

# The Trade Impact of Smart Factories

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## Executive Summary

1. Smart factories will transform what's traded, how we trade, who trades and when.
2. Smart factories link digital technologies (technologies built on data) with production processes.
3. In the wake of these changes, policymakers should update trade policies and agreements. Although trade agreements are written to be technologically neutral (not to favor specific technologies, and to be flexible enough to accommodate technological change over time), such agreements may not be clear or sufficient to address the changes posed by trade in data (which needs clarification) as well as the technologies that underpin smart manufacturing.

## Overview

Entrepreneurs and executives have long tried to make workshops and factories smarter. For example, American industrial evolution in the 19<sup>th</sup> century is a history of how engineers, managers and owners tried to diffuse new technologies such as the sewing machine, the reaper, the bicycle and the automobile. Mechanics in these sectors who had learned how to create productive factories disseminated these ideas to other engineers, mechanics and draftsmen creating ever more productive manufacturers (Hounshell:1984)










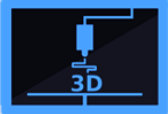
Today, entrepreneurs and executives continue that tradition, using data-based technologies to make their factories smarter. They use internet connected devices or integrated circuits which enable sensing, measure, control, and communication to better manage workers, machines and processes. By linking information technologies (modeling, big data, and artificial intelligence, etc.) with manufacturing technologies, these entrepreneurs and executives can meet rapidly changing global market needs in a timely basis.

Although smart manufacturing is not new, there is no official internationally accepted definition or terminology. The German and Chinese governments call smart manufacturing industry or factory 4.0 -the fourth manufacturing age (Rüßmann et al. 2015). The US Government defines smart manufacturing as systems that are “fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the factory, in the supply network, and in customer needs.” (NIST: 2017). With smarter factories, firms can improve manufacturing efficiencies and enable managers and workers to make better decisions.

In 2013, China had the largest share of smart factories globally (18.8%), followed by Germany (15.1%), the USA (12.5%), Japan (13.3%), and Korea 11.3. (Chang-do: 2016, 26-27). However,

some expect that the US will displace China as the number one location for such factories by 2021 (Deloitte/Council on Competitiveness: 2016).

This paper examines the impact of the technologies underpinning smart technologies upon trade. As Figure 1 illuminates, most of these technologies are built on gathering, manipulating, evaluating, and disseminating data.

Major Technologies Embedded in Smart Factories	
 <p><b>Big Data</b> (can also include AI)</p>	<p>Uses datasets to optimize quality, save energy and provide services. With massive amounts of data, individuals can effectively analyze whole supply chains.</p>
 <p><b>Cybersecurity</b></p>	<p>Service designed to protect devices using data from malware, spam, cyber-theft</p>
 <p><b>Autonomous Robots</b></p>	<p>Robots can mimic human movements and humans can manipulate and train these robots.</p>
 <p><b>The Cloud</b></p>	<p>Allows computing resources to be accessed in a flexible on-demand way with low management effort and lower costs.</p>
 <p><b>Simulation</b></p>	<p>Simulations allow manufacturers to test machine settings and products in the virtual world.</p>
 <p><b>Sensor Technology</b></p>	<p>Sensors embedded within devices which make IoT possible.</p>
 <p><b>Internet of Things</b></p>	<p>The IoT can bring improved process efficiencies, customer service, speed of decision-making, consistency of delivery and transparency/predictability of costs. The sensors communicating this data can create newly traded services monitoring machines (such as GE monitoring pilot control of jet aircraft).</p>
 <p><b>Augmented Reality</b></p>	<p>This technology superimposes a computer-generated image on a user's view, thus providing a composite view. Whereas virtual reality transposes the user, augmented reality augments what the user sees (her vision of reality).</p>
 <p><b>Horizontal &amp; Vertical System Integration</b></p>	<p>Integration of information technology with other services within a company.</p>
 <p><b>Additive Manufacturing / 3D printing</b></p>	<p>A process of making physical objects from three-dimensional digital models.</p>

Sources: Rimmer, 2017, Rüßmann et al. 2015.

Prepared by: Kailee Hilt

With the advent of cloud (and other data-driven) services, data in one country are increasingly stored, processed, and analyzed in another country. In this regard, data are essentially traded among individuals, firms, and states. Yet, there is no universal or even plurilateral system of rules to govern these cross-border data flows (Force Hill and Noyes: 2018, and de la Chappelle and Fehlinger: 2016). Policymakers have yet to find common ground on how cross-border data should be controlled, priced, protected, and made secure. Without such agreement, data could deglobalize as growing numbers of states restrict the transfer of many types of data (Gupta and Fan: 2018).

I argue that taken in sum, the technologies underpinning smart manufacturing could have two distinct and profound effects upon trade and trade rules. First, government efforts to foster smart factories could alter comparative advantage. In so doing, smart manufacturing will affect who trades what and when. Secondly, trade policymakers will also have to respond to the challenge of governing data and the technologies that underpin smart manufacturing (World Customs Organization: 2017).

The article proceeds as follows. First, I begin with some definitions. Next, I discuss how governments are trying to encourage smart manufacturing. I do not address how the technologies underpinning smart factories are leading to new types of relationships between individuals and firms or among firms. I note that it is an important component of the servicification of manufacturing (the growth of services affiliated with manufacturing). I then examine what trade rules say about smart factories and the technologies underpinning them. I next examine in depth two technologies that challenge current trade rules, 3-D printing and the Internet of Things (IoT). Finally, I develop some conclusions.

### **Definitions Used in this Overview**

Smart factories merge and integrate production processes and digital technologies (digital devices, methods, and systems built on data) (Rüßmann et al. 2015, 4). Data and information (processed data) have long been a key component of trade, but recently data have created new forms of trade. Most trade agreements since the mid-1990s have included aspirational (non-binding) language governing e-commerce (goods and services delivered via the internet.) Digital trade is a broader term which not only includes e-commerce, but also rules to govern services delivered via the internet and associated technologies (such as cloud computing, apps, and voice-over-internet calls).

### **Government Efforts to achieve Comparative Advantage in Smart Manufacturing**

Policymakers in many countries understand that they must invest in smart manufacturing technologies if they want to maintain a strong manufacturing sector (World Economic Forum and McKinsey, 2018; Ezell: 2016). Government officials can foster these sectors with tactics including funding research and development, using the tax code to stimulate types of investment, creating an effective enabling environment for diffusion of smart manufacturing, encouraging worker training, and using trade agreements to ensure market access (Leiva: 2017; Ezell: 2016, Ezell: 2018, World Economic Forum and McKinsey: 2018). For example, the German government has encouraged multi-sectoral collaboration to build smart factories since 2011. Germany has a strong head start because of its cooperative approach to manufacturing, focus on precision engineering and ability to disseminate new ideas and processes (Germany Trade and Investment: 2018; Bonvillian: 2016).

In contrast, the Chinese government is both a demandeur, a catalyst, and a venture capitalist for smart manufacturing. Smart factories are also a major focus of China's plan to facilitate modernization and diversification of the Chinese economy based on innovation. The "Made in China 2025" plan unveiled by Premier Li Keqiang in 2015 provides government support for the development of smart manufacturing technologies such as 3D printing, big data analytics, and

robotics.<sup>1</sup> Li aims to transform China into a “strong” manufacturing nation in a decade, and match the strengths of Germany and Japan as leading innovators in certain industries within two decades. China also has some real advantages because it has the world’s largest manufacturing base (Chang-do: 2016).

The US has also been trying to stimulate advance manufacturing using the power of government to convene, disseminate, and invest in smart manufacturing. A catalyst for US government action was a significant drop in manufacturing employment. Between 2000 and 2010, U.S. manufacturing employment fell by 5.8 million jobs, from 17.3 million to 11.5 million in 2015. Such jobs were an important route to the middle class for many Americans without college degrees, and the loss of these engendered significant social and economic upheaval in towns where plants left (Bonvillian: 2016).

Influenced by a series of key academic reports, recommendations from two presidential task forces, and a 2012 national strategic plan for advanced manufacturing, Congress enacted legislation in 2014 to address the issue. The Reinventing American Manufacturing and Innovation (RAMI) Act established Manufacturing USA, a federal program to support government-industry-academic collaboration to bridge the so-called “valley of death” in precompetitive technologies.

These national efforts all aim to spur innovation in smart manufacturing or advanced manufacturing. However, the OECD argues that policymakers should also create “effective institutions dedicated to technology.” Moreover, because data is an essential element of smart manufacturing, a unified approach to data and data openness, protection, and rules for sharing and control will be essential. Most states have yet to develop national data plans, yet data, as the OECD notes, needs “to be treated as a new infrastructure for 21st century production” (OECD: 2016, 3-4).

Table 2 summarizes the efforts of some nations to achieve comparative advantage in this new sector.

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<sup>1</sup> Made in China 2025 has 9 goals: enhancing innovation capability and boosting innovation in manufacturing; 2. Promoting the integration of industrialization and IT (e.g., promoting digitalization); 3. Strengthening the fundamental capacity of industry in basic components, basic processing technologies, basic materials, and basic industrial services; 4. Boosting the quality and recognition of Chinese brands; 5. Making Chinese manufacturing practices greener; 6. Targeting priority technologies and products; 7. Restructuring industry 8. Developing manufacturing as a service vice and services for manufacturing; and 9. Identifying opportunities for international collaboration. Ezell: 2018,34.

**Table 2: Summary of National Smart Manufacturing Policies / Programs by Country**

COUNTRY	SMART MANUFACTURING POLICY / PROGRAM	INVESTMENT LEVEL
<b>Canada</b>	<p>The “Strategic Innovation Fund” will consolidate and simplify innovative programming for various areas, including,</p> <ul style="list-style-type: none"> <li>a.) Strategic Aerospace and Defense Initiative</li> <li>b.) Technology Demonstration Program</li> <li>c.) Automotive Innovation Fund</li> <li>d.) Automotive Supplier Innovation Program</li> </ul> <p>It will encourage research and development, accelerate technology transfer and commercialization of innovative products, processes and services; facilitate expansion of firms; attract large scale investments; advance the development of technology through collaboration with academia, non-profit organizations, and private sectors.</p>	<p>The 2017 budget proposed 1.26 billion dollars over five-years, which will allocate repayable and non-repayable contributions to firms of all sizes across Canada's industrial and technology sectors.</p>
<b>China</b>	<p>The “Made in China 2025” is an action plan to promote the development of Chinese service-oriented manufacturing. The plan highlights 10 priority sectors relevant to smart manufacturing including:</p> <ul style="list-style-type: none"> <li>a.) New advanced information technology</li> <li>b.) Automated machine tools &amp; robotics</li> <li>c.) Maritime equipment and high-tech shipping</li> <li>d.) Modern rail transport equipment</li> <li>e.) New energy vehicles and equipment</li> <li>f.) Power equipment</li> <li>g.) New materials</li> <li>h.) Advanced medical products</li> </ul> <p>The plan also foresees the creation of 15 manufacturing innovation centers by 2020 and 40 by 2025.</p>	<p>The program was issued in 2015 and did not include a specific funding line; however, China invested 20 billion yuan (3.05 billion U.S. dollars) in “advanced manufacturing” in 2016.</p>

<b>France</b>	<p>Industrie du Futur aims to make France a leader in the world’s industrial renewal by bringing together professional organizations from industry and digital technology along with academic and technological partners. The main areas of the plan are:</p> <ul style="list-style-type: none"> <li>a.) Ecological transition</li> <li>b.) Vocational training</li> <li>c.) Innovation</li> <li>d.) Digital transformation of the public services</li> </ul>	<p>Starting in 2015 the government will invest €57 billion over 5 years.</p>
<b>Germany</b>	<p>Industrie 4.0 was implemented by the Ministry of Education and Research and the Ministry for Economic Affairs and Energy. It refers to the national and international activities that surround digital transformation in Germany. The platform unites stakeholders from various economic sectors, professional associations, scientific communities, trade unions, and government departments to collaborate on innovative strategies. The work of the platform consists of 4 concentrated areas:</p> <ul style="list-style-type: none"> <li>a.) Making content recommendations</li> <li>b.) Providing single source support</li> <li>c.) Promoting international networking</li> <li>d.) Mobilizing businesses -particularly small and medium sized enterprises</li> </ul>	<p>Funding of up to €200 million has been provided by the government, followed by €120 given by Ministry of Education and Research, and €80 given by Ministry for Economic Affairs and Energy.</p>
<b>Sweden</b>	<p>The “Smart Industries” strategy for new industrialization will strengthen companies’ capacity for change and competitiveness in a shifting landscape for manufacturing and production. The plan includes 4 focus areas:</p> <ul style="list-style-type: none"> <li>a.) Industry 4.0</li> <li>b.) Sustainable Production</li> <li>c.) Industrial Skills Boost</li> <li>d.) Test Bed Sweden</li> </ul>	<p>The strategy will invest 11.5 million SEK (1.24 million U.S. dollars, the project is to be reviewed in March 2020).</p>
<b>United Kingdom</b>	<p>The “Industrial Strategy” launched in 2017 seeks to create an economy that will increase productivity and earning power through the foundation of ideas, people, infrastructure, business environment, and places. Specifically, the Office for AI will</p>	<p>It will invest £725m in new Industrial Strategy Challenge Fund programs to capture the value of innovation.</p>

	work initially with six priority business sectors: cybersecurity; life sciences; construction; manufacturing; energy; and agricultural technology to find ways to boost productivity through artificial intelligence and data analytic technologies. In partnership with industry experts and academia, these bodies will foster research and innovation, stimulate demand and accelerate uptake across all sectors of the economy.	
<b>United States</b>	Inspired by the success of Germany’s famed Fraunhofer Institutes, Manufacturing USA currently comprises 14 institutes that are geographically dispersed. Each institute focuses on a core set of related technologies. The program has four stated goals: (1) To increase the competitiveness of U.S. manufacturing; (2) facilitate the transition of innovative technologies into scalable, cost-effective, and high performing domestic manufacturing capabilities; (3) accelerate the development of an advanced manufacturing workforce; and (4) support business models that help institutes to become stable and sustainable after the initial federal startup funding period.	Federal funds are authorized for a five-year period. The federal funding level is typically \$70-110M per institute, matched or exceeded by funding from private industry and other non-federal sources, with a minimum 1:1 cost share. To date, the federal-nonfederal ratio exceeds 1:2.

**Sources:** Kennedy: 2015, European Commission: 2017, France Ministry for the Economy and Finance: 2018, Government of Canada: 2018, Government Offices of Sweden: 2016, HM Government; 2017.

**Prepared by:** Kailee Hilt

Industrialized country officials may see smart manufacturing as a way to wed their digital expertise with longstanding management skills. They may hope that this linkage will bring manufacturing “back” to higher wage nations. They also hope to build new markets for customized and precision manufactured goods. On one hand, their hopes may be granted. According to technology analyst Steven Ezell, smart manufacturing “can lower labor costs relative to total costs,” so it could make at-the-margin manufacturing easier to locate in higher - cost areas. But African, Chinese, Indian, and other countries may find strategies that allow them to compete equally well for such firms with low cost loans or lower real estate prices or subsidized infrastructure. At the same time, smart manufacturers will require higher-skilled



workers on the shop floor, making it problematic for low-wage nations, where potential workers have limited skills. Finally, by reducing efficient minimum production scale, in part through customized manufacturing, smart manufacturing will make it more economically feasible to locate some work closer to the customer base, and that will often be in higher-income nations.” (Ezell: 2016, 22).

However, the belief that western democracies with unionized workers may dominate smart manufacturing may be overly optimistic. Few democracies can push forward with long term industrial planning without significant debate. Moreover, their citizens could be negatively affected by changes which could affect their jobs, income, and social/political views. Although executives will decide whether to invest, government policies and subsidies could play a deciding role in their decision-making process. In contrast with authoritarian states, citizens and policymakers alike may be reluctant to subsidize technologies that they fear could lead to economic and social upheaval. US history shows that sectors experiencing rapid improvements in productivity can increase output with fewer workers and lead to a rapid decline in sector employment (e.g., the agricultural sector from 1900 – 1930).

### **Trade Rules Governing Smart Factories**

There are no trade rules governing smart factories per se. The most multilateral trade agreement, the World Trade Organization (WTO) and most bilateral or regional trade agreements predate the invention of many of the technologies that underpin smart factories. Nonetheless, the WTO includes several agreements that govern trade in the goods and services produced by and essential to creating smart factories. These agreements include the Information Technology Agreement (ITA), which eliminates duties for trade in digital products; the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), which protects trade-related intellectual property pertinent to information technology; and the General Agreement on Trade in Services (GATS), which has chapters on financial services, telecommunications, and e-commerce that relate to cross-border data flows (Aaronson: 2018). Member states have also agreed not to tax electronic transmissions that flow across borders (ICTSD: 2017). These rules not only say what governments can and can't do regarding trade, but they also delineate how and when nations can breach these rules. Under the exceptions, signatory nations can restrict trade in goods, services and data in the interest of protecting public health, public morals, privacy, national security, or intellectual property, so long as such restrictions are necessary and proportionate and do not discriminate among the 164 WTO member states (Goldsmith and Wu, 2006).

Member states designed the GATS language to ensure it would remain relevant as technology changed, but several member states have said that they need clarification on specific points and want to update these rules to avoid misunderstanding. In 1998, Members agreed not to put customs duties on electronic transmissions, as noted earlier. However, since then they have made little progress. They have tried to delineate rules to govern e-commerce (goods and services delivered online) and trade in computer or digital services through a new agreement called the Trade in Services Agreement (TiSA). But they have not yet found consensus.

The GATS has two sets of exceptions when nations can breach these rules: The General Exceptions and the National Security Exception. Under these exceptions, signatory nations can



restrict trade in the interest of protecting public health, public morals, privacy, national security, or intellectual property, as long as such restrictions are necessary and proportionate and do not discriminate among WTO member states. There is no consumer protection exception. Moreover, WTO dispute settlement bodies have found that ‘measures must be applied in a manner that does not constitute arbitrary or unjustifiable discrimination or a disguised restriction on trade in services’. Finally, countries should ensure that they use these exceptions in a reasonable manner so as not to frustrate the rights that they have accorded to other members (Goldsmith and Wu, 2006).

Meanwhile, although the GATS states nothing explicitly about data flows, WTO members have begun to apply these obligations when settling disputes about cross-border data flows (Wunsch-Vincent, 2006; Goldsmith and Wu, 2006). The WTO Dispute Settlement Body has adjudicated two trade disputes related to data flows. These disputes have provided some insights into when and how nations can use the exceptions and clarified that the GATS apply to new computer services including e-commerce or 3-D printing.

In the absence of negotiating progress at the WTO, the United States, EU, Canada, and other nations have been actively pursuing bilateral and regional free trade agreements. For example, the Comprehensive and Progressive Trans-Pacific Partnership (CP-TPP) is a trade agreement among eleven nations bordering the Pacific including Japan, Australia, Canada, Mexico, Chile, and Malaysia. (The US was a signatory, but President Trump withdrew the US from the agreement in 2017.) CP-TPP includes language making the free flow of data a default; it bans requirements to locate data only in local servers; and bans requirements to divulge computer source code (e.g. algorithms). However, it also includes a wide berth of exceptions (Aaronson: 2018 forthcoming). NAFTA 2.0 (now the USMCA) also includes digital trade provisions including stronger language on privacy. As of this writing, no such regional agreement with binding language on data flows has come into effect. Moreover, because they are regional rather than universal, these agreements could further fragment the internet, raising costs for businesses that rely on cross-border data flows.

Finally, the three largest producers and markets for data, the US, the European Union, and China, are using domestic and foreign policies to reap data-based economies of scale and scope. Essentially, they have created three distinct data realms with different approaches to data governance (Aaronson and LeBlond: 2018). In the US realm, policymakers have put few limits on cross-border data flows. They use trade agreements to develop economies of scale and scope in data and to ban practices such as data and server localization requirements, which could distort trade as well as undermine US comparative advantage in data-driven sectors. In contrast, the EU has made personal data protection the top priority for its realm, in the belief that it will build trust and help netizens feel more comfortable as firms use their personal data. Finally, policymakers in the Chinese realm restrict the free flow of data and information both within China and between China and other nations. In so doing, Chinese officials maintain social stability and the power of the Communist Party, while simultaneously nurturing knowledge-based sectors such as artificial intelligence (Aaronson and LeBlond: 2018).

The data driven economy is not yet a global phenomenon. Many countries are putting in place plans to facilitate the development of data driven sectors. Figure 2 provides an overview estimation of these activities



### How Smart Manufacturing Technologies will Change Trade Policies

Table 3 describes some technologies that underpin smart factories and how they may affect existing trade rules. As the table illustrates, some of the technologies embedded in smart manufacturing will need clarification under existing trade rules. Others will require brand new trade rules to effectively regulate how they may affect trade.

**Table 3: Some of the Technologies Embedded in Smart Manufacturing and their Implications for Trade**

TYPE OF TECHNOLOGY	ISSUES RELEVANT TO TRADE RULES	COVERED? AREAS OF CLARIFICATION?	NEED NEW RULES?
<b>Big data and analytics (including AI)</b>	Treatment of cross-border data flows	Covered in WTO, established through trade disputes, but language is implicit.	Yes. Will need rules regarding application that have governance implications (e.g. disinformation and national security, stability, rules governing exceptions, privacy)
<b>Internet of Things</b>	Security and privacy (data protection issues)	Covered but bi-dimensional which could yield confusion and trade disputes. IoT=Data/services bundled in a good. Goods covered under GATT, services under GATS	Need clarity given different national approaches to national security, social stability and privacy/data protection. Raises questions for services where a nation has not made a commitment. IPR, valuation issues. May need new rules.
<b>Cybersecurity</b>	National security implications covered, but unclear. Not directly addressed in trade rules	Has become a trade issue justified under the exceptions. Some FTAs include cooperative language	Need clearer rules as to when nations can use cybersecurity to justify an exception re. GATS/GATT. No common norms regarding how to keep information secure and when governments can restrict data flows (censorship) to keep internet secure
<b>The cloud</b>	Leading to many trade debates re. privacy and national security	Incomplete and unclear	Will need clarification regarding when national jurisdiction ends, and clarification of exceptions for privacy and national security.

<b>Additive manufacturing/3D printing</b>	Policymakers are just beginning to address trade implications	Incomplete and unclear	Raises customs, rules of origin, valuation, and copyright issues. Could expand product differentiation and complicate definitions of “like product” (is a 3d printed item the same as a manufactured item?) May need new rules.
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Sources: Aaronson: 2018, Chander: 2015, Rimmer: 2017, WTO: 2018 (forthcoming) and 2017.

### Two Issues in Depth: 3-D printing and the IoT

**3D printing** refers to a manufacturing process in which a material is joined or solidified under computer control to create a multi-dimensional object based on a digital model (such as a 3D model or one build through computer aided design). 3D printing will make it easier to customize products for specific consumers, facilitating more localized supply chains.

3-D printing will have mixed effects on trade. If demand falls for one product one quarter, a company can easily adjust its output to products or locations where there is greater demand, facilitating trade (D’Aveni: 2018). But 3-D printing may also act as a disincentive to trade. The Dutch Bank ING argues that world trade will shrink by 23% in 2060 if investments in 3D printers continue at the current pace. The Bank also forecast that 3-D printing will reduce US trade deficits with Mexico and Germany (automotive) and China (machines, consumer products) (ING: 2017, 3).

3D printing will challenge trade policymakers in several ways, including:

- Making trade agreements less relevant because trade will be less essential to firms;
- Undermining trade norms of non-discrimination between goods made in traditional factories and goods made through 3-D printing;
- Elevating and expanding services embedded in manufacturing as more companies attempt to create personalized products linked to such services (as example, embedded sensors for heart problems and services monitoring those sensors), and
- Furthering regulatory competition regarding intellectual property. Firms might choose to locate in a specific country with stronger or more lax regulation in of 3-D printing for information technology, medicine and biotechnology (Kommerzcollegium: 2016).
- Furthering competition about how best to promote innovation-open sharing of plans and process vs. the more closed proprietary protection of knowledge and technologies (World Intellectual Property Organization-WIPO: 2015).
- Prodding policymakers to rethink rules of origin (where a product was made) and valuation (how a product is valued for customs purposes).
- Prodding policymakers to rethink what is a good, given that such much of a 3-D printed good is data and associated services (World Customs Organization: 2016).

**The IoT** enables advanced services by interconnecting (physical and virtual) things to identify, sense, network, and process data. Like 3-D printing, the IoT will have mixed effects on trade. It could improve shipping and transport efficiencies (Lund and Manyika, 2016 and The Economist, 2018). But it could also lead to a trade bottle-neck. Nations with greater research capabilities in the IoT, data analytics, and computing could enjoy first-mover advantages from the digitalization of industry, but populous countries rich in data could also use their data pools as leverage over such firms. These states could demand new models of compensation for data holders or new models of regulation of data to obtain market access (Aaronson and LeBlond: 2018).

The IoT challenges trade policymakers in several ways, including:

- Making services affiliated with goods more important to trade;
- Forcing a rethink of valuation given the import of embedded services (Chander; 2015, 8);
- Prodding policymakers to make personal data protection and data security a priority and clarify trade rules related to privacy. Consumers won't trust the IoT unless they know their data will be protected. However, nations must rely on the privacy exception if they want to maintain personal data in local servers (Aaronson: 2018a; Chander 2015; CIGI-Ipsos: 2018). Yet some see privacy regulations as a trade barrier (Gupta and Fan: 2018). The IoT and data protection can be reconciled. The US, EU, Mexico and Canada have agreed to trade rules which ban data localization except under the exceptions in the EU/Mexico FTA and USMCA. Privacy is a legitimate exception as noted above. The EU requires its trade partners to be found adequate to exchange personal data across borders. (These agreements are not yet in effect.<sup>2</sup>) This raises important security and cybersecurity questions for governments related to computers, telecommunications and cloud-related procurement (Finley: 2018). Many countries justify procurement rules that require certain types of data to be stored locally or requiring the purchase of certain types of products for national security reasons. Policymakers struggle to determine legitimate privacy and national security needs vs. trade distorting practices (Aaronson: 2018a).

### **Rules Governing Data Need to Be Updated and Clarified**

The technologies underpinning smart factories are built on significant amounts of data. Executives and entrepreneurs need to obtain this data from many different countries; these countries with have different regulations regarding the use of technologies and personal data. This creates a catch 22. Smart factories need global access to data to achieve economies of scale

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<sup>2</sup> See Digital trade Chapter EU/Mexico

[http://trade.ec.europa.eu/doclib/docs/2018/april/tradoc\\_156811.pdf](http://trade.ec.europa.eu/doclib/docs/2018/april/tradoc_156811.pdf) and for NAFTA It contains a review clause which the EU finalized in July 2018 see

[http://trade.ec.europa.eu/doclib/docs/2018/july/tradoc\\_157129.pdf](http://trade.ec.europa.eu/doclib/docs/2018/july/tradoc_157129.pdf). For the digital trade provisions in NAFTA 2.0, see

<https://ustr.gov/sites/default/files/files/agreements/FTA/USMCA/19%20Digital%20Trade.pdf>

and scope. Firms that can achieve economies of scale using data can decrease the costs of production of a good or service; economies of scope allow a firm to produce many different types of products to reduce costs. Policymakers in many countries want to encourage these scale economies with shared norms, rules, and exceptions to these rules. In developing these exceptions, these officials want to limit trade in some types of data to ensure the safety and privacy of their citizens. Hence, policymakers must devise a new approach to regulating trade in data because so much of this data is personal data.

To accomplish this aim, trade diplomats and internet policymakers could call for an international meeting to establish an interoperable approach to data protection and control which allows nations to evolve their own complementary approaches and make them interoperable. The meeting should be attended by a diverse set of individuals, firms and agencies involved in privacy and data protection issues, and it should be tasked to build on existing principles such as the APEC and OECD Privacy Principles. Companies and data protection officials have already found some common ground on helping companies that move data globally transcend different regulatory strategies. (Carson: 2014; Carson: 2015). But there seems to be a growing sense that the US approach is too focused on ensuring that personal data can be utilized as a commercial asset, while the EU has put the suppliers of personal data first. The organizers should establish a web site that will be “marketed” by participating governments. The architects of the site will ask netizens to crowd-source ideas about how to build on these existing principles while simultaneously empowering people to control their personal data (World Economic Forum: 2011.)

## **Conclusion**

Professor Mark Lemley of Stanford Law School warned that the internet has introduced a raft of new technologies that separate creativity from production and distribution and reduce the cost of all three activities. The technologies “challenge the basis for our economy as a whole” (Lemley: 2015, 515). Lemley is right: smart factories include many technologies that are changing how and what we produce and how we think about the relationship between products and associated services. Trade policymakers have a responsibility to ensure that the system of rules governing trade in both the data and technologies underpinning smart factories are governed in a transparent, accountable, and trusted manner. It won’t be easy.

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