Industrial Policy Reconsidered in a Digital World

By Kenji E. Kushida & John Zysman

In our current era, the advent of digital technologies and accelerating globalization is driving ever-faster commoditization of firms and products. With rapidly improving Information and Communications Technology (ICT) tools, manufacturing is decomposed with finer granularity, and corporate functions can be outsourced and offshored more than ever before. Services can be unbundled into activities that can be taken apart, reconfigured, and transformed with the application of algorithms. Overall, firms are experiencing accelerating shifts in the sweet-spot for markets and business models in their search for sustainable advantage.

As firms struggle to adjust in this global, digital world, governments are also under pressure to examine their options to retain value in their national contexts; wealthy nations face the challenge of how to remain wealthy.

Japan is no exception, and from this vantage it is worth reconsidering the potential role that industrial policy can play in its growth strategy. We will proceed in three sections, each of which builds from our previous research (indicated below the title), towards a set of recommendations for thinking about industrial policy in this digital, global era. Each point contributes something new to Japan's discourse about a new growth strategy.

I. The ICT Revolution: Led by Lead Users' Experimentation

Tools for Thought: What is New and Important about the "E-conomy" *by Stephen Cohen, J. Bradford DeLong,and John Zysman (Berkeley Roundtable on the International Economy, University of California at Berkeley, 2000).*

The "ICT Revolution" that we have lived through in the past couple decades has not only amplified productivity in each of the lead sectors of semiconductors, computers, and communications, but has given all economic sectors new "tools". These new tools opened new possibilities for economic organization, changing what can be done and how it can be done across a very wide range of industries.

In essence, the current technological revolution is making "tools for thought". The ICT tools are used to calculate, sort, search, and organize; they can affect every economic activity in which organization, information processing, or communication is important — in short, every single economic activity. These tools for thought are making possible new uses, lots of them, some with hard-to-see and some with easy-to-see benefits.

The ICT revolution developed largely in the US, through a distinct innovation process involving changes in business practices, organizations, market structures, and government policies. The process unfolded as follows: "lead users" of ICT tools, which were large corporations facing intense competition, first implemented large scale computer systems and networks to solve particular problems. They then *discovered new uses* for these ICT tools. This not only revolutionized their respective industries, but contributed fundamentally to progress in the use of computing. Through this process, computers themselves were transformed from large calculators into "what-if" machines; for example, airlines that implemented computer systems in the 1980s for record-keeping discovered they could utilize the data to completely reorganize their supply-demand management of routes and prices. Likewise, banks discovered that IT tools implemented into their back-end operations enabled the business processes themselves to be unbundled and moved all over the world, as well as many portions automated.


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The key was that *lead users of ICT tools faced newly liberalized environments, pressuring them into intense competition.* Government policy driving liberalization of these sectors was therefore critical, as well as the labor and other institutional environmental factors that facilitated firms to reorganize how they competed.

Wintelism: The American Response to Japanese Production Innovation

"Developmental Strategy and Production Innovation in Japan" by Laura Tyson and John Zysman in Politics and Productivity: The Real Story of Why Japan Works (New York, 1989).

"Globalization with Borders: The Rise Of Wintelism As The Future Of Global Competition" by John Zysman and Michael Borrus in Industry and Innovation *(4(2), 1997).*

The US-led IT Revolution was actually, in a broad sense, an American response to Japanese manufacturing prowess in a variety of high-tech sectors such as semiconductors, as well as major industries such as automobiles and consumer electronics. Japan's industrial policies, which included infant industry protection and government-mediated technological transfers among other policies, helped shaped the domestic economy. From this context arose the manufacturing innovations of lean production, along with business strategies focused on global market share.

US firms, particularly led by those in Silicon Valley, which was a significant manufacturing base for semiconductors and other computer products until the 1990s, were unable to match the Japanese manufacturing competitiveness. Their response was to change the dynamics of competition, creating a new production paradigm we called "Wintelism". In Wintelism, typified by the Windows Operating System and Intel processors, the value moved from final assembly to its constituent elements, each of which became a market in and of itself. This new design paradigm led to the rise of a new type of American high value-added firm, specializing in design and outsourcing manufacturing to Asian production networks. Cisco, Juniper, Dell, Nike, and more recently, Apple, are examples.

II. The ICT-Enabled Services Transformation

"Services with Everything: The ICT-Enabled Digital Transformation of Services" by John Zysman, Stuart Feldman, Kenji E. Kushida, Jonathan Murray, and Niels Christian Nielsen in The Third Globalization? Can Wealthy Nations Stay Rich in the Twenty-First Century? *(New York, OUP, 2013).*

The next chapter in the ICT Revolution is a fundamental transformation of services activities. Services were once considered a sinkhole of the economy, immune to significant technological or organizational productivity increases. Now, they are widely recognized as a source of productivity growth and dynamism in the economy that is changing the structure of employment, the division of labor, and the character of work and its location. This transformation, central to the growth of productivity and competition in the economy, poses basic policy and business choices.

The core of our story of the services transformation is not about the growth in quantity or value of the activities labeled services, the conventional emphasis of much of the writing about services. Nor is it about the revolution in digital technology. Rather, it is about how the application of rule-based information technology tools to service activities transforms the services component of the economy, altering how activities are conducted and value is created. When activities are formalized and codified, they become computable. Processes with clearly defined rules for their execution can be unbundled, recombined, and automated. The codification of service activities allows the rapid replication, analysis, re-configuration, customization, and creation of new services. We call this the "Algorithmic Revolution". Traditional business models can be made more productive, extended with ICT tools. And entirely new business models can be created, offering services previously impossible at any price.

The Services Spectrum

With the Algorithmic Revolution, tasks underlying services can be transformed into formalizable, codifiable, computable processes with clearly defined rules for their execution. The inexorable rise in computational power means that an ever greater range of activities are amenable to expression as computable algorithms, a growing array of activities are reorganized and automated. Indeed, core activities in services from finance through nursing can be captured and expressed as digital information.

There is a range of services activities to consider, from irreducible, to hybrid, to automated *(Table 1)*.

Irreducible services rely on humans for delivery, either because they require personal skills or attributes that only humans can offer, or for simple reasons of practicality and cost. ICT automated services rely on digital ICT to manage information and deploy it in ways that are useful and valuable to customers. Some automated services compete with and threaten existing manual services, or extend their reach, such as auctions or digital markets. Others offer entirely new services that could not be provided manually — for example, Google's search.

Hybrid services combine human and machine-based capabilities, either harnessing technology to improve and leverage the abilities of people, or depending on human talents to augment, deliver, customize, personalize, or otherwise add value to automated services. (They are not simply services in which some of the information involved in the process or transaction is captured electronically — such as a massage therapy business using digital software to manage reservations and accounting. Rather, a central

TABLE 1
The services spectrum

Irreducible services	Hybrid services	Automated services
Rely on humans to deliver services, which are typically created at the same time and in the same place they are delivered	Rely on a combination of humans and electronic tools to deliver services, using ICT and other systems to leverage or enhance human capabilities. This combination is often constituted as a system.	Rely on ICT or other technologies to deliver services that have been codified, digitized, and made available, often using electronic communication or distribution tools

Source: Zysman et al, 2013

element in the creation of value is digitally processed.)

A growing fraction of the most valuable and popular services are now hybrids. For example, accountants often rely heavily on software containing significant information about tax rules, bookkeeping systems, and financial principles that are able to store, analyze, update, and manipulate large amounts of data with ease, speed, and accuracy. However, they supplement the power of the software with personal judgment that helps them provide advice and insights suited to particular situations. Similarly, travel agencies handle most transactions digitally, but use human agents to handle complex cases and particularly high-value customers.

This system is highly dynamic, with particular services, service companies, and even entire industries moving, rapidly or slowly, from one position on the spectrum to another. As new technology and business systems are devised, the nature of possibilities continues to evolve. Services once practically unobtainable — access to vast stores of information now provided by a routine web search engine, for example — can now be obtained at virtually no cost in terms of time, money, or effort. The local limitations that constrain the availability of traditional human-delivered services are also reduced or eliminated by digitization.

Fully automated systems offer the greatest potential productivity gains. Because they rely on digital systems, the power, efficiency, and affordability of algorithmic services can be expected to improve in accordance with exponential increases in computing capabilities.

It is in the hybrid sector, where human delivery is combined with automation, that the deepest economic transformations are occurring. The value of hybrid services depends on human capabilities being augmented by increasingly sophisticated ICT systems.

Existing data on productivity, organized by traditional industrial sectors, is not optimal for measuring productivity increases across our divisions of activities — automated, hybrid, and irreducible. A rough estimate, taking select industries in which the bulk of activities fit into one category rather than another, yields the results in *Table 2*.

A Range of Business Model Transformations

There is a range of business model transformations made possible by the Algorithmic Revolution. Many business models entail delivery of the services themselves. Others are extended or transformed by the underlying tools available to them.

At one end, firms can use ICT services to enhance traditional business models, often by increasing their efficiency. For example, life insurance was among the first industries to transform their business models with the massive application of computing resources and algorithms. Wal-Mart’s early and extensive use of ICT to link suppliers and distribution radically increased its operational efficiency.

Firms can also extend traditional business models with ICT-Enabled Activities. Amazon extended a catalog retailer’s business model with an online storefront and user-generated reviews and ratings. A mining company took its traditional business of operating mining machines and shifted them to ICT-enabled remote operations — now it can offer remote mining operations as a service worldwide.

Existing firms often progress from one step to the next; they first enhance their traditional business model to improve efficiency, then move to extending the business model in new ways.

For new entrants, the ability to begin afresh with new business models that extend traditional ones offers an array of entry points. Amazon, for example, was not a traditional bookseller or retailer, starting from the ground up with an ICT-extended business model.

At the far end of the spectrum, entirely new business models are invented. Google is the prime example, linking advertising revenue to search. An interesting example of an entirely new business model can be found in virtual currency; users using real money to purchase virtual gifts, avatars, or other virtual goods within an online game or social networking site *(Table 3)*.

The consequences for business organization, production, and work are profound, just as work was transformed by the evolution of manufacturing. The automation of basic activities both frees, but also requires, professionals to perform more advanced tasks. And the analytical tasks of managing information flows generated by ICT-enabled services often require a different set of skills than providing the service itself.

Capturing the possibilities from the services transformation presents new policy challenges for governments and regions. Services are deeply rooted in social rules, conventions, and regulations. Consequently, capturing the value possibilities inherently

TABLE 2

Productivity increases (US 1995-2003), selected industries

Activity type	Industry	Productivity increase
Automated	Telecommunications	70.5%
Hybrid	Retail trade	53.0%
	Financial intermediation	66.2%
Irreducible	Business activities (consulting)	16.9%

Source: Groningen 60-Industry database, Zysman et al, 2013

TABLE 3

Range of business model transformations

ICT services enhance efficiency of traditional business models	Traditional business models extended with ICT services	Completely new business models through ICT

Source: Zysman et al, 2013

means recasting the rules, regulations, and conventions in which the services are embedded. Since they are embedded, selling services, often as systems, abroad is often more difficult than selling manufactured goods.

III. Cloud Computing Is Accelerating Services Transformation

"The Gathering Storm: Analyzing the Cloud Computing Ecosystem and Implications for Public Policy" by Kenji E. Kushida, Jonathan Murray and John Zysman in Communications and Strategies *(85, 2012).*

The ICT-enabled transformation of services is being accelerated by the advent of Cloud Computing as the new computing platform. Cloud Computing is a radically new way of delivering computing resources. The label "Cloud Computing" is overused for marketing purposes, but Cloud Computing is not simply anything on the web, nor does it automatically imply social networks such as Twitter or Facebook. Most importantly it is not a new word for old models of IT outsourcing or application hosting. Such definitions attempt to render the term too broadly or to use the term "Cloud Computing" to re-label the old as the new, and are therefore not useful.

Our definition is the following: Cloud Computing delivers computing services — data storage, computation and networking — to users at the time, to the location and in the quantity they wish to consume, with costs based only on the amount of resource used.

Put simply, Cloud Computing delivers the computing services to support business or personal needs without the user having to know how the underlying physical devices and software are configured or managed. Only a few global-scale firms can offer Cloud services at scale, since they require massive datacenters (see *Table 4* for further characteristics of Cloud Computing as we defined it).

The advent of global-scale Cloud Computing, which can act simultaneously as a production platform, innovation ecosystem, and global marketplace, has transformed the world from one of computing resource scarcity to one of abundance. Until this past decade, computing software and hardware were optimized to utilize scarce computing resources. However, now, processing capabilities can be "wasted" and considerably more processing resources can be mobilized towards certain services activities. Moore's Law, which roughly states that processing power will double every two years, has been the key driver of the computing of abundance.

In the new world of computing abundance, the Algorithmic Revolution driving the Services Transformation will accelerate.

IV. Reconsidering Industrial Policy

Having introduced the three parts of "Lead Users Driving the ICT Revolution", the "ICT-Enabled Services Transformation" and "Acceleration from Cloud Computing", let us now turn to the issue of industrial policy.

TABLE 4

Cloud Computing characteristics

- Users procure the "amount of computing" they want *without investing in their own infrastructure*. Only an Internet connection is required. Cloud services provide the *illusion of infinite resources on demand* available to users, regardless of their size and number.
- *Physical infrastructure is decoupled from applications and platforms*, which allocate computing, memory and storage resources without reference to underlying physical infrastructures. This is known as virtualization. Note also that the *physical location is decoupled* between the *physical location* of users and the Cloud datacenters.
- Cloud services transform computing from a capital expense to an operating expense. This changes the role of IT expenditures within the firm.
- Providers can dynamically add, remove, or modify hardware resources without reconfiguring the services that depend on them. This is a major difference from traditional datacenter outsourcing.
- Cloud Computing changes the location of data processing. Processing moves form the "edge" of the network, in PCs and private datacenters, towards the center of the network, in shared Cloud Datacenters.
- *Only a few firms are able to offer truly global-scale Cloud infrastructure* (e.g. Amazon, Google, Microsoft), with each firm requiring numerous datacenters costing more than $500 million each worldwide.
- Cloud Computing is *not simply all datacenter outsourcing*, and a large enterprise with a single datacenter is not a Cloud service provider. The real power of Cloud Computing is in the dynamic allocation of resources and the "illusion" of infinite scale.
  Social networking services, such as Facebook, Twitter, or Linkedin are not necessarily Cloud services in themselves. They can deploy Cloud Computing to deliver their services, and they can provide Cloud-based platforms for third party applications. However, not all do.
- Cloud Computing *does not automatically imply dumb terminals* or "thin" clients with little power at the user's end. Many Cloud services depend on powerful client processing capabilities, and networks are not always reliably fast enough. Processing power and storage capacity on user devices (smartphones, PCs) continues to improve in line with Moore's Law.
- Dropbox, the popular file storage and synchronization service, uses Amazon's virtual storage to deliver its functionality. It did not have to build massive datacenters on its own to start and rapidly expand its services.

Source: Kushida, Murray et al, 2012

Lead Users: Corporate Spending on IT

"Entrepreneurship in Japan's ICT Sector: Opportunities and Protection from Japan's Telecommunications Regulatory Regime Shift" by Kenji E. Kushida in Social Science Japan Journal *(15(1), 2012).*

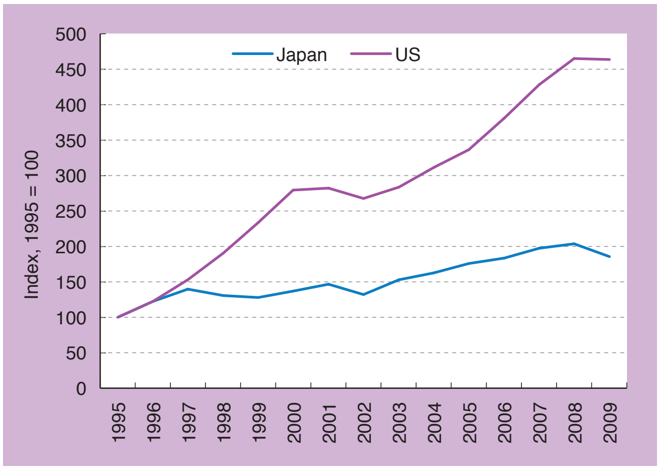
"The Services Transformation and Network Policy: The New Logic of Value Creation" by Kenji E. Kushida and John Zysman in Review of Policy Research *(26(1-2), 2009).*

From the 1990s onwards, the US innovation dynamic of large enterprises as the lead users of ICT continued. This is actually one of the most significant contrasts with Japan, as revealed by a comparison of the ICT investments by enterprises of the two countries. The gap is widening considerably *(Chart)*.

Japan is therefore in an odd position. Its industrial policies undoubtedly contributed to the spectacular success in fostering

CHART

Enterprise investments in ICT



Source: Ministry of Internal Affairs and Communications

high-speed, nationwide broadband networks — both landline and wireless — for consumers. Yet large Japanese enterprises are not positioned to become sophisticated lead users of ICT that can drive innovation and productivity gains.

This suggests further liberalization needed in areas with potentially heavy users of ICT, including finance, retail, healthcare, and other sectors. A lesson learned by the Japanese government was that fostering the network service buildouts was far easier than orchestrating their use by a variety of sectors, with different regulatory jurisdictions and industry dynamics.

US Industrial Policy Reconsidered

"The Innovative Enterprise and Developmental State: Toward an Economics of 'Organizational Success'" by William Lazonick at Institute for New Economic Thinking Annual 2011 Conference *(Bretton Woods, NH, 2011).*

It is also important to note that the pervasive role of the US government in supporting its basic research, which provides the foundation for Silicon Valley and much of its entrepreneurial activity, is often ignored — erroneously. The National Institute of Health (NIH), for example, invested $28.7 billion in life sciences research in 2006 alone. As William Lazonick writes, "Without NIH funding of the indispensible knowledge base, VC and public equity funds would not have flowed into biotech."

The backbone of much of the ICT Revolution — the Internet — was originally a network created by DARPA, the Defense Advanced Research Projects Agency, and then *handed over* to private management. The FCC, in piecemeal fashion, intervened continuously to keep the Internet an open platform, preventing the major telecommunications carriers such as AT&T from exerting control above the network layer. Only with this protection was all the innovation that occurred on top of the Internet possible.

Recommendations in Reconsidering Industrial Policy

"Leading Without Followers: How Politics and Market Dynamics Trapped Innovations in Japan's Domestic 'Galapagos' Telecommunications Sector" by Kenji E. Kushida in Journal of Industry, Competition and Trade *(11(3), 2011).*

We offer a few additional recommendations for reconsidering industrial policy.

— *Facilitate lead users:* Liberalization (which includes both deregulation and reregulation) to enable greater competition for major potential users of ICT.

— *Government as lead user of ICT:* The demonstration effect of the government as a lead user can be effective. The adoption of the Salesforce.com platform for the entire customer database of Japan Post led to greater confidence for other adopters.

— *Cultivating skills to internationalize services:* In an era of the Services Transformation with potential growth from services, it should be noted that internationalizing services is often more difficult than selling goods, since local rules, regulations, and business structures matter. Actively cultivating the types of people with international skills to sell hybrid services and systems abroad will be important.

- In internationalizing education, the issue of inviting foreign professors often gets attention, but raising the internationalization of university staff to interface between different education systems is also critical.

— *Invest heavily in world-class basic science:* Strengthening global-standard international peer review processes for allocating resources.

— *Invest in capacities to cultivate and harvest Silicon Valley innovations:* Governments around the world have attempted and largely failed to reproduce the ecosystems of Silicon Valley entrepreneurship. The challenge for Japan is to create capabilities to take advantage of the ecosystem.

— *Avoid the "Galapagos Syndrome":* Particularly in specific areas of potential strength that Japan is about to build out, such as Smart Grids and Smart Transportation, avoid isolating Japanese firms, despite an advanced market — a dynamic we have called "Leading without Follower".

- To avoid Galapagos Syndrome, attention to standards and business ecosystems at a very early stage of development, along with close partnership with global-scale firms operating in competitive markets, such as Toyota and Nissan, is likely to be more favorable than home-grown or heavy reliance on primarily domestic-focused firms. JS

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