

Where Will Work Come from in the Era of the Cloud and Big Data?

Or

Sustainable Growth and Work in the Era of Cloud and Big Data:
Will Escaping the Commodity Trap Be our Undoing?

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Abstract

Will the digital revolution, and its current manifestation in Cloud computing and platform-based work, inexorably lead to the elimination of jobs and work due to automation. Are new opportunities for work opening? Should we be thinking in terms of conventional work or is value creation the key? Certainly, nearly all firms are experiencing intense competition leading to commoditization based principally upon price. In the first section of this paper, we explore the pathways opened as cloud computing, transforms the way both goods and services are innovated, produced, and distributed. Production now has two aspects; classically understood manufacturing and ICT-enabled services, activities and virtual goods, both of which can be transformed to escape a commodity trap. As firms in advanced countries seek to sustain advantage in global markets, their efforts alter not only the terms of competition, but the character of work. The second section speculates upon the ways in which the cloud, as a platform, is transforming the nature of work, jobs, and employment. The emergence of cloud-based platforms such as, Airbnb, the Apple app store, Github, Google, LinkedIn, and Uber is redefining the forms and nature of value creation. Paradoxically, given that Google monetizes peoples' searches, Facebook and LinkedIn monetize posts, Github monetizes open source software creation, and App stores monetize software creations, it is also possible to argue that more value than ever is being created, even while traditional notions of employment are being challenged. This suggests that as a consequence of the implementation of cloud-based strategies; an entirely new category of work organization, which we term, the "Platform Economy" is emerging.

The advanced industrial democracies are struggling to sustain the employment and productivity growth necessary to expand the real income of the citizens. In large measure, the current struggle is around the efforts to escape what we call "the commodity trap." A diverse array of competitors use widely available conventional technologies to generate roughly similar standard goods, components and services. The resulting intense competition leads to commoditization, competition based principally on price. The consequence of the commodity trap, competition based principally on price, is intense pressure on wages and profit margins alike. One way out of this trap is for firms in the advanced countries to create distinctive higher value-added products – both goods and services. But how to do that?

In the first part of this essay we discuss pathways opened as ICT, and the latest ICT platform – cloud computing, transforms the way both goods and services are innovated, produced, and distributed. We emphasize that production now has two aspects; classically understood manufacturing and ICT-enabled services, activities and virtual goods, these are transformed in the effort to escape the commodity trap. As firms in advanced countries seek to sustain advantage in global markets, their efforts alter not only the terms of competition, but the character of work. In the second part of the essay we explore how cloud is transforming the very nature of work, creating entirely new platforms for the organization and monetization of work. Work and its organization and labor market dynamics are being recast by an entire array of developments. Here we focus on one consequence of the implementation of cloud based strategies; entirely new category of work organization, which we term, the “platform economy.” Even as advanced country firms find new competitive advantage, the platform economy they are generating is characterized by interesting new types of work contingency.

The case of Cargotec helps us understand how firms can escape the Commodity Trap through integrating their business offering through utilizing ICT-enabled services. In recent years, Cargotec, a Finnish company that produces port equipment, began facing intense competition, particularly from Chinese producers offering very similar products. Rather than compete principally on price, the company decided to begin selling “port management services.”ⁱ If successful, this will not mean that Cargotec will end its manufacturing business. Rather it increases the intelligence of its products, developing a digital platform capable of managing and integrating the various types of port equipment they are offering. Cargotec hopes to go to its customers with a proposition: “Buy a Chinese crane? Great, but your port will be more competitive, much less expensive as well, if you buy our integrated system.”ⁱⁱ Effectively,

Cargotec has created a platform upon which a port owner can manage all of their operations. This is a first step in an increasing integration of entire production systems. This development that is being repeated throughout the industrial and service worlds is only a first step in what is becoming possible with the cloud. And, it is with the transformation of manufacturing that we begin our exploration of the transformation of the economy and work.

However, there is much more. The cloud is computational enabler for the creation of entirely new workplaces and new markets for work. In addition to the rising tide of open source software, a type of value creation that does not have direct monetization, there are new methods of organizing compensated work.ⁱⁱⁱ The key to this new organization of work are the cyber-platforms ranging from oDesk-eLance, Amazon Mechanical Turk, Uber, Airbnb, and TaskRabbit to Youtube, Udemy, and Amazon self-publishing. We distinguish the difference between online contracting platforms and what we term “cyber-consignment” platforms. Both types of platforms are already affecting the ways in which work is organized and the relationship of those performing the work to society as a whole. There is every prospect that the effects will continue to grow.

The Production Transformation

We are only at the beginning of the transformation of production. We consider in this section the transformation of services, as ICT-enabled services continue to expand, and of traditionally understood manufacturing. In the second section of the essay we consider the impact of these transformations on employment and labor market dynamics. We begin though with the Cloud Accelerator.

The Cloud Accelerator^{iv}: The latest information technology platform, cloud computing, is accelerating both the transformation of services and manufacturing. Why will Cloud be such an accelerant? First, cloud computing makes computation-intensive resources widely available, not only to startups and small and medium-sized businesses, but also to smaller innovative groups within major companies, or even individuals building a new app from open-source software components downloaded from GitHub. That means access to and the deployment of big data, design tools, prototyping, analytics for new materials, or just sophisticated logistics is becoming ubiquitous. This turns many of these into a commodity, even as they themselves can be used to make and share unique new products, both virtual and material, and services. Fundamentally, the Cloud speeds the development and deployment of new applications and tools.

Second, without delving into the details of Cloud architecture, the new “how” of computing will make the development and deployment of applications and services less expensive and faster. So we expect ever-greater experimentation by large and small firms, and ever more rapid change in the services and production arrangements that are provided. We move from an era of computing scarcity to an era of computing abundance.^v The cost of cloud computation and software is trending towards zero, as cloud computation itself is becoming the ultimate commodity (Bort 2014)!^{vi} A consequence of the cost of computation trending toward zero is that it becomes an inexpensive resource for both work automation, which will alter most if not eliminate many jobs, and the creation of websites, content, and the development and deployment of integrated systems – all of which will create jobs, indeed requiring creativity.

ICT-enabled Services: ICT-enabled services and service systems have become a source of continual disruption in the economy and labor markets.^{vii} It shouldn't have come as a surprise

that digital technology revolutionizes the service economy. The application of rule-based ICT tools to service activities alters how activities are conducted and how value is created. The fundamentals of this Algorithmic Revolution are simple:^{viii} tasks underlying services can be transformed into formal, codifiable processes with clearly defined rules for their execution. When activities are formalized and codified, they become computable.^{ix} Processes with clearly defined rules for their execution can be unbundled, recombined, and automated. The inexorable rise in computational power and the development of sensor technology means that computable algorithms can express an ever-greater range of activities, and consequently a growing array of service activities are reorganized and automated or, as Zuboff observed “informed.”^x

The impact of this ICT-enabled service transformation is pervasive. Once this was principally a matter of finance, insurance, retail and entertainment – sectors that are at their core about information and hence directly affected by the revolution in information. Now, because of the radically reduced cost of embedded processing power, services are increasingly embedded within products. Indeed, often manufactured products are sold as delivery mechanisms for the services. For example, MP3 players are portals to music provision sites^{xi}, cranes are enmeshed in port-management services, and agricultural equipment is now a mechanism for integrating weather information, managing soil content, allocating fertilizer, and predicting yield. In this world, algorithms function as the machines that process data. The key to this world of ICT-enabled services is the data that is generated, combined with yet other data, and mined to create higher value-added products and services but also to new value propositions. This is really the story of the Internet of Things, the Industrial Internet, and the varied other flashily branded versions of the story.^{xii}

These systems have at least three important characteristics. *First*, ICT-enabled services, and service systems, rest on capital-intensive goods and infrastructures and share production characteristics with manufacturing. Google's collection of server farms and Intel's chip manufacturing plants require capital investments of billions of dollars. *Second*, value is created in the service system, which is what the system can do, not in the basic cost of the individual elements. Therefore, competition is based on the value creation of the system, not on the cost of physical inputs and labor per se. Reducing energy use in buildings by the installation of algorithm-run control systems is an example. *Third*, some of the ICT-enabled service systems generate local employment directly. Sensor systems, for example, to control energy use in buildings such as to assess safety on bridges, or to monitor patients require the installation and maintenance of physical systems, even as the ability to predict physical system failure improves making maintenance scheduling more efficient. Assessing the balance of jobs created by ICT-enabled services and those destroyed by the power of digital processing will be difficult.

The Manufacturing Transformation: Classically understood manufacturing is the other part of the story. 21st Century manufacturing is being pulled in two directions, both facilitated by ICT tools. On the one hand, and the best understood and widely discussed, the decomposition of manufacturing, and indeed of ICT-enabled services, has produced complex cross-national supply networks. Production is not only geographically dispersed, but phases of the production process are increasingly localized in specialized regions.^{xiii} For example, conceptualization, development, and design of new product groups is associated with, for example, Silicon Valley.^{xiv} Volume production, particularly in electronics has become associated with firms such as Foxconn operating in China. As important, in some countries, including the United States,

that decomposition has in some sectors undermined the core infrastructure of skills and knowhow required for competitive advantage in production.^{xv}

On the other hand, the rapid evolution of advanced manufacturing often has the opposite effect, encouraging the re-composition of production as well as the re-integration of development and production. ICT tools support, promote, and accelerate innovation across the production phases of twenty-first century manufacturing: ideation, design, prototyping, fabrication, supply chains, sustainability, and engineering services.^{xvi} This rapid evolution of tools and materials lead to a reintegration of production in which design, as an example, needs to take into account rapidly evolving choices of materials and processes. Just as with ICT-enabled service systems, manufacturing systems require continuous recalibration and re-integration of the array of rapidly evolving tools across the phases of the production system. GE reports that often separating design from fabrication creates real problems in new product development and sustaining innovation in existing products.^{xvii} While, the result, it seems, is returning production of some products to the United States, the movement offshore continues apace. In a slightly different vein, Toyota, seemingly concerned about losing competitive advantage if it depends for batteries on its long time supplier, has begun its own internal development of batteries for hybrids.

A question that must be answered by firms and places: “In which cases is manufacturing a strategic asset, essential to competitive advantage, and in which cases is it a vulnerable commodity that can be safely outsourced?” Or very simply, *Can you control what you can't produce?*^{xviii} There will not be a single or dominant answer, and that answer may change over time and by product. Rather there will be a mosaic resulting from varied strategy choices by firms and policy choices by “places”.

What May Be the Consequences of the Production Transformation? The basics of the production transformation are increasingly evident. The consequences are much harder to estimate. Let us note several of the crucial issues:

- * First, where will production take place? We posed the question of whether the dynamics of decomposition with dispersed supply chains or an emerging logic reintegration of production will dominate. In the case of each paradigm of production, though, the question remains; will aspects of production cluster in particular places? Will phases of production concentrate in particular places? Although production has dispersed, Silicon Valley is the archetype of new product creation while today China is the archetype of volume production. With ICT tools including but not limited to the hyped development of 3D printing, the common enabler across the 21st century manufacturing continuum, in the cases of reintegrated production what will the location patterns look like? What local competencies and characteristics will determine the location of reintegrated production.^{xix}
- * Second, what will the tools be? Who will build the tools? Who will be the next generation toolmakers? Will they emerge from those who have a mastery of the underlying digital technology and learn to move forward make practical applications of the technology? Will the new tools come from the technology community? Or, conversely, will, for example, those who know industrial processes and material in manufacturing reach backward into the pool of emerging technologies and craft new approaches? Will the new tools build on existing industrial know-how? At the risk of a cliché, will Silicon Valley geeks or German and Italian tooling companies become

the tool makers of the next era and be able to extract the most value from their particular value chain? Most likely, both, but they will succeed very differently.

- * Third, will a radically new system of production emerge? Will a world of craft design and production become a new paradigm, or will highly integrated volume production with a capacity to create differentiated products emerge? The labels “Industrial Internet” “Internet of Things”, “Internet of Everything” “Cyber-Physical Systems”, “ICT-enabled services and manufacturing” all are attempts to envision and frame the ongoing and future transformation. But none can depict the character of that transformation. The outcome, or rather the several outcomes, since there will likely be more than one, could be powerfully shaped by the particular country or region that takes the lead, the place where dyads of tool and platform innovators and lead users emerge. In ICT-enabled services one would argue that this has been the United States. In manufacturing there are multiple challengers from Europe, Asia and the United States. The visions, methodologies, and preferred outcomes, are likely be quite different.

II. Where Will Work Come from in the Era of the Cloud and Big Data?^{xx}

In this section of the essay we ask, what might be the consequences for employment and the dynamics of labor markets of the transformation of production, ICT and cloud based, depicted above. Again, there are many sources of the reconfiguration of work and labor markets. We focus here on the consequences of ICT tools and ICT platforms.

Some things are evident: Many jobs will be eliminated; there will be fewer workers on the shop floor.^{xxi} Many others will be transformed in character; what it takes to be a designer or

an engineer is being changed by the ICT tools. As an exercise, it is important to try to estimate how the digital future will reshape existing work. But looking backwards does not tell us what is unfolding.

It is possible to formalize the changes to work that automation and digitalization may create. The most obvious changes are:

1. Jobs eliminated by automation.
2. Jobs transformed by automation.

These first two categories rest on an analysis, inherently, of data about existing jobs.

Brynjolfsson and MacAfee (2014), Osborne and Frey (2013) and others have suggested that computerization/automation is likely to eliminate major proportions of the work force. Such analyses suggest that automated processes will substantially reduce demand for existing jobs. Indeed, in that case, the skill-biased technical change paradigm that economists claim has explained the relative bifurcation of the work force may have run its course, as technical change (combined with services offshoring) is now threatening many of the “skilled” as well.^{xxii} But should we be so pessimistic? While 3D printing or customized volume production may reduce direct production jobs, they will, arguably, increase demand for product design and market analysis. In that case, then critical set of competencies and skills will just have shifted?

We observe that the historical tendency of capitalism as an economic model has always been to incorporate more human beings into the workforce, be they women whom only fifty years ago were, in a significant measure, not directly employed in the workforce, individuals retired from the workforce, or those living in the formerly communist nations. So, where should we be looking for the new workers being integrated into the work force?

1. New jobs created to build new tools and platforms for existing functions, the development and application of new tools from manufacturing design to big data analysis. Undoubtedly, the demand for data scientists has increased dramatically, but those using the tools to develop applications for 3D printers would have to be included. The Berkeley Invention lab in the computer science department is open to those focused on design; while 3D printers can now be found in sophisticated art schools.
2. Entirely new functions and products. This includes the proliferation of websites/cum platforms upon which various value-creating activities are undertaken.

Existing labor market data makes it possible to make some tentative and partial assessment for the first two categories that are essentially job destruction. The latter two categories, sources of new work, and other categories of work creation that might and, even we would suggest are emerging, requires imagination and speculation.

Consequently, we may be able to state the problem, what is the balance of job creation and destruction? We can, certainly, sketch scenarios that suggest different models of next-generation production and their employment consequences. While we cannot count the jobs that will be created, it may be possible to identify categories that may expand. Moreover, the scenarios we might generate, and their quantitative implications, of course, rest on assumptions about how new technologies are deployed. How technology is deployed and utilized, we know from examining previous technological changes, powerfully shapes the employment outcomes, both in terms of the number and character of jobs. In the ICT era it is evident in studies of RFID and call centers that the character and number of jobs depends on decisions about

deployment.^{xxiii} Consequently, one cannot credibly estimate an answer to the crucial questions: how many jobs, what sort, and where?

So, what can we do? We speculate here that the very logic of work creation is shifting. Our attention, we suggest, should not be on counting what cannot, at this point, be counted, but on trying to cipher out the new dynamics of firm creation and work generation.

Technology Platforms and Job Creation: One way of thinking about ICT firms is that many of the most successful build technological platforms upon which other firms build their businesses.^{xxiv} More recently, much attention has been given to the role of platforms and their economics. It has been recognized that the ecosystems that emerge around particular software or Internet websites create the value of those websites. To illustrate, the value of Facebook is derived from the platform it has created for the delivery of user-created content. As a firm, it has no value without the user-generated content. For Facebook, the largest revenue stream it generates is from delivering its users to advertisers. However, there are other monetization methodologies, for example, the gaming firm, Zynga, was built upon sales of games to Facebook users, but must pay a percentage of its income to Facebook. Thus, we can see Facebook as platform upon which users/free content providers, advertisers and service firms (i.e., games) interact.

Further consideration of Facebook's business model can provide hints as to where new work is being created and create a base for our further discussion of new work. First, the preponderance of the human "work" is not at Facebook itself, but is done by the user-posting content, as the posts are the raw material that Facebook monetizes. However, there is another group of workers and that is the employees of all the firms such as Zynga and individuals that are in the Facebook ecosystem. In 2011, one study estimated that Facebook App economy had

created the equivalent of 53,000 jobs (Hann et al. 2011).^{xxv} This would be in addition to the 3,200 employees Facebook had at the end of 2011. By 2014, Facebook had grown to approximately 10,000 direct employees, but it is not known whether the number of employees in the App Economy had grown apace. Regardless of quality of the estimate of the Facebook App economy, it is nearly certain that there are more persons working in Facebook's App economy than at Facebook itself, though almost certainly their total income is not as great as that of Facebook's direct employees.

The Facebook example provides the clue as to where and how the development of the platform economy may be creating significant "income" opportunities. The remainder of this section will discuss these opportunities. We turn first to the well-known platforms such as Craigslist, eBay, Amazon Market, Uber, and Airbnb. Each of these creates a cyber-market for products or services that undermine existing markets; some of which are highly regulated.^{xxvi} In the case of eBay and Craigslist, it is possible that some new income is being created. For Uber and Airbnb, it is a question whether new "rides" or new "hotel space" is actually being created. That is, it is less clear what new jobs are being created. The platforms rather may function solely or largely to drive wages down as the legal boundaries to market entry are eroded. Uber, and others like it, one might argue took formally organized markets such as for taxicabs and are restructuring them with unregulated workers providing service as needed. By contrast, platforms such as TaskRabbit and Amazon Mechanical Turk provide, quite different, micro work opportunities; work mobilization that would not be possible without the Internet. eLance and oDesk (now merged) have taken the informal market such as that for IT-related contract work and created a virtual contracting platform or cyber-formalized this work. TaskRabbit and Mechanical Turk are cyberformalizing contingent microwork. In certain cases, these are

replacing existing work, while in others they are creating new work and therefore new income sources. Of course, given that these sites are creating relatively open entry global platforms with few, if any price barriers/regulation, it is possible that they will drive the price per quanta of work to the lowest global price.

Platforms, such as YouTube, Amazon self-publishing, Kickstarter, Indiegogo, and the like, provide individuals creating virtual products, or trying to raise money to support projects, an opportunity to earn income in two different ways: Youtube and Amazon self-publishing provide creators the opportunity to monetize finished products. In these cases, the platforms collect revenue either through purchase (Amazon) or through advertising income. There is ample discussion regarding how the income is highly skewed toward the most successful contributors, but it is possible to earn a significant direct income on both sites. Also, many of the more successful contributors can create offline or ancillary income from the “fame” they developed online. An example of the growth of these types of sites is the Anaheim Vidcon Conference, which is YouTube-centric and targeted at online video creators. It has grown from 1,400 attendees in 2010 to over 18,000 in 2014 (Wikipedia 2014). This suggests that a new income-generation opportunity has emerged around Youtube. There is evidence that a similar process is underway for Amazon self-publishing.^{xxvii}

The final and probably largest online marketplaces are the Apple and Google app stores. These marketplaces/platforms dwarf the others. For example, as of January 2014 Apple had paid-out a total of \$15 billion since 2008.^{xxviii} Another website estimated that between June 2013 and June 2014, Google paid out \$5 billion to its developers.^{xxix} Of course, these payouts follow a power curve with a long tail of developers that receive little or nothing.^{xxx} The sheer size of

these markets means that they do generate a significant amount of income for certain firms and individuals.

Platforms are then, can be, sources of new work or methods for reorganizing the delivery of existing work. From the larger societal perspective, the question is whether these new sources and organizational structures for organizing work will offset the certain destruction of work prophesied by Brynjolfsson and MacAfee and others. Certainly, the platform owner, not the participant, captures a portion of any value created. Indeed, an economic policy question revolves around whether the current value capture regime that is characterized by enormous winners and a long tail of losers is the socially desirable outcome or, in fact, will contribute to greater income and wealth inequality. Furthermore, as we consider next, these sources of work are not “employment” in the current sense of the term.

Platforms and the Gig/1099 Economy

Cloud computing and the platform technologies clearly push toward an economy with a far larger proportion of independent producers, rather than employees.^{xxx1} Gerald Friedman (2014) argues that this is resulting in the formation of a gig economy composed of transient employees.^{xxxii} We go further that Friedman analytically by suggesting that this transformation is yielding two different types of workers: contractors and consigners. What they both share is that their compensation comes from the platform owner and is reported to the tax authorities through the Internal Revenue Service 1099 form, rather than the W-2 forms reported by employers. This highlights the vital difference, Uber drivers are not Uber employees and YouTube video producers are not Google employees.

Today, there is a proliferation of cloud platforms upon which individuals can contract for project work on a website or consign virtual products such as self-published books or YouTube

videos. We see two distinct types of work compensation arrangements, though in both cases, the contractor/producer receives their income through the intermediary of the platform owner that reports to the US tax authorities through an IRS 1099 form. The first type of work arrangement is gig work, whereby the relationship is predicated upon an agreed-upon contract prior to undertaking the work. This work ranges from the micro-work of Amazon's Mechanical Turk and the relatively simple coding and search engine optimization projects such as those offered by eLance or ODesk (now merged) to the sophisticated Ph.D.-level research projects posted on InnoCentive's website . It also encompasses a new way of contracting for work which is in the form of crowd-funded projects typical of Kickstarter or Indiegogo. In these cases, the funding may support all manner of activities including charity; however there is a transfer of monies in advance for a good or service. The important point in the gig economy is that there are no ties between those purchasing the good or service, and those receiving the good or service after it is delivered. The relationship is entirely contractual and contingent.

The second work arrangement is, what we term, the "cyber-consignment model." Obviously, consignment is not an entirely new compensation scheme. Typically, artists have consigned their work to art galleries or other intermediaries that perform the sales function. In contrast to the contracting model, in the cyber-consignment model increased purchases dramatically shift the returns for the producer. For virtual products, returns increase with no further work on the part of the producer. In these product areas, winner-take-all-like returns can be created. For example, Psy's Gangnam-Style video has had more than 2 billion YouTube downloads, downloads which almost certainly have generated in excess of \$5 million.^{xxxiii}

Several implications of the 1099/platform economy should be considered:

First, how are the fruits of the value creation divided? This is not strictly speaking a matter of capital vs. labor, since many of the contractors and all consigners provide both labor and capital. Rather it is, ultimately, a balance between the power of the platform owners and those providing the ultimate product.^{xxxiv} While undoubtedly an important question, there are other questions such as, “What features of labor market rules varies the ability of workers or platform owners to capture value?” This is likely to vary across places and across “functions”.

There is likewise competition amongst different kinds of companies, different forms of capital, about how value created is to be shared. Indeed, platforms which can be footloose represent a form of global capital in rivalry with more traditional local companies. For example, the Uber platform threatens the local taxi company; and the medallion owners, whether corporate or individual, will see their assets depreciate in value. Indeed, Uber, the platform, has a grandiose global possibility of aggregating the local taxi industry globally displacing or subsuming what were previously disparate local capitals. In terms of rooms sold per day, Airbnb is already the largest “hotel” company in the world.^{xxxv}

At this point, there are more questions than answers, but let us return to the subject of employment and work. The illustrations in this section suggest that significant aspects of the employment relationship and the types of work available will be transformed. There is also the possibility that there will be as much or even more work being performed. However, the relationships, the organizational arrangements through which the work is performed may well be radically altered. If the gig economy expands to become more prevalent, then how will health insurance, worker compensation, and retirement that are based on traditional employment be provided? Indeed, could the provision of these sorts of “benefits” be a set of market apps

themselves, or might the provision form the basis of institutionalized forms of worker organization, the 21st century Union.

Because most of these new consumer-oriented platforms are introduced in the US first, what will be their effect and how will they be regulated in other nations? However, it is possible that with the Internet of Things, new platforms will emerge, and so the question of which organizations are likely to introduce these and how will that effect the global distribution of value is likely to become important?

III. Implications for Policy and Strategy:

Throughout the economy the transformation of production is overturning the terms of competition and the basis on which value and advantage are created. Questions such as the organization of production or management of ICT, which were until now responsibilities of the CTO or head of manufacturing, are today strategic C-suite questions. Corporate strategies will, once again, be rethought, generating opportunity, if not for workers, certainly for pundits.

The escape from the commodity trap creates its own problems. As firms move to escape the commodity trap, developing and deploying the new ICT technologies, they may overturn existing employment structures and social policies. Policymakers that are concerned about employment and equality are faced with dilemmas.^{xxxvi} They are called upon both to support these transformations, but also prepare for what are likely to be disconcerting outcomes. Supporting the transformation requires, for example, not only building the information infrastructure and investment in the skills to build and deploy the ever-evolving ICT tools, but also creating the market rules encouraging experimentation in new methods of value creation and innovation. There are likely to be intense political fights about who captures and loses the value

and jobs these transformations create. An exclusive focus on classic manufacturing will mislead us, as will one that focuses exclusively on software or services delivered by a conventional firm. The work will not be on the factory floor, but it also will not be confined to a group of software writers gathered in a conventional office workplace. There certainly will be jobs in the development and deployment of tools and of ICT-enabled service systems, but these are unlikely to be sufficient and may not even be where most of the new “work” is created. The work may emerge in and around the new “platforms”.

For the global economy, the question is, what will be the social and economic consequences of the resulting struggles? There are, for now, only questions, endless questions. Who will be the winners and losers? Will the winners be Uber, classic taxi medallion owners, or something else entirely?^{xxxvii} What social policies will be required in a gig/1099 economy when traditional corporate mechanisms for delivering health and retirement benefits have evaporated? Rather than “LinkedIn.com”, will new forms of unions play the role of job halls? Will ICT financial tools improve the functioning of the financial system, its ability to support business development, or, for instance, create high speed platforms that generate advantage for a limited few traders? Will crowd sourcing be an opportunity for innovative startups or for innovative fraudsters? Will renting a room in your house on Airbnb be a violation of zoning rules that discomfits your neighbors?

There are issues quite particular to the United States. Here, in the United States, many of the social benefits, such as unemployment insurance and retirement, are linked with direct employment, while all of the “work” we have just examined is done by contractors or on a cyber-consignment basis. If this reorganization of the compensation system continues to expand, how will a middle-class society be produced? Further, even for the platforms a race to the bottom

might encourage their work providers, those who symbiotically create value for the platforms, to drop out completely. Ultimately, the question is whether the rise of the Cloud-based platform economy will generate work and income in a next-generation economy, or pessimistically, complete a collapse of middle-class economy?

ⁱⁱ <http://navis.com/solutions>

ⁱⁱ We anticipate that many would assert that the Chinese firms will soon have the capability of building such integrated systems. Agreed. That emphasizes the need for continuous innovation. A next step will be to integrate all of the other IT systems in the port including the IT- and sensor-enabled cargo container – the IoT. For example, can the crane and port system also combine weather data to better predict the throughput of the port during a typhoon – something that may be more valuable than ever given global climate change.

ⁱⁱⁱ On the creation of value in open source software, see, for example, Benkler, Y. (2006). *The wealth of networks: How social production transforms markets and freedom*. New Haven: Yale University Press.

^{iv} This section is drawn from work done by Jonathan Murray, Kenji Kushida, and John Zysman. There are four principal pieces.

- 1) "The Next Epoch in Cloud Computing: Implications for Integrated Research and Innovation Strategy." Kushida, K. E., J. Murray, P. Scaglia, J. Zysman, prepared for DG Connect, European Commission. Online as BRIE Working Paper 2014-4.
- 2) The most recent is: Zysman, J., Murray, J., & Kushida, K. (2013). *Clouducopia: Into the era of abundance*. CLSA University. Web. Retrieved from www.clsau.com.
- 3) Kushida, K., Murray, J., & Zysman, J. (2011). Diffusing the cloud: Cloud computing and implications for public policy. *Journal of Industrial Competition and Trade*.
- 4) Kushida, K., Murray, J., & Zysman, J. (2012) *The Gathering Storm: Analyzing the Cloud Computing Ecosystem and Implications for Public Policy*. *Communications and Strategies*.

For up to date discussion of these issues see Jonathan Murray's Blog: www.adamalthus.com/

^v Op. Cit. Zysman et al. *Clouducopia: Into the era of Abundance*".

^{vi} Bort, J. (2014, November 10). What is the "Race to Zero" and why does it make tech companies nervous? *Slate*.

http://www.slate.com/blogs/business_insider/2014/11/10/cloud_storage_race_to_zero_means_companies_are_lowering_prices_and_raising.html

^{viii} Zysman, J. (2006) The 4th service transformation: The algorithmic revolution.

Communications of the Association for Computing Machinery: Special Issue on Services Sciences, 48.

^{ix} By now we can all recite the examples, such as, bank ATMs have automated simplified bank transactions, and consumers increasingly book airline tickets and car rentals online. In major enterprises, payroll processes long ago were reorganized and largely automated. For a more general discussion of this, see, for example, Gospel, H., & Sako, M. (2010). The unbundling of corporate functions: the evolution of shared services and outsourcing in human resource management. *Industrial and Corporate Change*, 19(5), 1367-1396.

^x Nordhaus, William D. "The Progress of Computing." Working Paper. Version 5.2.2 Yale University Press and NBER (2002). On "informating" see Zuboff, S. (1988). *In the age of the smart machine: The future of work and power*. New York: Basic Books.

^{xi} We use the word “provision” rather than “stores,” because there were and are sites for music access that violate copyright. Further, as a digital good, music can be shared without purchase.

^{xii} While the first example is from the consumption, the second two examples are related to production. In production, the information is often combined with and directs or adds value to the movement of atoms from the physical world.

^{xiii} Breznitz, D., & Murphree, M. (2011) *Run of the Red Queen: Government, Innovation, Globalization, and Economic Growth in China*. New Haven: Yale University Press. See, also, Kenney, M., & Florida, R. (Eds.) (2004) *Locating Global Advantage: Industry Dynamics in the International Economy*. Stanford: Stanford University Press.

^{xiv} See, for example, M. Kenney (Ed.). (2000). *Understanding Silicon Valley: Anatomy of an Entrepreneurial Region*. Stanford: Stanford University Press.

^{xv} With services outsourcing, it is also possible to lose skills in the organization’s staff functions.

^{xvi} For a North American perspective see, P. Wright, “Manufacturing Metropolises: Design, Fabrication, and Service” in UNIDO 2013 *21st Century Manufacturing*_Ed. Zysman, J., D. Breznitz, M. Kenney, and P. Wright. For a European perspective, see: Securing the Future of German Manufacturing: Recommendations for implementing the strategic initiative INDUSTRIE 4.0 Final report of the Industrie 4.0 Working Group, German Federal Ministry of Education and Research. (Forschungs Union and Acatech) April 2013.

^{xvii} For an early discussion of this issue, see Florida, R. and Kenney, M. 1990. *The Breakthrough Illusion: Corporate America's Failure to Link Production and Innovation*. (New York: Basic Books)

^{xix} When considering the question of production relocation, it is important to remember that China is well on its way to becoming one of the largest markets in the world, even as East Asia now has roughly the same GDP as Europe and North America.

^{xx} Some parts of this section draw upon Martin Kenney’s research in progress on platforms and value creation in the virtual economy.

^{xxi} We are not making a universal claim as it is possible that globally there may be just as many factory floor workers. However, the bulk of these may be in low-wage nations. For example, during the last four decades, while the number of garment and shoe-making workers declined in the developed nations, the number in developing nations increased enormously. Therefore, in the global economy shoe and garment factory employment may have increased.

^{xxii} Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: work, progress, and prosperity in a time of brilliant technologies*. WW Norton & Company. See, also Frey, C. B., & Osborne, M.A. (2013). The future of employment: How susceptible are jobs to computerisation? *Oxford Martin School Working Papers*. For an early discussion of offshoring, see Dossani, R., & Kenney, M. (2007). The next wave of globalization: Relocating service provision to India. *World Development* 35, (5): 772–791.

^{xxiii} Batt, Rosemary and Hiro Nohara. 2009. “How Institutions and Business Strategies Affect Wages: A Cross National Study of Call Centers.” *Industrial and Labor Relations Review*. 62(4):533-52.

^{xxiv} See footnote #1 for the classic references on this topic.

^{xxv} “The Facebook App Economy,” Hann, I.-H., S. Viswanathan and B. Koh. (2011). University of Maryland, (September).

^{xxvi} Carver, C. (2014). *E-Fencing Detection: Mining Online Classified Ad Websites for Stolen Property* (Doctoral Dissertation). Retrieved from University of Ontario Institute of Technology.

^{xxvii} In the case of Amazon, it could be that the current struggle between Amazon and traditional publishers, such as, Hachette is an expression of Amazon’s desire to disintermediate the publishers entirely.

^{xxviii} Lomas, N. (2014, January 7). Apple: \$10B In App Store Sales In 2013, \$15B Paid Out To Developers To Date. *TechCrunch*. <http://techcrunch.com/2014/01/07/apple-10b-in-app-store-sales-in-2013-15b-paid-out-to-developers-to-date/>.

^{xxix} Google, Inc. (2014). The Secrets to App Success on Google Play.

^{xxx} See, for example, Faletski, I. (2012). Apple's App Store: An economy for 1 percent of developers. *C-Net*. <http://www.cnet.com/news/apples-app-store-an-economy-for-1-percent-of-developers/>

^{xxxi} There is one other set of employees that should be considered in this transformation and they are the platform owner’s direct employees. These are the aristocracy of the new labor force. Working as they do in venture capital-funded firms, their compensation is, in part, contingent as it is based on equity. Given the high failure rate for venture capital-funded firms, their employment, while full-time, is also uncertain until their firm “makes” it.

^{xxxii} Friedman, G. (2014). Workers without employers: shadow corporations and the rise of the gig economy. *Review of Keynesian Economics* 2 (2): 171-188.

^{xxxiii} As of December 2014, Gangam Style had 2.1 billion views. A typical video generates between approximately \$2,500 per million views. Of course, for more popular videos the compensation rates are likely to be higher.

^{xxxiv} Of course, the State can also play a role in shifting this power balance.

^{xxxv} *Economist*. (2014, October 16). New lease of life. *The Economist*. <http://www.economist.com/blogs/gulliver/2014/10/airbnb>

^{xxxvi} Zysman, J., & Breznitz, D. (2013). Facing the Double Bind: Maintaining a Healthy and Wealthy Economy in the 21st Century. In Breznitz, D. & Zysman, J. (Eds.) *The Third Globalization: Can Wealthy Countries Stay Rich in the Twenty-first Century?* Oxford, Oxford University Press.

^{xxxvii} For example, few have considered that Uber has now developed an international “taxi” or rather individual transportation provision platform. One could imagine the taxi regulation system remaining in place in every one of the markets served by Uber, but now taxi dispatch would be through Uber, and Uber would reap a percentage of every dispatch.