WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Manufacturing for Growth
Strategies for Driving Growth and Employment

Volume 3: Manufacturing Value Chains Driving Growth
A World Economic Forum Report
in collaboration with Deloitte Touche Tohmatsu Limited

John Moavenzadeh
Senior Director
Head of Mobility Industries
World Economic Forum USA

Maxime Bernard
Senior Manager
World Economic Forum USA

Craig A. Giffi
Vice-Chairman
US Leader, Consumer & Industrial Products
Deloitte United States
(Deloitte LLP)

Dorothy Powers
Project Manager
Deloitte United States
(Deloitte Consulting LLP)

Disclaimer

The viewpoints expressed in this report attempt to reflect the collective engagement of individuals as Green Growth Action Alliance members and do not necessarily imply an agreed position among them or institutional endorsement by any participating company, institution or organization involved in the Alliance, or of the World Economic Forum.

World Economic Forum
Geneva

Published by World Economic Forum,
Geneva, Switzerland, 2013
www.weforum.org

World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel.: +41 (0) 22 869 1212
Fax: +41 (0) 22 786 2744

contact@weforum.org
www.weforum.org

Contents

Acknowledgements

These reports would not have been possible without the dedication and insights from individuals around the world who shared their perspectives on this important topic. The Manufacturing for Growth project team would like to thank all involved for contributing their time, perspective and passion to the creation of these reports. A full set of acknowledgements is provided in the executive summary.

Introduction

The Future of Manufacturing report (April 2012) identified a number of factors that will shape the future of competition between countries and companies. Three areas rose to the top as the most critical: human capital and talent development; innovation and technology advancement; and strategic use of public policy emphasizing collaboration between policy-makers and business leaders. This series of Manufacturing for Growth reports addresses these key competitive factors and defines ways to drive economic growth and high-value job creation through manufacturing industry sectors.

The Manufacturing for Growth series comprises three volumes:

- **Volume 1: Globally Competitive Policy seeks** to define the features of effective, comprehensive national industrial policy. This volume focuses on six countries chosen to represent both historic manufacturing giants and new and emerging manufacturing powerhouses. This cross-section was selected as representative of developed and emerging economy nations to showcase the unique aspects of each and, more often than not, the similarities in what manufacturing executives recommend to policy-makers.

  Volume 1 was informed by discussions with over 70 chief executives of multinational manufacturing companies, which resulted in:

  - Policy recommendations common across all interviews conducted in support of this project
  - Specific country policy recommendations for:
    - Emerging economies – China, Brazil and India
    - Developed economies – Germany, Japan and the United States
  - An outline of various policy instruments that are available to policy-makers and significantly influence competitiveness
  - An analysis of some critical policy areas most frequently cited by chief executives around the world as having a direct impact on their companies' ability to compete

  In addition, an appendix comparing tax, energy and environmental policy instruments for the six focus countries discussed in Volume 1 is available for download at www.deloitte.com/us/policyframework.

- **Volume 2: Partnering for Competitiveness** examines case studies of public-private collaboration from around the world that enable innovation and technology advancement and promote talent development.

- **Volume 3: Manufacturing Value Chains Driving Growth** illustrates the value and jobs created by specific industry sectors – aerospace, automotive and chemicals – from a global macro-view as well as a micro-view of the impact that a single product value chain or single production facility can have on a location.

To access the entire series electronically, visit http://wef.ch/mfgla13.

Project Methodology

During the World Economic Forum Annual Meeting 2012, the Forum-Deloitte LLP project team presented key findings from *The Future of Manufacturing report*, the culmination of a one-year project that explores why manufacturing is a key driver of economic growth, how the global manufacturing ecosystem has changed and continues to change, and what the key factors for both companies and countries will be to compete in the future.

In a largely unified response, project stakeholders – senior manufacturing executives, policy-makers and civil society leaders – directed the Forum-Deloitte team to continue the project by defining specific, effective, near-term ways to react to these future competitive factors. The resulting project, Manufacturing for Growth, defines key strategies for driving growth and high-value job creation through manufacturing industry sectors, and provides best practice examples for reacting to universal challenges in the area of talent development and innovation.

The Manufacturing for Growth project brings together extensive primary and secondary research from industry, academic and policy leaders. The extended global project team conducted face-to-face interviews around the world with over 70 chief executives of multinational manufacturing companies. Insights from these interviews were supplemented with input collected during workshops hosting senior manufacturing leaders, including members of the Project Consultative Group, in the following locations:

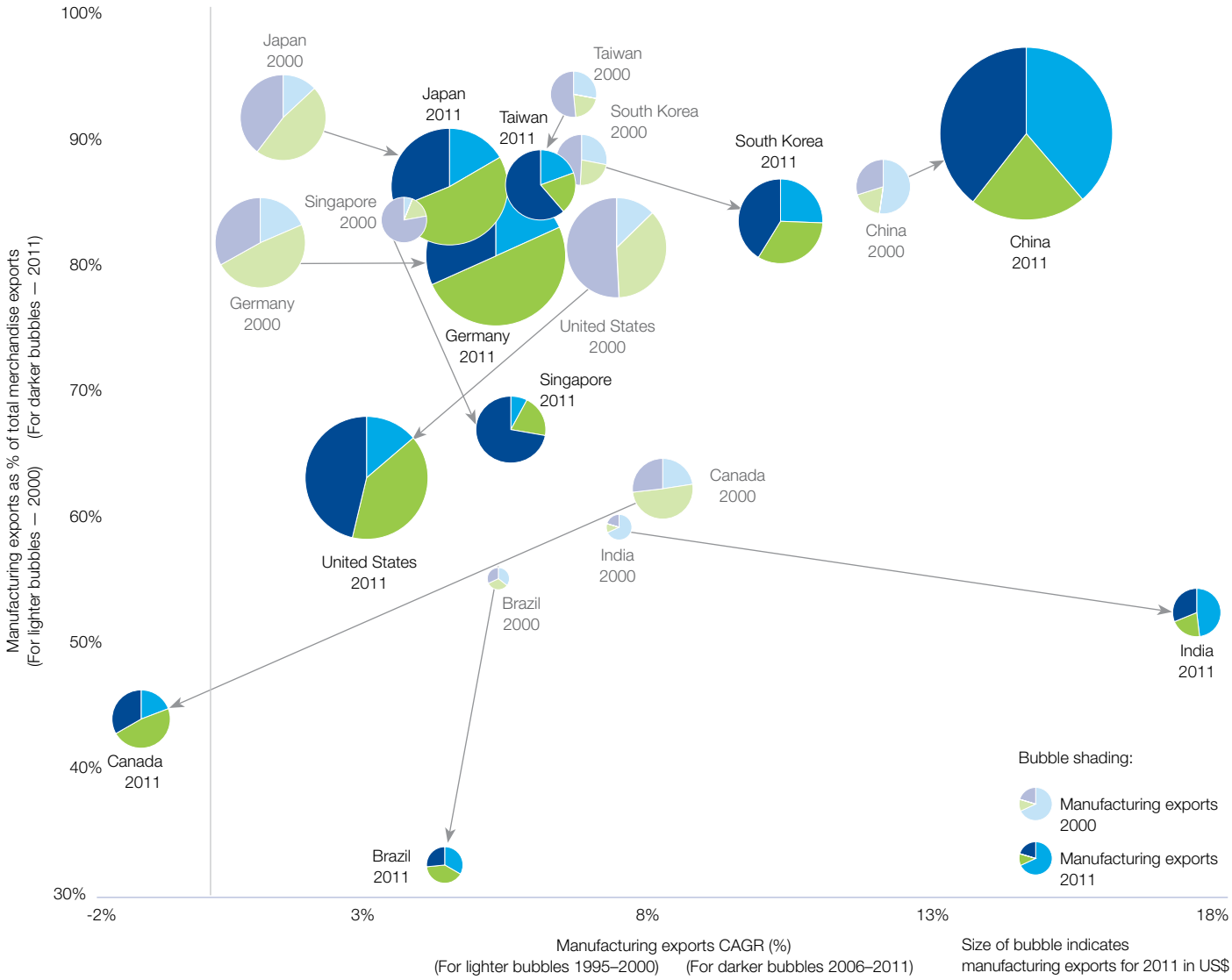
- World Economic Forum private session in Tokyo, Japan: 24 April 2012
- Manufacturing & Society in the 21st Century, in collaboration with the Aspen Institute, Aspen, USA: 17 August 2012
- World Economic Forum private session in Berlin, Germany: 17 October 2012
- World Economic Forum private session in New Delhi, India: 6 November 2012
- Talent-Driven Innovation Symposium, in collaboration with the Manufacturing Institute and Alcoa Foundation, Washington DC, USA: 28 November 2012
- World Economic Forum private session in Davos, Switzerland: 24 January 2013

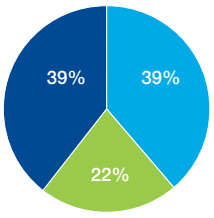
The project team also gleaned findings from the Forum's official sessions on manufacturing during the Annual Meeting of the New Champions in Tianjin, People's Republic of China, in September 2012 and the World Economic Forum on India in Gurgaon, India, in November 2012.

Additionally, this effort benefited from the invaluable time and content developed with a number of experts in the areas of policy, value chain analysis, human capital and specific manufacturing sectors: Deloitte Tax LLP; Deloitte Consulting's Energy Practice; the National Association of Manufacturers; Duke's Center on Globalization, Governance & Competitiveness; The Dow Chemical Company; and Nissan.

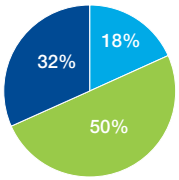
Comparative Economic and Related Data

2011 manufacturing export competitiveness by size, skill and technology

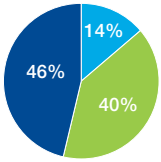




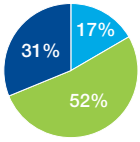
China
$1,768.5 billion (2011)
$219.3 billion (2000)



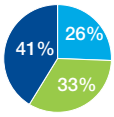
Germany
$1,226.3 billion (2011)
$459.2 billion (2000)



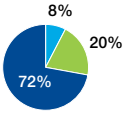
United States
$952 billion (2011)
$644.6 billion (2000)



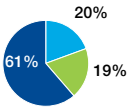
Japan
$724.8 billion (2011)
$449.4 billion (2000)



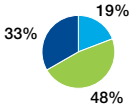
South Korea
$473.5 billion (2011)
$154.9 billion (2000)



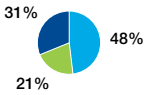
Singapore
$279 billion (2011)
$117.5 billion (2000)



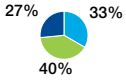
Taiwan
$270.7 billion (2011)
$141.0 billion (2000)



Canada
$202.3 billion (2011)
$175.4 billion (2000)



India
$151.7 billion (2011)
$26.0 billion (2000)



Brazil
$84.2 billion (2011)
$31.6 billion (2000)

Source: Deloitte Touche Tohmatsu Limited analysis [iv]

Percentages in these bubbles are for 2011

Key:

- Exports of manufactured goods with high skill and technology intensity
- Exports of manufactured goods with medium skill and technology intensity
- Exports of manufactured goods with low skill and technology intensity; and labour-intensive and resource-based manufactured goods

Note: The classification of goods into different degrees is based on Standard International Trade Classification (SITC) codes, UNCTAD [v]

Source: Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, 2013 Global Manufacturing Competitiveness Index


P CU 1 980 4
PONU 143725 9
42G1
PONU 142691 1
42G1
POCU 1142
42G1

Volume 3
Manufacturing Value Chains Driving Growth

Macroeconomic forces, including the spread of free trade, accessibility of digital manufacturing technology, and rise of the global middle class, have resulted in value chains being distributed around the globe. Research and development can take place in one location, engineering in another and manufacturing in yet another, while consumers are scattered across different regions. Today's manufacturing value chains are complex, highly interconnected and rapidly changing, which leads to a series of challenges and questions for policy-makers and business leaders alike in navigating this environment. As policy-makers drive to create more jobs and improve the quality of life for people within a country, manufacturing leaders are increasingly responding to an attractive global pool of talent, resources, capabilities and consumers. An understanding of the global, macroeconomic perspective as well as the local perspective is critical to shaping richer, more thoughtful dialogue between business and policy-makers.

To better inform this dialogue, Section 3 of our primer includes a series of illustrations and analyses of the value and jobs created in three manufacturing sectors: aerospace, automotive and chemicals. These sectors were selected due to their size and impact on countries, and as representative of several broader themes: globalization, including shifting consumer and production markets; increasing use of technology, digitization and advanced processes; and growing requirements for a talented workforce. Concepts are used from value chain analysis frameworks and methods to showcase the widespread economic value that each of these sectors brings to a country and local economy. For each sector, the report highlights a series of perspectives which, taken together, can help drive a more nuanced understanding of today's manufacturing ecosystem:

- **Global industry view** – demonstrates where output or revenues are generated today and where they are forecast to be over the next decade. As each sector has a unique story when it comes to global value creation, the report identifies the messages that demonstrate what has shaped the current global landscape and what matters with regard to employment, talent and wages at a macro-level.
- **Global trade view** – analyses the import and export trends over the past 10 years for each sector. The report looks at the top countries that dominate the global market from an export perspective and what the trajectory for those countries has been over the previous decade. The changing patterns of trade of manufactured products across borders help to demonstrate shifting conditions – from a resource, capabilities, political and societal perspective.
- **Facility view** – captures an illustrative snapshot of a production facility and the associated economic impact on a local community, including direct and indirect jobs, net economic impact and induced effects from the construction of a new plant. These analyses demonstrate why policy-makers clamour to attract manufacturing companies to establish operations in their city, state or region.
- **Product view** – conducts an examination of a single product value chain, showing where it influences multiple locations around the world from a consumer, jobs and supply base standpoint. These illustrations show manufacturing sector illustrations that are technologically advanced and environmentally conscious, and require a variety of qualified, skilled workers.

The report also contains commentary from value chain analysis experts to explain why an understanding of these topics is critical to driving growth and prosperity for companies and countries. Also included are insights from industry experts discussing sector-level trends that define the future of the industry. In combination with the policy recommendations and public-private partnership organization best practices, these graphics, data sets and essays can inform the dialogue between business and policy-makers by providing a global and local perspective of the network of value and jobs created by manufacturing sectors.

Why the World Suddenly Cares about Global Supply Chains[1]

By Gary Gereffi and Joonkoo Lee

Global supply chains have been a familiar part of the international business landscape for decades. From a management perspective, there are always issues connected with the efficient and timely distribution of goods that flow across supply chains. From an industry perspective, there are questions about how the industry is organized in terms of the size and ownership of major manufacturers and their suppliers, and where these companies are located. From a national competitiveness perspective, countries are concerned about whether they can gain and maintain the production, sales and research capabilities needed to develop and make low-cost, high-quality or high-tech products.[2] Finally, global supply chains matter for international development as well, since the ability of countries to prosper depends on their participation in the global economy, which is largely a story about their role in global supply chains.

The Governance of Global Value Chains (GVCs)

Globalization has given rise to a new era of international competition that is reshaping global production and trade and thereby altering the organization of industries.[3] Since the mid-1960s, US companies have been slicing up their supply chains in search of low-cost and capable suppliers offshore. This process of "global outsourcing" initially focused on the simple assembly of parts supplied by US manufacturers, typified by the US production-sharing or "twin plant" programme with Mexico, but the pace of offshore production soon accelerated dramatically.[4] In the 1970s and 1980s, US retailers and brand name companies joined manufacturers in the search for offshore suppliers of most categories of consumer goods, which led to a fundamental shift from what had been "producer-driven" supply chains to "buyer-driven" chains. The geography of these chains expanded from regional production-sharing arrangements to full-fledged global supply chains, with a growing emphasis on East Asia.[5] In the 1990s and 2000s, the industries and activities encompassed by global supply chains grew exponentially, covering not only finished goods but also components and sub-assemblies, and affecting not just manufacturing industries, but also energy, food production and all kinds of services.[6]

As supply chains go global, more intermediate goods are traded across borders, and more parts and components are imported for use in exports.[7] In 2009, world exports of intermediate goods exceeded the combined export values of final and capital goods, representing 51% of non-fuel merchandise exports.[8] Governments and international organizations are taking notice of this emerging pattern of global trade, which is being called a shift from "trade in goods" to "trade in value added" and "trade in tasks".[9,10]

The GVC framework focuses on globally expanding supply chains and how value is created and captured therein. By analysing "the full range of activities that firms and workers perform to bring a specific product from its conception to its end use and beyond",[11] the GVC approach provides a holistic view of global industries from two contrasting vantage points: top down and bottom up. The key concept for the top-down view is the "governance" of global value chains, which focuses mainly on lead firms and the organization of global industries; the main concept for the bottom-up perspective is "upgrading", which focuses on the strategies used by countries, regions and other economic stakeholders to maintain or improve their positions in the global economy.[12]

GVC Consolidation and the New Math of Value-added Trade

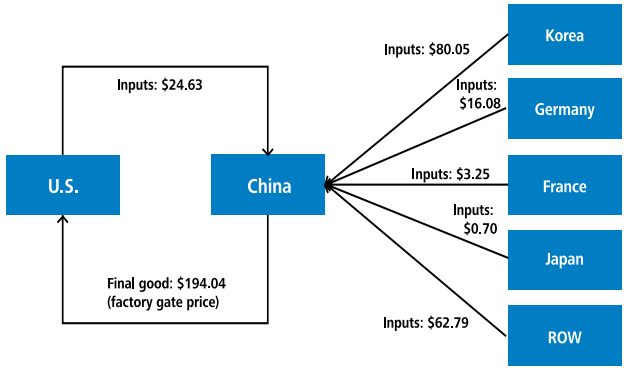
Over the past decade, many global value chains have experienced a shift in production from North to South in the global economy, and large emerging economies are playing very prominent roles in these industries as exporters and also new markets.[13] While most intermediate goods are still traded within large regional economic blocks like the European Union rather than across them,[14] Asia's linkages to the European Union and North America represented the two highest inter-regional import flows of intermediate goods in 2008. Asia imported more intermediate goods than it exported, indicating the region's high level of integration with global supply chains.[15] In electronics, manufacturing is concentrated to a handful of contract manufacturers (e.g. Hon Hai/Foxconn, Flextronics and Quanta), whose factories are also clustered in China.[16]

China has benefited greatly from this high level of concentration in global supply chains.[17] China's "supply chain cities" are a perfect illustration of how China is turning scale-driven specialization into a persistent competitive advantage for the country. From foreign direct investment-driven clusters in Guangdong to single-product clusters in Zhejiang, China's sheer size has allowed it to develop broad manufacturing clusters at the regional level. These specialized clusters are linked, on the one hand, to East Asian suppliers of key parts and components and, on the other hand, to global buyers to bring Chinese products to the world market.[18]

Paradoxically, however, China does not create or capture most of the value generated through its value chain exports. In fact, as more types of intermediate goods are traded within global supply chains, the discrepancy is growing between where final goods are produced and exported and where value is created and captured. For example, Apple's iPhones are entirely assembled in China by a Taiwanese contract manufacturer (Foxconn) and exported to the United States. When a traditional measure that assigns the gross export value of the product to the exporting country is used, China is charged the total factory gate price (US$ 194.04) in its entirety for exporting one unit of an iPhone4, and it incurs a US$ 169.41 trade deficit with the United States for each unit shipped – i.e. the final good factory price (US$ 194.04) minus US inputs sent to China (US$ 24.63) and the value added by assembly costs in China (US$ 6.54) (see Figure 1).

In value-added terms, however, most of the value for the iPhone4 is created in Korea (US$ 80.05), which supplies the two most expensive components – display panels and memory chips – for the product,[19] while China contributed only US$ 6.54 to the assembly of the iPhone4. Thus, the largest portion of the US trade deficit from its iPhone4 imports is incurred not with China, but via indirect exports from Korea and other high-value component suppliers. This is not an exception for the world's largest manufacturing country. Domestic content only accounts for about half of China's manufacturing exports and it is even smaller (18%) in its processing exports, mostly done by foreign-owned firms.[20]

Figure 1. US Bilateral Trade Balance with China for One Unit of the iPhone 4 (US$)



Us trade balance with	China	Korea	Germany	France	Japan	Rest of world	World Total
Gross	-$169.41	0	0	0	0	0	-$169.41
Value added	-$6.54	-$80.05	-$16.08	-$3.25	-$0.70	-$62.79	-$169.41

Source: OCED (2011, p. 40)

Shifting End Markets and Regional Supply Chains

As world trade is bouncing back from the 2008-2009 economic crises, developing economies are becoming the main engine of world economic recovery. Stagnant growth in demand in the global North since the mid-1980s was exacerbated by the latest crisis, whereas demand is quickly growing in the global South, particularly large emerging economies like China, India and Brazil.[21] Over the period of 2005-2010, the merchandise imports of the European Union and the United States increased by 27% and 14%, respectively, while emerging economies expanded their merchandise imports much faster: Brazil (147%), India (129%), China (111%) and South Africa (51%).

From a GVC perspective, this shift highlights the growing and distinctive roles of lead firms from developing country vis-à-vis global buyers in reorganizing their supply chains. In sub-Saharan Africa, for instance, the recent entry of South African clothing manufacturers into neighbouring countries (such as Lesotho and Swaziland) has led to the rise of regional value chains driven by South African retailers. Compared to the US retailer-driven chain, these regional chains focus on shorter production runs and quick response with higher fashion content, and are based on direct relationships to large South African clothing retailers.[22]

The GVC literature shows that value chains oriented to different end markets often entail distinct upgrading opportunities.[23,24] For example, the demand in lower-income countries for less sophisticated products with regard to quality and variety can have major upgrading implications.[25] On the one hand, lower entry barriers and less stringent product and process standards in emerging markets can facilitate the participation of developing country firms in global supply chains. They can engage in higher value-added activities, such as product development and design, which they would have little chance to do in the global chains. With more intimate knowledge of local and regional markets vis-à-vis multinational firms, they can generate "frugal" innovations that are suitable to resource-poor environments.[26] On the other hand, solely focusing on low-income markets could lock suppliers into slimmer margins and cut-throat competition. Their knowledge advantage in local markets often quickly evaporates when multinational firms catch up in learning the markets, as found in the Chinese mobile phone industry.[27]

Beyond Business Strategies

The GVC paradigm links scholarly research on globalization with the concerns of both policy-makers and social activists, who are trying to harness the potential gains of globalization to the pragmatic concerns of specific countries and social constituencies that feel increasingly marginalized in the international economic arena. Recently, there is a growing concern in both developed and developing countries that the economic gains of participating in global supply chains do not necessarily translate into good jobs or stable employment, and in the worst case, economic upgrading may be linked to a significant deterioration of labour conditions, or social downgrading.[28],[29] Research is now being carried out to determine under what conditions participation in global value chains can contribute to both economic and social upgrading in developing countries.[30]

A propitious development for policy-relevant research is the major advance in GVC metrics related to value creation and value capture.[31,32] As showcased by the iPhone study, existing trade statistics are not sensitive to changing patterns of global production and trade. This is also the area where GVC analysis and supply chain management research can be mutually beneficial.[33] Sophisticated value chain data disaggregated by business functions can complement existing country-level trade statistics and industry-level input-output data, providing a clear picture of who is gaining and losing in global value chains.[34] When combined with data on employment, they will greatly advance our understanding of both economic and social development opportunities in the global economy.

Gary Gereffi (Ph.D., Yale University) is a professor in the Department of Sociology at Duke University. He also serves as the Director of the University's Center on Globalization, Governance & Competitiveness.

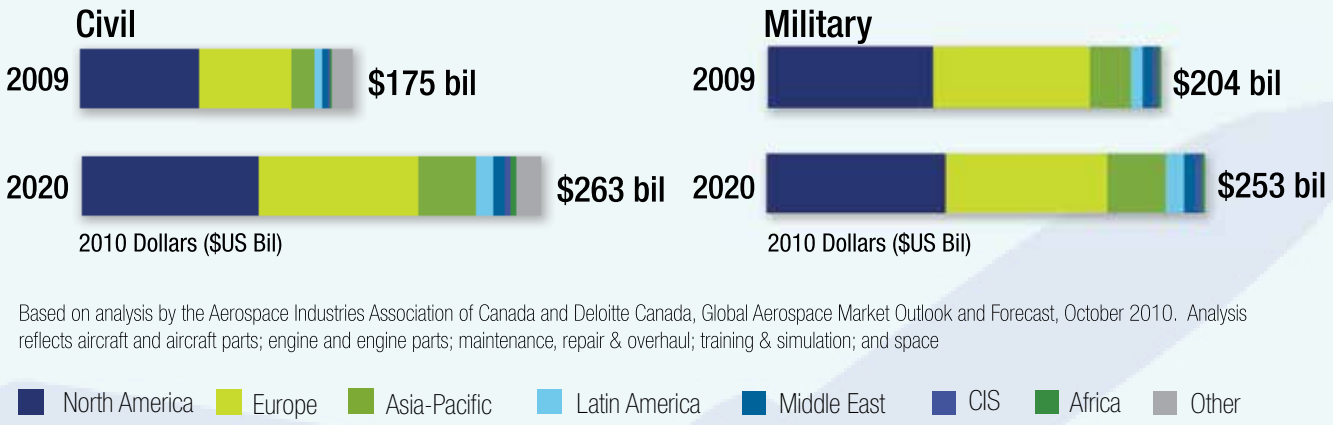
Joonkoo Lee (Ph.D., Duke University) is an assistant professor in the School of Business at Hanyang University, Seoul, South Korea.

Aerospace Industry Overview

Flying High: Value, Skills, Jobs

The Aerospace industry continues to be dominated by a few countries in North America and Western Europe. However, new entrants are challenging this paradigm, as Brazil, China, and India are poised to take greater shares of value in global aircraft production. As competition increases in new locations, income levels and travel demands increase, and emerging markets change – from education to security demands, IP protection to infrastructure – the aerospace industry will continue to grow and become more global.

Global Aerospace Revenues



Based on analysis by the Aerospace Industries Association of Canada and Deloitte Canada, Global Aerospace Market Outlook and Forecast, October 2010. Analysis reflects aircraft and aircraft parts; engine and engine parts; maintenance, repair & overhaul; training & simulation; and space

Elevated Skills and Wages

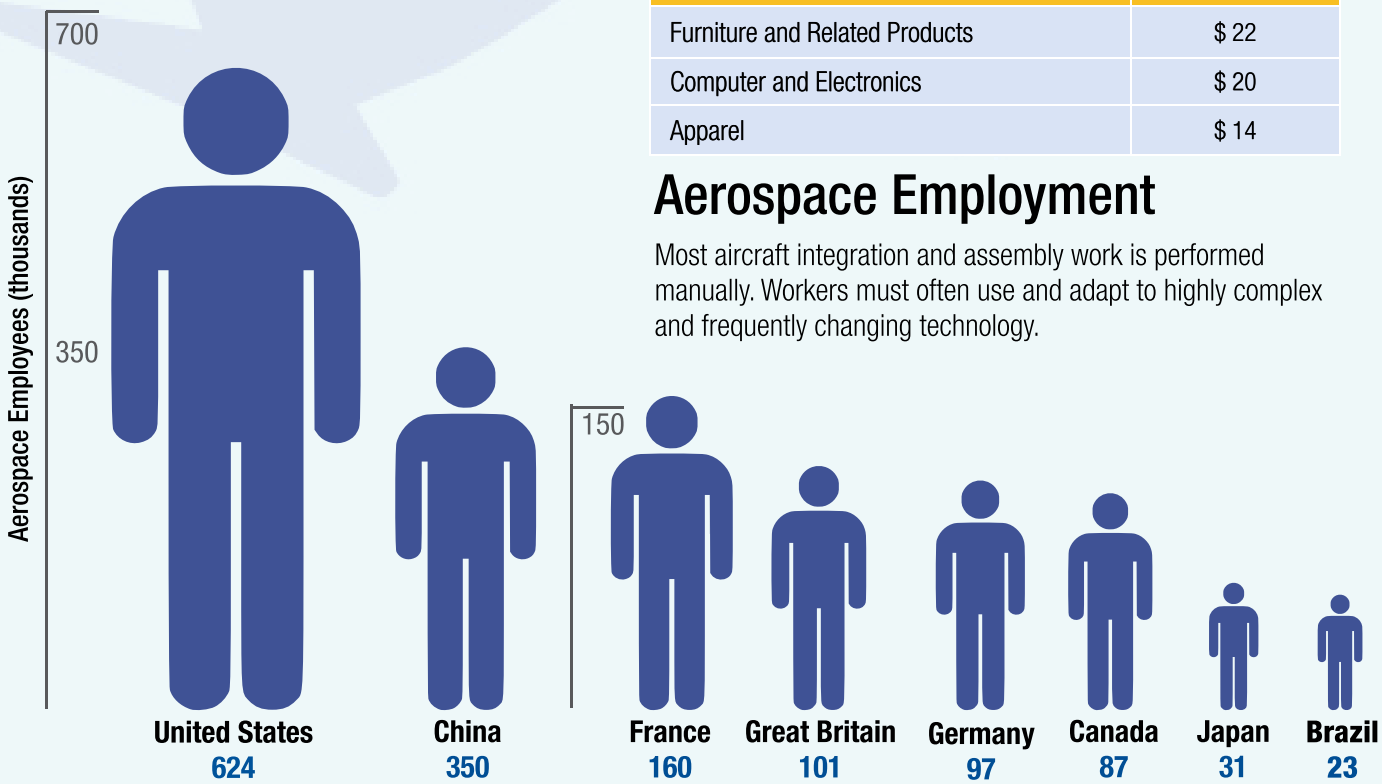
Global median hourly wages, sector to sector comparison, select countries (2007 $US)

Labour represents the second largest expense after purchased inputs in terms of industry cost structure.

Manufacturing Sector	$ US
Petroleum and Coal Products	$ 46
Aerospace	$ 45
Chemicals	$ 36
Automotive	$ 30
Paper	$ 30
Manufacturing (overall)	$ 28
Furniture and Related Products	$ 22
Computer and Electronics	$ 20
Apparel	$ 14

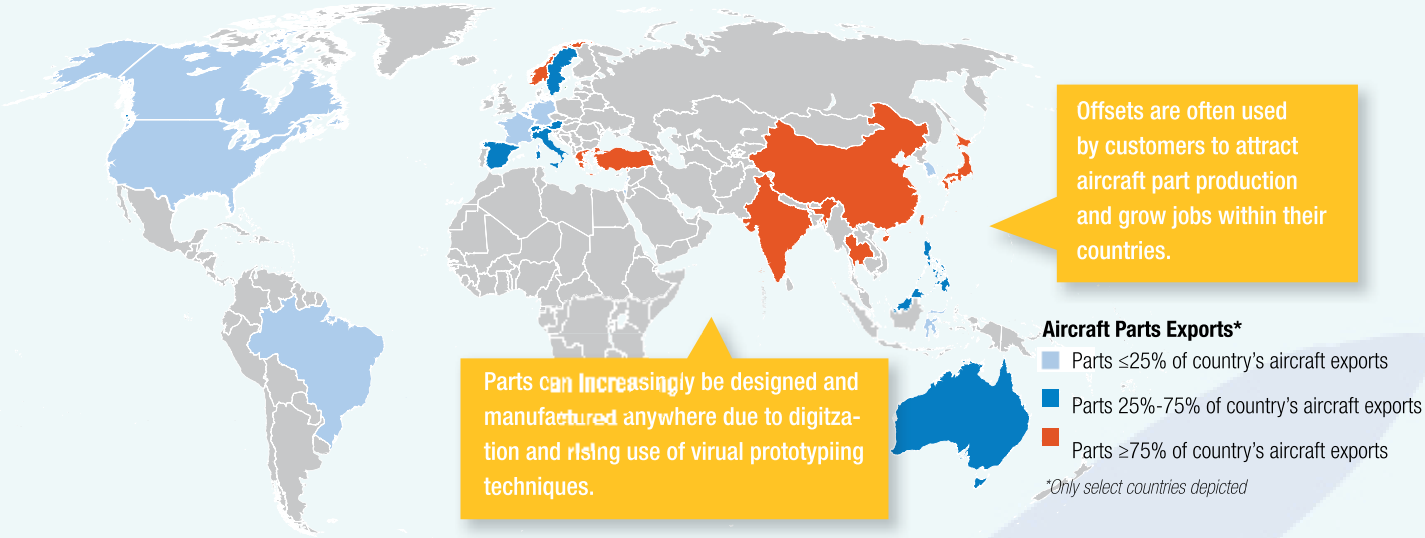
Aerospace Employment

Most aircraft integration and assembly work is performed manually. Workers must often use and adapt to highly complex and frequently changing technology.

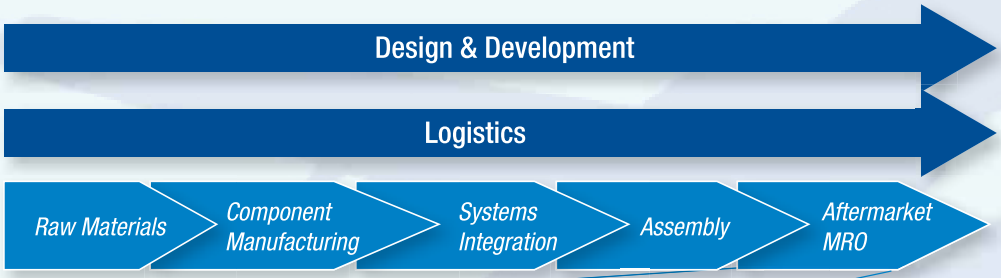


Climbing the value chain

Component manufacturing, the industry gateway



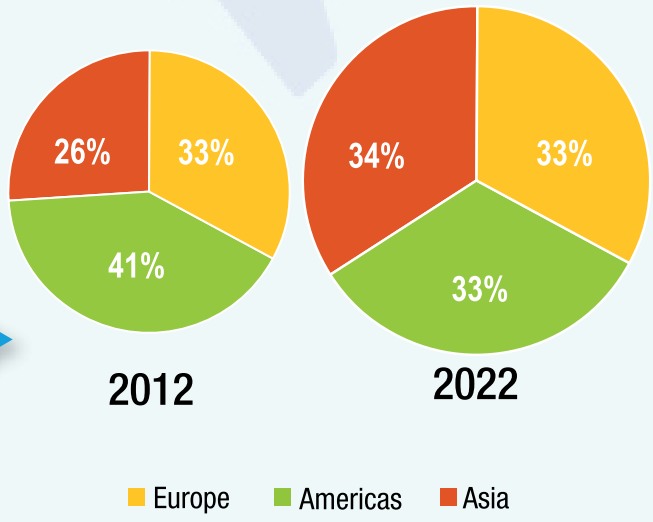
Value is added before and after an assembled aircraft leaves the plant



Looking Forward
Through 2020, commercial aerospace revenues are expected to grow more quickly than military, with fastest growth forecast in Asia-Pacific and Latin America

Maintenance, Repair & Overhaul (MRO)
A growing segment of the value chain, follows trends in new consumer markets

MRO Spending
2012 $US Bil



MRO Market Share Shifts East
(Commercial)

Global Aerospace and Defence Outlook[35]

Overview

Revenues for the Aerospace and Defence (A&D) industry are expected to increase modestly in 2013, given large increases in global revenues for commercial aerospace coupled with declines in defence spending. The global defence industry should expect to see more aggressive competition for fewer large defence programmes. In contrast, the commercial aerospace sector is expected to reach record levels of revenue in 2013. The balance of defence and commercial production activity should provide the diversification the A&D industry may need to continue to thrive and grow.

Global Defence and Security

Continued global economic challenges coupled with revenue gaps and cost pressures in 2013 may result in flat to somewhat negative revenue performance, lower returns on invested capital and margin contraction for many defence industry companies, creating pressure to consolidate in order to squeeze out excess defence segment capacity. In response, the segment is likely to undergo more streamlining of its cost structure, divestiture of non-core assets, and additions of gap filling, as well as game changing acquisitions. Companies have also renewed foreign military sales efforts into new geographic markets.

Global Commercial and Business Aircraft

Along with record revenues in 2013, it is likely that the new trend of global production levels above 1,000 aircraft per year for the third year in a row (see Figure 1) will continue. Backlogs are expected to continue growing, with airlines continuing to update their fleets with new fuel-efficient aircraft in order to stay competitive. Suppliers to aircraft original equipment manufacturers (OEMs) are likely to be challenged to keep pace with production requirements and are expected to invest in skills development, tooling and manufacturing capacity.

Global Outlook

The A&D industry is becoming more global due to heightened competition, growing travel demands and increased security requirements in emerging markets. Globalization provides opportunities for lower cost and for technologically advanced product introductions. Increasingly, these products can be designed and manufactured virtually anywhere. Globalization is also affecting product selections, in that military and commercial customers alike are requiring that value be “offset” by placing work in their countries of origin. This tendency is likely to continue, as traditional countries are pressured to keep their jobs at home, but is balanced by the need for companies to grow revenues and continue to reduce labour costs. The trend in the industry towards globalization is also marked by new market entrants, particularly in the commercial aircraft segment.

US Outlook

No matter the outcome of the budget sequester action, there is likely to be continued pressure to reduce defence expenditures. Continued debate on several important questions regarding US defence and security policy and investment priorities are expected to shape the financial performance of the defence industry. The formulation of a renewed US defence strategy, coupled with the resulting war fighter requirements, and ultimately the defence budget, will likely provide the guidance necessary for defence contractors to size their workforce appropriately, to understand what revenues they can count on, and therefore what their financial performance will be in 2013 and beyond.

Indian Outlook

Due to the increasing demand in A&D equipment for the armed forces, India continues to be one of the promising A&D markets in the world. Milestones in certain deals are expected to be achieved in 2013, such as submarines, missiles and the Indian Air Force Medium Multi-Role Combat Aircraft (MMRCA). More overseas companies will be involved in the Indian market and new joint ventures are likely to be signed between Indian private and overseas companies. The Indian government will continue to focus on indigenization with increasing presence of Indian companies that could expect certain fiscal and economic benefits from the government. Indian companies will likely succeed with the help of foreign companies, which creates a benefit for both.

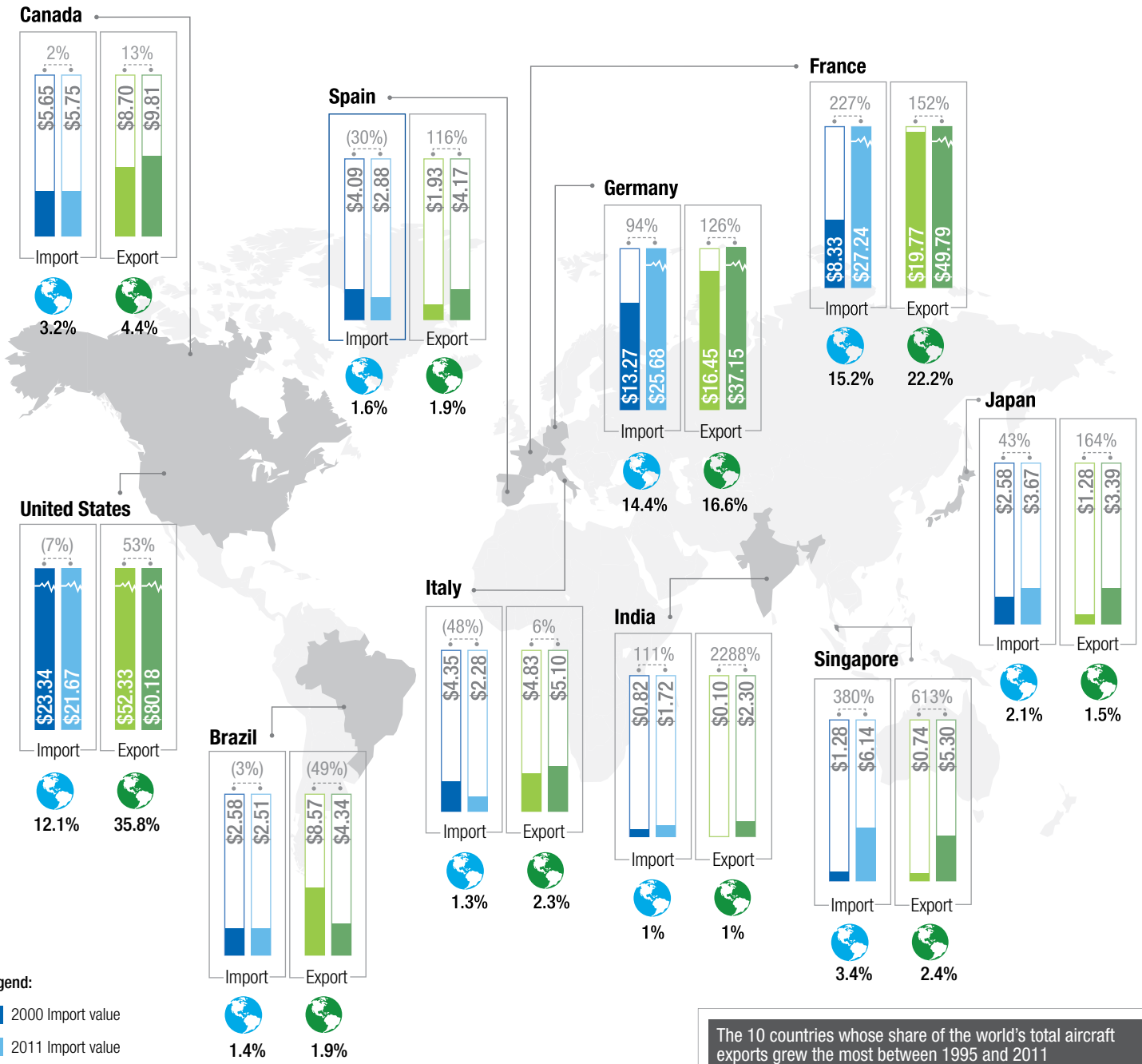
Canadian Outlook

The Canadian A&D industry shows strong performance leading into 2013. The increasing demand for civil aircraft, which constitutes more than 76% of the Canadian A&D industry, represents the main driver for growth in the segment in 2013. Given its relatively low dependence on the defence segment, the Canadian A&D industry is not impacted as much from the defence downturn in the United States and in Europe. Furthermore, Canadian defence will likely soon begin to see the benefits of the National Shipbuilding Procurement Strategy which awarded contracts to two Canadian shipyards that will have an estimated aggregate value of CAD$ 35 billion over the next 20 years.

Continued innovations that are the hallmark of this industry should power the next generation of technology development that can contribute to safer, more fuel-efficient aircraft, as well as more capable weapons to help keep war fighters out of harm’s way.

Aircraft import and export by country

The global aircraft import and export analysis illustrates country-level trends between 2000 and 2011. The export market is concentrated with the top 10 countries representing over 90 percent of the total global export value. China, a significant importer of aircraft, has increased its export activity since 1995 and became the world's 12th largest exporter in 2011.



Legend:

- 2000 Import value
- 2011 Import value
- 2000 Export value
- 2011 Export value
- % change Import/Export Value 2000-2011
- % share (imports as % of global total, 2011)
- % share (exports as % of global total, 2011)

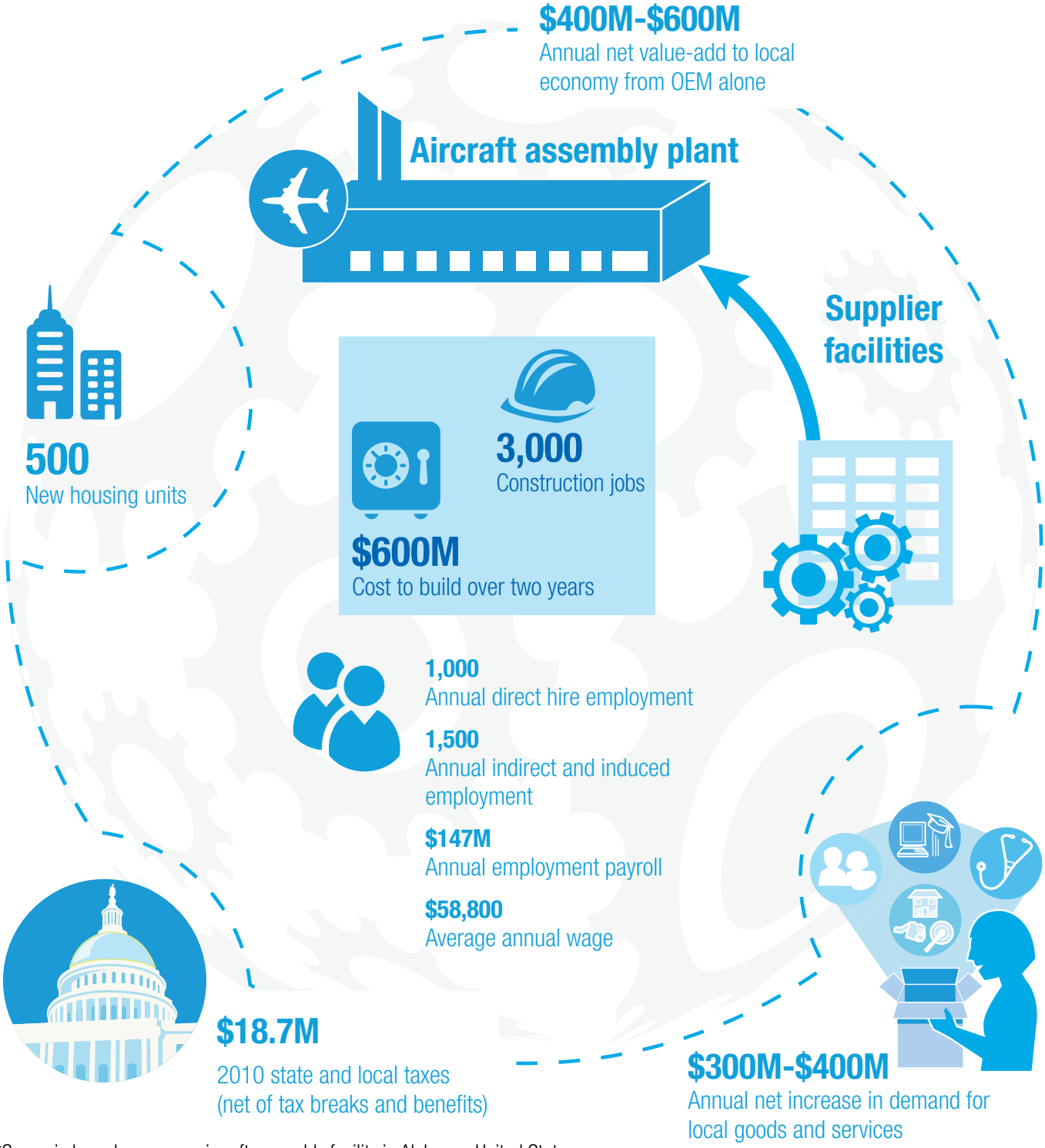
Source: Deloitte and Maplecroft analysis. UNCTAD, UNCTADstat.
Note: All trade values expressed in constant 2011 $US billions

The 10 countries whose share of the world's total aircraft exports grew the most between 1995 and 2011	
Germany	Japan
France	China
Singapore	Argentina
Brazil	Spain
India	United Arab Emirates

Combined share of world exports in 1995: 33%
Combined share of world exports in 2011: 49%

Economic impact of new aircraft manufacturing facility

A new aircraft assembly plant is expected to have a long-term annual impact of up to $1B on a local economy.



*Scenario based on a new aircraft assembly facility in Alabama, United States.
Source: Deloitte analysis.

New heights of globalization

Large aircraft manufacturers have truly global supply chains, partnering with and sourcing from suppliers all over the world. Each system or component represents a value chain in itself, with implications to employment and economies. A closer look at GE Aviation and its GEnx engine reveals the global reach of one of many complex systems that make up an aircraft.

GE Aviation Engine Value Chain

GE has orders for 15,000 new aircraft engines between now and 2020; there are currently 25,000 GE engines in use

GE Aviation has recently become more integrated with its global value chain, acquiring an Italian parts supplier and a 3-D printing company, and creating a venture to secure access to silicon carbide, a critical raw material in high-tech ceramics

These decisions help the company protect its intellectual property, accelerate the design and development process, and secure supply of inputs to meet future global demand

A deep-dive look at the GEnx engine illustrates the global network that comes together to make an aircraft engine

About GE

GE Aviation is a world-leading provider of commercial and military jet engines and components as well as avionics, electric power, and mechanical systems for aircraft with an extensive global service network to support these products. GE Aviation operates in more than 80 locations worldwide and employes 39,000 people; it is part of the General Electric Company, which has total global employment of 300,000 people in 100 countries.

Source: geaviation.com/shows, 2012. Linebaugh, Kate. "GE brings Engine Work Back," The Wall Street Journal, February 2013.

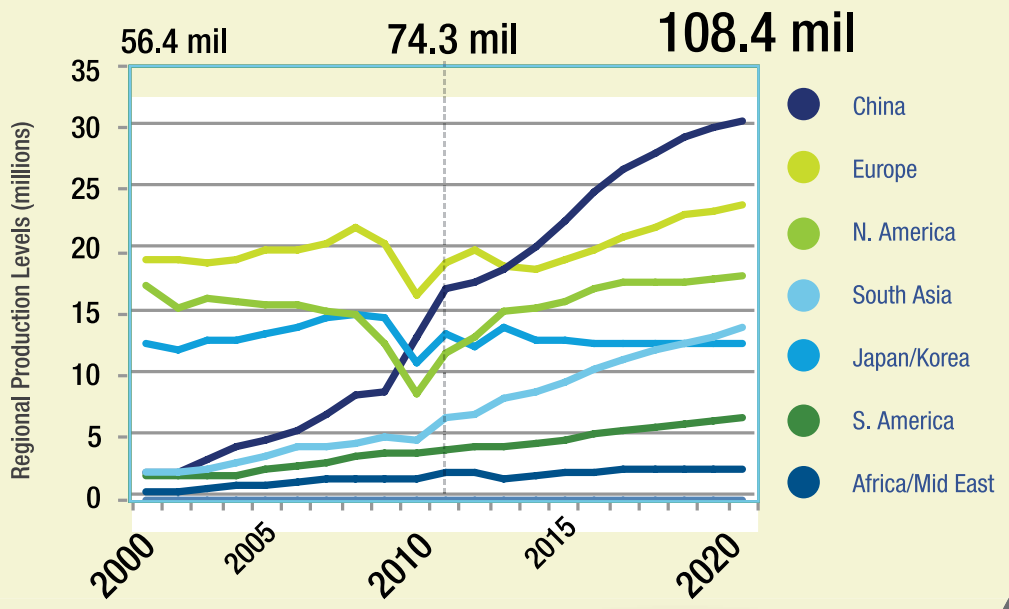
Automotive Industry Overview

A Vehicle for Growth

The auto industry continues to grow while making a shift towards emerging economies.

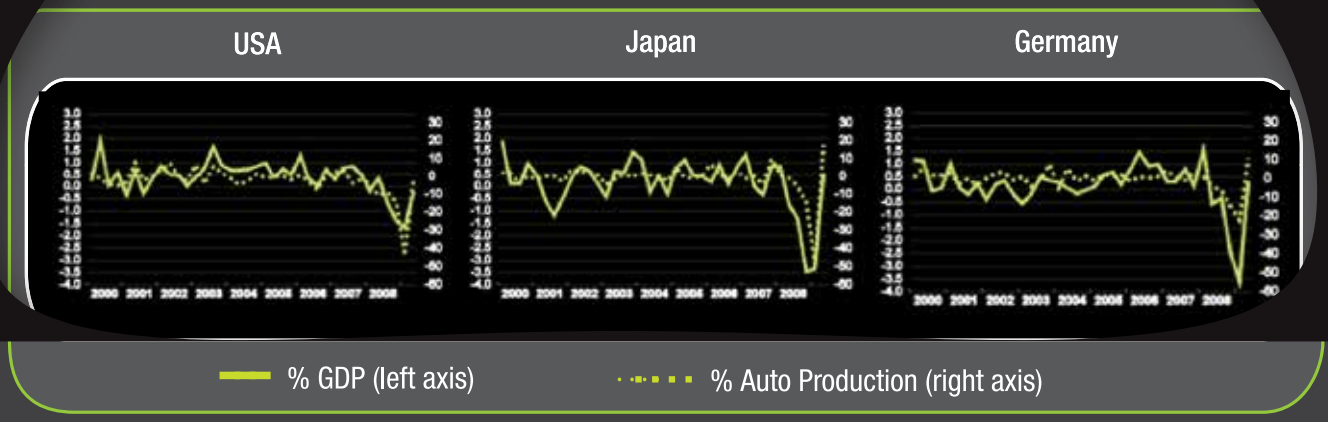
The auto industry has become increasingly global with production expanding in response to newly emerging markets and demand centers. Given its broad geographic footprint and strong jobs multiplier effect, the auto industry played a significant role in the economic rebound following the 2008 financial crisis. Consumer demand has risen since the depths of the global downturn, particularly fueled by strong auto demand in emerging markets, which have thereby stimulated national and global economies.

Global Vehicle Production Growth



The Link between Automotive Industry and Economy

GDP and Automotive Production Growth are Highly Correlated



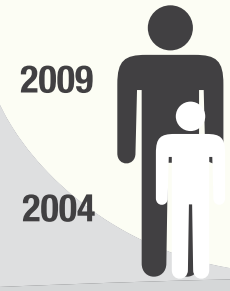
Production Growth
CAGR 2009-11 (%)

Sales Growth CAGR 2009-11 percent (%)

- >15
- 0 to 15
- <0

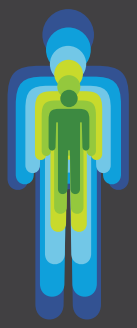
Looking Forward

Innovation will be the catalyst in reshaping the automotive industry as new global trends – such as urbanism, sustainability, connectivity, and energy security – evolve and new markets continue to grow in developing nations.



Motor Vehicles and Parts
Employment and Wage Growth
5-Year CAGR (2004-2009)

Employment has grown considerably more in developing nations.



The Multiplier Effect
For every one job created in Auto another five jobs are created in the broader economy

Brazil

Employees	Wages
7.2%	8.0%

China

Employees	Wages
9.4%	18.8%

India

Employees	Wages
11.3%	1.5%

Advanced Manufacturing Value-added Paradox (AMVAP)

Economic Development Considerations for Policy-Makers

The path to economic prosperity for a nation is tied to the robustness of its manufacturing sector, and the ability to accumulate productive knowledge and skills resulting in innovative products that can be competitively traded in global markets. This premise was convincingly argued by Ricardo Hausmann and Cesar Hidalgo in the *Atlas of Economic Complexity*:[36] "Our most prosperous modern societies…hold a diversity of knowhow and…are able to recombine it to create a larger variety of smarter and better products." The more advanced the product sets a nation can produce – and the more advanced the manufacturing processes employed – the greater the prosperity of the nation.

For policy-makers keen on creating high-value jobs for its citizens, the answer then seems straightforward. Seek out and attract investment from the most advanced manufacturing organizations for the most advanced facilities possible. Indeed, competition to attract manufacturing investment and foreign direct investment between nations and between individual geographic regions within nations is increasing.[37] The economic benefit or value-added to the nation – and the specific geographic region – can be significant due to the strong multiplier effect of advanced manufacturing through the economy.

But do the most advanced manufacturing facilities truly have greater economic benefit or value-added when the focus is on a geographic region versus the nation as a whole? Should local policy-makers seek out the most advanced research and production facilities to locate in their community, or would they be better off with medium- or low-tech manufacturing?

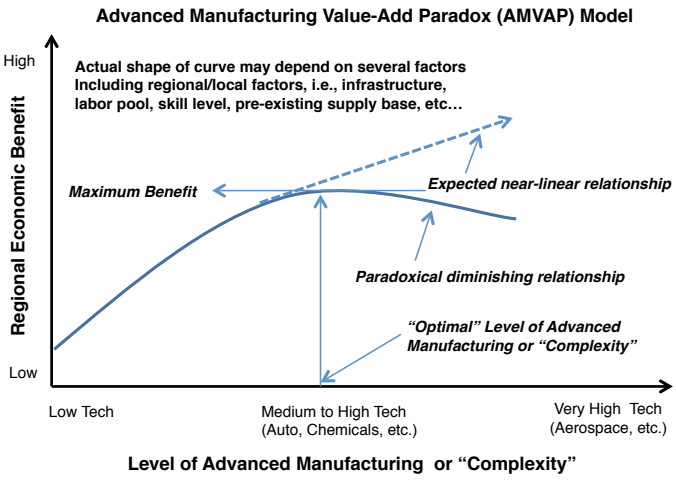
Based on preliminary analysis, the answer is at best complicated – and suggests that while advanced manufacturing at its highest level may be exactly what a nation must pursue to achieve greater prosperity, the local value-added of a geographic region may be better served with manufacturing that lends itself to the creation of geographic clusters of like companies and suppliers in close proximity.

Low-tech manufacturing is easily trumped in terms of value-added to a geographic region by medium- and high-tech manufacturing because of the higher level of skills required and wages paid, as well as the overall level of business and public investment made into the region, which is typically much greater. Additionally, the multiplier effect of medium- and high-tech manufacturing can be greater as robust supplier networks often co-locate in the region to further enable just-in-time (JIT) manufacturing processes, as in the automotive industry.

But as the product becomes increasingly sophisticated and complex, requiring unique or specialized suppliers contributing complex subsystems and access to advanced global supply networks, as occurs in the aerospace industry, the close proximity of supplier to manufacturing or final assembly facility location often gives way. The critical requirement of access to specialized suppliers and unique global supply networks – not located in close geographic proximity – takes priority. The value-added to the geographic region may actually be less, if clusters of like companies and their supply base are not formed in the region as a result of the need to access highly specialized and advanced suppliers in other parts of the world.

While a linear relationship was expected between the economic value-added for a region and a higher level of advanced manufacturing, the research instead found more of an "inverted U" parabola. This suggests that there is some level of optimal advanced manufacturing facility for a region, after which a diminishing benefit accrues. This most likely varies considerably, depending on a number of factors including the maturity, vitality and competitiveness of the region's underlying manufacturing supply network and the degree to which similar manufacturing organizations and public infrastructure – such as research universities and technology centres – are present in the region.

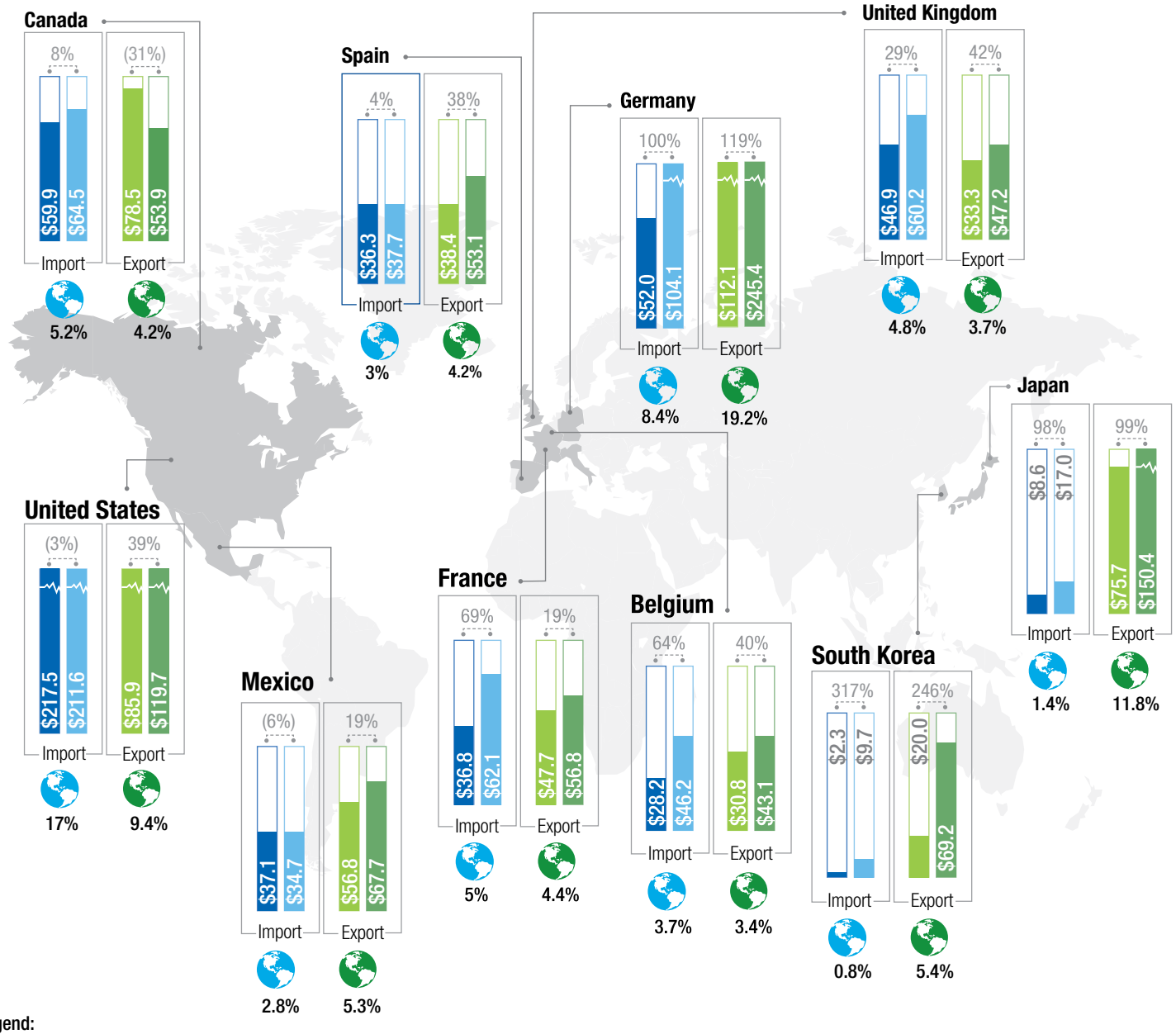
Advanced Manufacturing Value-added Paradox (AMVAP) Model



Source: © Giffi, Roth, Holdowsky, Gangula, Chaudhuri; The Advanced Manufacturing Value-added Paradox Model; DTTI Working Paper Series, 2012)

Automotive import and export by country

The global automotive import and export analysis illustrates country-level trends between 2000 and 2011. In 2011, the top 10 exporters, primarily developed economies, (highlighted below) represented over 70 percent of the total global export value. Over this same time period, developing economies, led by China's 1,377 percent increase, demonstrated significant growth in imports.



Legend:

- 2000 Import value
- 2011 Import value
- 2000 Export value
- 2011 Export value
- % change Import/Export Value 2000-2011
- % share (imports as % of global total, 2011)
- % share (exports as % of global total, 2011)

Source: Deloitte and Maplecroft analysis. WTO.
Note: All trade values expressed in constant 2011 $US billions

The 10 countries whose share of the world's total automotive exports grew the most between 1995 and 2011	
South Korea	Thailand
China	Slovakia
Mexico	Hungary
Czech Republic	Turkey
Poland	India

Combined share of world exports in 1995: 6%
Combined share of world exports in 2011: 24%

Economic impact of new auto assembly plant

An automotive assembly facility can have a profound impact on regional and local economies.

$2.1B
Annual OEM net value-add to local economies

OEM assembly plant

Supplier facilities

4,600
New housing units

$211M
2010 capital investment

$1.5B
Cumulative capital investment

24,300
Direct/indirect/induced employees

$566M
Annual employment payroll

$23,300
Average annual wage

10,000
Direct/indirect/induced employees

$518M
Annual employment payroll

$51,800
Average annual wage

$61.3M
2010 state and local taxes

$1.7B
Annual net demand increase for local goods and services

*Scenario based on an new assembly facility in Alabama, United States.
Source: Deloitte analysis.

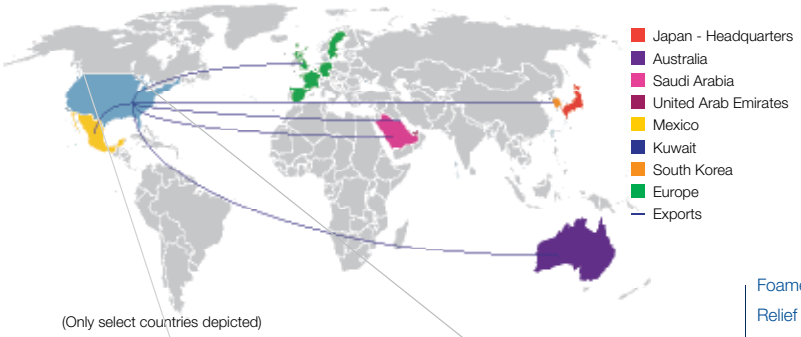
Global vehicle, sourced locally

The 2013 Altima is manufactured with parts from suppliers headquartered all over the world, with supplier sourcing clustered around the sites of assembly in Smyrna, Tenn., and Canton, Miss.
The Altima is primarily sold in North America, though it is exported to a number of global locations, including Australia and the Middle East.
The production of the Altima directly supports over 26,000 Nissan jobs across the value chain - both in the U.S. and abroad.

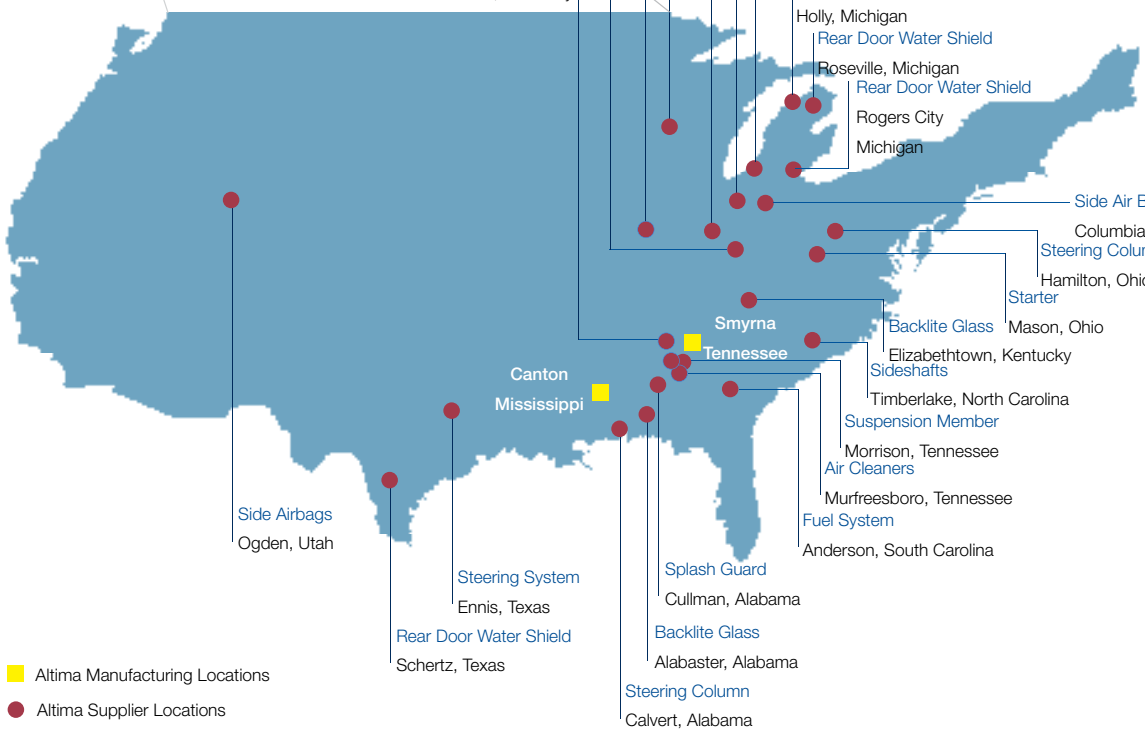
Nissan human capital allocation for the Altima built in the Americas
(Approximate number of employees)

Category	Headcount
Manufacturing	6,300
Reasearch & Development and Design	600
Marketing & Sales	280
Distribution & Sales	19,400

Nissan Altima Supplier Headquarter Nations and Export Locations



Supplier Plant Locations for the Nissan Altima



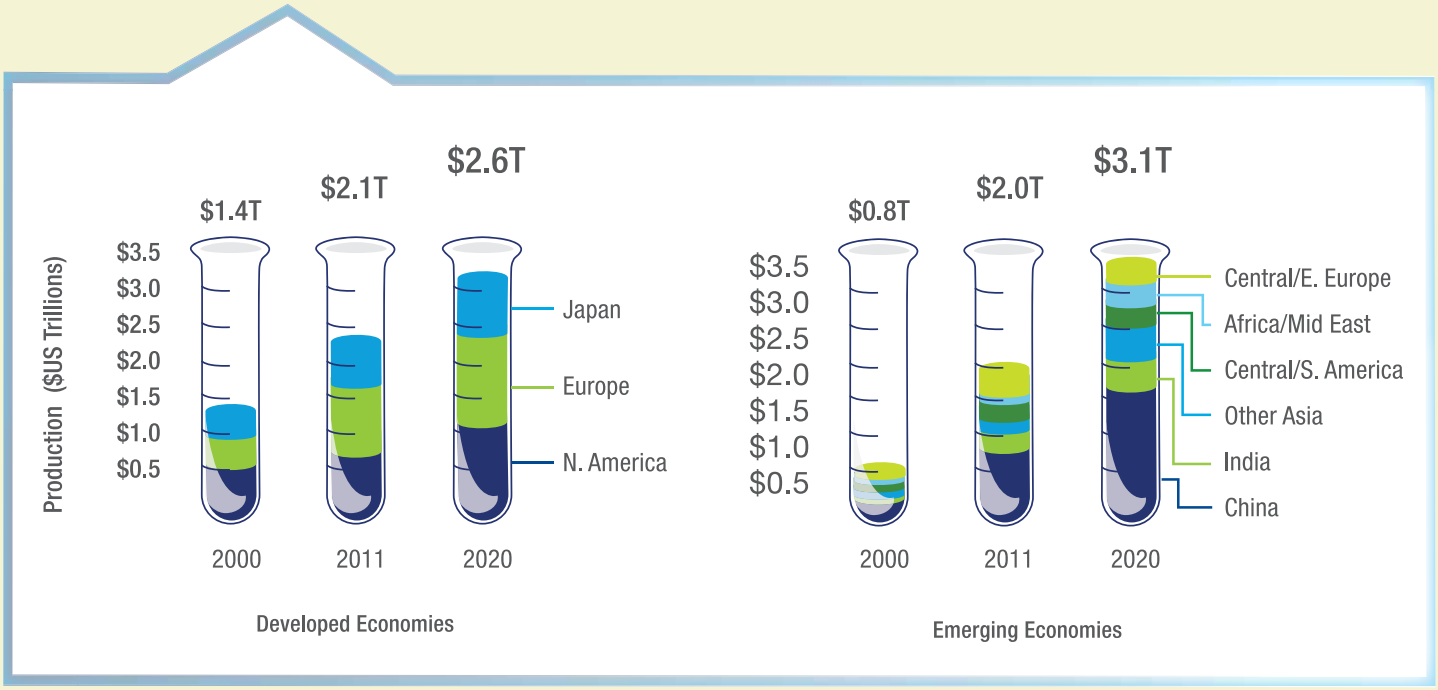
About Nissan
Headquartered in Yokohama, Japan, Nissan Motor Co., Ltd. manufactures vehicles in 20 countries and areas of the world and offers products and services in more than 160 countries. With 2011 sales of over $105 billion, Nissan employs more than 160,000 people worldwide.
Source: Nissan Motor Co., Ltd. Nissan 2012 Annual Report. 2012 IHS.

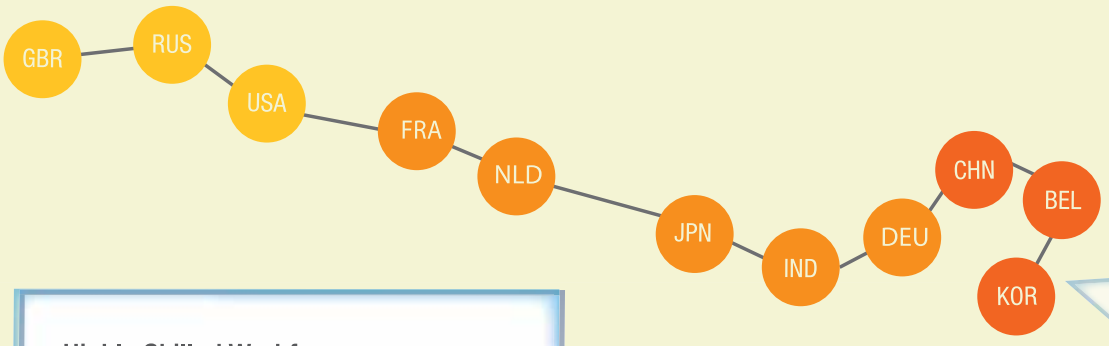
Chemicals Industry Overview

CHEMICALS FUELING EMERGING NATIONS

The Chemical industry is growing and the landscape is changing. Global chemical output grew 84% between 2000 and 2010 with emerging economy producers (led by China) accounting for 65% of the increase. Forecasts project that global chemical sales will continue this emerging economy led growth recording another 38% worldwide by 2020 and through 2050 at 3% CAGR. Job creation followed the production shift to these new locations, and wages have increased dramatically in Asia.

Global Chemical Production Surges





CHEMICAL INTENSITY

Of Chemical producers, China, Korea and Belgium have the largest percent of their GDP attributable to Chemical production

Value of Chemical Shipments (as a percent of country GDP)

<5% 5-10% >10%

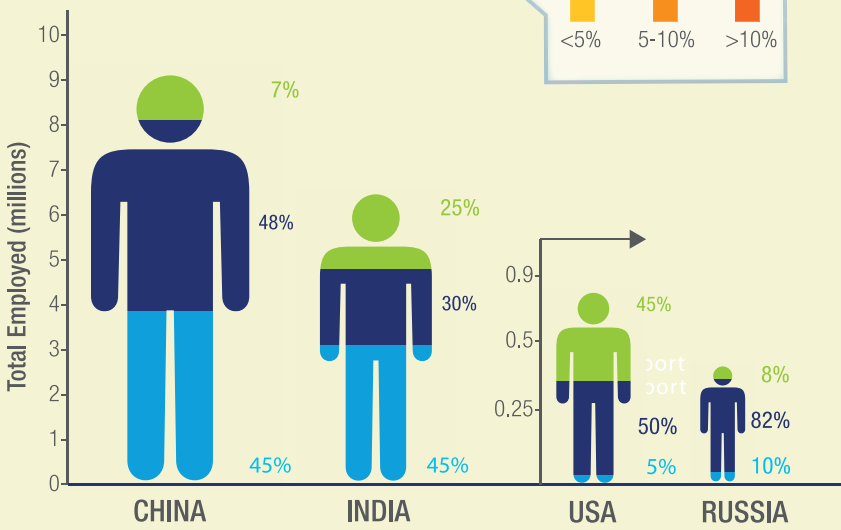
Highly Skilled Workforce

Although there is an uneven distribution of Chemical employee skill levels between countries, on average the industry has a highly talented labor force.

HIGH Tertiary Education

MED Upper Secondary to Post Secondary Education

LOW Primary to Lower Secondary Education



Chemicals Wages Spike

Percent of Growth in Employee Wages (2000-2009)

Wages expressed in 2009 $USD

Wage Increase | Wage Decrease

Average Chemical Employee Wage ($USD - 2009)

$100K
$75
$50
$25
$10
$5
$1
$0

16% USA $80,100

33% GBR $45,265

-1% FRA $59,586

13% NLD $75,025

4% GER $70,727

14% BEL $81,424

78% KOR $32,371

42% JPN $44,004

85% RUS $ 7,411

59% CHN $ 5,327

24% IND $ 3,814

Global Chemicals Players

- Major Chemical Producers
- Rising Chemical Producers
- Minor Chemical Producers

Looking Ahead

The Chemical industry is expected to continue to expand with growth of about 3% per year projected to 2050. During this time, analysts expect that the role of emerging nations will continue to expand.

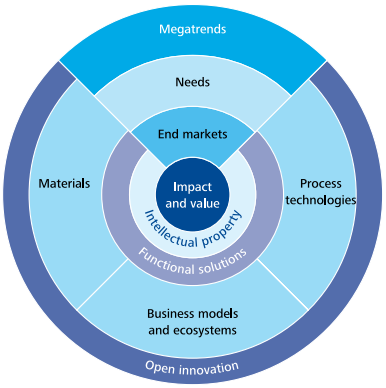
	GERMANY	JAPAN	UK	S. KOREA	FRANCE	BELGIUM	NETHERLANDS
	24%	36%	27%	33%	27%	15%	22%
	60%	59%	49%	58%	48%	60%	43%
	16%	4%	24%	9%	24%	25%	35%

Advanced Materials Systems[38]

Challenges associated with traditional business models of selling materials by volume have become increasingly apparent in industry performance for the past two decades. At the same time, many manufacturing sectors have seen significant rates of erosion in their performance. Yet, industries that are enabled by materials are particularly well poised to capture value in current global markets through the development of systems-level solutions to address globally unmet needs.

The Advanced Material Systems (AMS) framework provides a new way for manufacturers to address these challenges and invigorate value generation by pursuing opportunities in large markets, enabled by materials technologies. This approach has the potential to spur growth, create value and renew innovation by delivering functional solutions (physical systems enabled by the specific performance properties of materials and process technologies) to markets and customers to address unmet market needs driven by global megatrends.

Advanced Marterials Systems Framework



Source: DTTL Global Manufacturing industry group, October 2012

The AMS framework calls for utilizing inventive combinations of materials from existing industry inventories (versus solely relying on discovering new molecules and materials), process technologies, new business models and open innovation partnerships. It is a call to action for players in AMS to rethink conventional approaches. Four areas of opportunity for creating and claiming value in a complex, evolving AMS landscape are:

1. **Open innovation:** Open innovation describes companies' use of external and internal ideas, technologies and resources to reach the market. Innovations include technology and product development, and approaches to commercialization through partnering to take solutions to market.
2. **Systems-level design:** In the AMS framework, value-capture lies in the capacity of existing materials to serve as building blocks for integrated solutions, rather than in their inherent commodity value. Deloitte research shows that markets now favour systems integrators over materials suppliers, thereby ushering in a new era of integration engineering.
3. **Global market trends:** Evolutions in global markets point to challenges and opportunities for AMS solutions: 1) carbon-source-agnostic fuels and chemical feedstock as alternatives to petroleum; 2) more emphasis on the circular economy, requiring materials' reuse to be engineered at the systems level of functional solutions; 3) decentralized and scalable solutions to serve emerging markets; and 4) the increasing role of reverse innovations.
4. **End-user-defined performance criteria:** Implicit to potential value capture in AMS is a keen understanding of real end-user needs and a willingness to permit end-user performance requirements to dictate the design of AMS solutions.

With the AMS approach, innovation moves beyond the frontier of new molecules and materials to functional solutions that use combinations of materials, process technologies, new business models and open innovation partnerships and collaborations to create and grow new businesses.

Case Study – Public-Private Partnership: Carbon-Fibre Composites

Stakeholders Ford Motor Company, The Dow Chemical Company and Oak Ridge National Laboratory have partnered to explore carbon-fibre composites for low-cost, energy-efficient transportation.

Unmet need: Ongoing trends related to sustainability and energy-efficiency have resulted in a need to reduce high-volume-vehicle weight and energy consumption.

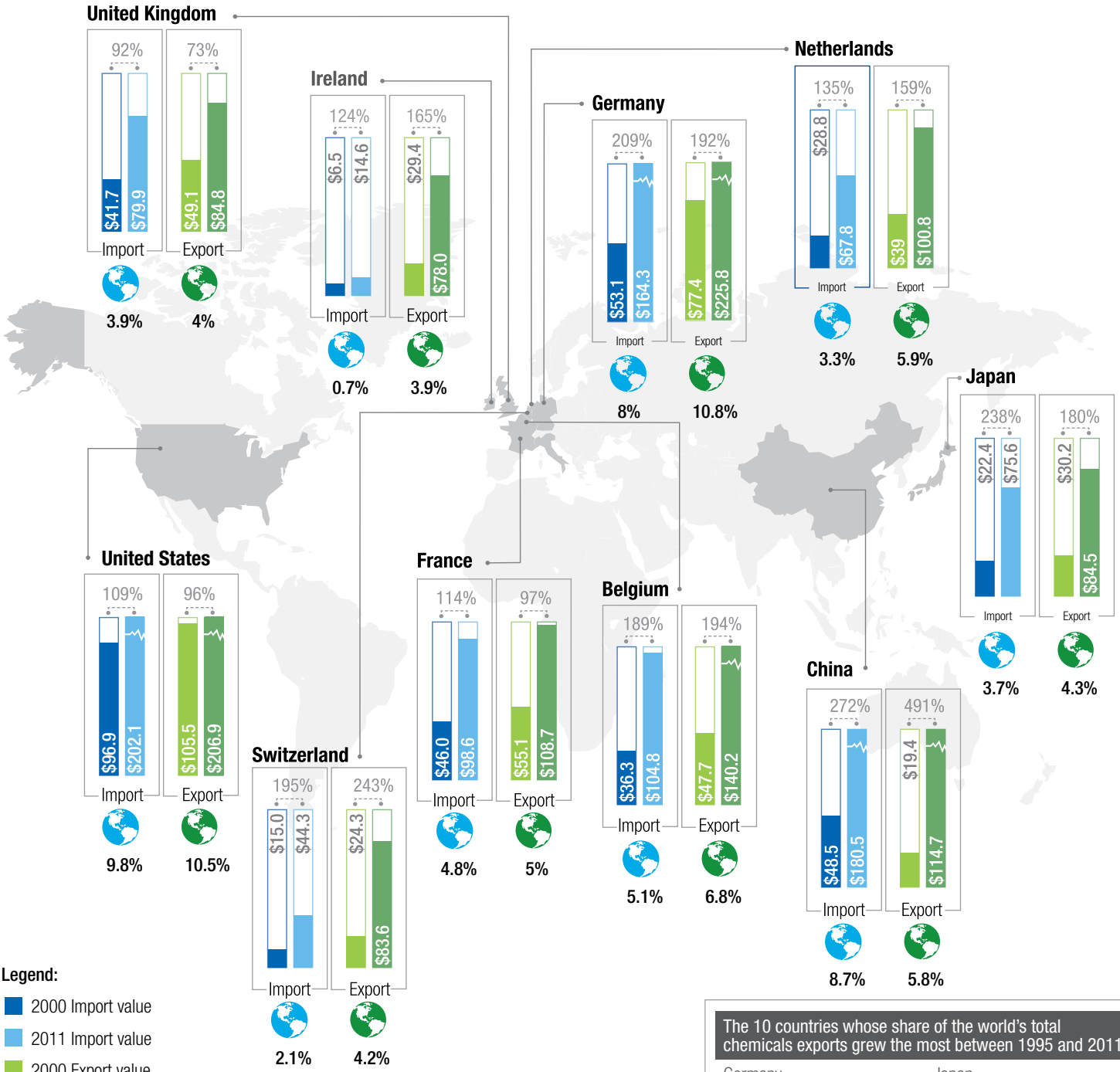
Material innovation: The manufacture of lighter-weight vehicles calls for carbon fibre to be developed at a lower cost and high volume. The Dow Chemical Company (Dow) has partnered with the US Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) to expand the sources of precursors for the carbon fibres needed to make composites affordable for the automotive industry.

Process technology: Process and design technologies that enable these materials to be applied to composite automobile frames, as well as manufacturing methods for high-volume applications, will be the key for success. Frames made with these innovative designs and manufacturing processes could potentially reduce vehicle weight by up to 750 pounds.

Ecosystem and business model: To best utilize their combined expertise in materials, process technologies and federal research grants, Ford, Dow and ORNL established a partnership in April 2012 to develop these lower-cost, energy-efficient vehicles, to which the US DOE committed US$ 9 million in June 2012.

Chemicals import and export by country

The global chemicals import and export analysis illustrates country-level trends between 2000 and 2011. Historically a concentrated market, the current export landscape is increasingly global with the top 10 countries representing only about 60 percent of the total export value. Germany and the United States, however, continue to drive the market, occupying the top two positions of both the global import and export markets in 2011.



Legend:

- 2000 Import value
- 2011 Import value
- 2000 Export value
- 2011 Export value
- % change Import/Export Value 2000-2011
- % share (imports as % of global total, 2011)
- % share (exports as % of global total, 2011)

Source: Deloitte and Maplecroft analysis. WTO.
Note: All trade values expressed in constant 2011 $US billions

The 10 countries whose share of the world's total chemicals exports grew the most between 1995 and 2011	
Germany	Japan
France	China
Singapore	Argentina
Brazil	Spain
India	United Arab Emirates

Combined share of world exports in 1995: 33%
Combined share of world exports in 2011: 49%

Economic impact of new ethane cracker

A new petrochemical facility that would process ethane is projected to have total annual economic output of $4.8B.

Attracts a wide range of industry and suppliers to nearby locations: Could attract up to $16B in private investment

Ethane cracker

Supplier facilities

In 2005, the company spent over $26M by purchasing goods and services from local vendors and businesses

$1B-$2B
Investment

10,000
Direct construction jobs

8,000
Indirect construction jobs

2,000-8,000
Direct/indirect/induced employees

$50M
Annual employment payroll

400-600
Operations jobs at the plant

The company pays more than $16M million in state and local taxes and $6M is property taxes that help fund public education as well as police and fire departments.

*Scenario based on a new petrochemical complex in Pennsylvania, United States.
Source: Deloitte analysis.

Dow's global, highly-skilled workforce

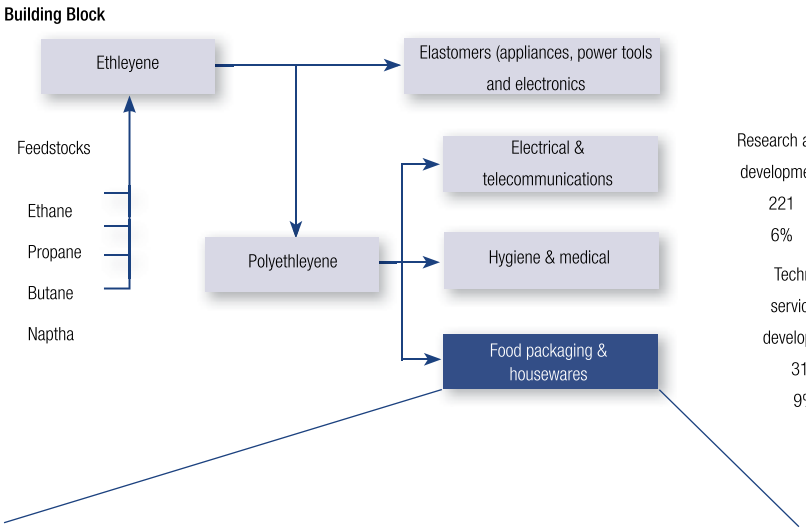
Operating successfully in the chemical industry requires a skilled labor force and geographic proximity to end markets; Dow Performance Packaging, a division of Dow Chemical Company, illustrates both of these attributes. Dow Performance Packaging is an $11 billion global business that is the largest materials supplier to the packaging sector. Performance Packaging boasts a diverse portfolio with 4,055 products and 160 end use applications

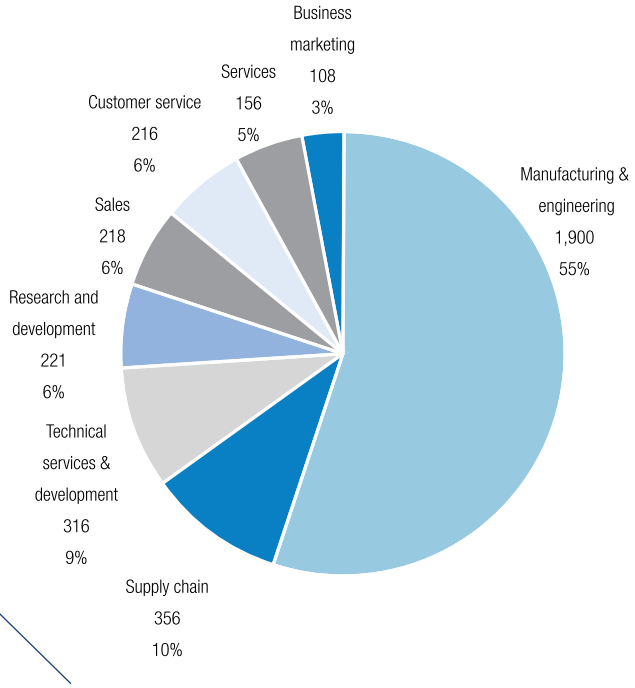
Partial Overview of Dow Ethylene Value Chain

Ethylene is a critical input to the production of high-value derivatives that support a wide range of industries. Dow's flexibility at its U.S. and European crackers enables use of different feedstocks in response to price conditions.

Highly Skilled Chemical Workforce

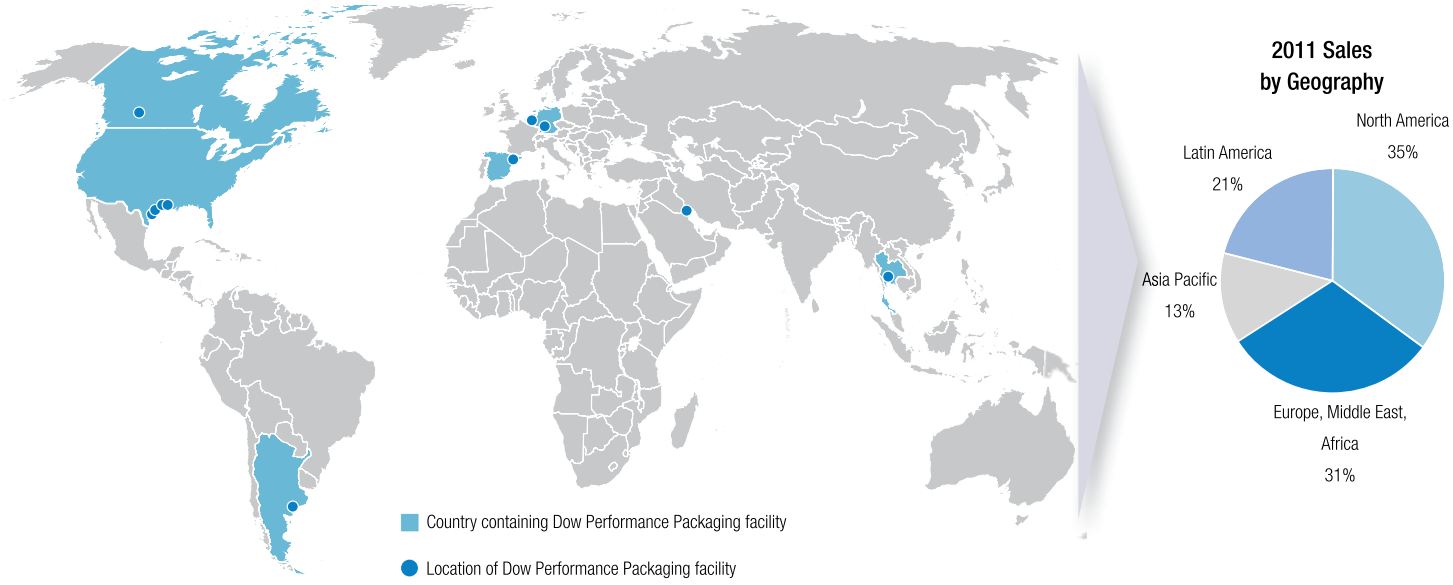
Of Performance Packaging's 3,491 global employees, an estimated 70% are in technical, STEM-related roles.





Dow Performance Packaging's Geographic Footprint

Performance Packaging operates 11 manufacturing facilities worldwide. From these sites, it delivers over 300,000 shipments per year to its 2,000+ customers in 100 countries.



About Dow

Dow Chemical Company is the second largest chemical company in the world with $60 billion in sales. Dow employs over 49,000 at its 197 manufacturing sites in 36 countries and sells to customers in 160 countries

Source: The Dow Chemical Company; 2011 Databook: Solutions at Work Dow Databook. 2012.

Infographic End Notes

1. Flying High: Value, Skills, Jobs: Deloitte analysis based on data from:
   - Deloitte & Touche LLP and the Aerospace Industries Association of Canada. Global Aerospace Market Outlook and Forecast, Phase 3. October 2010. Civil and Military historical and forecasted revenues.
   - Bureau of Labor Statistics, Hourly Compensation Costs for All Employees: US Dollars (2007 $).
   - German Aerospace Industries Association (Bundesverband der Deutschen Luft- und Raumfahrtindustrie e.V. – BDLI). Press release: The German Aerospace Industry 2011. 16 April 2012.
   - Groupement des Industries Françaises Aeronautiques et Spaitales. Assessment of the French Aerospace, Defence Electronics and Security Industry 2011. April 2012.
   - Aerospace Industries Association of Canada. The State of the Canadian Aerospace Industry Performance 2011. July 2012.
   - Aerospace Industries Association. Year-end Review and Forecast. December 2012.
   - UK Aerospace Survey 2012.
   - Aerospace and Defence Industry Association Europe.
   - Import, export data from UN Comtrade, US International Trade Commission database. Data shown from 2011.
   - Team SAI, The Global MRO Forecast 2012-2022. MRO Americas 2012 Conference (http://teamsai.com/media/content/2012_teamsai_global_mro_forecast_120329-print-ver-final.pdf).
   - Tortoriello, Richard. Standard & Poor's Aerospace & Defense Industry Survey. 26 July 2012.
2. Aircraft import and export by country. Source: Deloitte and Maplecroft analysis based on data from:
   - Exports: Merchandise trade matrix – detailed products, exports in thousands of dollars, annual, 1995-2011 UNCTAD, UNCTADstat (http://unctadstat.unctad.org/TableViewer/tableView.aspx?ReportId=24739). 19 December 2012. 1995-2011: Aviation exports as % of world total – UNCTAD.
   - Imports Merchandise trade matrix – detailed products, imports in thousands of dollars, annual, 1995-2011. UNCTAD, UNCTADstat (http://unctadstat.unctad.org/TableViewer/tableView.aspx?ReportId=24741). 19 December 2012. 1995-2011: Aviation imports as % of world total – UNCTAD.
3. Economic impact of new aircraft manufacturing facility: Deloitte analysis based on data from: AL.com. Airbus Mobile: It's official – big jets will be manufactured in Alabama. 2 July 2012 (http://blog.al.com/live/2012/07/airbus_mobile_its_official_-_b.html). 1 December 2012.
4. Global aircraft: Source: The Boeing Company. Boeing website, Airframer, GE Annual Report and website, website for Farnborough International Airshow 2012, GE Aviation.
5. A Vehicle for Growth: Deloitte analysis based on data from:
   - Light Vehicle Production Forecast. 2012 HIS.
   - Production and Sales. Economist Intelligence Unit (EIU).
   - Haugh, David, Annabell Mourougane and Olivier Chatal. "The Automobile Industry in and beyond the crisis". OECD Economics Department Working Papers No. 745. 26 January 2010 (http://www.oecd.org/economy/economicoutlookanalysisandforecasts/44089863.pdf).
   - UNIDO Industrial Statistics Database. INDSTAT4 2012 ISIC Rev.3. 3410, 3420, 3430.
   - Key indicators of Labor Market (KILM) and the United States Bureau of Labor Statistics, International Labor Comparisons.
   - International Organization of Motor Vehicle Manufacturers website.
6. Automotive import and export by country. Deloitte and Maplecroft analysis based on data from: Merchandise trade by commodity – Automotive products 1995-2011, WTO (http://stat.wto.org/StatisticalProgram/WSDBViewData.aspx?Language=E). 19 December 2012.
7. Economic impact of new auto assembly plant. Deloitte analysis based on data from: 2010 HMMA Economic Impact Study. Hyundai Motors Manufacturing Alabama (http://www.hmmausa.com/?p=2359). 1 December 2012.
8. Nissan Micrographic. Source: Deloitte and Nissan analysis. Nissan 2012 Annual Report. 2012 HIS.
9. Chemicals Fueling Emerging Nations. Deloitte analysis based on data from:
   - Business of Chemistry (Annual Data).xls. American Chemistry Council, 2011.
   - 2012 Guide to the Business of Chemistry. American Chemistry Council, 2012.
   - Global Chemical Outlook. United Nations Environment Programme, 2012.
   - World Economic Outlook (WEO) data, IMF: GDP, Deflator. EconStats (http://www.econstats.com/weo/V005.htm). 2 January 2013.
   - Yearly Average Exchange Rates for Converting Foreign Currencies into US Dollars. IRS (http://www.irs.gov/Individuals/International-Taxpayers/Yearly-Average-Currency-Exchange-Rates.). 9 January 2013.
   - World Bank Indicators – GDP (current US$). The World Bank (http://data.worldbank.org/indicator/NY.GDP.MKTP.CD). 2 January 2012.
   - The World Input- Output Database (WIOD): Contents, Sources and Methods. 7th Framework Programme. April 2012.
   - SEA: Socio-Economic Accounts, including industry output, value added, capital stock, wages and employment by skill type.xls. The World Input- Output Database (http://www.wiod.org/database/sea.htm). November 2011.
   - UNIDO Industrial Statistics Database. INDSTAT4 2012 ISIC Rev.3.
10. Chemicals import and export by country. Deloitte and Maplecroft analysis based on data from: Merchandise trade by commodity – Chemicals products 1995-2011, WTO (http://stat.wto.org/StatisticalProgram/WSDBViewData.aspx?Language=E). 19 December 2012.
11. Economic impact of new ethane cracker. Deloitte analysis based on data from:
    - Norco Refinery. Shell (http://www.shell.us/aboutshell/projects-locations/norco.html). 1 December 201.
    - NPR. Shell Picks Pittsburgh Area for Major Refinery. 15 March 2012 (http://www.npr.org/2012/03/16/148702640/shell-picks-pittsburgh-area-for-major-refinery). 1 December 2012.
    - ICIS.com. Shell's new ethylene cracker in Appalachia may be the first of several. 26 August 2011 (http://www.icis.com/Articles/2011/08/29/9488406/shells-new-ethylene-cracker-in-appalachia-may-be-the-first-of.html). 1 December 2012.
    - AOL Energy. Regional Impacts Cited as Shell Chooses Site for Massive Petrochemical Complex. 16 March 2012 (http://energy.aol.com/2012/03/16/regional-impacts-cited-as-shell-chooses-site-for-massive-petroch/). 1 December 2012.
    - Frac Tracker. Ethylene Cracker Would Contribute Jobs, Air Pollution. 20 January 2012 (http://www.fractracker.org/2012/01/ethylene-cracker-would-contribute-jobs-air-pollution/).
    - Morgan, Rachel. Ethane cracker plant could generate 8,000 jobs. Shale Reporter. 18 September 2012 (http://m.shalereporter.com/syndicated/article_28a178e5-fd71-5d92-aa86-f8c90997662b.html).
    - Allegheny Conference on Community Development. PELGP Economic Impact Analysis. September 2012.
12. Dow Micrographic. Source: Deloitte and Dow analysis. The Dow Chemical Company; 2011 Databook: Solutions at Work Dow Databook 2012. Retrieved on 20 December 2012 from http://www.dow.com/sustainability/pbreports/databook.htm.

Text End Notes

1. Excerpt from: Gereffi and Lee. Why the World Suddenly Cares about Global Supply Chains. Journal of Supply Chain Management. July 2012. Volume 48, Number 3, pp. 24-32.
2. Pisano, G.P. and W.C. Shih. "Restoring American Competitiveness", Harvard Business Review, (87:7/8), 2009, pp. 114-125.
3. Gereffi, G. "Global Value Chains and International Competition ", Antitrust Bulletin (56:1), 2011, pp. 37-64.
4. Dicken, P. Global Shift: Mapping the Changing Contours of the World Economy. Guilford Press, 6th edition, New York, 2011.
5. Gereffi, G.. "Commodity Chains and Regional Divisions of Labor in East Asia", Journal of Asian Business (12:1), 1996, pp. 75-112.
6. Engardio, P., A. Bernstein and M. Kripalani. "Is Your Job Next?" Business Week, 3 Febrary 2003.
7. Feenstra, R.C. "Integration of Trade and Disintegration of Production in the Global Economy", Journal of Economic Perspectives (12:4), 1998, pp. 31-50.
8. WTO and IDE-JETRO, op. cit.
9. OECD. "Global Value Chains: Preliminary Evidence and Policy Issues", Organisation for Economic Co-operation and Development, DSTI/IND(2011)3, Paris, 2011, http://www.oecd.org/dataoecd/18/43/47945400.pdf.
10. WTO and IDE-JETRO, op. cit.
11. Gereffi, G. and K. Fernandez-Stark. "Global Value Chain Analysis: A Primer", Center on Globalization, Governance & Competitiveness, Durham, NC, 2011, http://www.cggc.duke.edu/pdfs/2011-05-31_GVC_analysis_a_primer.pdf.
12. Gereffi, G, op. cit.
13. Staritz, C., G. Gereffi and O. Cattaneo. "Editorial", International Journal of Technological Learning, Innovation and Development (4:1-3), 2011, pp. 1-12.
14. OECD, op. cit.
15. WTO and IDE-JETRO, op. cit.
16. Sturgeon, T.J. and M. Kawakami. "Global Value Chains in the Electronics Industry: Was the Crisis a Window of Opportunity for Developing Countries?" World Bank Policy Research Working Paper, No. 5417, Washington DC, 2010.
17. WTO and IDE-JETRO, op. cit.
18. Gereffi, G. "Development Models and Industrial Upgrading in China and Mexico", European Sociological Review (25:1), 2009, pp. 37-51.
19. Keller, K. "iPhone 4 Carries Bill of Materials of $187.51, According to iSuppli", iSuppli Press Release, 2010, http://www.isuppli.com/Teardowns/News/Pages/iPhone-4-Carries-Bill-of-Materials-of-187-51-According-to-iSuppli.aspx.
20. Koopman, R., Z. Wang and S.-J. Wei. "How Much of Chinese Exports Is Really Made in China? Assessing Domestic Value-Added When Processing Trade Is Pervasive", National Bureau of Economic Research Working Paper, No. 14109, Cambridge, MA, 2008, http://www.nber.org/papers/w14109.
21. Staritz, C., G. Gereffi and O. Cattaneo, op. cit.
22. Morris, M., C. Staritz and J. Barnes. "Value Chain Dynamics, Local Embeddedness, and Upgrading in the Chothing Sectors of Lesotho and Swaziland", International Journal of Technological Learning, Innovation and Development (4:1-3), 2011, pp. 96-119.
23. Palpacuer, F., P. Gibbon and L. Thomsen. "New Challenges for Developing Country Suppliers in Global Clothing Chains: A Comparative European Perspective", World Development (33:3), 2005, pp. 409-430.
24. Gibbon, P. "Governance, Entry Barriers, Upgrading: A Re-Interpretation of Some GVC Concepts from the Experience of African Clothing Exports", Competition and Change (12:1), 2008, pp. 29-48.
25. Kaplinsky, R., A. Terheggen and J. Tijaja. "China as a Final Market: The Gabon Timber and Thai Cassava Value Chains", World Development (39:7), 2011, pp. 1177-1190.
26. Clark, N., J. Chataway, R. Hanlin, D. Kale, R. Kaplinsky, L. Muraguri, T. Papaioannou, P. Robbins and W. Wamae. "Below the Radar: What Does Innovation in the Asian Driver Economies Have to Offer Other Low Income Economies", INNOGEN Working Paper, No. 69, Milton Keynes, United Kingdom, 2009, http://oro.open.ac.uk/15241/.
27. Brandt, L. and E. Thun. "Going Mobile in China: Shifting Value Chains and Upgrading in the Mobile Telecom Sector", International Journal of Technological Learning, Innovation and Development (4:1-3), 2011, pp. 148-180.
28. Barrientos, S., G. Gereffi and A. Rossi. "Economic and Social Upgrading in Global Production Networks: A New Paradigm for a Changing World", International Labour Review (150:3-4), 2011, pp. 319-340.
29. For example, the offshore production of high-tech electronics, such as Apple products, has led to the disappearance of middle-income jobs in the United States while generating a large group of Chinese workers suffering excessive working hours, violation of labour laws and hazardous factory conditions (see Duhigg and Bradsher 2012; Duhigg and Barboza 2012).
30. Lee, J., G. Gereffi and S. Barrientos. "Global Value Chains, Upgrading and Poverty Reduction", Capturing the Gains Briefing Note, No. 3, 2011, http://www.capturingthegains.org/pdf/ctg_briefing_note_3.pdf.
31. OECD, op. cit.
32. WTO and IDE-JETRO, op. cit.
33. Note that the iPhone study and other similar studies (e.g. Linden, Kraemer and Dedrick 2009; Dedrick, Kraemer and Linden 2010) are based on tear-down analysis generated by supply chain management consultancy like iSuppli.
34. Sturgeon, T.J. and G. Gereffi. "Measuring Success in the Global Economy: International Trade, Industrial Upgrading, and Business Function Outsourcing in Global Value Chains", Transnational Corporations (18:2), 2009, pp. 1-36.
35. "2013 Global aerospace and defense industry outlook", Deloitte Touche Tohmatsu Limited, http://www.deloitte.com/view/en_GX/global/industries/manufacturing/aerospace-defense/cfaedba33641c310VgnVCM1000003256f70aRCRD.htm#.
36. "The Future of Manufacturing: Opportunities to Drive Economic Growth", World Economic Forum, April 2012.
37. Ibid.
38. Deloitte Touche Tohmatsu Limited. Reigniting growth: Advanced Materials Systems. Deloitte Global Services Limited. 2012.

WORLD ECONOMIC FORUM

COMMITTED TO IMPROVING THE STATE OF THE WORLD

The World Economic Forum is an independent international organization committed to improving the state of the world by engaging business, political, academic and other leaders of society to shape global, regional and industry agendas.

Incorporated as a not-for-profit foundation in 1971 and headquartered in Geneva, Switzerland, the Forum is tied to no political, partisan or national interests

World Economic Forum
91-93 route de la Capite
CH-1223 Cologny/Geneva
Switzerland

Tel +41 (0) 22 869 1212
Fax +41 (0) 22 786 2744

contact@weforum.org
www.weforum.org