines and considers its import for meaningful work and social well-being. It argues that a key element for social well-being is to recognize and revalue the human labor in automation. Although essential for many forms of automation, the human role is often obscured. This under-examined area warrants attention for its social effects in the wake of job transformation. The chapter makes visible how human labor is central to automated work and posits that recognition and revaluation recenters the human and contributes to social well-being.

The chapter begins by contextualizing the discussion within current frameworks for understanding automation and its effects on work and social well-being. These tend to cycle between dystopian fear about the loss of work and utopian hype about the freedom from work. A critique is offered for movement beyond these two frames that argues for consideration of the ways in which automation transforms work and alters the role of the human worker. Next, the chapter presents the concepts of "fauxtomation," heteromation, and human infrastructures as heuristics for understanding the ways in which human labor is hidden in augmented and automated work. The recognition and revaluation of concealed human labor is advanced through the example of Robotic Process Automation (RPA) that illustrates the human role in automated work. The chapter concludes with a discussion of strategies for reclaiming the human role in augmented and automated work in ways that maintain social well-being in a highly automated job market.

DISCOURSES OF FEAR AND HYPE OF WORK AUTOMATION

The Dystopian Fear of Loss of Work

Discussions about automation and its effects on work and social well-being tend to cycle between binaries of dystopian fear about the loss of work to utopian hype about freedom from work. In the dystopian vein, the implications of work automation for social well-being are dire. Broad technological trends in the past have reduced human labor with negative effects on employment and wages. The "Engels Pause," named after the German philosopher Frederick Engels who discovered it, identifies the period during the nineteenth-century Industrial Revolution in the U.K. when wages were flat for about half a century in spite of the increased productivity afforded by automation (Manyika & Sneader, 2018).

In the fourth industrial revolution, augmented and automated forms of work are predicted to impact the lives of millions of people. The Mckinsey Institute states that "up to half of all work activities globally could be automated" in the next decade (in Hodson, 2019, p. 17). The mass production of robots could establish an automated workforce with significant consequences--robot in Czech means "worker." In the manufacturing sector, 20 million jobs worldwide are expected to be replaced by robots by 2030 according to Oxford Economics (2019). These effects may be especially pronounced in heavy manufacturing regions of the world such as China and South Korea. Workers who are impacted by automation may be rendered unemployed or experience stagnant wages (Srnicek & Williams, 2016), or a reduction in wages (DeCanio, 2016).

The high levels of unemployment that automation is expected to precipitate may bring detrimental personal and social consequences. Experienced on a macro-scale, the harms of unemployment may be multiplied and contribute to income inequality, political polarization, and social instability (Oxford Economics, 2019). Increases in unemployment or underemployment due to automation are also regarded a factors that may strain intergenerational social relations and worsen intergenerational inequality as “smart machines substitute directly for young unskilled labor, but complement older skilled labor” (Sachs & Kotlikoff, 2012, p. 3). Diminished employment prospects affects individuals both economically and in terms of their sense of self and role in society.

The Utopian Hype of Freedom from Work

Conversely, other predictions about automation and its effects on work and social well-being are characterized by utopian hype about the possibility of a world relatively free from the demands of full-time work or the mundane and repetitive aspects of work that make some jobs unfulfilling. Increased productivity, economic growth, and the creation of new jobs in the aftermath of job destruction are cited as reasons to support the development and growth of automated work (Fourie, 2016; Srnicek & Williams, 2016). The World Economic Forum (WEF) contends that 58 million more jobs will be created than displaced by automation by 2022 (in Kinson, 2019). Rather than commencing a crisis, the automation of work is regarded as an economic boon rife with opportunity.

Srnicek and Williams (2016), advocate for social and economic policies that move society toward full automation. Since automation enables high levels of productivity, the economic needs of workers could be met by working fewer hours. If automation creates the conditions “for huge swathes of boring and demeaning work to be permanently eliminated” (Srnicek & Williams, 2016, pp. 1-2), then workers could enjoy more leisure. With more free time available, workers could pursue opportunities for personal growth, education, and community and political involvement. Such positive endeavors could serve to enhance the well-being of both the individual and society.

However, leisure without sufficient material resources is not leisure. Implicit in calls for the full automation of work is the assumption that increased automation would invariably lead to increased leisure, rather than to other possible outcomes such as unemployment, underemployment, stagnant wages, increased inequality, generational inequality, political polarization, overwork, or other undesirable changes. Authors in the utopian vein are quick to add that for the positive social and economic visions to be realized, there would need to be concomitant social and economic policies to mitigate against harms to personal and social well-being (Manyika & Sneader, 2018; Oxford Economics, 2019; Srnicek & Williams, 2016). Specific policy measures called for include a universal basic income, a shorter work-week that provides workers with sufficient pay and benefits, and a change in the cultural valorization of the work ethic to decouple the tight link between an individual’s self-worth and identity with their occupation (Srnicek & Williams, 2016). The policies would have to be implemented comprehensively and effectively in order to preserve not only wages, but also meaningful work and human dignity.

Predictions about the effects of automation on the future of work and social well-being that center on either the dystopian fear of massive unemployment or the utopian promise of freedom from work do not tell the whole story. Such formulations construct the future of work in binary terms that do not illuminate the complex ways in which work is transformed through automation. In these versions of the future, the emphasis is relatively narrow focusing primarily on whether levels of employment will decrease or increase and the specific ways in which work processes, themselves, change is less clear. The current reality is more nuanced. Although ultimately limited in their utility, both visions of fear and hype signal change in social organization of work that automation portends.

MOVEMENT BEYOND THE FEAR AND HYPE BINARY OF WORK AUTOMATION

One way to move past the binary frames of fear and hype that characterize the effects of automation on work is to shift from macro-level perspectives to a more specific examination of automation and employment. Discussions about automation that “equate the term to the substitution of humans by machines simplifies the notion of automation and masks whether automation is of entire job roles or of specific job tasks” (Coombs et al., 2017, p. 7). Depending upon the type of analysis conducted, the conclusions drawn about the number of jobs lost or gained through automation changes and different patterns emerge. For example, the influential and heavily cited research by Frey and Osborne (2013) predicts that up to 47% of jobs in the U.S. and up to 850,000 jobs in the U.K. could be lost through machine learning and mobile robotics forms of automation. Frey and Osborne use a job focused approach that considers the likelihood of whole jobs being eliminated by automation. This methodology has been questioned because it assumes that the work tasks across various jobs are relatively homogenous and that automation would affect most of them.

Critics such as Arntz and Zierahn (2016) argues that work is better understood as consisting of many different tasks that are not equally susceptible to automation. While routine tasks may be automated, complex non-routine tasks are less likely to be automated. A task based analysis points to more modest job losses from automation. In their analysis of the thirty-four countries of the Organization for Economic Cooperation and Development (OECD), Arntz and Zierahn (2016) found that only 9% of jobs were open to automation. Further, analyses that use a history based approach to examine the ways in which previous technological developments have impacted patterns of employment tell yet another story. These studies conclude that the main effect of automation is to reconfigure work practices rather than create large-scale job loss (Badke, 2015; Fourie, 2016). Still others contend that it is too soon to know with accuracy what the long-term effects of automation on work will be (Edwards & Ramirez, 2016).

Although the future cannot be known with certainty, all of these studies confirm that automation transforms work. Just as the binary frames of fear and hype both signal change in the organization of work, so too studies done using different methodologies--whether job based, task based, or history based--all share the conclusion that "the largest effect of automation will be job transformation" (Gownder, 2016, n.p.). While the number of jobs lost or gained is unclear, the notion that work, itself, will be reshaped is clear. What role does augmentation and automation play in work?

THE RECONFIGURATION OF WORK THROUGH AUTOMATION

Work automation "has tended to concentrate on commercial aspects of 'intelligent assistants' for human workers" (Brooks, 1991). By 2022, it is predicted that "one in five workers will have artificial intelligence as their co-worker" (Meister, 2018). Augmentation and automation processes are applied to physical work, manufacturing work, service work, and intellectual work. The technical potential for automation varies across work sectors and activities. Manufacturing and transportation are considered mature areas that have already experienced the automation of many work processes. Other sectors, such as service work, are developing areas of automation. Whether work will be automated is determined by three criteria. First, work most open to automation is routinized and repetitive such as predictable physical work performed in predictable environments (e.g., assembly line production, food preparation, welding and soldering, packaging), data collection, and data processing. Second, work less open to automation is unpredictable physical work performed in unpredictable environments (e.g., forestry, raising livestock, and construction) and work that involves communication and interaction with stakeholders. Third, work least open to automation requires the application of expertise and the management of people. Such assessments about the likelihood of automation are based solely on how work activities can be adapted using the technical tools available.

Social and Cultural Aspects of Work Automation

However, the technical tools available do not fully determine whether work will be automated. Social and cultural values, attitudes, beliefs, and practices also shape the ways in which automation may be integrated into work. For example, social trust and human understanding of automation function as key mediators and play a greater role than technical capabilities. In their study of real-world work automation, Balfe, Sharples, and Wilson (2018) found that human "understanding of automation rather than [technical] reliability or competence" (p. 494) was the main factor in establishing trust and adoption. In addition, the levels of trust change and evolve over time and impact the effectiveness of automated systems (Hengstler et al., 2016). If workers trust a system, their use is more likely to be effective. Additional social factors that shape the adoption of automation include the costs and benefits, availability and skill of workers, advantage of automation relative to human workers (beyond the reduction of labor costs), governmental regulations, and cultural acceptance especially in care occupations such as nursing, childcare, eldercare, early childhood education, and others.

In care work, there is currently no consensus about automation. Decker, Fischer, and Ott (2017) contend that "it is in no way agreed that people in need of care will accept as 'care' what a robot is able to render" (p. 352). Metzler, Lewis, and Pope (2016) maintain that the emotional labor of care can only be adequately provided by humans. The labor of child care, for example, involves "empathetic reactions that exceed the current and foreseeable capability of service robots" (Decker et al., 2017, p. 352). According to Oxford Economics, work that "requires compassion, creativity, or social intelligence is likely to be carried out by humans 'for decades to come'" ("Robots to Replace," 2019, n.p.). Others, however, note the positive outcomes of automated systems in care work with the elderly and claim that augmentation and automation of certain work tasks could create time and space for caregivers to attend to more human-centered aspects of work (Goeldner et al., 2015). While the technical feasibility of work automation is a necessary element, automation is not strictly a technological or economic matter.

Thus, the ways in which automation may be integrated into work is complex. According to Chui, et al. (2016), automation "affects portions of almost all jobs" (p. 1) but that does not mean that all jobs will be automated. In their comprehensive study of 2,000-plus work activities for over 800 occupations, they found that less than 5 percent of occupations could be completely automated by existing technology. However, they also found that 45% of the individual work activities that comprise these occupations could be automated. This pattern extends across all levels of work hierarchies. Between one-quarter to one-third of the CEO's work tasks could also be automated (Chui et al., 2016). These results do not mean that 45% of jobs will be automated. Rather, the study reveals that within most jobs there is a significant portion of work activities that can be automated.

Conclusions about the scope of augmentation and automation on work suggest four implications. First, a major effect of automation is to alter the ways in which work is performed as portions of jobs are augmented or automated. Second, because most automation occurs to portions of jobs--particular job tasks and activities--it is unlikely to render whole jobs and occupations extinct. Third, even in the midst of automation, the role of the human worker persists. Fourth, given the human role in automation, the import for social well-being is significant: If the essential role of human labor were more fully recognized and revalued, then work may be made more meaningful and social well-being enhanced. The remainder of this chapter focuses on these themes.

THE LIMITS OF WORK AUTOMATION

Augmentation and automation entails a shift in the role of the human participant in work. Rather than focus understandings primarily in terms of employment and unemployment, the automation of work can be reframed as creating changes in the social organization of work. Predictions that assume a future with an absence of work, for example, obscure the ways in which automation and augmentation “reconfigure work practices, rather than replace workers” (Mateescu & Elish, 2019, p. 4). Yet, few discussions examine the more nuanced ways in which automation “disrupts the conditions of work” (Mateescu & Elish, 2019, p. 11). It may be more fruitful to examine how automation changes work and consider the role of the human worker in altered work processes.

As “more job roles change than become totally automated” (Meister, 2018), the human role changes but endures. Instead of rendering human labor redundant, work processes that employ automation and augmentation require human labor to function properly (Davenport, 2019; Mateescu & Elish, 2019; Taylor, 2018). But these same processes also often obscure the human role. Human dimensions of work may be hidden by pronouncements about automation that foreground technological processes while ignoring human inputs. Work that may appear to be automated actually depends on the attention, oversight, skill, management, and decision-making of humans to accomplish tasks. In such augmented and automated forms of work, the human role, while refashioned is, nonetheless, vital. Human inputs persist even in the midst of work that is augmented and automated. How can the human role be recovered and revalued in augmented and automated work?

THE HUMAN LABOR OF AUTOMATED WORK

In a “revolutionary” work context “in which humans and robots work together” (Gownder, 2016, np), the human side of this partnership is frequently obscured. “It is easy and common to disguise one type of labor for the other” (“Anthrotechnomisnomia,” 2019, n.p.). Taylor (2018) recounts the example of a customer at a restaurant who appeared astonished and impressed when the app on his phone "knew" that his meal was ready twenty minutes early. That is, until the server informed him: "That was actually me. I sent you the message when your meal was ready" (np). The human labor that goes on, often behind the scenes, to produce products and services is hidden because the technology is perceived to automate work. Such understandings and depictions of work normalizes the concealment of human labor. Automation emphasizes the labor of machines and masks the labor of humans.

Fauxtomation

The hidden human labor in automation is known by three terms: 1) fauxtomation, 2) heteromation, and 3) human infrastructures. Each offers its own nuanced perspective on the erasure of human labor. Writer and artist Astra Taylor calls the phenomenon "fauxtomation" (Taylor, 2018). Taylor combines the word "faux" meaning fake with automation to express the ways in which work that is accomplished through human effort is perceived to be wholly automated. "Automated processes are often far less impressive than the puffery and propaganda surrounding them imply" (Taylor, 2018, n.p.). Fauxtomation serves to lift the veil on automation to uncover the actual human relations in the work of production. In addition, the concept critiques the logic of concealment and its effects. If labor is hidden, then it does not need to be acknowledged or recompensed. Fauxtomation demystifies the relationship between essential human labor and the processes of automation that normalize its devaluation.

Heteromation

The concealment of human labor in automation raises further questions about work, itself. If work is hidden, is it still work? Created by cognitive scientist Bonnie Nardi (2017), the term "heteromation" denotes the ways in which technology, when applied to work, results in "the invisible extraction of economic value from human labor without acknowledging or rewarding it" (MIT Press, 2017, n.p.). While capitalism has always been about minimizing the critical inputs of labor that go into the creation of products and services, Nardi argues that work processes that rely on a technological ecosystem often render the labor of the human that accomplishes work invisible. The term heteromation identifies the human labor in automated work that is uncompensated and unrewarded.

Many work activities have already been shifted away from paid employees to unpaid human users whose labor is unrecognized, such as the labor involved in design competitions, citizen science, writing product reviews, moderating forums, and self-service work in airports, banks, and shops. These tasks range from mundane to cognitively sophisticated. Many involve creative and affective forms of labor and tremendous energy. One of the most pernicious effects of heteromation is that, as Nardi (2017) states,"the value of individuals' contribution is not acknowledged and rewarded. It gives people a narrow slice of their real contribution, and hides the ways their labor is turned into a commodity and sold" (n.p.). To the extent that automation organizes labor in ways that facilitate its perception as non-work, the dynamic reinforces hidden labor and perpetuates the myth of automation. Heteromation calls out the normalization of the concealment of human work that makes the lack of recognition and remuneration of human labor seem natural.

RECLAIMING THE HUMAN IN AUGMENTED AND AUTOMATED WORK

Human Infrastructures

Like Taylor and Nardi, Mateescu and Elish (2019) observe that changes in the organization of work due to automation obscure the human role and "produce reconfigurations and obfuscations of new labor practices" (p. 11). Mateescu and Elish (2019) focus attention on the "human infrastructures" of automation--the essential role of the human laborer in automation. "The human worker is an example of 'human infrastructure,' the integral human component of a socio-technical system without which that system cannot properly function" (Mateescu & Elish, 2019, p. 13). Human infrastructures consist of the support that humans provide for automation such as anticipating glitches, smoothing over technological problems, and resolving technical imperfections. More concretely, it involves performing tasks large and small from adapting and cleaning parts, troubleshooting problems, updating old or malfunctioning code, maintaining systems, backing up systems, modifying human speaking patterns, movements, and rates of work in order to be intelligible to machines, as well as other behavioral and psychological orientations that humans perform to accommodate technologies. Human infrastructures are not just forms of technical work but rather all of the forms of work that facilitate autonomous systems. Human infrastructures are the labor that produces the work of automation.

The concept of human infrastructures centers the human labor in augmented and autonomous systems. The importance of human work is frequently "imagined as a mere intermediate step on the way to better artificial intelligence and more autonomous machines [but autonomous systems are] made possible through the obfuscation of attendant human labor" (Mateescu & Elish, 2019, pp. 13-14). In other words, autonomous systems appear autonomous because of the work performed by humans. Moreover, autonomous systems appear autonomous because "the work that employees do to facilitate new systems is often undervalued even as popular perceptions of automation frame these roles as increasingly obsolete" (Mateescu & Elish, 2019, p. 6). Rather than being a superfluous extra layer, human labor is essential, although it is often undervalued or perceived to be expendable.

Human Infrastructures in Retail and Agriculture

Mateescu and Elish's (2019) research on the use of automation in retail and agricultural applications shows how automation tools are often added to work contexts in a piecemeal manner that reconfigures rather than replaces workers. For example, automation in grocery stores like self check-out and customer-operated scanners depend on human workers to oversee them and make adjustments that compensate for the rough operation of the technology. In these cases, automaton has not resulted in making work less routinized or created more time for workers to pursue creative aspects of work. Instead, the automated systems "place greater pressures on frontline workers to absorb the risks and consequences of cost cutting experiments" (Mateescu & Elish, 2019, p. 6). In the retail sector, automation does not replace human labor or free human labor, but it does reconfigure the role of human labor with human labor playing a critical role.

In the agricultural sector, automated farming tools such as data-driven soil sensors and smart tractors are also usually added in a piecemeal fashion that similarly results in the reconfiguration of work. Forms of automation cannot simply be dropped into farm work. Rather, automation requires that humans transform their work routines and make significant changes to the physical infrastructure (Mateescu & Elish, 2019). This includes everything from investments in broadband internet to changing the arrangement of fields that must now be understood as complex datasets to be managed by humans through the use of still other automated tools. Like the retail sector, automation in agriculture does not take the place of humans or free them from work, but it does transform how work is done with the human element at the center.

ROBOTIC PROCESS AUTOMATION (RPA) AND THE ESSENTIAL HUMAN ROLE

Robotic process automation (RPA) offers an example of how automation and augmentation does not so much eliminate workers as much as reconfigure the essential human role in work. Because RPA is wizard-driven and does not require coding, it is accessible and widely used across a variety of work sectors. RPA "interacts with the existing information technology architecture" ("Robotic Process Automation," 2019, n.p.) of an organization and can be used to automate tasks across applications and systems. To be automated by RPA, work processes must be manual and repetitive, rule-based, have an input that is in electronic form and readable in electronic form, and be part of an existing information technology system. Work tasks are broken down into a series of defined rules and commands that are carried out by software bots in tandem with human labor.

Fundamentally, RPA is "a software program that runs on an end users pc, laptop, or mobile device that can mimic the action of a human user" ("Robotic Process Automation," 2019, n.p.). RPA ranges from service robots that provide assistance for humans to complete physical tasks such as cleaning, sorting, and packing to artificial intelligence engines that mimic human-like skills in information processing. The IQBot in the Automation Anywhere RPA can "learn" from the data that it receives and, in turn, act on those inputs. Likewise, the Jiffy RPA tool, used with Fortune 100 companies boasts a "data ingestion engine" that can "take in any form of data" and use "big data enabled document processing engine for 'near human' decisioning" ("Robotic Process Automation," 2019, n.p.). As a prevalent form of automation, RPA augments and automates human work.

RPA enables data migration and is typically used to automate workflow and back office tasks that require significant amounts of human labor such as repetitive clerical work, data entry, filling out forms, loan and transaction processing, data manipulation, report distribution, and financial statement updating. It is used across work settings including healthcare (patient registration and billing), human relations (payroll, new employee forms, hiring shortlisted candidates), insurance (claims processing and clearance, premium information), manufacturing and retail (sales statements, billing), telecom (management of service orders), logistics and travel (accounting, ticket reservations, passenger information), banking and financial services (card activation, fraud claim), government (change of address, license renewal) and others ("Robotic Process Automation," 2019).

A significant effect of the integration of RPA is the reconfiguration of work with the creation of a new division of labor between the work that is carried out by automated systems and and the work carried out by humans. Employees work alongside or with the assistance of autonomous or semi-autonomous systems, physical robots, and other smart technologies but humans also perform a larger set of work activities beyond those that are augmented or automated. RPA alters the organization of work in ways that require human infrastructures to achieve the autonomous accomplishment of work.

RECOGNIZING, REVALUING, AND RECENTERING THE HUMAN IN AUGMENTED AND AUTOMATED WORK

Returning to the concept of human infrastructures in making autonomous systems function, Mateescu and Elish (2019) note, autonomous "technologies can perform intelligently only if there are human attendants creating and maintaining the conditions of their intelligence" (p. 13). In the case of RPA, the implementation, execution, oversight, trouble-shooting, and other aspects are a wholly human endeavor. Considerable human work is required in planning, design, setup, and testing to determine what will count as solutions for RPA processes. The centrality of the human role continues as workers labor alongside automated systems providing the human infrastructures of support and maintenance. Further, human labor is essential for testing, detecting and diagnosing issues, devising solutions, and resolving problems. Recognizing the human infrastructures of autonomous systems is a critical first step in revaluing the human role of autonomous work.

New Skills and Responsibilities for Human Workers

As the RPA example further illustrates, reconfigurations of work through automation and augmentation often require new skills and responsibilities on the part of human workers, but the "new skills are usually unacknowledged and uncompensated" (Mateescu & Elish, 2019, p. 4). As systems are automated, "employees' roles change from worker to supervisors of automated processes" (Charalambous et al., 2015). RPA requires human supervision for creating and programming bots, training them, testing them, managing them, and addressing and solving ongoing problems. Recognizing the new skills and responsibilities of supervision and oversight that workers must master is another key step in revaluing the human role of autonomous work.

The Stressful Human Work of Vigilance in Automation

With increased supervisory responsibilities, human work roles involve new forms of expertise around the skill of vigilance. Vigilance refers to the capacity of humans "to maintain focus and attention and stay alert to stimuli over prolonged periods of time" across a variety of sensory modalities (Warm, Parasuraman, & Matthews, 2008, p. 433). As a form of labor, the work of vigilance is usually minimized, regarded as undemanding, or overlooked altogether. However, in their study of both behavioral and neural measures of vigilance, Warm, Parasuraman and Matthews (2008) found that the tasks associated with vigilance "are exacting, capacity-draining, and resource demanding" (p. 438). In addition, vigilance "imposes substantial demands on information-processing and is highly stressful" (Warm, Parasuraman, & Matthews, 2008, p. 435). To the extent that taxing new forms of labor are unrecognized, the human role in automation is concealed. Recognizing the challenging and stressful work of vigilance is another important step toward revaluing the human labor in automated work.

The Human Labor of Decisions, Interpretations, and Judgements

Another human infrastructure in work automation is making decisions, interpreting information, and forming judgements. RPA and other automated software and machines are capable of excellent performance in carrying out well-defined tasks, but it is humans who establish the correct goals, interpret results, and provide assessments of solutions. Such skills are difficult if not impossible to produce through automation. For example, work-log data tracking and smart assistants for workers that keep track of warehouse inventories, logistics, and productivity require humans to manage these elements (Nezhad, 2015). Similarly, automated systems that use artificial intelligence to identity and organize evidence in cybersecurity forensics investigations need humans to make sense of the findings (Al Fahdi et al., 2013). Internet pioneer Daniel Berninger, who led the first Voice Over Internet Protocol (VoIP) at Verizon, HP, and NASA, observes, "robot reverence attempts plausibility by collapsing the breadth of human potential and capacities. . . Human beings remain the source of all intent and the judge of all outcomes" (in Anderson, Rainie, & Luchsinger, 2018, p. 83). The irreplaceable human labor of making decisions and forming interpretations and judgements must also be recognized and revalued in augmented and automated work.

Emotional, Interpersonal, and Communicative Human Labor in Automation

Many human skills are unattainable by the artificial intelligence used in augmented and automated work. Within artificial intelligence, a distinction is made between strong artificial intelligence and weak artificial intelligence. Strong artificial intelligence has "superhuman intelligence and at present remain a fictional aspiration" (Hislop et al., 2017, p. 7). Weak artificial intelligence can perform a particular task such as probability reasoning or visual perception. They outperform humans, but have limits. For instance, artificial intelligence is incapable of engaging or managing social interactions appropriately (Hislop et al., 2017). Soft skills—like conflict management, effective communication, and emotional intelligence--are not achievable by automated systems (Gaskell, 2019). Mitchell refers to the limits of automation tools and applications as the "barrier of meaning" denoting "the lack of human-like understanding in smart machines" (Mitchell, 2019, p. 1). Work activities that are impossible to automate include managing, mentoring, and developing people, as well as interacting with people in empathetic and emotionally intelligent ways and applying expertise in making decisions, planning, and creativity. Recognizing the interpersonal and communicative work that humans perform is also necessary for revaluing human labor in automation.

Ethics of the Human-Machine Relationship

Finally, the human infrastructures of automated work raise ethical questions about the relationship between workers and systems, themselves. Automation in professional settings like healthcare, education, research, military, and transport, can perform many functions that humans do, but what is the relationship between workers and machines? What are the rights of each? Are certain forms of automation moral agents? Should robots be held accountable for their actions? Where is the line between human agency, control, and autonomy and the decision-making purview of automation? What criteria determine the domains of each? Some researchers argue that although smart machines do not currently possess moral status, their "rights" should be safeguarded because "people who abuse robots would be likely to be abusive toward animals and humans" (Coombs et al., 201, p. 15). Luxton (2014) advocates for smart machines to enact ethical actions toward humans and other machines. Recognizing the ethical dimensions of the worker-machine relationship is a final requirement for revaluing human labor in automation.

In sum, recognizing, revaluing, and re-centering the human in automated work entails uncovering the ways in which the human role is reconfigured but nonetheless essential. These include recognition of the human infrastructures of autonomous systems. Recognition of the new skills and responsibilities of supervision and oversight that workers must master. Recognition of the challenging and stressful work of vigilance. Recognition of the irreplaceable human labor of making decisions and forming interpretations and judgements. Recognition of the emotionally intelligent, interpersonal, and communicative work that humans perform. And, recognition of the ethical dimensions of the worker-machine relationship. In each of these, acknowledgement is the necessary first step toward revaluing and re-centering human labor in work augmentation and automation.

MAINTAINING SOCIAL WELL-BEING IN A HIGHLY AUTOMATED JOB MARKET

Solutions and Recommendations

Given the reshaped relationship between human labor and machines, there are a number of implications for meaningful work and social well-being. It matters whether human labor remains hidden or is revealed. The recognition of human labor enables its revaluation and re-centers the human role. In addition, if the essential human dimension is made visible and recognized, then the perceived threat of automation may be lessened and automation may gain greater acceptance. Four strategies for movement in the direction of increased recognition of the human role in work automation follow.

Civic Conversations with Awareness of Language

First, a practical step is to initiate civic conversations about automation and the human role with special attention paid to the language used to describe automation. Words shape understandings and perceptions. For example, is automation "deployed" into work? Or is automation "integrated" into work? The difference between the terms deployment and integration spotlights different aspects of automation. The term integration focuses attention on the social context of work, the role of workers in particular situations, and norms and practices. These are all necessary for the accomplishment of work, but are often omitted from discussions of automation and its effects on work and workers. The word deployment highlights the technology. Rather than talking about the deployment of automation into work and the removal of workers, technologists, designers, businesses, and citizens might consider the ways in which automation is integrated into work and "share ideas about what is just and fair, and will contribute over the long term to human well-being" (Nardi, 2017, n.p.). If workers are re-centered in the integration of automation, then work could build on laborers' knowledge and skills rather than foreclose them.

More Accurate Media Representations

A second practical way to achieve increased recognition of the human role in work automation, is for media reports to include information about the ways in which automation is reliant on human labor. Media representations often shape public understandings. Rather than focus on the ideal technological result achieved under perfect conditions that valorizes the technology, media accounts could give equal time to "the labor of integration and the humans who are either left in the lurch or relied upon to smooth out a technology's rough edges" (Mateescu & Elish, 2019, p. 7). In this way, a more accurate picture of automation is presented to the public and one that contributes to re-centering the human role.

Attention Paid to the Human Experience of Automated Work

Third, increased consideration could be given to the design and human experience of work. Implicit in the development of augmented and automated systems is an understanding of the human worker. These tacit understandings need to be made more explicit and designed intentionally with input from workers. It is possible for automation and human labor to evolve together in ways that help humans work better (Anderson, Rainie, & Luchsinger, 2018). A productive and less socially threatening goal is to build for technological and human complementarity with human labor in concert with technological systems, rather than fully autonomous systems with superfluous human labor. Design work for smart machines with smart humans. The guiding principle of this perspective is that the development and adoption of technological innovation must always be assessed for its capacity to meet human needs and preserve human agency rather than the driving imperative to displace human labor. As the human role is recognized, time and resources for training and retraining needs to be available with occupational agility a part of the culture of work. Establish pathways for the human experience of work that include flexibility, shared economic gains, and shared governance to preserve human autonomy.

Human-Centered and Life-Affirming Automation

Finally, the best of automation and augmentation is human-centered and life-affirming. It extends human capability by sensing, comprehending, acting, and learning to foster collaborative intelligence (Daugherty & Wilson, 2018; Jarrahi, 2018). This is a co-evolutionary process in which the mundane activities of work are automated thereby "producing new efficiencies and enhancing human capacities [to] optimize people's lives" (Anderson, Rainie, & Luchsinger, 2018, p. 85). The aim of automation is not simply to reduce labor costs or increase productivity, but to facilitate freedom from mundane tasks and enable people to develop new, creative, and meaningful work that utilizes social, emotional, and other knowledge. Enacted at a macro-scale, such automation could "allow greater societal progression" (Anderson, Rainie, & Luchsinger, 2018, p. 82). There is enormous potential for growth as currently only about 5 percent of human work activities draw upon human creativity (Chui et al., 2016). Automation and augmentation designed and integrated from this perspective may afford movement toward more meaningful work that enables social well-being in the midst of smart machines.

FUTURE RESEARCH DIRECTIONS

In the second machine age, smart systems will continue to evolve and the role of humans in relation to work and machines will continue to shift. Technological developments "complement and augment labor, creating increased demand for labor in new ways" (Coombs et al., p. 10).

Jobs will be transformed as technology is integrated across occupations. What is the future of current trajectories? Given the current landscape, there are a number of strands that can be identified for further research. As additional forms of technology such as mobile sensors, wearable sensors, remote workforce management, and new work locations change the organization of work and the role of the human worker, what does this mean for understandings of work, the accomplishment of work, and the social significance of work? How will workers, themselves, respond as automation is adopted more widely? Will workers embrace augmented and automated systems, alter them in unexpected ways, sabotage them, or reject them?

Integration of technological augmentation and automation into forms of work are complex processes with both technical and social dimensions. Research is needed to gain insights about how the best of automation and augmentation may be realized. In many situations, humans prefer to be helped or served by other humans. A possible outcome is that automation may increase the value of human labor (Lee, n.d.). In service work, care work, and therapeutic work, for example, what is the preferred human role and what is the role of augmentation and automation? For example, how best should communicative labor be performed, such as interacting with voice recognition and other smart systems? Could affective computing in which "machines speak the language of emotions" (Somers, 2019, n.p.) be used in ways that contribute to meaningful work and enhance social well-being? In what ways do forms of work augmentation and automation pose questions for privacy, trust, and well-being? How best should privacy, trust, and well-being be ensured?

CONCLUSION

This chapter explores the nature of work where human labor is a complement to machines and considers its import for meaningful work and social well-being. It posits that while prevalent discourses of fear and hype have limited utility, they do attest that augmentation and automation entail a shift in the role of the human participant in work. Thus, the automation of work can be reframed as reconfiguring work. It may be more fruitful to examine how automation changes work and consider the role of the human worker in altered work processes. To this end, the chapter argues that, while essential, the human role in automation is often obscured. Drawing on the concepts of fauxtomation, heteromation, and human infrastructures, the chapter uncovers hidden forms of human labor and argues that a necessary element for social well-being is the recognition and revaluation of human work in automated processes.

Reclaiming the human in augmented and automated work includes recognition of the human infrastructures of autonomous systems. Recognition of the new skills and responsibilities of supervision and oversight that workers must master. Recognition of the challenging and stressful work of vigilance. Recognition of the irreplaceable human labor of making decisions and forming interpretations and judgements. Recognition of the emotionally intelligent, interpersonal, and communicative work that humans perform. And, recognition of the ethical dimensions of the worker-machine relationship. Such recognition and revaluation re-centers the human and contributes to social well-being.

The import of social well-being in a highly automated job market calls for increased attention paid to the role of humans in making automated systems work. Four strategies for movement in this direction are presented. These include, first, the initiation of civic conversations about automation and the human role with special attention paid to the language used to describe automation. Second, insistence that media representations and reports include information about the ways in which automation is reliant on human labor. Third, consideration of the design and human experience of work automation that includes training, flexibility, shared economic gains, and shared governance to preserve human autonomy. Fourth, design and development of forms of automation and augmentation that is human-centered and life-affirming thereby extending human capability and fostering collaborative intelligence.

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KEY TERMS AND DEFINITIONS

Artificial Intelligence: Forms of machine learning, neural networks, deep learning, and natural language processing used to automate tasks.

Augmented Intelligence: A range of technologies including machine learning, predictive analytics, natural language processing, and object recognition applied to work.

Automation: A range of advanced developments in information technology and computing applied to work to make a device, process, or system self-operative.

Engels Pause: Named after the German philosopher Frederick Engels. It refers to the fifty-year period in the nineteenth-century Industrial Revolution in the U.K. when workers' wages were flat despite increased productivity from automation.

Fauxtomation: Coined by writer and artist Astra Taylor. It combines the word "faux" meaning fake with automation to express how work accomplished through human effort is falsely perceived as automated.

Heteromation: Created by cognitive scientist Bonnie Nardi. The term identifies human labor in automated work that is hidden and uncompensated.

Human Infrastructures: Denotes the essential role of human labor in socio-technical systems that enables automation.

Robotic Process Automation: Software used to automate tasks across applications and systems of an organization.