

# WHERE WILL WORK COME FROM IN THE ERA OF THE CLOUD AND BIG DATA

## Thought Brief by John Zysman and Martin Kenney

**John Zysman's** recent work focuses on how the advanced countries adjust to radical changes in the global economy. Publications on this theme include *The Third Globalization: Can Rich Countries Stay Wealthy in a Changing Global Economy?* Zysman's book *Manufacturing Matters: The Myth of the Post-industrial Economy* addressed 25 years ago many of the same questions we are discussing today. Recent updates to that work are *Escape from the Commodity Trap: Will the Production Transformation Sustain Productivity, Growth and Jobs?* (written for the European Commission debate on strategies to adapt to a changing global economy); *21st Century Manufacturing*; *Services With Everything: The ICT-Enabled Digital Transformation of Services*; and an array of work on issues such as cloud computing.

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Advanced industrial democracies are struggling to sustain the employment and productivity growth necessary to expand the real income of their citizens. In large measure, the current struggle is around 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, meaning competition based principally on price. The consequence of this commodity trap 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, including both goods and services. But how to do that?

In the first part of this brief, we discuss pathways opened as information and communications technology (ICT) and the latest ICT platform, cloud computing, transform 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, both of which will be 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 also the character of work. In the second part of the brief we explore

how cloud computing is transforming the very nature of work, creating new platforms for the organization and monetization of work. Here we focus on one consequence of the implementation of cloud-based strategies: an entirely new category of work organization, which we term the “platform economy.” Even as firms in advanced countries find new competitive advantage, the platform economy is generating interesting new types of work contingency.

We begin our exploration of the transformation of the economy and work by examining the transformation of manufacturing. For example, the case of Cargotec, a Finnish company that produces port equipment, helps us understand how firms can escape the commodity trap by utilizing ICT-enabled services to integrate their business offerings. Facing intense competition, particularly from Chinese producers offering very similar products, the company decided to begin selling “port management services.”<sup>1</sup> Instead of competing principally on price, the company will increase the intelligence of its products, developing a digital platform capable of managing and integrating the various types of port equipment it offers. Cargotec hopes to go to its customers with a proposition: “Buy a Chinese crane? Great, but your port will be more competitive and much less expensive if you buy our integrated system.”<sup>1</sup> This kind of development, which is being repeated throughout the industrial and service worlds, is only a first step in what is becoming possible with the cloud.

The cloud is a 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.<sup>2</sup> Key to this new organization of work are cyber-platforms ranging from Elance-oDesk, Amazon Mechanical Turk, Uber, Airbnb, and TaskRabbit to Youtube, Udemy, and

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<sup>1</sup> We anticipate that many would assert that Chinese firms will soon have the capability of building such integrated systems, and we agree. 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.

Amazon self-publishing. We distinguish 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, as well as the transformation of traditionally understood manufacturing. In the second section of the brief we will consider the impact of these transformations on employment and labor market dynamics.

## THE CLOUD ACCELERATOR<sup>3</sup>

The latest information technology platform, cloud computing, is accelerating the transformation of both services and manufacturing. Why is the cloud 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 sophisticated logistics is becoming ubiquitous. These resources 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. 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.<sup>4</sup> The cost of cloud computation and software is trending toward zero as cloud computation itself is becoming the ultimate commodity.<sup>5</sup> 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.

## ICT-ENABLED SERVICES

ICT-enabled services and service systems have become a source of continual disruption in the economy and labor markets.<sup>6</sup> 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:<sup>7</sup> tasks underlying services can be transformed into formal, codified processes with clearly defined rules for their execution. When activities are formalized and codified, they become computable.<sup>2</sup> 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 mean 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.”<sup>8</sup>

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

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<sup>2</sup> By now we can all recite the examples: 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.

processing power, services are increasingly embedded within products. Indeed, manufactured products are often sold as delivery mechanisms for the services. For example, MP3 players are portals to music provision sites,<sup>3</sup> 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 more data, and mined to create higher value-added products and services as well as new value propositions. This is really the story of the Internet of Things, the Industrial Internet, and various other flashily branded versions of the story.<sup>4</sup>

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, assess safety on bridges, or 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.

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<sup>3</sup> 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.

<sup>4</sup> 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.

# 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 one hand is the best understood and widely discussed decomposition of manufacturing and of ICT-enabled services, which has produced complex cross-national supply networks. Production is geographically dispersed, and phases of the production process are increasingly localized in specialized regions.<sup>9</sup> For example, conceptualization, development, and design of new product groups is associated with Silicon Valley.<sup>10</sup> Volume production, particularly in electronics, has become associated with firms such as Foxconn operating in China. In some countries, including the United States, this decomposition has in some sectors undermined the core infrastructure of skills and knowhow required for competitive advantage in production.<sup>5</sup>

On the other hand, the rapid evolution of advanced manufacturing often has the opposite effect, encouraging the recomposition of production as well as the reintegration of development and production. ICT tools support, promote, and accelerate innovation across the production phases of 21st century manufacturing: ideation, design, prototyping, fabrication, supply chains, sustainability, and engineering services.<sup>11</sup> This rapid evolution of tools and materials leads 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 reintegration of the array of rapidly evolving tools across the phases of the production system. GE reports that separating design from fabrication often creates real problems in new product development and sustaining innovation in existing products.<sup>6</sup> While the result, it seems, is returning

<sup>5</sup> With services outsourcing, it is also possible to lose skills in the organization's staff functions.

<sup>6</sup> 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)

production of some products to the United States, the overall movement offshore continues apace. In a slightly different vein, Toyota, seemingly concerned about losing competitive advantage if it depends for batteries on its longtime supplier, has begun its own internal development of batteries for hybrids.

The question that must be answered is, 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?*<sup>12</sup> There will not be a single or dominant answer, and that answer may change over time and by product. There will be a mosaic resulting from varied strategy choices by firms and policy choices by particular regions.

## 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, other questions remain: Will aspects of production cluster in particular places? Will phases of production concentrate in particular places? With ICT tools including but not limited to 3D printing—the common enabler across the 21st century manufacturing continuum—changing reintegrated production, what will the location patterns look like? What local competencies and characteristics will determine the location of reintegrated production?<sup>7</sup>

<sup>7</sup> When considering the question of production relocation, it is important

- Second, what will the tools be? Who will be the next-generation toolmakers? Will those who have a mastery of the underlying digital technology learn to move forward and make practical applications of that technology? Or, conversely, will those who know industrial processes and material in manufacturing, for example, reach backward into the pool of emerging technologies and craft new approaches? Will the new tools build on existing industrial knowhow? At the risk of a cliché, will Silicon Valley geeks or German and Italian tooling companies become the toolmakers of the next era and be able to extract the most value from their particular value chain? The answer is, 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,” and “ICT-enabled services and manufacturing” all are attempts to envision and frame this 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 to be quite different.

## WHERE WILL WORK COME FROM IN THE ERA OF THE CLOUD AND BIG DATA?<sup>8</sup>

In this section of the essay we ask what might be the consequences for employment and the dynamics of labor markets of the ICT- and cloud-based transformation of production depicted above. Again, there are many causes 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.<sup>9</sup> Many others will be transformed in character; ICT tools are changing what it takes to be a designer or an engineer. As an exercise, it is important to try to estimate how the digital future will reshape existing work. But looking backward 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 analysis of data about existing jobs. Brynjolfsson and McAfee (2014), Osborne and Frey (2013), and others have suggested that computerization and automation are likely to eliminate major portions of the workforce by substantially reducing demand for existing jobs. In that case, the skill-biased technical change paradigm that economists use to explain the relative bifurcation of the workforce may have run its course, as technical change (combined with offshoring of services) is now threatening many of the “skilled” as well.<sup>13</sup> But

<sup>8</sup> Some parts of this section draw upon Martin Kenney’s research in progress on platforms and value creation in the virtual economy.

<sup>9</sup> 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.

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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.

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, the critical set of competencies and skills will 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, who only 50 years ago were, in a significant measure, not directly employed in the workforce; individuals retired from the workforce; or those living in formerly communist nations. So where should we be looking next for new workers being integrated into the workforce?

1. New jobs created to build new tools and platforms for existing functions, and 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 must also be included. Berkeley's Invention Lab 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 and platforms upon which various value-creating activities are undertaken.

Existing labor market data makes it possible to make some tentative and partial assessments of the two categories that are essentially job destruction. Analyzing the sources of new work, and other categories of work creation that might emerge, will require imagination and speculation.

Consequently, we may be able to state the problem as: 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, rest on assumptions about how new technologies are deployed. We know from examining previous technological changes that how technology is deployed and utilized powerfully shapes the employment outcomes, in terms of both 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 depend on decisions about deployment.<sup>14</sup> 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 should instead be on trying to decipher the new dynamics of firm creation and work generation.

## TECHNOLOGY PLATFORMS AND JOB CREATION

One way of thinking about ICT firms is that the successful ones will build technological platforms upon which other firms build their businesses.<sup>15</sup> Recently, much attention has been given to the role of platforms and their economics. It has been recognized that the value of particular software or websites comes from the ecosystems that emerge around them. 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 that user-generated content. The largest revenue stream Facebook 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 it must pay a percentage of its income to Facebook. Thus, we can see Facebook as a 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 serve as 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, another group of workers is the employees of all the firms, such as Zynga, and individuals in the broader Facebook ecosystem. In 2011, one study estimated that the Facebook app economy had created the equivalent of 53,000 jobs.<sup>16</sup> 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 grew apace. Regardless, it is nearly certain that there are more persons working in Facebook's app economy than at Facebook itself, though their total income is almost certainly 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 undermines existing markets, some of which are highly regulated.<sup>17</sup> 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 of whether new "rides" or new "hotel space" are actually being created. That is, it is less clear what new jobs are being created; the platforms may function solely or largely to drive wages down as the legal boundaries to market entry are eroded. One might argue that Uber and others like it took formally organized markets, such as those for taxi cabs, 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 cyber-formalizing contingent micro-work. 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 or regulations, it is possible that they will drive the price per quanta of work to the lowest global price.

Platforms such as YouTube or Amazon self-publishing provide individuals who are creating virtual products an opportunity to earn income in two different ways: First, they provide creators the opportunity to monetize finished products. In these cases, the platforms collect revenue through either purchases or 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. Second, 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.<sup>18</sup> 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.<sup>10</sup>

The final and probably largest online marketplaces are the Apple and Google app stores. These marketplace platforms dwarf the others. For example, as of January 2014 Apple had paid out a total of \$15 billion since 2008.<sup>19</sup> Another website estimated that between June 2013 and June 2014, Google paid out \$5 billion to its developers.<sup>20</sup> Of course, these payouts follow a power curve with a long tail of developers that receive little or nothing.<sup>21</sup> The sheer size of these

<sup>10</sup> 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.

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

Platforms, 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 McAfee and others. Certainly the platform owner, not the participant, captures a portion of any value created. Indeed, one economic policy question is 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 ECONOMY

Cloud computing and platform technologies clearly push us toward an economy with a far larger proportion of independent producers rather than employees.<sup>11</sup> Gerald Friedman argues that this is resulting in the formation of a gig economy composed of transient employees.<sup>22</sup> We go further than 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

<sup>11</sup> There is one other set of employees that should be considered in this transformation: 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.

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 income through the intermediary of the platform owner that is reported to U.S. 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-oDesk 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, which almost certainly have generated in excess of \$5 million.<sup>12</sup>

Several implications of the 1099 or platform economy

<sup>12</sup> As of December 2014, Gangnam Style had 2.1 billion views. A typical video generates approximately \$2,500 per million views. Of course, for more popular videos the compensation rates are likely to be higher.

should be considered:

First, how are the fruits of the value creation divided? This is not, strictly speaking, a matter of capital versus 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.<sup>13</sup> While this is undoubtedly an important question, there are other questions, such as what features of labor market rules affect the ability of workers or platform owners to capture value. This is likely to vary across places and across “functions.”

There is likewise competition among different kinds of companies, different forms of capital, about how value created is to be shared. Indeed, platforms that can be footloose represent a form of global capital in rivalry with more traditional local companies. For example, if the Uber platform threatens the local taxi company, the medallion owners, whether corporate or individual, will see their assets depreciate in value. Indeed, Uber has the potential to globally aggregate the local taxi industry, 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.<sup>23</sup>

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, or 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 funds 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?

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<sup>13</sup> Of course, the State can also play a role in shifting this power balance.

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

## 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 concerned about employment and equality are faced with dilemmas.<sup>24</sup> They are called upon both to support these transformations and to prepare for what are likely to be disconcerting outcomes. Supporting the transformation requires, for example, not only building the information infrastructure and investing in the skills to build and deploy the ever-evolving ICT tools, but also creating the market rules that encourage experimentation with 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 and destroy. 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. Who will be the winners and losers? Will the winners be Uber, classic taxi medallion owners, or something else entirely?<sup>14</sup> What social policies will be required in a gig or 1099 economy when traditional corporate mechanisms for delivering health and retirement benefits have evaporated? Rather than LinkedIn, will new forms of unions play the role of job halls? Will ICT financial tools improve the functioning of the financial system and its ability to support business development, or, for instance, create high-speed platforms that generate advantages for a limited few traders? Will crowdsourcing 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 also issues quite particular to the United States, where many 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 survive? Further, even for new platforms, a race to the bottom might encourage 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 the middle class economy.

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<sup>14</sup> 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 taxi dispatch would be through Uber, and Uber would reap a percentage of every dispatch.

# END NOTES

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