

WAGE AGAINST THE MACHINE:

The Wealth and Power
Inequality on the Automation
of Labor

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Electronics Engineers
August 2019



WASHINGTON
INTERNSHIPS
for STUDENTS
of ENGINEERING

A major part of sustainability is social justice, here and everywhere. Think of it this way: justice is a technology. It's like a software program that we use to cope with the world and get along with each other, and one of the most effective we have ever invented, because we are all in this together. When you realize that acting with justice and generosity turns out to be the most effective technology for dealing with other people, that's a good thing.

Kim Stanley Robinson

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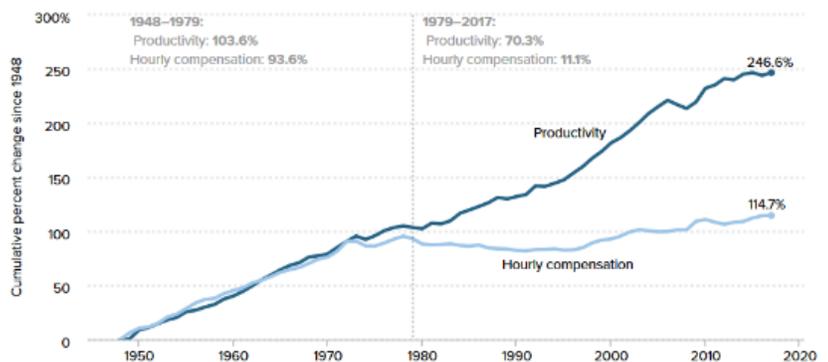
Executive Summary

While the automation of labor has persisted for a long time, it is increasing rapidly with the exponential advancement of technology. This can be seen best in an MIT Technology Review that analyzed several different reports on how automation would affect jobs in the future. It found that many jobs would be lost, and many would be created. As the date of prediction increases, the predicted job loss and gain increased exponentially.

Most jobs created from automation will be new collar jobs. These are jobs that work with technology instead of against it and have a much higher bar of entry such as certificates and degrees. The jobs being destroyed because of automation are entry level jobs that require little if any previous knowledge. This means that workers who do not have higher levels of education are most at risk of automation. Moreover, these people are usually on the lower end of the socio-economic scale and are affected most by wealth inequality.

The relationship of automation, wealth inequality, and worker power can best be seen in this figure from the Economic Policy Institute (EPI). From 1950 to 1980, productivity growth and hourly compensation increase at about the same rate (10% deviation), while from 1980 to 2017 productivity continued to increase while hourly compensation stayed stagnant (60% deviation). The almost constant productivity growth is in part due to automation in that it gets work done both cheaper and faster.

Productivity growth and hourly compensation growth, 1948–2017



Notes: Data are for compensation (wages and benefits) of production/nonsupervisory workers in the private sector and net productivity of the total economy. "Net productivity" is the growth of output of goods and services less depreciation per hour worked.
Source: EPI analysis of Bureau of Labor Statistics and Bureau of Economic Analysis data. Updated from Figure A in Bivens et al. 2014.

Figure 1: Productivity growth and hourly compensation growth from 1948-2017

There is a positive causal relationship between automation, productivity, and economic growth. However, the prosperity being created by automation is only going into the hands of those that own the means of production instead of laborers. Wealth inequality can be attributed to this divergence of productivity and hourly compensation. If hourly compensation continues to stagnate, automation will only make this problem worse.

Quick Facts: Wealth Inequality

- U.S. income inequality is the highest it's been since 1928
- 3 men (Jeff Bezos, Bill Gates, Warren Buffett) own as much as the bottom 50% of Americans
- The average worker needs to work a month to make what a CEO makes in an hour
- The average CEO gets paid 380 times as much as the average worker
- Black & Latino Families are twice as likely to have 0 wealth

Raising hourly compensation has traditionally been done through the collective bargaining of workers. Unions have been the only venue for workers to collectively bargain and have been the most effective pressure group that lobbied for policies helpful to economically disadvantaged citizens. This can be seen in another study done by the EPI that showed an inverse relationship between union membership and wealth inequality; as union membership falls, wealth inequality rises and vice versa. This is because without a union, workers do not have the capabilities to organize their voices. Policy with regards to automation must include the workers and people that are being affected by it. As jobs are being destroyed due to automation, the ones being created must have a space for workers to bargain on their wages and conditions.

The first recommendation to alleviate these problems would be for the Department of Labor (DOL) to implement a national retraining program for workers displaced by automation. The goal of this program would be to upskill workers and provide a temporary safety net. This program would assist displaced workers transition into new collar jobs and provide a short-term economic fallback fund. The DOL would manage state-level job security councils filled by industry representatives, union members, and state-level personnel to offer workforce training, skills assessments, job referrals, and case management services. The workforce training would be done in education- and industry-collaborative programs that offer certificates in new collar work.

The second recommendation would be an implementation of a Labor-Centered Innovation Policy (LCIP). The goal of this would be to have a national innovation system, which is a framework for the country's purpose of innovation. Under LCIP, this framework would specifically be on issues grounded in labor. This would be facilitated through government research organizations such as the National Science Foundation (NSF) and National Institute of Standards and Technology (NIST). These organizations would have industry collaborative programs that innovate, research, and develop new technologies with the purpose of making workers lives better. This innovation policy would also contribution to the United Nations' (UN) call for countries to commit to their 17 Sustainable Development Goals.

The third recommendation would be for companies with revenue of one billion dollars to have a co-determination supervisory board. This would be done through legislation, and the goal would be for workers to have a larger voice in how companies are managed thereby shifting company values from shareholders to stakeholders. The supervisory board would be elected half by stockholders and half by workers. When a company has a union, one third of the workers elected must be representative of the union. The supervisory board then appoints and supervises a board of management that is one fourth the size of the supervisory board.

Foreword

About the Author

Jillian Johnson is a senior at Christian Brothers University located in Memphis, Tennessee. She will graduate in December 2020 with a B.S. in Interdisciplinary Studies of Electrical Engineering and Cognitive Neuroscience, a minor in Mathematics, and a Data Analytics certificate. She currently serves as the IEEE Regional Student Representative for the Southeast, IEEE CBU Student Branch Professional Awareness Committee Chair, Gay-Straight Alliance Programming Chair, President's Ambassador, and is a student researcher in the Cognitive Neuroscience Lab. Additionally, she is a member of her school's honors program and professional engineering fraternity, Theta Tau. Upon graduating, she intends to further her education in pursuing a PhD in Cognition & Perception Psychology. Her interests include consciousness, systems analysis, post-structuralism, artificial general intelligence, information theory, robotics, and semiotics.

About the WISE Program

The Washington Internships for Students of Engineering (WISE) program was founded in 1980 through the collaborative efforts of several professional engineering societies and has become one of the premier Washington internship programs. Each summer, the WISE societies select outstanding 3rd or 4th year engineering/ computer science students, or students in engineering/computer science graduate programs, from a nation-wide pool of applicants. The students spend nine weeks living in Washington, D.C. to gain exposure to legislative and regulatory policy-making through leaders in the Administration, federal agencies, and advocacy groups. In addition, each student is responsible for independently researching, writing, and presenting a paper on a topical engineering-related public policy issue that is important to the sponsoring society. For more information about the WISE program, visit www.wise-intern.org.

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Acknowledgements

Without my parents, I would not be the person I am today. Primary thanks go to the people I owe my life to, Ronald and Christine Johnson. Thank you to IEEE for changing my life through its volunteer opportunities, networks, and funding. I owe this D.C. summer experience to the IEEE-USA hosts and office. Special thank you to Erica Wissolik, Diana Librizzi, Russell Harrison, and especially Faculty Member in Residence Dr. John Weidner. Additionally, I would like to thank Dr. Marc Canellas, Mina Hanna, Dr. Rachel Haga, Natalie Hayes, Dr. John Ventura, Dr. Jeffrey Sable, and Michael Ardoline for mentoring, inspiration, and/or editing assistance.

Acronyms

AFL-CIO – American Federation of Labor and Congress of Industrial Organizations

BPA – Business Process Automation

EPI – Economic Policy Institute

ETA – Employment and Training Association

EU – European Union

FW-HTF – Future of Work at the Human-Technology Frontier

GAO – Global Accountability Office

IA – Industrial Automation

IPA – Intelligent Process Automation

ILO – International Labor Organization

MIT – Massachusetts Institute of Technology

NIST – National Institute of Standards and Technology

NSF – National Science Foundation

ODJFS – Ohio Department of Job and Family Services

OECD – Organization for Economic Co-operation and Development

PATCO – Professional Air Traffic Controllers Organization

RAMTEC – Robotics Advanced Manufacturing Technology Education Collaborative

RPA – Robotic Process Automation

TIPC – Transformative Innovation Policy Consortium

TUC – Trade Unions Congress

UBI – Universal Basic Income

WIA – Workforce Investment Act

Introduction

People have been dreaming for millennia about a world where the toil of work becomes unnecessary. This dream became possible with the advent of automation and its implementation within the workplace. Automation, derived from the term automata, is the technology by which a process or procedure is performed with minimal human assistance. Isaac Asimov predicted gadgetry to relieve mankind of tedious jobs by 2014[1]; finally, the abolition of work was within reach.

This utopia has not been realized, despite rising fears of the means to do so. Instead, work controls almost everyone's lives through the onerous need of economic security. While automation has the potential to release people from these grueling demands, in this current moment it is a source for more economic anxiety. A study by the Pew Research Center indicates that 72% of Americans are worried about increasing automation in the workplace and fear of being displaced. Conversely, 80% of Swedes see automation and artificial intelligence as a positive influence for labor[2].

While people fear automation taking their jobs, there is data showing that more jobs are being created than are being lost. However, these jobs hereby referred to as new collar jobs, require a much higher bar of entry than the ones being lost. Unlike blue and white collar jobs new collar jobs require technical and soft skills needed to work in the contemporary tech industry. However, many people would not have these skills without specialized training.[3]. While 58 million net new jobs are estimated to emerge from companies' shift to automation[4], how those jobs will be filled gives way to the underlying changes that must occur.

The key driving force of this issue is the rapid development of technology causing unprecedented changes to the state of work. Technological advancement has been a prevailing force beginning with the wheel, human settlements, and agriculture. Human innovation has long been a driver of economic and social success, and it will continue to be so for years to come. Currently, technology is at a place where algorithms are mimicking mental tasks and supercomputers are merely 30% less powerful than the human brain[5]. While these specific advances are only beginning to hit the market, their predecessors have been there for a while. Companies have capitalized on these fast-paced, labor-saving wonders and have created markets where this is the baseline for competition. However, the profits of these productivity gains are only going to one end of the socio-economic scale[6].

Many workers will see their jobs shift with automation, but potentially millions will lose their jobs and suffer from significant economic and social hardships. Following current trends, automation will exacerbate current economic divides through increased wealth disparity, which is already at an all-time high due to the prevalence of the shareholder value model[7]. For people already struggling with economic anxieties, job loss would put further stress on the most vulnerable while taking away a sense of purpose and identity. This could lead to an increase of people affected by mental health disorders such as depression, anxiety, and other illnesses – potentially even leading to a suicide epidemic.

Without the right set of solutions, the displacement of workers could cause irreversible damage to most of the American population. Due to the upskilling of needed work, many workers at both the top

and the bottom of this more automated and polarized economy might find themselves working very long hours for diametrically opposite reasons. Those with scarce skills and high marginal productivity, as well as their employers rationally converge around long hours of work. By contrast, low-wage workers will scramble to work longer hours or multiple jobs just to make ends meet[8].

This issue has generated significant public reaction and concern primarily from organized labor, tech, and academic groups. These groups have been key in highlighting the vast power inequalities automation is giving rise to. In 2017, the AFL-CIO and ILO formed the Commission on the Future of Work and Unions to address the ways technology is changing how work is done, what is worked on, and how unions should evolve into this new landscape[9]. Similarly, there has been a vocal outcry from tech workers demanding a seat at the table where decisions are being made about what technology is built and how it will affect workers. This has resulted in the organization of new labor movements for broadly tech related workers such as the Tech Workers Coalition[10], Silicon Valley Rising[11], the Democratic Socialist of America's National Tech Committee[12], and the Teamster's Tech Industry Organizing campaign[13].

The real-world impact of automation is tough to understate. Even 2019 Democratic primary candidates have included the issue in their platforms. Andrew Yang and Marianne Williamson address the problem directly by advocating for a universal basic income (UBI) as a solution[14], while Bernie Sanders and Elizabeth Warren indirectly address it with their plans for free college[15] and making capitalism more accountable[16]. The question isn't whether displacement is an issue – the question is how it will be addressed.

1. Background

To have a full grasp on the reason why displacement due to automation is happening, it must be looked at with a reference of its historical significance. The development of automation has had significant ties to the development of economics, therefore this relationship is a key insight into how automation's future may play out. By looking at how different societies have dealt with automation displacement of their time, as well as its discussions by thinkers of their time, it becomes apparent where and how they have failed. Proper solutions require this information for an unknown future. This problem is not new by any means; the accelerating speed at which the problems are manifesting is.

1.1 History of Automation Displacement

According to economic historian Gregory Woirol, the phenomenon of technological unemployment is likely to have existed since at least the invention of the wheel[17]. Workers may have been displaced out of their jobs by primitive machines dating back to the second millennium BC, where this problem was addressed by ancient China and ancient Egypt through centrally run relief programs[18]. In ancient Greece, large numbers of laborers became unemployed due to both the effects of technology of the time and to the competition from slaves, justly deemed "machines of flesh and blood". The Greeks addressed this problem by letting the laborers starve to death, be forced into slavery, or sometimes be given handouts – but the conservatives of the time heavily criticized this option for wasting public money[19].

The medieval and early renaissance period saw a widespread adoption of new technologies. However, mass unemployment began to appear in Europe in the 15th century as a result of population growth and the changes in land availability. This caused a reaction of technological fear, leading to bans and even executions of those trying to promote the machines[20].

The Industrial Revolution begins the unbreakable relationship of automation, increased wealth, and economic theory. After the Glorious Revolution of 1688 in England, the ruling class became less sympathetic to workers' concerns. They addressed fears of unemployment due to automation through Mercantilist policy. This policy held that by introducing labor saving technology, unemployment would be reduced and allow British firms to increase their market share against foreign competition[21]. The mid-18th century did not see this to be the case. Machines displaced workers, and their time spent learning skills of their craft went to waste as their role in industry was deemed useless. This led to a radical faction known as The Luddites that combatted this displacement through direct action by destroying machines. The protestors were eventually suppressed with legal and military force[20].

After the Industrial Revolution came the Technological and Digital Revolutions. The Technological Revolution was a phase of rapid industrialization generally dated between 1870 and 1914. This era herald in manufacturing and production technology that enabled the widespread adoption of technological systems such as telegraph and railroad networks, gas and water supply, and sewage systems. Living standards improved while the greatest economic growth in the shortest period came out of it. Fears of technological unemployment were temporarily subdued by growth and prosperity[22].

Conversely, The Digital Revolution saw a shift from mechanical and analogue electronic technology to digital electronics. This period has been defined as starting in the late 1950s and continues today. Central to this revolution is the mass production and widespread use of digital logic circuits and its derived technologies, including the computer, cell phones, and the Internet. These innovations transformed traditional production and business techniques and leads the current fears of automation displacement[23]. Since the publication of *Race Against the Machine* in 2011 by MIT professors Andrew McAfee and Erik Brynjolfsson, there has been a prominent concern about technological unemployment. However, within this concern there is an optimistic spin: “the key to winning the race is not to compete against machines but to compete with machines.”[24]

1.2 History of Wealth and Power Inequality

As the golden age of capitalism ended in the 1970s, unemployment rose and remained relatively high for the rest of the century. In the 1980s, Ronald Regan implemented trickle-down economic policies that reduced taxes and promoted unrestricted free-market activity[25]. This, along with other policies, gave rise to a shareholder value era of capitalism that implies the ultimate measure of a company’s success is the extent to which it enriches shareholders.

The legal and regulatory framework that has allowed this situation has mainly bloomed out of Regan’s attack on union strength and continued by Clinton’s financial deregulation. Before the politically induced steep decline in union strength that began in 1981, unions were the most effective pressure group that lobbied for policies helpful to economically disadvantaged U.S. citizens. It was found that the politically induced reduction in union strength helped produce stagnation in incomes of those near to below the middle of the income distribution during times when most prosperous family incomes accelerated rapidly. These events occurred when political deregulation of finance also contributed to the post 1980 acceleration in U.S. income inequality probably by increasing the ability of financial specialists to bargain for higher pay[25].

While some academics point to the 1970s, a decade of sharp declines in union density, as being the turning point for the decline of unions, Joseph McCartin (executive director of the Kalmanovitz Initiative for Labor and the Working Poor at Georgetown University) argues that to truly understand the roots of the decline of unions one must go back to the post-World War II years. This era brought two notable failures for unions: the passage of the Taft-Hartley Act and the failure of a coordinated campaign to unionize the South[26].

The Taft-Hartley Act (1947) prohibited secondary boycotts and “sympathy” boycotts and opened the door to the right-to-work laws which prohibit employers from hiring only union employees – that now exist in 27 states around the country. This legislation also required that union leaders sign affidavits swearing they weren’t Communist sympathizers; refusal to sign meant they would lose many of the protections guaranteed by the Wagner Act, the landmark 1935 labor law that established the National Labor Relations Board and guaranteed workers the right to organize[27].

When the Taft-Hartley Act came out, labor unions were in the middle of “Operation Dixie”, a campaign to organize the non-unionized textile industry in the South. Anti-union business leaders in the region used the accusation that the leadership of some of the industrial unions were Communists, or

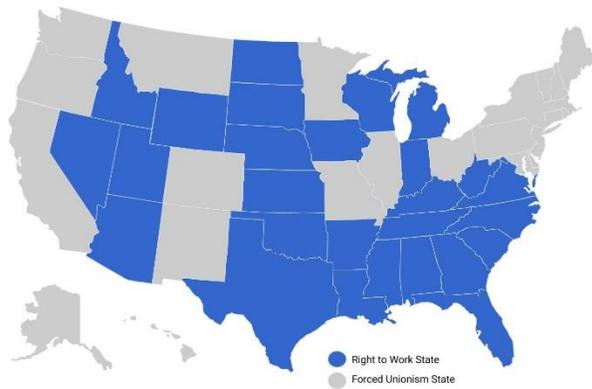


Figure 2: U.S. graph of right-to-work laws

Communist-leaning, to whip up opposition to Operation Dixie. Union foes also relied on another particularly powerful boogeyman – desegregation – to increase opposition to the industrial unions among white workers in the Jim Crow South. In one publication, typical of the time, distributed by the Southern States Industrial Council, one article asked, “Shall We Be Ruled by Whites or Blacks?” and others alluded to the creeping threat of communism to traditional values[28].

In the 1938 Mackay Radio decision, the US Supreme Court indicated employers were free to retaliate against strikers by giving away their jobs in the event of an unsuccessful strike. Employers largely avoided using this permanent replacement tactic but after Reagan’s hardline stance on unions, employers routinely threatened to permanently replace strikers and do so. At great risk of their careers, PATCO members declared a strike seeking better working conditions, better pay, a 32-hour work week, and to be excluded from the civil service clauses that prevented them to strike. By doing this, the union violated 5 U.S.C. (Supp. III 1956) 118p (now 5 U.S.C. 7311), which prohibits strikes by federal government employees[26].

After supporting PATCO’s efforts in his 1980 campaign, Ronald Reagan declared the PATCO strike a “peril to national safety” and ordered them back to work under the terms of the Taft-Hartley Act, and demanded that they go back to work within 48 hours otherwise their jobs would be forfeited. The PATCO workers refused to return to work and Reagan fired all 11,345 striking air traffic controllers who ignored the order and banned them from federal service for life. This forced the FAA to hire and train enough air traffic controllers to replace the ones that had been fired; it took three years in normal conditions to train a new controller. Reagan’s harsh response validated many employers efforts to union bust and ushered in the vicious employer attacks of the 1980s and helped to normalize anti-union behavior[26].

1.3 Philosophical Relevance

The issue of automation displacing workers has been raised out of multiple centuries that were caused and dealt with differently. Thinkers have flip-flopped from optimistic to pessimistic views throughout history and it is no different today. However, the fears of technological unemployment cycle back into the collective consciousness in one way or another. Fortunately this recent wave is not the first. By looking at the past philosophical reflections of these problems, new insight may be gained into how to go about them.

Ancient Greece sparked the first scholarly discussion of the problem posed by technological unemployment. Aristotle speculated in Book One of Politics that if machines could become sufficiently advanced, there would be no more need for human labor:

“If every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, say the poet, “of their own accord entered the assembly of the Gods;” if, in like manner, the shuttle would weave and the plectrum touch the lyre without a hand to guide them, chief workmen would not want servants, nor masters slaves.”

-Aristotle, Politics (384-322 B.C.E.)[29]

Aristotle saw that the human condition largely depends on what machines can and cannot do; moreover, it can be imagined that machines will do much more. If machines did more work, the quote proposes, then everyone would be freer. Which poses the question, if machines have progressed to do more work in modern times, why are we not freer? Furthermore, if only those with the skills to build the machines of the future are rewarded a decent income, what happens to everyone else? What happens to the steel mill and auto factory workers, to the butchers and bank tellers, and, increasingly, to the accountants, professors, lawyers, engineers, and physicians when artificial intelligence improves?[30]

Near the end of the Industrial Revolution, discussions about worker displacement gained intensity. Due to the creation of the modern discipline of economics, automation displacement could be viewed in a new light. While there was a rejection of mercantilism, the new economists largely agreed that technological unemployment would not be an enduring problem. However, prominent thinkers such as JS Mills and David Ricardo claimed that innovation could push down wages for the working class and cause long-term unemployment[31]. This thought was challenged by Jean-Baptiste Say, who argued that no one would introduce machinery if they were going to reduce the amount of product. This led to the creation of Say’s Law which states that supply creates its own demand and any displaced workers would automatically find work elsewhere once the market had time to adjust. This idea was expanded upon by Ramsey McCulloch with his development of a system of compensation effects. These are labor friendly consequences of innovation which “compensate” workers for job losses initially caused by new technology.

Compensation theory was attacked on the argument that none of the effects were guaranteed to operate by a new economist building on the views of Ricardo and Mill: Karl Marx. Marx’s ideas went much further than Ricardo and Mill by presenting a deeply pessimistic view of technological unemployment. He argued that it was a serious problem in the short-term and would lead into the broader context of the immiseration of workers under a capitalist system. However, he also believed that technological improvement was part of a social and political process that would lead eventually to widespread prosperity albeit at the expense of the existing capitalist economic system. While his views attracted many followers and founded an enduring school of thought, mainstream economics were not dramatically changed. However, some of his ideas are currently being considered by mainstream political and economic thought due to heightened wealth disparity and lack of control over working conditions:

“Labor no longer appears so much to be included within the production process; rather, the human being comes to relate more as watchman and regulator to the production process itself. As soon as labor in the direct form has ceased to be the great well-spring of wealth, **labor time**

ceases and must cease to be its measure. Capitalism thus works towards its own dissolution as the form dominating production.”

-Karl Marx, Fragment on Machines, *Grundrisse* (1873)

Marx argues that as labor becomes alienated from the production/management process, such as seeing the productions as value instead of human labor, then humans are left to be nothing but guards to the production machine. If the production process is valued over the labor itself, as is the case when workers are replaced with machines without care, then the laborers will be worse off as their abilities are no longer seen as valuable to the system. The value of labor, of work and of innovation, must be raised to a higher importance than then products and material goods that come out of it.

In 1989, Francis Fukuyama released “The End of History?”, a set of essays discussing the idea that humanity had reached the end point of mankind’s ideological evolution and that the universalization of Western liberal democracy was the final form of human government. Capitalist realism, described as “the widespread sense that not only is capitalism the only viable political and economic system, but also that it is now impossible even to imagine a coherent alternative to it”, has now become the prevailing economic thought.

Automation can be a valuable resource and has been seen by some as a Prometheus, something that fundamentally alters the human condition. It has proved a very important mode of change for the world, and more importantly, work. Automation will have a large role to play within the future of work, and it has the potential to be very beneficial to workers. However, it must be understood how automation impacts overarching systemic issues that affect these workers.

2. Automation Displacement

As history has shown, automation displacement is not a recent problem, and neither are the fears that come out of it. As technology becomes increasingly capable to do most jobs, there is a natural fear that arises. Many have already been displaced with no means to upskill themselves. Today, there is a massive wave of fear but there is also call for hope. New jobs are being created to replace the ones being lost, but often times these jobs require a much higher bar of entry than their predecessors.

2.1 Effects on Work

Major disruptions in work occur due to automation which can be shown in worldwide falls in various ways. Most prominently, manufacturing employment, falls in pay for low to medium skilled workers even as productivity rises, and skilled jobs (translation, legal research, low-level journalism) and empathy jobs (care work, entertainment, art) are able to be done by machines.

Automation comes in many different varieties and may displace workers in different ways. Industrial Automation (IA) - the use of robots and other automated machines in industrial settings – displace labor in various forms, such as replacing a manufacturing process with 3D printing. While some IA displaces workers, other IA are used to improve working conditions, such as, using collaborative robots called cobots, in hazardous environments[32]. While IA replaces a worker’s role in an industrial process, Business Process Automation (BPA) replaces non-manufacturing processes such as

accounting, contract management, and HR. Examples are various software tools used across areas such as HR, accounts, and contract management[33]. Robotic Process Automation (RPA) is higher level automation where software is used in certain circumstances to augment process performance and perform complex tasks. This fulfils a primary function in one critical area such as customer order processing[34]. Furthermore, Intelligent Process Automation (IPA) uses artificial intelligence (AI) to learn how to mimic human computer interactions and deliver intelligent outcomes. This may include machine learning techniques that enable computers to adapt, change, and even test different approaches based on data retrieval[35].

While the exact number of people being affected by automation displacement is difficult to decipher due to a lack of detailed data[36], it can generally be stated that the displacement of workers due to automation will affect a significant number of people across industries. One study reports that from 2000-2010 robots and artificial intelligence were responsible for about 87% of jobs lost in the United States[37]. In a global report by the OECD, the automatability of different tasks within a given job were assessed based on a survey of skills in 2015. The study found that across 32 countries 14% of jobs were highly vulnerable with a 70% chance of automation, and 32% of jobs were slightly vulnerable with a 50-70% chance of automation, putting 210 million people at risk[38].

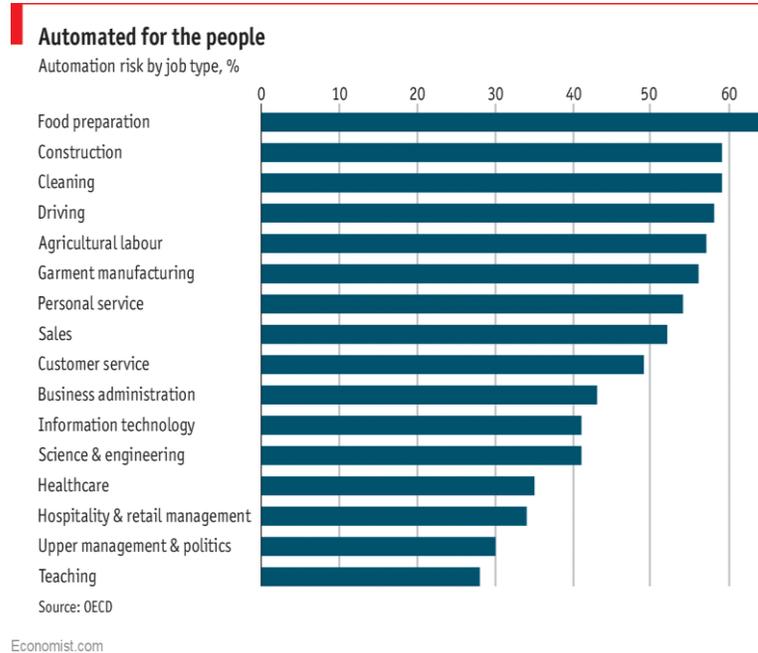


Figure 3: Job types susceptible to automation by risk percentage

The US Government Accountability Office's (GAO) report on Workforce Automation found in 2016 that certain groups, such as workers with no college education and Hispanic workers, tended to hold jobs more susceptible to automation and this could be disproportionately affected by changes if they occur[36]. Other groups of people particularly susceptible to automation are those in the platform-based gig-economy, where employees are hired as independent contractors and are readily replaced by others and machines[39].

An MIT Technology Review article discovered little consistency or agreement between predictions on exactly how many jobs will be lost due to automation after analyzing several reports published between 2013 and 2017[40]. Although some studies seemingly accurately predicting through 2020-2021, jumping ahead a decade the numbers become incomprehensibly larger. As technology becomes more prevalent and embedded within different sectors of the economy, some countries are calling for policy that expedites the process. For example, the UK Government has been discussing decreasing

cost of AI licensing models and sensors to propel development and investment in automation, which could cause future automation displacement to be even more far reaching and rapid[41].

Automation displacement will potentially affect lots of people in almost every job field, but those most susceptible will be Hispanic workers and workers with no college education. Those on the lower end of the socio-economic scale will feel the harshest effects of displacement.

By When	Where	Jobs Destroyed	Jobs Created	Report
2018	US jobs	13,852,530	3,078,340	Forrester
2020	worldwide	1,800,000	2,300,000	Gartner
2020	15 countries	7,100,000	2,000,000	WEF
2025	US jobs	24,186,240	13,604,760	Forrester s
2030	worldwide	400M-800M	555M-890M	McKinsey

Figure 4: Predictions of how automation will impact work

2.2 New Collar Jobs

While there is much fear surrounding the loss of jobs, there are jobs to be gained. 133 million new jobs are estimated to emerge from companies' shift to automation. These jobs will be what are considered new collar jobs, requiring relevant skills sometimes obtained through vocational training[3]. Typical new collar jobs include: cloud computing technicians, database managers, cybersecurity analysts, user interface designers, and other assorted IT roles[42]. While these jobs require a much higher bar of entry and specific skills that typically require training, certificates, or even degrees to be qualified, this poses a problem for workers who do not have jobs to acquire this training due to having been replaced by automation in past jobs.

New Collar Jobs are being fueled by transformations in the landscape of science, and technology. Specifically, technological and scientific breakthroughs in areas such as materials, mechanics, and digital systems have been leading the way. Recent breakthroughs in manipulating atomic or molecular structures to improve the physical properties of materials, new gene-level techniques allowing for the manipulation of biological systems, including the human genome, progress in digital areas including advancements in information technology and computing, data analytics, and virtual and augmented reality have all contributed to the growth of new-collar jobs. While individually impressive, it is the combination of these many advances and new breakthroughs that can unlock even more transformative technological change[43].

The biggest hurdle to displaced workers joining the new-collar workforce is the obvious lack of ability to gain new skills while unemployed. To help alleviate this issue, some policy has been enacted, including the United States. The "New Collar Jobs Act" was released by Representatives Ted Lieu (California), Matt Cartwright (Pennsylvania) and Ann McLane Kuster (New Hampshire) in July 2017 to address this issue. The Act sought to provide scholarship funding and debt relief for individuals who study cybersecurity training. In August 2017, Virginia Lt. Governor Ralph Northam announced a vocational training program titled "Get Skilled, Get A Job, and Give Back", focused on skills for new collar jobs.

While this policy is a good starting point for helping displaced workers, it is not adequate for the enormous, multi-faceted problem. Workers are going to be displaced at rapidly increasing rates, and many jobs will be left open with few qualified applicants. All displaced workers must have a way to affordably transition into unfilled jobs.

2.3 Proposed Policy

To date, the only policy put in place that has affected technological unemployment directly has been in South Korea in 2017. This year, South Korea became the most automated country on earth with one robot for every 19 employed humans. This caused the government to change the tax laws to hinder future automation increases. Additionally, in the European Union, a robot tax had previously been part of Mady Delvaux's bill imposing ethical standards for robots. The European Parliament rejected this aspect when it voted on the law.

Similar policy has been proposed in the US tracing back to 1940 when Joseph C. O'Mahoney tabled an automation tax bill in the Senate. Bill Gates has supported a similar "robot tax", a legislative strategy to disincentivize the replacement of workers by machines and bolster the social safety net for those who are displaced. In 2017, San Francisco supervisor Jane Kim developed a task force around these strategies, stating that income disparity attributable to robots is widely visible in her district.

This type of policy is a superficial fix for symptoms of a much deeper problem. The definition of robots and automation in the workplace is vague at best. Technology has become integrated and necessary for day-to-day lives, let alone functioning in the workplace; would companies using computers be taxed for having robots? These policies are all based on the assumption that solely automation is the source for destroying jobs and income disparity, instead of some of the more underlying problems within the development of automated technologies. 2015, Stephen Hawking criticized machine owners for initiating a "lobby against wealth redistribution", giving insight into the underlying problems with not just automation, but with how the current economic system not only allows, but promotes the unequal distribution of wealth expedited by automation.

However, as it has been seen, automation increases the standard of living and work, so disincentivizing the implementation of automation would only impede technological development. Robotics companies including Savioke and the Advancing Automation trade group have fought robot taxes, calling them an "innovation penalty". EU Commissioner Andrus Ansip rejected the idea of a robot tax, stating that any jurisdiction implementing one would be less competitive as technological companies are incentivized to move elsewhere. In the 2019 World Development Report, prepared by Simeon Djankov and Federica Saliola of the World Bank, opposed a robot tax, arguing that it would result in reduced productivity and increased tax avoidance by large corporations and their shareholders.

While the issue has been recognized, there is a lack of action being taken by those in power. Corporate interests have been interfering with any policy proposed as to increase profit margins and stifle the power of the working class.

3. Wealth Inequality

While automation displacement may be a problem, there are underlying economic issues exacerbating the issue. Wealth inequality is the extent to which income is distributed in an uneven manner among the American population. The reasons for this inequality are not well understood and result from an interaction of multiple factors including automation and the decline of labor unions. As automation creates extreme economic growth and productivity gains, wealth inequality shows that

those gains will be distributed unfairly if radical change to America's economic distribution is not made.

3.1 Automation's Impact

By taking a case study investigation into the manufacturing industry, the number of Americans employed in manufacturing has dropped significantly over the past decade due to automation. Manufacturing employment dropped 20 percent between the peak in 2000 and the end of the most recent expansion in 2007. Since the recession started, manufacturing employment has fallen by an additional 15%. Over the past decade manufacturers have shed a net 5.6 million jobs.

The transformation of the manufacturing industry has made manufacturers more productive. Manufacturing productivity has doubled since 1987 and has increased during the past decade. Today, manufacturing workers produce 38% more per hour than they produced in 2000. As a result, America produces more manufactured goods today than a generation ago. Production has risen 46% since 1987. Since 2000, manufacturing output has remained relatively stable even as the manufacturing workforce has shrunk. America's manufacturing base remains strong, but technology allows manufacturers to produce more goods with fewer workers.

Further showing how automation has increased productivity, the Economic Policy Institute released a study looking at productivity and hourly compensation growth from 1948-2017.

After tracking closely in the three decades following World War II, from 1979 to 2017 productivity grew 70.3% while hourly compensation of production and nonsupervisory workers grew just 11.1%. Meaning that productivity grew six times faster than typical worker pay[44].

"The data shows not only rising inequality in general, but also the persistence, and in some cases worsening, of wage gaps by gender and race," EPI states in its State of Working America 2018 report, "Wage growth since the Great Recession has continued to follow this trend, and the divergence is at the root of numerous American economic challenges"[45].

The data shows that both productivity and output have increased while employment has declined, and hourly compensation has stayed stable. The force driving inequality has not been a lack of productivity by American workers; instead, the lion's share of gains from increased productivity has gone to a tiny segment of wage earners at the top. As productivity rises, employment goes down, and wages stay the same, automation is only making wealth inequality worse.

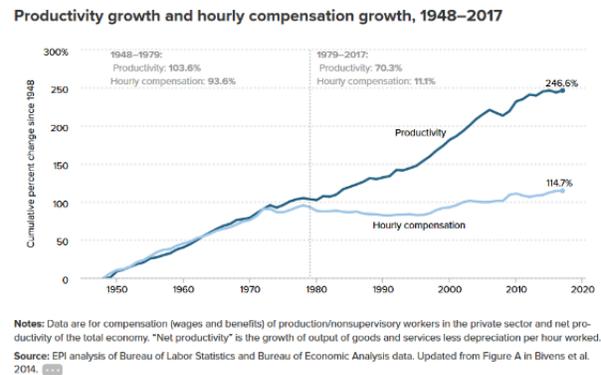


Figure 6: Productivity growth and hourly compensation

3.2 How Bad Could It Be?

Harvard business professor and behavioral economist, Michael Norton and Dan Ariely, asked more than 5,000 Americans how they thought wealth was distributed in the United States. Dividing the country up into 5 groups of the top, bottom, and middle three 20% groups, the economists asked people

how they thought the wealth in this country was divided and what they thought the ideal distribution was. 92%, or 9 out of 10 people said it should look more equitable than what they think it is. It's telling that most Americans already know that the system is skewed unfairly; however, the ideal is as far removed from the perception of reality as the actual distribution is from what Americans think it is. Not only do the bottom 20% and the second 20% (the bottom 40%) of Americans barely have any of the wealth, but the top 1% has more of the country's wealth than 9 out of 10 Americans think the entire top 20% should have[46].

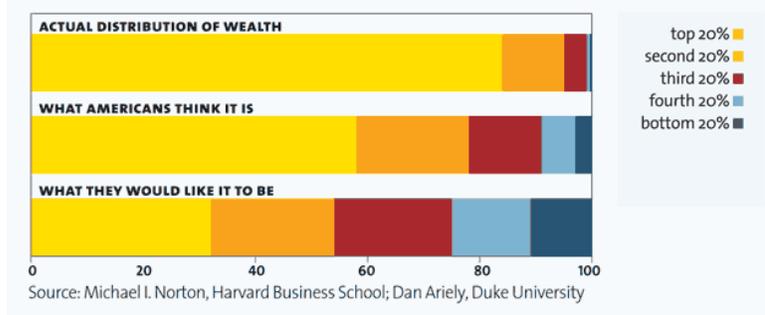


Figure 7: Actual, perceived, and ideal wealth distribution of America

If America's 311 million population is reduced to a representative of just 100 people, split up into the 5 groups above, and have a pile of cash distributed to them. If the pile of cash is distributed like the actual distribution above: the poorest Americans barely register on the scale, the middle class is barely distinguishable from the poor, and the rich of the top 10-20th percentile are worse off than the other two distributions. Only the top 10% are better off – so much so that the top 2-5% are off the chart at this scale. The top 1% has a stack of money 10 times more than what can be shown on the graph. It must be restacked and added as a new column. 1% of Americans have 40% of all the nation's wealth. The bottom 80%, or 8 out of 10 people, only has 7% between them[47]. This has only gotten

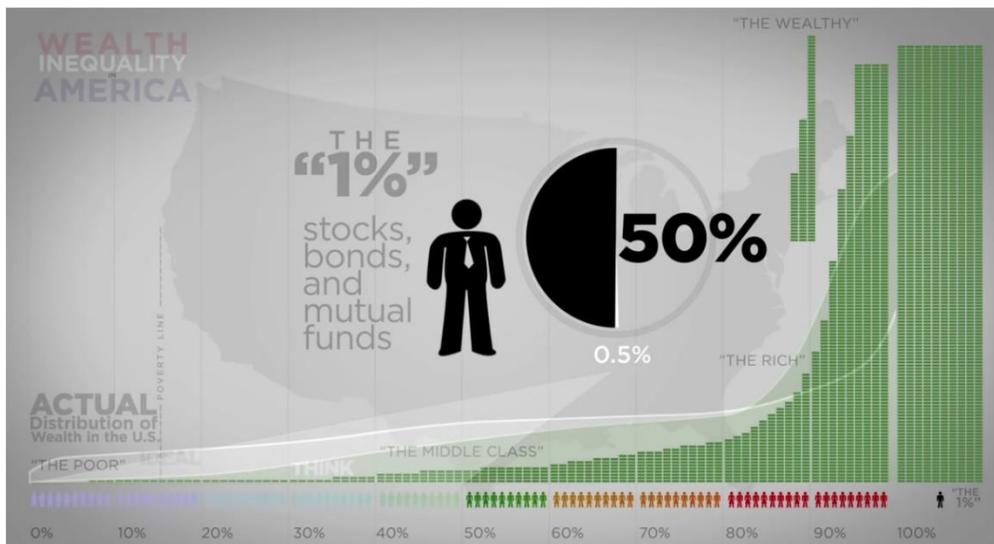


Figure 8: Actual wealth distribution in America represented by 100 people [33]

worse in the last 20-30 years. While the top 1% take home nearly a quarter (24%) of the national yearly income today, in 1976 they took home only 9% nearly tripling their share of income [47]. The top 1% owns nearly half (50%) the country's stocks,

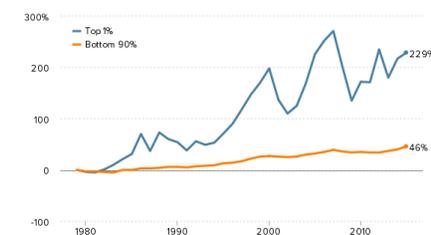
bonds, and mutual funds, while the bottom 50% own only half of 1% (0.5%) of these investments[48].

These people are not investing – they are just scraping by. CEOs make 380 times the wage of an average employee, however, it is not reasonable to believe that the CEO is working 380 times harder than the average employee and certainly not justifiable. Not the lowest paid employee, but the average earner in the company. The average worker needs to work for more than a month to earn what the CEO makes in one hour[49].

The rise in American inequality is extreme even when using comprehensive income measures, which include taxes and transfers. In the EPI's analysis of data from the CBO in 2018, they showed change in comprehensive income – including cash, market-based incomes (wages and salaries, dividends, rent, capital gains, and business income); non-cash income, such as employer contributions to health insurance premiums; and cash and non-cash government transfers like Social Security, food stamps, Medicare, and Medicaid. One striking aspect of the figure is the large decline in top 1% incomes following the onset of the Great Recession after 2007. However, a similarly large fall in top 1% incomes resulted from stock market declines following the 2001 recession as well, and as the figure shows, as of 2015, these incomes mostly recovered. Even with the losses, the top 1% of household income has grown 229% since 1979, far in excess of the slower 46% growth – just 1.0% annualized growth – for the bottom 90% of households[50].

Top 1 percent incomes grew five times as fast as bottom 90 percent incomes

Change in real annual average household income, by income group, 1979–2015



Notes: Data are for comprehensive income, including market income, social insurance benefits, and means-tested transfers. Average income for the bottom 90th was constructed using a simple weighted average of the bottom four quintiles and the 91–90th deciles.

Source: EPI analysis of data from the Congressional Budget Office (2018).

Economic Policy Institute

Figure 9: Income inequality since the 80s

3.3 Shareholder Value Model

This compounding inequality is being driven by the increasing financialization of corporations and the focus on maximizing shareholder value[7]. The dominant idea in corporate governance is that shareholders come first. In fact, executives who maximize shareholder value benefit by securing the stock options have led to an explosion in their personal wealth. This has produced a singular focus on rewarding shareholders and neglecting all other stakeholders including employees, customers, suppliers and distributors, the environment, and communities where the business is located. Firms neglect their wider social obligations and limit investment in human capital development, innovation, and research; in fact, they are encouraged to do so. Rather than investing in their future, companies are under constant market pressure to yield dividends and make huge share buy-backs that leave them without funds for more productive investments.

Rather than shareholders investing money in companies, they have been ripping out corporate funds and leaving companies with a net deficit rather than investment. The profits of companies have been distributed almost entirely to shareholders in the form of dividends and share buy-backs, leaving barely anything to, for example, raise the living standards of the laborers that made the money.

Compounding inequality has disfigured the world with the super-rich monopolization of assets. The sustained and rapid inflation in top income shares has significantly contributed to the accelerating rate of income inequality. Explanations for this increasing rate have been attributed to changes made in the Reagan and Clinton administrations, and the replacement of progressive taxation by regressive taxation.

Enhancing the prosperity of the economy and society has devolved into the much narrower goal of maximizing shareholder value. Shareholder primacy is a damaging ideology and has destabilized industry and compounded inequality. A commitment to long-term value creation is required and must respect the contributions and interests of all stakeholders – starting with labor.

4. Power Inequality

Power inequality is the lack of diversity of voices when deciding how work is managed which has long been a problem. Unions are critical to the solution, as they have been the only proven way to give workers a voice on their conditions via collective bargaining. As workers fear for their jobs and get frustrated with having no voice in how their work is managed, outcries and activism occurs. The ability for workers to collectively bargain have been seen to make conditions for all workers better; union or not.

4.1 Automation's Impact

The effect of automation on the voice of workers is multi-faceted. Directly, it creates less people available to bargain for rights and exacerbates the systematic issues labor movements fought against. Indirectly, it has created new reasons for labor to have a voice in the management of their work due to rising ethical questions of the role technology plays within the workplace and within the world.

Automation can rapidly improve the lives of many and create great wealth. For example, the automation of critical tasks in medicine should dramatically reduce the cost of health care while improving accessibility and equality of treatment. Realizing this potential prosperity means moving to an economy in which work plays a much different role from the one it does currently; one that includes working class people in decisions about how their lives will be affected.

While Americans are extremely worried about being displaced by automation, countries with strong labor movements such as Sweden embrace the change — and so do their unions. The European Commission found that 80 percent of Swedes have a positive view of robots and AI[51]. Swedish employees benefit from increased profits through automation by receiving higher wages from the increased productivity automation allows for. In addition, Sweden's free health care, education, and job transition programs dampen the risk of losing a job. The US, by contrast, provides almost none of these services[52]. Sweden's trucking unions have encouraged the implementation of autonomous vehicles, because, while the workers would be displaced, they would be able to find higher paying, better jobs.

The lack of worker representation and voice in companies, along with the development of new questionable technologies, has created a space where ethical issues are not considered in order to make profit. However, there have been many recent examples of workers taking action against the establishment of their companies, pointing out and changing decisions that have been ethically questionable.

4.2 Unions and Shared Prosperity

As union membership has declined, and therefore the power of workers to collectively bargain against the companies they work for, income inequality has risen. The Economic Policy Institute has found

that union membership has fallen to around 1920s levels, and inequality has dramatically worsened. This correlation of inequality and the rise and fall of unionization is not surprising, as stronger unions have always acted as a channel to vocalize workers' needs. For instance, the passage of the National Labor Relations Act in 1935 led to both "the countervailing power of labor unions and gave them the ability to raise wages and working standards for members and non-members alike". This correlation between unionization and relative equality has been consistent since.

Additionally, the Economic Policy Institute released a study that compared union membership to the share of income going to the top 10% of wage earners from 1918-2008. It shows that these two variables have an inverse relationship. As union membership goes up, wealth inequality goes down; as union membership declines, wealth inequality rises. This statistic is one of the most signifying evidence that unions create and promote shared prosperity.

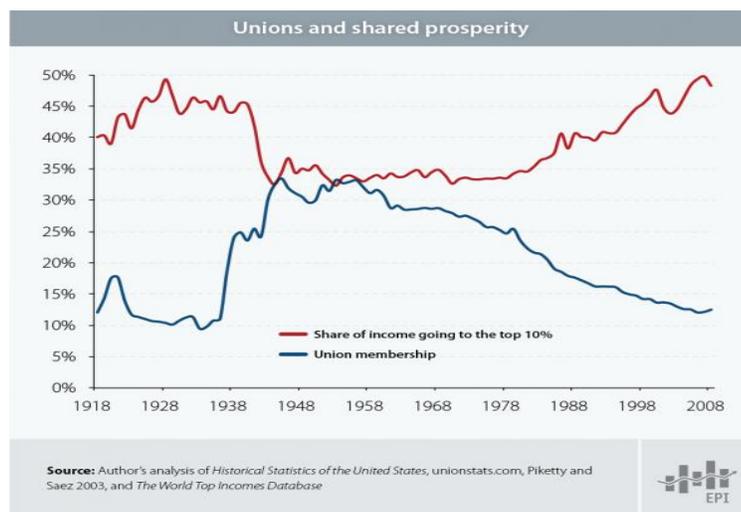


Figure 10: Union membership and share of income going to the top 10% of wealth owners

Automation is not a new challenge for the union movement. In a pamphlet published in 1956, the TUC (Trade Unions Congress) took a decidedly optimistic approach.

"Automation offers the prospect of higher pay, greater leisure, and healthier and less strenuous work," it said, but argued unions would need to make sure the benefits of greater productivity were shared with workers. In the 21st century, unions are taking the optimistic stance again by lifting ambitions and using the fear of automation as a recruiting tool and showing how they can be of help.

In Germany, the industrial union IG Metall is already using its power to translate productivity gains from technology into shorter hours of work for the German workforce. Earlier this year, it struck a landmark agreement with the Sudwestmetall employers' federation which gave workers the right to move from a 35- to a 28-hour week, while preserving the right to return to longer hours. IG Metall's chairman called it "a milestone on the path to a modern, self-determined world of work."

4.3 Activism and Collective Bargaining

Due to the lack of worker's bargaining power, new movements and new calls have been made to reclaim their rights. The increase of job automation is one of these calls and prompted 50,000 Las Vegas members of the Culinary Workers Union to demand protections against automation. Bethany Kan, director of communications at the Culinary Workers Union states, "We know that many hospitality jobs are slated to be automated in the next coming years, so we want to make sure that we're innovative and thinking about how we can protect workers and their jobs. Our automation and technology proposals deal with protecting workers. We know technology is coming and we want to make sure that workers are protected and have a say in how technology is implemented in their workplace"[53].

Workers also spoke up about ethically questionable uses of technology. In 2019, workers at Google caused ‘Project Dragonfly’, a censored search engine built to comply with China’s anti-free speech standards, to be terminated. The pressure for this project to be dropped was comprised of human-rights activists as well as workers, but the workers played a central role in the whistle-blowing[54]. Furthermore, thousands of Google employees signed a petition demanding Google cancel its contracts on Project Maven, a controversial Pentagon drone AI imaging program, and dozens of employees resigned in protest[55]. This led Google to pull out of the contract, however, they have since hired gig-economy workers to work on it[56].

Groups such as the Tech Workers Coalitions and Silicon Valley Rising have come into recent popularity as general tech-related organizing groups. These groups act as spaces for anyone tech adjacent, from the cafeteria workers at Facebook to Amazon warehouse employees, to organize and share ideas of how technology related jobs should be oriented. Additionally, they have been shown to help members of their groups form unions. For example, Silicon Valley security officers and Facebook’s cafeteria workers have formed their union with the assistance of these groups[57]. White-collar software engineers have also made attempts to unionize, most recently with the cloud-based logistics company Lanetix. In response, Lanetix fired them according to a complaint the engineers filed with the National Labor Relations Board[58].

Union-busting in the tech sector similar to that of Lanetix is not rare. Robert Noyce, co-founder of Intel, stated that “remaining non-union is essential for survival for most of our companies”. Steve Jobs of Apple was also famously anti-union, stating that unions shouldn’t exist anywhere. Recently, Tesla’s union-busting trial has been an important mark on how technology sectors may go about unionizing in the future and if they can unionize at all. Tesla has been accused of breaking federal law to restrict organizing as well as retaliating against pro-union workers. This was done by placing anti-union statements in contract agreements, and the firing of Richard Ortiz for pro-union activity. Elon Musk has taken his anti-union rhetoric to Twitter: “Why pay union dues & give up stock options for nothing?”[59]

The AFL-CIO has commissioned policy on the Future of Work that will discuss how workers of the future should go about gaining collective bargaining power - the most important aspect of organizing workers. As it has been seen, there have been many reasons for why workers want this power. Forming unions and being able to negotiate wages and other conditions is of utmost importance for workers to gain back power over their working conditions.

“[The American worker] is smart enough to know, in his bones, that salvation lies – not in reshuffling the chairs in the boardroom or the executive suite – but in the growing strength and bargaining power of his own autonomous organizations.” -Lane Kirkland, Professor of Law at the University of Pennsylvania Law School, President of AFL-CIO (1982)[60]

5. Recommendations

There are three central problems within the scope of this paper: lack of transition programs for workers displaced by automation, the growing income inequality exacerbated by automation, and the inability of workers to collectively bargain. The lack of transition programs for workers displaced by automation is directly addressed, while income inequality and bargaining power are indirectly addressed through programs that shift value systems towards workers.

5.1 National Retraining Programs for those Displaced by Automation

A national retraining program for those displaced by automation would help alleviate the problem of the unprecedented amount technological unemployment due to automation. It would not fix the problem of the jobs loss, but it would create a stress-free transition program to fill new-collar jobs.

5.1.1 State Programs to be Modeled

Many states have led the way when it comes to retraining programs surrounding this issue. Ohio, Tennessee, and Michigan have created programs that assist the retraining process of workers. Additionally, the US Department of Labor already has programs in place that if funded and expanded could help more people.

Through the Ohio Department of Job and Family Services (ODJFS), programs such as reemployment activities for unemployment compensation recipients reduced unemployment rates in Ohio. These programs include a resume and job bank created in partnership with Monster.com and refocused efforts to increase the number of On-the-Job Training opportunities available for Ohioans[61].

Tennessee Career Centers offer different types of skill training such as workshops, seminars, and other services on an individualized basis. Additionally, the federal government and state of Tennessee provide additional job programs and grants for secondary education. Those who use the centers, including potential job applicants, can apply for grants that allow adults and displaced workers to access resources at Tennessee Colleges of Applied Technology. Displaced workers can use these resources to receive workforce training, skills assessment, employment-related testing, referral, and case management services[62].

The Michigan New Jobs Training Program allows community colleges to provide free training for employers that are creating new jobs in Michigan, paid for by capturing the state income tax associated with the new employee's wages. This is a local program where individual community colleges work directly with employers and local economic development to support job creation. Furthermore, there are no restrictions by industry or employer size. Additionally, Michigan has launched skilled trades program called Going PRO that assists workers to find new collar jobs. This includes training for programs in fields such as advanced manufacturing, automotive manufacturing, construction, energy, healthcare, and information technology. Through the Michigan Works! Agencies (MWAs), displaced workers are eligible for funds in these career and training services[63].

While these programs are a great start for retraining workers, there are still problems that they do not have the funds to address. While helpful that workers are eligible for funding to pay for the training, but they still need additional resources to provide for themselves and their families.

The US Department of Labor's Employment & Training Administration (ETA) has expanded their Industry-Recognized Apprenticeship Programs (IRAP) to \$183 million in grant awards and \$100 million in grant funding. However, many are unaware of these programs and funding. More visibility to these programs is needed, and as well as pairing with state-wide programs that offer technical training[64].

5.1.2 Educational Programs to be Modeled

Educational programs that transition workers into new collar jobs are exemplified by the RAMTEC program in Ohio. RAMTEC is the nation's only provider of robotics and advanced manufacturing industry certifications in one place. They offer excellent skilled training as post-secondary education. This is a perfect example of the training workers require to move into new collar jobs.

RAMTEC offers industry training that includes 38 robotic workstations and 8 industry certifications. Industry partners in this program include FANUC, Yaskawa Motoman, Parker Hydraulics, Mitsubishi PLC, Allen-Bradley PLC, and Lincoln Robotic Welding. Specific certifications are Welding & Fabrication and Robotics. This kind of industry-education collaboration is extremely useful to workers and makes job searching easier. To estimate the expense of a course and certificate, Robotics & Automation Training offered is only 52 hours and costs \$2,995. Paired with state grants, this program becomes very accessible. These certificates result in large pay raises and, in turn, pay off the initial cost. However, programs need to be enacted to enable people to take time off to train while supporting themselves and their families[65].

5.1.3 Job Security Councils

A network of job security councils jointly run by industries and unions may be implemented to assist laid off workers with skills that are still in demand and out of reach of automation. They would track which jobs and skills are most in demand and adapt quickly to market changes so that workers will be put into the most needed jobs. These entities would be non-profit insurance-based organizations providing Individualized transition service to all redundant employees covered by the agreement.

The programs, funded through social partner contributions instead of state or national funding, would require employers to pay into them. If they lay employees off, those workers would receive financial support and job counseling from the council to help reintegrate them back into the workforce as soon as possible. These councils are more effective than government-administered programs because they intervene immediately after a layoff. This type of system may be a beneficial option for companies that have enacted the co-determination model.

A similar council exists in Sweden for all laid-off workers. These existing programs would have had incredible success with 80-90% of workers placed into similar jobs, if not better, within 8 months and would make great examples for future work in the States[66].

5.1.4 Cost Analysis

While implementing retraining and educational programs will be expensive, the data shows that retraining and public assistance programs at an unprecedented level will be needed to keep most people economically stable. The inevitable march of mechanization will spur greater productivity, boosting wages, consumption and economic growth – thus creating a boom that leads to an even

greater number of jobs. If retraining programs such as this are implemented it will be paid off by the prosperity that it creates. The correlations between automation, productivity, and economic growth show that there will be more than enough influx of money to afford these programs. It is unknown how fast this program would help people, but if modeled correctly there are viewable gains through its implementation in Europe.

Those that would gain from this solution would be the many workers that have and will be displaced by automation. Instead of being laid-off and fearing for their economic security, they will have a comfortable fall back. Many who have gone through similar programs have said that the availability of job counselors have alleviated tremendous psychological trauma that they would have experienced fearing how to make their next paycheck[67].

5.1.5 Evaluation

To evaluate how well retraining programs are working, there must be an evaluation of how many people are displaced by automation a year. NYU Professor Rob Seaman has called for funding for a Census program which measures technology adoption in US businesses[68]. This information could then be compared with employment numbers to see if displacement is happening, at what rate, and what kind of jobs are most affected. To evaluate this program, information from the census could be taken and compared to the number of people who have been placed into new jobs and how long they have been there. Similar data in the OECD has been used to evaluate national retraining programs. Sweden leads in helping displaced workers find new jobs – over 85% of such workers find new jobs within a year. Data also shows that this is primarily because of arrangements between employers and social partners[69].

5.2 Labor-Centered Innovation Policy (LCIP)

Instead of spending money on Silicon Valley startups to create ideas of the next big thing, innovation policy should be directed towards creating new long-term jobs that help workers. By centering the US's innovation policy around labor, and expanding labor research, the values that the country holds around its labor force may shift into a more positive direction. Currently, the US has no national innovation system.

5.2.1 Why and How?

National innovation systems have been proposed by the OECD as “a set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and provides the framework within which governments form and implement policies to influence the innovation process.”[70] It is a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artefacts which define new technologies. In short, an Innovation Policy would be the framework in which government promotes, creates, and transforms new technologies. A labor-centered innovation policy would be a framework used to promote, create, and transform new technologies with specifically the *laborer* in mind.

A country's innovative performance largely depends on how the actors within the framework relate to each other as a collective system of knowledge creation. For example, public research institutes, academia and industry serve as research producers carrying out R&D activities. On the other hand,

governments, either central or regional, play the role of coordinator among research producers in terms of their policy instruments, visions, and perspectives for the future[70].

The idea of a labor-centered innovation policy is reinforced by the section of Philosophical Relevance: if labor is no longer valued over the productions of the labor, then any innovation made will simply be made to produce more material items and wealth at the expense of the betterment of people and the non-monetized value they may put into the world. By crafting innovation policy with labor, or human value creation, at its center then people's lives will be affected and accounted for. Automation, if continued, will be found to be the largest, fastest, and cheapest producer of material goods. A restructuring of how the U.S. defines value must be made; whether that means optimizing human labor, environmental impact, or general betterment of all people has yet to be determined. For the case of this paper, it will be defined as labor. This must be started with innovation policy and labor must be the focus.

5.2.2 Framework

An example of how labor-centered innovation policy would work can be modeled by The Frames of Innovation from the TIPC (Transformative Innovation Policy Consortium) of the SPRU (Science Policy Research Unit at the University of Sussex). This model attempts to re-think innovation policy and draws on evolving and emerging academic theory in socio-technical transitions. This framework has sustainable development goals in mind, reflective of the UN's Agenda 2030, and includes inequality, employment, and pathways to economic growth and development.

There have been different approaches, or "frames" for what an innovation policy should be. The first framing refers to policies aimed at generating social benefits through R&D investment. The second framing refers to the systemic relationship between innovation investments, and the industrial and institutional framework of a country (the National Systems of Innovation). The third and current framing refers to transformative innovation policy that explicitly and fundamentally addresses societal goals as a primary focus.

A. Frame 1: R&D and Regulation

The first framing incentivizes the market to produce socially and economically desired levels of science knowledge, primarily implemented by subsidies and measures to enhance how appropriate the innovation is. The most important element of innovation in this framing is the discovery process and gives rise to a linear model in which technology is the application of scientific knowledge. The linear model prefers discovery over application because the benefits of application are assumed to be carried out through an adequate functioning of the market system[71].

B. Frame 2: National Systems of Innovation & Entrepreneurship

The second framing enhances knowledge production, supports commercialization, and bridges the gap between discovery and application. Different forms of learning are required for this to succeed: acquired by using, producing and interacting; acquired by a cross pollination from different disciplines; acquired by the capacity and capability formation of firms; and acquired by entrepreneurship. The promotion of innovation through these varying

approaches helps to build technology platforms, technology clusters, and stimulates interaction and human capital formation[71].

C. Frame 3: Transformative Innovation Policy

The third framing starts with the negative impacts and externalities of innovation that overtake positive contributions. This frame focuses on mobilizing the power of innovation to address a wide range of societal challenges including inequality and unemployment. It emphasizes policies for directing socio-technical systems into socially desirable directions and embeds the process of change in society. It explores issues around socio-technical system change to produce a structural transformation in: governance arrangements between the state, the market, civil society, and science; experimentation and social learning; responsible research and innovation; and, finally, a more constructive role for foresight to shape innovation processes from the outset and on a continuing basis[71].

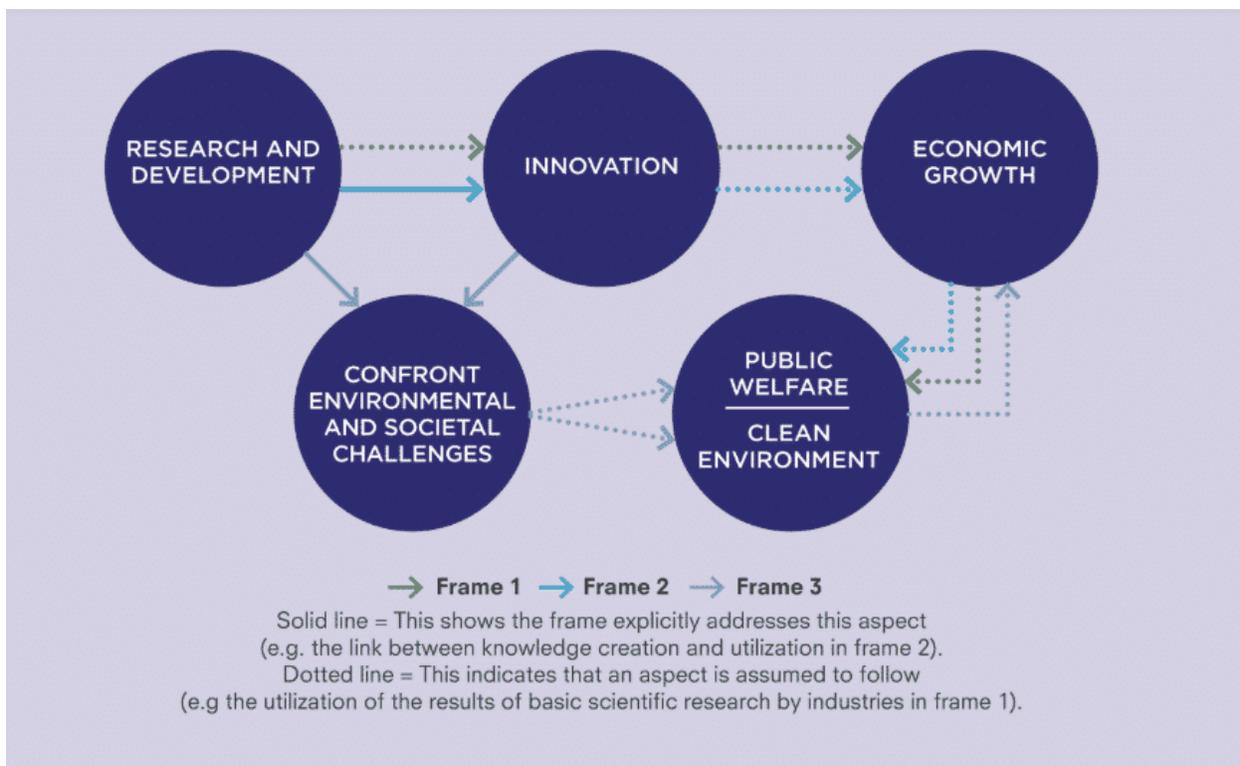


Figure 11: Flowchart of innovation policy framework.

Frames 1 and 2 assume public welfare will be addressed through new knowledge and innovation utilized by industry to achieve economic growth. Conversely, Frame 3 explicitly and fundamentally addresses societal goals as a primary focus. By tackling societal challenges first and foremost, it can be assumed that there will be greater productivity and less inequality, therefore, increased economic growth. This is a flow counter to Frame 1 and 2 and is visualized in the flow chart of Figure 8.

5.2.3 Expanding NSF Convergence and FW-HTF Research

The NSF has identified Convergence Research in 2018 as some of the 10 Big Ideas for Future NSF Investment. Convergence Research is an interdisciplinary research area focused on solving complex problems around societal needs. It entails integrating knowledge, methods, and expertise from various disciplines and forming novel frameworks to catalyze scientific discovery and innovation. Convergence Research has two primary characteristics: research driven by a specific compelling problem, and deep integration across disciplines. Meaning the problems addressed arise from either deep scientific questions or pressing societal needs, and require multiple viewpoints to pursue knowledge, theories, methods, data, research communities, and languages that become intermingled and integrated. This may result in new frameworks, paradigms, or even disciplines to form sustained interactions across multiple communities[72].

The NSF (National Science Foundation) has done incredible research in terms of how technology is related to labor. Specifically, Growing Convergence Research has created a space for interdisciplinary research to solve large scale societal issues. In 2018, NSF announced research awards, issues under the FW-HTF (Future of Work at the Human-Technology Frontier), to shape the human-technology partnership for the well-being of workers and their productivity. This award should be expanded to encourage more research in this area.

Within Convergence Research, the FW-HTF investment responds to challenges and opportunities for the future of jobs and workers in a landscape with rapid social and technological changes by supporting convergent research at the intersection of future work, technology, and workers. The aims of this research are to: understand and develop the human-technology partnership; design new technologies to augment human performance; illuminate the emerging socio-technological landscape and understand the risks and benefits of new technologies; understand and influence the impact of artificial intelligence on workers and work; and foster lifelong and pervasive learning[73].

These research frontiers should be central to the LCIP as core examples of where the innovation policy should be directed. By focusing research on technological impact of workers, the long-standing issues that have systematically worsened due to it may come into a popular purview and value.

5.2.4 Cost Analysis

Shifting innovation policy around workers and socio-economic issues would require little funding. However, there will be funding needed to expand the NSF research with this innovation policy in mind, which can be redirected from anywhere within the NSF. There is no defined strategy for how to get this money, but there are definite calls for funding. If more research is put into innovations for the future of work, more jobs and people will be better off. The economic benefits from this research will succeed or equilibrate the money spent on it.

5.2.5 Evaluation

To evaluate LCIP performance, multiple facets of its impact must be studied. This includes impacts on work, automation, technology, and innovation. These areas may be evaluated by various modes. Scholars that have created supportive institutions and organizations that relate to these issues could be used to evaluate innovation. The ways automation has been implemented into work, specifically

with how it affects workers, could be used to evaluate work and automation. Worker consideration of the invention of new technologies could also be used as an evaluation metric.

5.3 Co-Determination Model for Businesses with Large Revenue

This recommendation is that corporations responsible for over \$1B in revenue must switch to a co-determination model of their board of directors and company. Under this model, a certain percentage of the board would be elected by and represented by workers. The practice of board level representation is widespread in developed democracies. Some exist in the United States, but it is not widespread by any means. This recommendation would give workers the power to vocalize their needs when it comes to automation displacement and its resulting profit distribution.

5.3.1 Worker Representation on Boards

Co-partnership or “worker participation” is the practice of workers in an enterprise having the right to vote for representatives on the board of directors in a company. It also refers to staff having binding rights special bodies, known as work councils, to address issues in their workplace. Work councils can be considered shop-floor representation of workers.

In smaller companies, work councils may elect worker representatives who act as intermediaries in exercising the workers’ rights. These representatives guarantee that the employees are being informed or consulted on decisions concerning employee status and rights. In a one-tier management system for larger companies, employees are directly given seats on a board of directors. In two-tier or higher management systems, employees are given seats in a supervisory board and sometimes a management board.

Moving to a co-determination model to have more worker representation on boards primarily exists: to reduce management-labor conflict by improving and systematizing communication channels; to increase bargaining power of workers at the expense of owners by means of legislation[74]; and to correct market failures by means of public policy[75].

5.3.2 Stakeholders over Shareholders

As mentioned in Section 3.3 the shareholder value model is the practice by which the ultimate measure of a company’s success is the extent to which it enriches shareholders. By shifting away from this model and instead placing the stakeholders (i.e. employees, customers, suppliers and distributors, the environment, communities where the business is located, and possibly shareholders) as the metric for success, the company will benefit more people and the world.

To shift corporate values from shareholders to stakeholders requires significant overturning and change, mainly a fundamental change in corporation’s value system. The co-determination model will help to make this shift by diversifying the voices present in decision making, and therefore diversifying the value system.

A corporation should be reflective of all its effects. It has been shown that corporations neglect many basic things such as environmental protection and the wellbeing of their workers in favor of profit. The ethics of firms are compromised in the interest of increasing share value[76].

By moving to a stakeholder framework, with representatives of each stakeholder on the board, the intrinsic worth of a business will be changed to be measured by a combination of financial success, usefulness to society, and satisfaction of employees. The priorities become determined by the makeup of the individuals that heavily rely on the wellness of the company. Stakeholder value therein relies on corporate social responsibility and long-term financial stability as a core business strategy.

5.3.3 Similar Proposals

Similar proposals of the co-determination model have been enacted in other countries; some examples exist in the US as well. These models have affected countries like Germany and Sweden very positively and have been reflected in the general happiness of workers.

In Germany, Mitbestimmung is the modern law on codetermination. This law allows workers to elect representatives (usually trade union representatives) for almost half of the supervisory board of

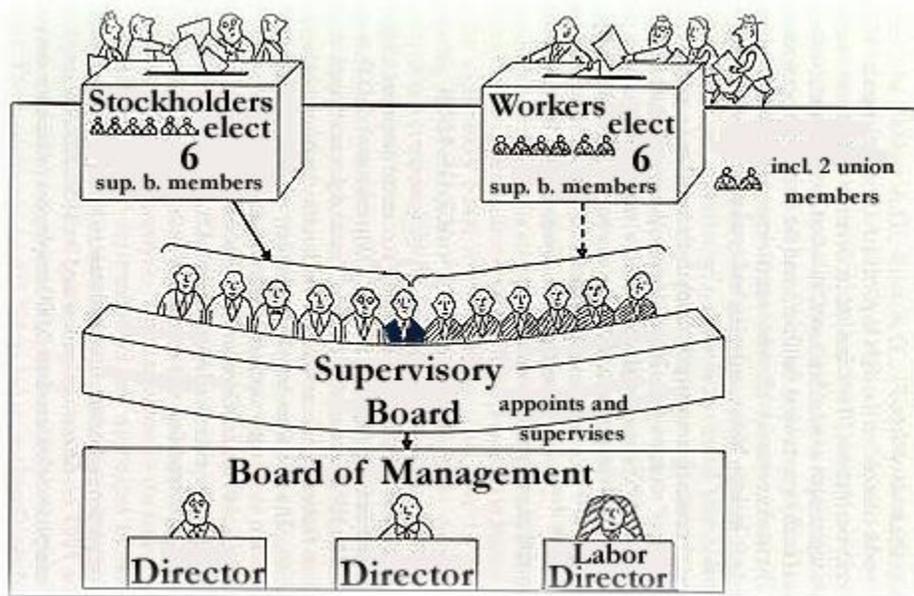


Figure 12: German Co-determination model

directors. This board is half elected by stockholders and half elected by workers. When the company has a union, one third of the elected workers must represent union interest. The supervisory board then appoints and supervises a board of directors with the skills they see fit at the time [77].

In Sweden, workplace

representation is through the local union at the workplace without any other channel. Legislation requires the employer to inform and negotiate with the unions at the workplace before making major changes, and many of the practical arrangements for doing so, which elsewhere in Europe are fixed by law, are left in Sweden to local negotiations[78].

The United States has, in Massachusetts, the world's oldest codetermination law that has been continually in place since 1919, although it is voluntary and relegated to only manufacturing companies. However, many universities enable staff to vote in the governance structure and in the 1970s, a number of large corporations including Chrysler appointed workers to their board of directors pursuant to collective agreement with the labor union[79].

In April 2018, four Senators sponsored the Reward Work Act (S.2605) which would amend federal legislation to require all listed companies to have one-third board representation for workers. Polls

showed majority support among Americans for the measure. In August 2018, Elizabeth Warren sponsored a new Accountable Capitalism Act that would require 40% of the board of directors be elected by employees in federal corporations with incomes over \$1 billion.

The idea of co-determination is not new, and its implementation in the US has been done before. However, the scale at which this recommendation is proposing would be. While considered an extreme measure, at this current moment, something must be done to give workers more power in the decisions companies make.

5.3.4 Offsetting Costs

Shifting to a co-determination model will cost no money and may increase the funds a company would have as they would no longer have to give out market shares to shareholders. The disruption this would cause would be unprecedented

5.3.5 Evaluation

The effects of a co-determination model would generally be evaluated by the amount of power workers have in the decisions their companies are making. For this to be done, multiple variables must be considered. A ratio of overall productivity and wage compensation should be used to determine how well the new model will work.

Final Notes

The fears of automation and job loss are a reoccurring theme throughout history. At face value it is a binary problem: if you stop automation then you stop job loss. The structures, institutions, and systems we live under; however, are not binary and therefore no problem under it can be fixed in this way. The fears of automation and job loss can be examined as existential fears of an unstable system that supports a country's life. It quickly turns into fears of losing healthcare, losing wages, losing a decent standard of living, and so forth. The U.S. can fix these problems through healthcare for all, unemployment benefits, social services, and programs that benefit everybody. The means for these programs to be achieved can be done through technological development with the help of institutions whose goal is to better the lives of all. Employer duties and burdens - such as healthcare, paid leave, and retirement funds - should be considered basic rights and offered regardless of where (or if) someone works. Human labor is artificially and unnecessarily taxed because of these costs, thus creating a demand to replace it entirely with robotic labor. Technology should be used as a means to free humanity from its limiting material conditions; instead, it is being used to reinforce the barrier between what can be achieved.

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