



2016 Top Markets Report **Industrial Automation**

Overview & Key Findings

Introduction

The United States is a major global producer of industrial automation equipment. In 2015, U.S. companies exported nearly \$10.5 billion worth of products to foreign markets. This was down from nearly \$10.7 billion in 2014, representing the first decrease in annual exports since the 2008 recession. Most of these sales went to highly developed markets with deeply embedded industrial bases and robust public infrastructure. As will be illustrated, however, demand for automation equipment is also growing in developing markets, which are more geared toward commodity production and lesser-valued outputs.

2015 has seen a number of high level developments that have broadly affected global markets. In the currency markets, the rising strength of the American Dollar created headwinds for many U.S. manufacturers by reducing prices of imported products into the domestic market. At the same time, the strong dollar raised prices of U.S. exports, particularly in the Eurozone and emerging markets like Brazil. In China, the 2nd largest global economy suffered significant slides in the stock market, attributed to signs of slowing growth. The exceedingly low cost of oil also affected many exporting countries across the world. By the end of 2015, however, for the first time since the 2008 recession, the Federal Reserve raised key interest rates as a general show of confidence in the strengthening U.S. economy. The December 2015 unemployment rate declined to 5.0 percent, the lowest in nearly a decade. Going into 2016, the U.S. economy appears poised for growth, even as much of the world struggles.

As global markets face uncertainty, developing an export strategy has become more important than ever for U.S. companies. Businesses looking to increase sales and profit, reduce dependence on the domestic market, and stabilize seasonal fluctuations should consider selling abroad. Nearly 96 percent of consumers live outside the United States, and two-thirds of the world's purchasing power is located in foreign countries.

Key Findings: Top Markets and Methodology

This ITA *Top Markets* report attempts to assess the global market for automation equipment by analyzing U.S. exports in this sector: what products they are, where they are going, and the dollar value attached to each sale. To establish a priority of foreign markets that offer the best prospects for U.S. producers of industrial automation equipment, four criteria were used:

- total volume of U.S. industrial automation exports in 2015, as measured by U.S. Census Bureau Foreign Trade Division;
- compound annual growth rate (CAGR) of U.S. industrial automation exports between 2009 and 2015, as measured by U.S. Census Bureau Foreign Trade Division;
- most up-to-date ranking (2012) of market by United Nations Industrial Development Organization (UNIDO) "Competitive Industrial Performance Index"; and
- level of growth in industrialization as measured by rate of improvement in 2009 through 2012 UNIDO "Competitive Industrial Performance Index" rankings.

U.S. exports are defined as products originating in the United States, which is an important distinction to make in an increasingly globalized economy. Products that do not meet the minimum threshold of content made in the United States are not taken into account.

In ranking markets, ITA placed the most emphasis on the total volume of exports in 2015. It is presumed that markets with historically high U.S. exports will continue to have high volumes in the future for a variety of reasons. Historic export trends indirectly take into account factors specific to the United States, such as geography, Free Trade Agreements (FTA) and size of market opportunity.

Some may contend that size of the market is the most important factor in global rankings. In other words, the largest markets will present the greatest market opportunities. While valid to an extent, this logic does not take into account the variety of economic, historic and political factors that shape global trade. For example, top-ranked Mexico is not objectively the “largest” global market for industrial automation equipment, a position held definitively by China. Mexico, nonetheless, continues to present unparalleled opportunities for U.S. exporters because of its shared border and lack of tariffs. China, on the other hand, may be the largest importer of industrial automation products in the world, but U.S. exporters must contend more with regional competitors, such as Japan, Korea and Taiwan, which will affect pricing and market entry. Size also does not take into account market access barriers, such as tariffs, or policy prescriptions, such as export controls, which may apply to U.S. exporters. As a result, while the information provided in this report may be of general use to companies across all of industry, its utility is truly intended for U.S. exporters of industrial automation products.

Based on aggregated trade data and global industrial indices, this report ranks global markets based on their export potential. These rankings represent the best current understanding of market opportunities. Paired with on-the-ground market intelligence from U.S. Foreign Commercial Service officers, this report aims to assist exporters in better determining global sales opportunities in their industry.

This *Top Markets Report* will focus on the export forecast for products falling broadly into five categories:

- **Sensors and Instruments** for monitoring and controlling process variables, including temperature, pressure, viscosity, voltage current and more
- **Electric Motors and Actuators** including alternating and direct current motors, servos, electrical, hydraulic, and pneumatic actuators, and more
- **Electrical Relays and Industrial Control** equipment, including electro-mechanical relays, solid state relays, motor control relays, as well as motor control centers, programmable logic controllers (PLC) and more
- **Material Handling** equipment, specifically conveying and elevating equipment
- **Industrial Robots**, including those used in spot welding, sorting, palletizing, painting and more

This report does not take into consideration exports of services, such as those provided by systems integrators. Nor does it account for software solutions related to automation, such as Product Lifecycle Management (PLM), Enterprise Resource Management (ERM) or others. Trade data derived from services is not readily available or consistent across markets, and therefore, statistics used for automation equipment could be used as a proxy

Figure 1: Projected Top Markets for 2016-2017

1	Mexico	8	South Korea	15	Thailand	22	Peru	29	Venezuela
2	Canada	9	Netherlands	16	Ireland	23	Australia	30	Chile
3	Germany	10	Vietnam	17	Colombia	24	France	31	UAE
4	China	11	United Kingdom	18	Norway	25	Switzerland	32	Israel
5	Poland	12	Brazil	19	India	26	Belgium	33	South Africa
6	Japan	13	Saudi Arabia	20	Italy	27	Argentina	34	Malaysia
7	Singapore	14	Taiwan	21	Russia	28	Spain	35	Hong Kong

indicator for services exports. If a country is a major recipient of U.S. equipment exports, it will likely have associated trade in related services.

For most of the products in these sectors, their utility lies not in stand-alone application but in integration. A vulcanized rubber conveyor belt on its own may be a commodity, but combined with a servo motor and motion control within a distribution warehouse, it becomes much more. Similarly, a PLC may physically be an inert piece of IT hardware, but after being connected to sensor inputs and control outputs, however, it becomes the central nervous system of a factory floor or food processing plant. It becomes the lynchpin for an automated system, and its success or failure can be extremely consequential.

Top Markets

The top 35 markets ranked in this report are geographically and economically diverse. They account for over 90 percent of all U.S. exports in the industry, with a minimum threshold of \$40 million in annual exports to each market in 2015. While the traditional markets of Western Europe figure prominently, growth in Asia and Latin America has been more widespread and has been strongly taking root. For U.S. exporters, the greatest export opportunities are not only in the largest markets. Many other considerations may be taken into account, including geographic and cultural proximity, ease of doing business, tariffs and market access, technical barriers to trade, and more. By ranking markets based on aggregate trade flows, this report helps to account for these considerations while offering further detailed information in the five country case studies.

The five country case studies selected for further reference are chosen to illustrate a variety of points. Robust sales to Canada and Mexico, for example, are highly dependent on geographic proximity and ease of market access through the North American Free Trade Agreement (NAFTA), which is now in its 21st year of existence. Across the Pacific, Singapore is one of the most highly developed industrial economies in the world and is a major consumer of U.S. automation equipment. As a free-trade partner, market access is wide open, and sales are expected through the future. In Brazil, a number of headwinds that include tariffs and a slowing economy will challenge export growth in the short term. Finally Germany, the largest European market and top-

ranked by United Nations industrial indices, is seen as one of the most regulated but rewarding destinations to do business. Entering the German market is often seen as key to entering Europe as a whole. With automation and connectivity at the core of the Industrie 4.0 initiative to improve manufacturing productivity, Germany is an important market for U.S. exporters. While these five countries are specifically highlighted, the U.S. Foreign Commercial Service maintains a presence in all of the top markets ranked in this report.ⁱ

Policymakers should appreciate the different competitiveness issues and market characteristics that impact exporters in each sector. For more country-specific information on local business practices and the economic and political environments, the U.S. Commercial Service also provides in-depth Country Commercial Guides that can be accessed online.ⁱⁱ

Industry Overview and Competitiveness

Broadly speaking, automation is the act of reducing manual labor inputs into products or processes. There are many reasons for automating processes. One is the need to reduce the amount of direct labor and decrease costs. Some tasks are truly “mindless” and may be undesirable to even low-skilled workers. By using automation to reduce the number of monotonous tasks, businesses can better allocate resources to higher value propositions, such as research or business development. Other reasons for automation include the needs to improve product quality, to consistently meet exacting specifications, or to improve speed of output. In many industrial settings, certain tasks are also inherently dangerous or unsanitary for human workers. Automation of these tasks can improve occupational health and safety outcomes while reducing the number of worker compensation cases and costs for claims.

Today, according to a study by the McKinsey Global Institute, as much as 45 percent of activities individuals are paid to perform can be automated.ⁱⁱⁱ Many of the technologies that have underpinned the move toward automation have existed for decades. As the technologies have progressed, however, the level of automation across any number of industrial settings has reached unparalleled levels. In public transit, supervisory control and data acquisition (SCADA) systems are enabled by industrial automation products to ensure trains and traffic

grids remain fluid and decongested. One look inside of a major postal distribution or logistics center reveals an almost staggering array of complexity that is made manageable by automation. Within the food and beverage industry, process controls are the key to ensuring that different batches of the same soft drink consistently look, smell and taste the same.

The United States is a top tier global supplier of industrial automation equipment and is home to a robust domestic industry. On one side of the spectrum, hundreds of small to medium-sized enterprises (SMEs) typically offer products to compete in highly specialized equipment and component markets. Many of these pure-play companies are family owned and tend to focus on particular products for specific industries or applications. These make up the majority of automation equipment companies.

The greatest proportion of equipment sales, however, is generated by automation divisions of Fortune 500 industrial conglomerates. U.S. headquartered companies include GE (NYSE: GE), Johnson Controls (NYSE: JCI), Emerson Electric (NYSE: EMR), Rockwell Automation (NYSE: ROK), and others such as Danaher Corporation (NYSE: DHR) and Honeywell International (NYSE: HON). These companies are often structured to provide products and services that are tailored to the unique settings of end-use industries. With employee counts ranging in the tens of thousands, these companies often enjoy robust presence in major markets throughout the globe.

The United States is also home to a large number of automation systems integrators. These companies are service-providers, with engineering and production expertise, that install or integrate automation products into existing machinery, factory lines, warehouses and more. They typically are certified by original equipment manufacturers (OEMs) to work directly with end-users, and they specialize in certain industries or applications. Integrators tend to be SMEs that provide in-depth expertise of local business needs and conditions, a business model that tends to be domestically oriented and less export-driven.

Market Drivers: End-Use Industries

The industrial automation market is tied to the performance of end-use industries, particularly

those that rely heavily on high-volume output and process repeatability. These include automotive, food and beverage, metals and materials, oil and gas, packaging, pharmaceuticals, and more.

The automotive industry is one of the largest end-use industries for automation equipment. A single automobile can have as many as 15,000 precision parts with a premium placed on interchangeability.^{iv} In 2013, 86.9 million motor vehicles were produced around the globe with almost 76 million units produced outside of the United States.^v As a high-volume industry focused on mass-production, the automotive industry relies on multiple tiers of suppliers to provide components and subcomponents for each vehicle. From the bearings and parts in a seatbelt locking mechanism to the body of the car, most vehicle parts are currently produced using highly automated machinery.

Motor vehicle assembly is also highly automated. According to the International Federation of Robotics (IFR), the automotive sector is the largest end-user of industrial robotics, accounting for almost 98,900 installations in 2014.^{vi} Most carmakers today rely on articulated robotic arms with heavy payloads and multiple axes of rotation to do spot-welding, arc-welding, material handling, surface coating and inspection. In each case, robots allow for greater precision at a greater speed of production. The downstream benefits in quality have made industrial robotics a near prerequisite to any automotive assembly operation.

In consumer goods, the food manufacturing industry is also a major end-user of industrial automation equipment. The market for food manufacturing is estimated at over \$750 billion in the United States alone,^{vii} and McKinsey estimates the global food and agribusiness industry at \$5 trillion.^{viii} Subsectors, such as animal feed production, sugar processing, confections, condiments and dairy, make up an essential industry for a growing global population. For major manufacturers of globally branded products, most new plants are automated in their entirety. While large manufacturers may have the funds to automate entire operations, many SME processors with limited means also recognize the value in targeting specific processes in the product lifecycle for automation.

The same can be said for the beverage industry. Revenue from soft drinks, breweries, wineries and

distilleries was estimated at \$500 billion in 2014 in the United States alone.^{ix} From ingredient delivery, mixing, bottling and secondary packaging to distribution, the beverage industry relies on numerous processes and steps before reaching the consumer. As with food manufacturing, beverage producers are often highly regulated for safety and sanitation. In most markets, quality control is an absolute requirement, and thus, finding solutions to eliminate human error is a major driver in improving operations.

There are many other end-use sectors to consider, but the point to underscore is that virtually any foreign manufacturer in a process-intensive industry is a potential customer for U.S. automation equipment. While many of these are mature industries, what is new is the increasing degree of scalability and drive to increase interoperability between machinery, sensors, controllers, drives and other equipment. As any enterprise grows to accommodate increasing productivity demands, be it a manufacturer or utility provider, the need for hardware and control capabilities increases as well. As with information and communications technology (ICT) hardware in general, the rapid pace of improvement in speed and data processing in industrial ICT hardware has been a major enabler of progress across the globe. ITA expects this trend to continue to drive sales through the short and long-term.

Global Competitive Landscape

Relying on global trade data collected by the United Nations Statistics Division, ITA projects that competition will continue to come from suppliers in Asia, Western Europe and Mexico. According to U.N. data, in 2014, the United States was the third largest exporter of automation equipment in the world, behind China and Germany.^x

Since 2007, China has been the largest exporter of equipment. It has also been the fastest growing in terms of global export market share, increasing from 11.4 percent in 2004 to 20.2 percent in 2014. The United States, on the other hand, has seen the largest decline over the same period, falling from 15.1 percent to 9.8 percent. Japan was the fourth largest exporter in 2014, but it also saw a decline in market share.

Asia

In Asia, the major competing markets are China, Japan and South Korea. China has been the largest producer of automation equipment for nearly a decade. Much of this has been due to offshore assembling for major multinational firms by contract manufacturing companies. For example, Taiwan-headquartered Foxconn traditionally assembles ICT products for export into western markets. Growth, however, is also being propelled by an increase in domestic consumption and a drive to improve manufacturing productivity in-country. Some sources estimate that output within China from Chinese-owned firms will surpass that of foreign-owned firms by 2020.^{xi}

In Japan, emphasis on product quality and lean manufacturing has made the country a leading developer and supplier of automation equipment. Japan is well-known for revolutionizing computer-numerical control (CNC) technology, becoming a global powerhouse in manufacturing controls for the machine tool industry. Japan is also well-known for industrial robotics. While China has recently eclipsed Japan as the leading global producer, according to the IFR, Japan is estimated to have the largest operational stock of industrial robots in the world.^{xii} Some of the country's major industrial conglomerates, such as OMRON, Fanuc, Yaskawa and Mitsubishi, are diversified across robotics and other automation products.

Korea has emerged as one of the prominent "Asian Tigers" and is one of the top 10 producers of automation equipment. The IFR notes that Korea had the highest robot density in the world,^{xiii} a point analysts attribute largely to government actions and initiatives.^{xiv}

Europe

Western European companies continue to compete tightly with U.S. companies in global markets. In 2014, the largest European exporters were Germany, Italy, France and the United Kingdom.

In Europe, Germany is considered the leading voice in smart manufacturing and productivity. Germany is Europe's largest exporter of automation equipment by far and surpasses the United States as the second largest in the world. Germany is home to the Industrie 4.0 initiative, which aims to "utilize the

enormous potential of digitization... to strengthen Germany's manufacturing base."^{xv} The world's largest automation trade show, the Hannover Messe, draws roughly 225,000 participants each year. Germany is home to thousands of SMEs and a number of leading multinational corporations, including Siemens AG and Bosch Rexroth.

Across Europe, countries, such as Italy, France and Switzerland, are home to a number of prominent automation companies. Companies like Schneider Electric of France and ABB of Switzerland are leading providers of industrial control systems. At the time of writing this *Top Markets Report*, ABB is also one of the largest industrial robotics companies to manufacture in the United States. Italy's Comau Group, a subsidiary of automotive giant Fiat-Chrysler, has also produced advanced automation systems for years.

Mexico

Mexico, like China, has traditionally been a large market for assembling and manufacturing by major multinational firms. Much of this trend has been driven by the North American Free Trade Agreement (NAFTA), Mexico's oldest and most consequential free trade agreement. As a result of lower labor costs and close geographic proximity, many U.S. multinational firms have acquired manufacturing operations in Mexico for the purpose of eventual resale in the U.S. market. Mexico, however, has also entered into over 40 free trade agreements with Japan, the European Union and others, providing further incentive for larger multinational companies to expand growth into the Americas.^{xvi}

Challenges and Barriers

The International Trade Administration (ITA) regularly engages with foreign governments to improve outcomes for U.S. exporters.

Market Access

In the automation sector, tariffs affect many products in a number of countries. Opening market access through tariff reduction remains a critical strategy for many countries, including Brazil, China, India and more. By increasing the price of the product for the consumer, tariffs affect the cost-competitiveness of imported items and have distortionary effects on the market. While tariffs

have traditionally provided a source of revenue, they can also be used to protect politically-sensitive domestic industries by prohibitively raising the cost for outside competition. The United States continues to push for open access to markets through expansion of free trade agreements (FTA), such as the Trans-Pacific Partnership (TPP) or the Transatlantic Trade & Investment Partnership (T-TIP). The United States also continues to push for market access through established multi-lateral fora, such as the World Trade Organization (WTO), and bilateral fora with trade partners like China and India through the U.S.-China Strategic & Economic Dialogue and the U.S.-India Strategic & Commercial Dialogue.

Content Localization

ITA also seeks to engage foreign governments on issues of content localization. Content localization requirements are typically set forth by governments as a means of ensuring that a certain percentage of inputs into a product are sourced from domestic manufacturers. In return, the local manufacturer may receive preferential treatment in taxation and/or subsidies, among other incentives. For example, Brazil gives tax reductions on and exemptions to many industrial ICT equipment and goods that are produced locally and qualify under the Basic Production Process (Processo Produtivo Básico, or PPB).^{xvii} The PPB offers incentives for the creation and development of products with a certain minimum amount of local content, creating barriers for U.S. exporters.

While calls by foreign governments to increase local content production are not in themselves barriers to trade, they can raise concerns if they lead to actual requirements. Similarly, in 2015, the Chinese Ministry of Industry and Information Technology unveiled "Made in China 2025," an industrial policy that intends to upgrade Chinese manufacturing through technology and skilled labor. The plan also calls for Chinese companies in targeted sectors to raise domestic content to 70 percent. These priority sectors include advanced ICT equipment, automated machine tools, industrial robotics and power equipment, among others.^{xviii} While these calls are not necessarily detrimental to trade, ITA monitors them closely for their potential to affect U.S. exports. Through bilateral fora, such as the U.S.-Brazil Commercial Dialogue and the U.S.-China Joint Commission on Commerce and Trade, as well as with

our FTA partners, ITA continues to advocate for the same preferential treatment to be given to U.S. exports in these sectors.

Technical Barriers to Trade

ITA closely monitors technical regulations issued by governments and the development of standards, which include voluntary product specifications set forth by hundreds of regional and industry-specific standards-developing organizations (SDOs). Oftentimes, governments will incorporate voluntary standards set by SDOs into their regulatory regimes, making them mandatory for their respective markets. When regulations become overly burdensome or have the effect of limiting imports from otherwise qualified vendors, they can become trade irritants and, in some cases, be classified as technical barriers to trade (TBT).

Since 1995, the EU has mandated that all machinery used within the 28 EU members be built to comply with the “Machinery Directive” on safety; European Economic Area countries (EEA, which includes Iceland, Liechtenstein and Norway) also follow this directive. Machinery manufacturers indicate their compliance with this directive by placing a “CE” marking (short for the French *Conformité Européene*) on their products. The easiest means for demonstrating compliance with the EU Directive is to show conformity with the recognized European Standard associated with it. Thus, to use the “CE” marking, many manufacturers demonstrate conformity to the appropriate standard or standards. For U.S. producers that manufacture to standards developed by U.S.-domiciled SDO’s, this can require expensive changes to the product. Apart from the direct costs of retooling and reconfiguring models for the European market, there is opportunity cost from the lost sales of U.S. products that are not modified for export. As a result, companies interested in doing business in Europe should be well versed in the “Machinery Directive” and its requirements.^{xix}

While CE marking has become an understood cost of doing business in Europe, an area long of concern to the U.S. Government and ITA has been the EU practice of spreading its standards regime to other countries through the EU Neighborhood Policy (ENP) and through European Free Trade Agreements (FTA). The ENP consists of 16 markets in Eastern Europe, Africa and the Middle East^{xx} and is designed to

promote closer economic and political integration with markets where the EU has strong trade ties but that are unlikely to become EU members. As part of the ENP or as a signatory to an FTA, countries are often provided with aid and technical assistance to develop their markets and, in exchange, are often conditioned to adopt EU standards and directives. The effect is market access barriers in many instances for U.S. companies. Policymakers should be aware of EU agreements with other markets that obligate countries to withdraw from conflicting standards.

Export Controls

The United States Government restricts the sale of certain products and technologies to foreign countries or persons through a broad, interagency Export Control policy. The purpose of this policy is to safeguard U.S. national security interests and foreign policy objectives by limiting the sale of sensitive equipment, software and technology. While most U.S. products shipped to foreign markets are innocuous and used strictly for commercial purposes, other products may possess a “dual-use” capability; that is, they can be used for legitimate commercial applications but can also be used for military or proliferation activities. As a result, the United States Government maintains regulations in tandem with international agreements such as the Wassenaar Arrangement and Missile Technology Control Regime, which lay out rules and restrictions for exporting or releasing products to foreign countries or persons.^{xxi}

For industrial automation equipment, many of the applicable licensing requirements are located in the Commerce Control List (CCL) of the Export Administration Regulations (EAR), which enumerates specific items regulated by the U.S. Department of Commerce, Bureau of Industry and Security (BIS).^{xxii}

While the CCL enumerates specific items that require export licenses, the EAR also contains additional requirements applicable to most other items, which may require licensing based on the receiving entity (end-user) and/or the end-use of the product. For example, further regulatory requirements will likely apply to equipment sold for use in creating weapons or munitions, even if the equipment is not covered by an entry in the CCL. Also, some exports to certain countries may require further licensing, including both embargoed

destinations and other countries such as China, India or Russia. BIS also maintains a *List of Parties of Concern*, which enumerates individuals and entities that may be subject to licensing requirements or whose export privileges are denied outright. Finally, some items are not controlled by BIS but are instead subject to regulation by another agency, which may maintain separate licensing requirements.

While not all manufacturing technology products will require licensing, exporters will save valuable lead-time by familiarizing themselves in advance with the relevant Export Control regulations and utilizing the numerous compliance trainings that are regularly scheduled by the Bureau of Industry and Security.^{xxiii} More importantly, export control violations may carry significant repercussions, including substantial criminal, civil and administrative penalties. Exporters may also find local assistance through the Department of Commerce's network of 108 U.S. Export Assistance Centers.^{xxiv}

Opportunities

The global market for automation is growing. Going into 2016, the demand for integrated and scalable products is at an all-time high in order to meet the growing expectations of consumers. This is not only the case in highly-industrialized economies but also in developing nations as many companies simply bypass old technologies and leap-frog straight into the trends of today. As traditional IT principles continue to merge with manufacturing, companies that are able to harness concepts of "digital factory" will be at a distinct competitive advantage in their respective industries.

U.S. automation companies are keenly aware of this reality. Around the globe and across all industries, the paradigm of production is shifting towards digitization. Factories can no longer afford to run at the "surface level." They need data collected by sensors in order to measure throughput, systems to provide analysis in real-time, and controls to optimize performance.

U.S. companies are well-positioned to play a leading role in driving technical change in the global value chain. While the United States will continue to be a leading innovator and market for automation technologies, ITA is dedicated to partnering with U.S. companies that are looking to sell overseas. With a robust network in over 100 U.S. cities and 80 countries worldwide, ITA is a ready and able partner in unlocking the potential of exporting.

ⁱ Note: Switzerland and Venezuela are “Partner Posts,” meaning export promotion and commercial responsibilities are delegated to the State Department in the Economic Section of the U.S. Embassies in Bern and Caracas, respectively.

ⁱⁱ <http://www.export.gov/ccg/>

ⁱⁱⁱ Michael Chiu, James Manyika, Mehdi Mirejadi. “Four Fundamentals of Workplace Automation” *McKinsey Quarterly*, November 2015.
http://www.mckinsey.com/insights/business_technology/our_fundamentals_of_workplace_automation

^{iv} Klier, Thomas, and James Rubenstein. 2008. “The Parts of Your Vehicle.” In *Who Really Made Your Car?: Restructuring and Geographic Change in the Auto Industry*. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research, pp. 1-30

^v Alan K. Binder, ed. “Ward’s Automotive Yearbook 2014” *Ward’s Automotive Group* (Southfield, MI)

^{vi} <http://www.ifr.org/industrial-robots/statistics/>

^{vii} Gale Business Insights Global - dollar value calculated through aggregating revenues of industries falling under NAICS 311, “Food Manufacturing”.

^{viii} Lutz Goedde, Maya Horii, Sunil Sanghvi. “Pursuing the global opportunity in food and agribusiness” *McKinsey & Company*, July 2015

http://www.mckinsey.com/insights/food_agriculture/pursuing_the_global_opportunity_in_food_and_agribusiness

^{ix} Gale Business Insights Global- dollar value calculated through aggregating revenues of industries falling under NAICS 3121, “Beverage Manufacturing”.

^x This data reflects global exports between countries and should not be taken to indicate total levels of output for export and internal consumption. For example, countries like Germany rely heavily upon exports, while less is consumed in the domestic markets. For countries like the United States that are significantly larger in size and population, most of production is consumed internally, with less reliance on exporting.

^{xi} Georg Stieler “Industrial Automation in China” *Automation.com*, July 2015

<http://www.automation.com/automation-news/article/industrial-automation-in-china>

^{xii} <http://www.ifr.org/industrial-robots/statistics/>

^{xiii} Ibid.

^{xiv} John Edwards “The Quiet Giant of Asian Robotics: Korea” *Robotics Business Review*, May 2014

http://www.roboticsbusinessreview.com/article/the_quiet_giant_of_asian_robotics_korea

^{xv} German Federal Ministry of Economic Affairs and Energy (BMWi)

<http://www.bmwi.de/EN/Topics/Economy/Industrial-policy/industrie-4-0.html>

^{xvi} M. Angeles Villarreal “Mexico’s Free Trade Agreements” *Congressional Research Service*. July 3, 2012.

<https://www.fas.org/sgp/crs/row/R40784.pdf>

^{xvii} United States Trade Representative “2015 National Trade Estimate Report on Foreign Trade Barriers” p. 43.

<https://ustr.gov/sites/default/files/2015%20NTE%20Combined.pdf>

^{xviii} Scott Kennedy “Overview: Made in China 2025” *Center for Strategic & International Studies*, June 1, 2015.

<http://csis.org/publication/made-china-2025>

^{xix} http://ec.europa.eu/growth/single-market/european-standards/harmonised-standards/machinery/index_en.htm

^{xx} http://eeas.europa.eu/enp/index_en.htm

^{xxi} <http://www.wassenaar.org/>

^{xxii}

<https://www.bis.doc.gov/index.php/regulations/commerce-control-list-ccl>

^{xxiii} <http://www.bis.doc.gov/index.php/compliance-a-training/current-seminar-schedule>

^{xxiv} <http://export.gov/eac/index.asp>