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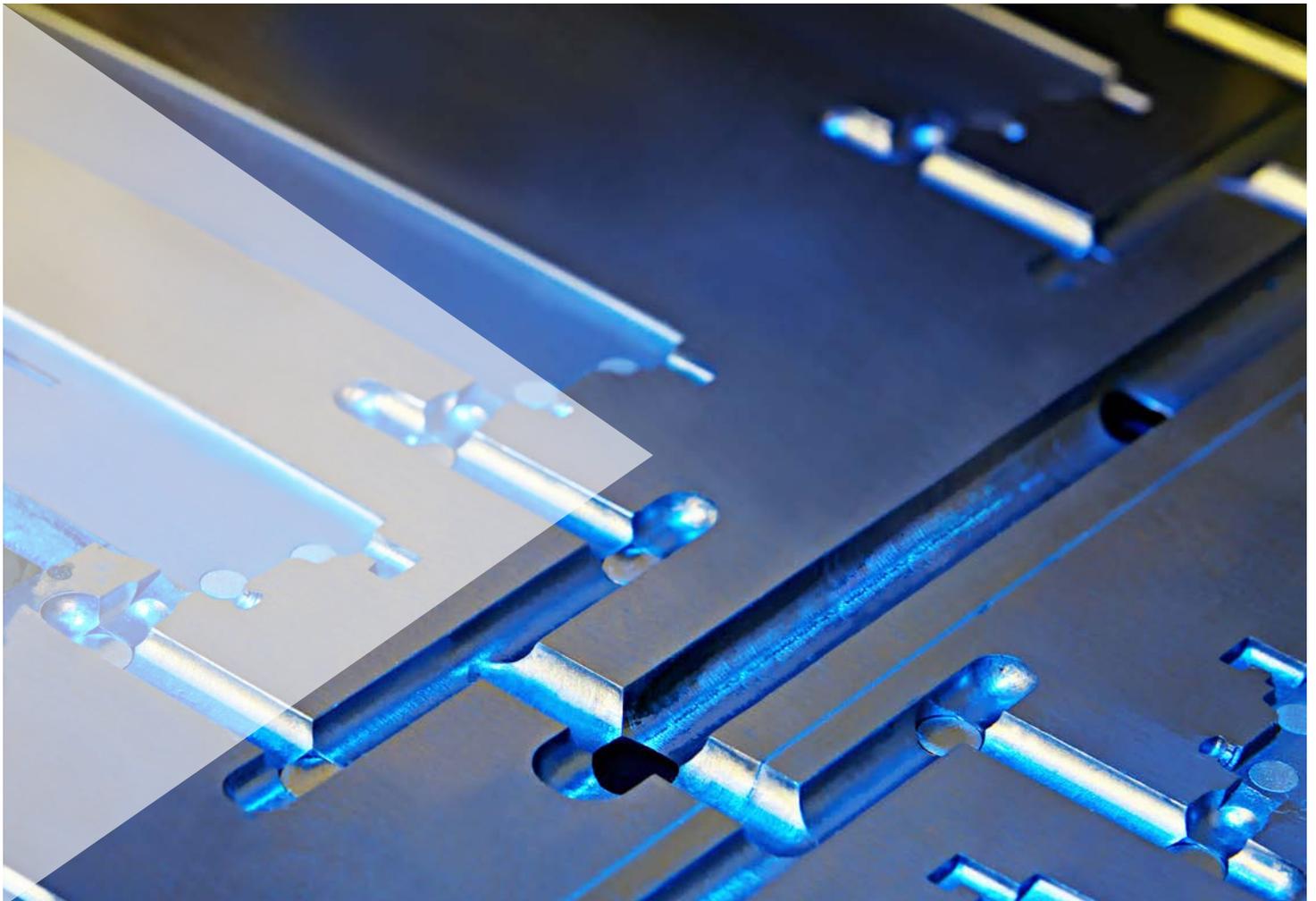
Global Agenda Council on the Future of Manufacturing

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# The Future of Manufacturing: Driving Capabilities, Enabling Investments

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November 2014



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This report was completed and edited by Jean-Paul Rodrigue (Hofstra University), Fadi Farra (Whiteshield Partners), Jun Ni (University of Michigan), João Carlos Ferraz (BNDES) and Ludovico Alcorta (UNIDO).

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# Foreword

This report focuses on an analysis of trends in global manufacturing, mostly from a value chain perspective, and represents a joint effort between the World Economic Forum Global Agenda Council on the Future of Manufacturing and the United Nations Industrial Development Organization (UNIDO). It emphasizes that future developments in global manufacturing are increasingly relying upon the development of capabilities related to innovation, labour and infrastructures. Developed countries have experienced a substantial decline in manufacturing employment, but this trend has also been counterbalanced by improvements in manufacturing capabilities. While developed countries remain among the most competitive, as noted by UNIDO's Competitive Industrial Performance Index, many developing countries have substantially improved their industrial competitiveness. An overview of the apparel industry stresses the fact that value chains can be upgraded to help manufacturing actors develop their capabilities. Still, corporate and national strategies to expand and improve manufacturing capabilities would benefit from a more concerted effort.

The World Economic Forum Global Agenda Council on the Future of Manufacturing and UNIDO have issued a joint declaration in Abu Dhabi in 2013 with the intention to launch a Global Manufacturing Capabilities Forum. The initiative aims to identify, analyse, discuss, and propose solutions to problems faced by manufacturing worldwide as well as to serve as a platform to address global manufacturing issues and business challenges, including questions related to global value chains and regional developments, and to examine policies for building manufacturing capabilities at the global level.

This report was completed and edited by Jean-Paul Rodrigue (Hofstra University), Fadi Farra (Whiteshield Partners), Gary Gereffi (Duke University), Jun Ni (University of Michigan), João Carlos Ferraz (BNDES) and Ludovico Alcorta (UNIDO).

# Chapter 1.

## The Future of Manufacturing: Challenges and Opportunities in a Shifting Global Economy



# Global Manufacturing at a Threshold: Emerging Technologies and Geographies

## The Three Pillars of Manufacturing

Manufacturing relies on three fundamental pillars: factors, standards and costs (Figure 1). Factors are the necessary means to undertake manufacturing and are commonly known as the factors of production, such as labour, capital and resources. Standards are the level at which the factors of production can be effectively used, as they represent a regulatory and operational framework. For instance, both

nations and manufacturing firms have different standards concerning quality, reliability, safety and security. They influence the nature of and conditions under which the factors of production can be used. The use of factors and standards for the purpose of production obviously comes at a cost, which is related to the productivity factors, including input costs, as well as regulatory (compliance) and distribution costs. Viewed within a comparative framework, these three pillars define the competitiveness of a nation.

Figure 1: The Three Pillars of Manufacturing

Factors	Standards	Costs (Productivity Factors)
<ul style="list-style-type: none"> <li>– Labour</li> <li>– Land</li> <li>– Infrastructure</li> <li>– Resources / Energy</li> <li>– Technology</li> <li>– Capital</li> <li>– Market</li> </ul>	<ul style="list-style-type: none"> <li>– Quality</li> <li>– Interoperability</li> <li>– Consistency</li> <li>– Reliability</li> <li>– Environment</li> <li>– Safety</li> <li>– Security</li> </ul>	<ul style="list-style-type: none"> <li>– Input</li> <li>– Regulatory</li> <li>– Financial</li> <li>– Distribution</li> </ul>

Source: Global Agenda Council on the Future of Manufacturing

The manufacturing sector has one of the highest multiplier effects on an economy and is a major driver of knowledge building and job creation. Factors ranging from human capital development to infrastructure and innovation, as measured by the economic complexity of a country, have a 0.75 correlation with economic growth.<sup>1</sup> The growing level of complexity of the economic base is therefore linked with economic growth.

## The manufacturing sector is subject to continuous yet cyclical changes

Technological innovation and economic growth are closely related and can be articulated with the concept of cycles or waves. Each wave represents a diffusion phase of technological innovations creating entirely new manufacturing sectors, and thus opportunities for investment and growth. The current wave began in the 1990s and mainly relies on information systems. These have tremendously modified the transactional environment with new methods of communication and more efficient forms of management of production and distribution systems

(logistics). This has spawned new industries related to personal computing devices (mostly computer manufacturing and software programming), but more recently e-commerce as information processing has converged with telecommunications. This reflects both a growing potential for innovation, and the capacity of economic systems to derive commercial opportunities from an innovation once it has been adopted.

## Most changes are disruptive for manufacturing

Technological innovations have dramatically changed how goods are created, transported, distributed and consumed, and will continue to do so. The global manufacturing landscape is being transformed by information technologies as well as economic processes linked to the exploitation of the comparative prices of labour, resources and energy across regions. In addition, mergers and acquisitions have transformed the manufacturing landscape with new networks of production where large conglomerates dominate. However, the drivers that have impacted manufacturing in the last decades are being reassessed.

Common processes such as outsourcing and offshoring are being counterbalanced by nearshoring or even reshoring, as input costs are changing and capabilities are being developed. Information technologies particularly are playing a greater role in manufacturing and the value chains into which they are embedded. This goes beyond the mere rapid exchange and storage of information and its related managerial capabilities. Entirely new manufacturing processes such as 3D printing have yet to significantly impact the manufacturing landscape, but these impacts could be far-reaching.

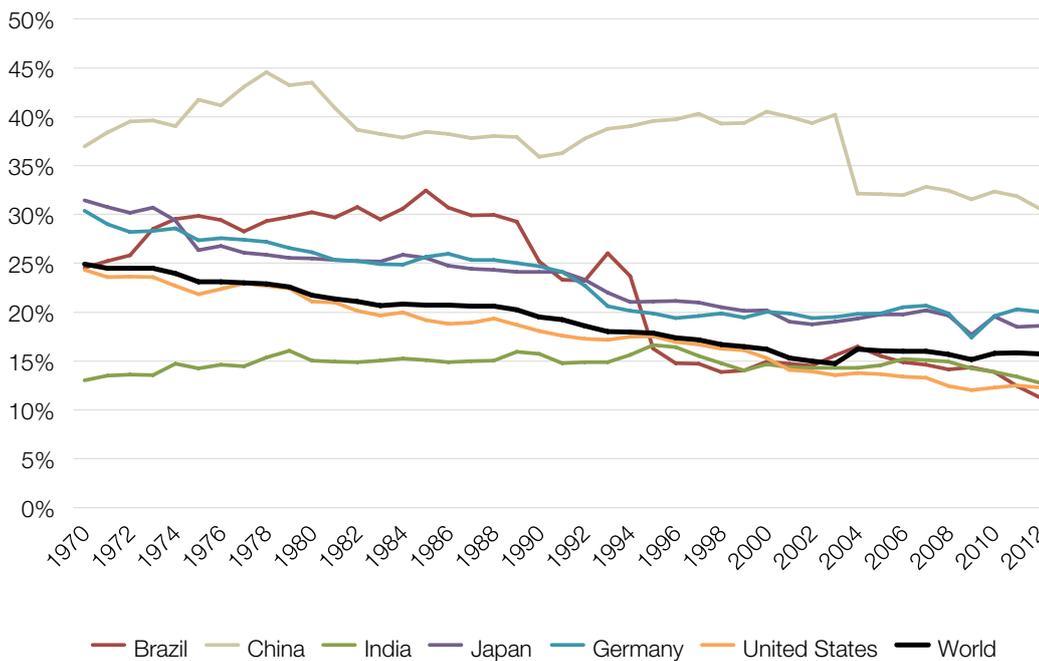
### The manufacturing sector has been in a phase of transition for decades

The manufacturing sector, which employed more than 476 million people in 2010 (including manufacturing related services), represents only 16.6% of global employment. If manufacturing related services are excluded and only formal and informal employment in manufacturing is included, the figure becomes 391 million people. The share of manufacturing activities and employment as it relates to Gross Domestic Product (GDP) continues to drop globally,

and is now at 17%, as compared to 27% in 1970 (Figure 2). In addition, manufacturing employment as a proportion of total employment fell from 18.7% in 1970 to around 16.6% in 2010. Many economies have seen this proportion decline rapidly, such as the United States at 12% in 2010, while some have seen it decline less rapidly, such as China at 33% for the same year. This underlines the enormous productivity of the manufacturing sector, reminiscent of the agricultural sector, where fewer workers are able to provide for a growing output.

Therefore, current metrics, such as manufacturing as a percentage of GDP, do not accurately reflect the global and complex nature of manufacturing, especially as it relates to Global Value Chains (GVCs), their impacts on capabilities and knowledge dissemination across these chains. This illustrates that many activities considered as services, such as distribution and even retailing, have become more integrated into value chains, and solely considering manufacturing and manufacturing employment can be misleading. A more complex advanced manufacturing framework is emerging.

Figure 2: Manufacturing as a Percentage of GDP, 1970-2011, Selected Countries



Source: United Nations Statistical Division. The World Bank, World DataBank, World Development Indicators. <http://data.worldbank.org/data-catalog/world-development-indicators>

### Changing and promoting the manufacturing discourse

To identify and address the fundamental drivers behind manufacturing, there is a need to use more relevant and adapted metrics and to better align public and private stakeholders at the global level. The Global Agenda Council on the Future of Manufacturing thus proposes two actions:

- Identifying and establishing a **COMMON MANUFACTURING CAPABILITIES DISCOURSE** where public and private stakeholders can engage more effectively with the

challenges brought forward by the global drivers of change in manufacturing. Such a discourse could be based on GVCs, knowledge networks, as well as manufacturing standards.

- Agreeing on a **GLOBAL MANUFACTURING PLATFORM**, where dialogue, negotiation and the promotion of the manufacturing agenda could be articulated. Such a platform, the Global Manufacturing Capabilities Forum (GMCF), is being implemented in collaboration with the United Nations Industrial Development Organization (UNIDO).

### Box: Defining Advanced Manufacturing

Manufacturing is a highly complex activity, which is affected by many key factors including, but not limited to, governmental policies, trade agreements, infrastructure, Foreign Direct Investment (FDI), workforce and talent development, wage growth, energy supply, access to resources, innovation ecosystem, and currency exchange. Advanced manufacturing is defined as the technological, organizational, social and environmental strategies that improve manufacturing so that it can meet the goals of enterprises, society and governments, and adapt to change. This definition reflects the growing level of integration across the value chains of the functions of production, distribution and consumption.

The “fundamentals” behind a successful advanced manufacturing strategy include focusing on identifying and addressing capability and innovation gaps through

manufacturing, effective FDI strategies, strong talent and infrastructure development, as well as access to finance. Putting manufacturing back at the centre of country competitiveness can help address, in the longer term, both job creation and challenges around encouraging higher productivity.

There are, however, a number of trade-offs and conflicting requirements when establishing a more comprehensive and sustainable manufacturing strategy. These include trade-offs between local jobs vs global outsourcing, job creation vs productivity, protectionism vs free trade, national technology development vs technology transfers, technology enabling vs standalone manufacturing, and short-term vs long-term strategies.

Source: *A Proposed Advanced Manufacturing Framework for Policy-makers, the Private Sector and Society*. 2012. Geneva: Global Agenda Council on Advanced Manufacturing, World Economic Forum.



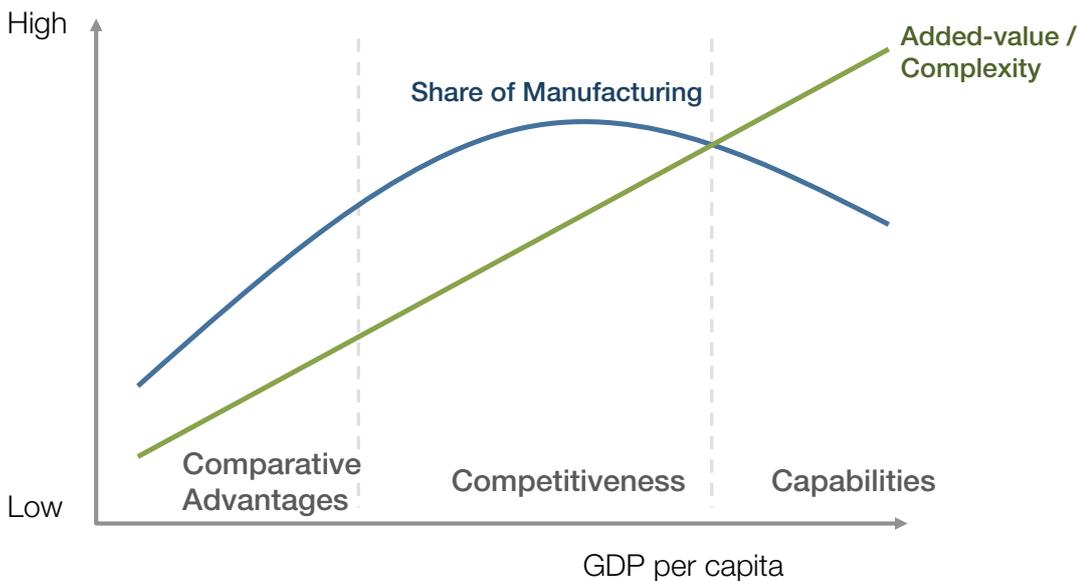
# Focusing on Manufacturing Capabilities

## Shifting Towards Manufacturing Capabilities

Public policy attention is shifting from the promotion of competitiveness to the development of capabilities, which is perceived as a more effective strategy to improve competitiveness. The main rationale is that **COMPETITIVENESS TENDS TO FOCUS ON DECREASING DIFFERENT COSTS, WHILE CAPABILITIES FOCUS ON INCREASING THE ADDED VALUE** provided by manufacturing. The manufacturing sector is also subject to transitions as economies develop, along with their capabilities (Figure 3). These stages are not necessarily sequential since a country can “jump” directly to a higher stage, but this is not common.



Figure 3: The Transition towards Manufacturing Capabilities



Source: Global Agenda Council on the Future of Manufacturing

Therefore, each stage in economic development is characterized by different manufacturing concerns and policies.

- **COMPARATIVE ADVANTAGES:** In the earlier stages, concerns relate to the comparative advantages which a country already has because of its factor endowments. Some may be permanent (e.g. resources), while others may be temporary (e.g. cheap labour). This stage tends to be a factor driven stage.
- **COMPETITIVENESS:** Later, the focus moves to improving comparative advantages through strategies aimed at promoting them (standards, infrastructure, education,

finance, etc.). For instance, investments in infrastructures such as ports, rail and highways generally promote the competitiveness of the area in which they are taking place. This stage tends to be efficiency driven.

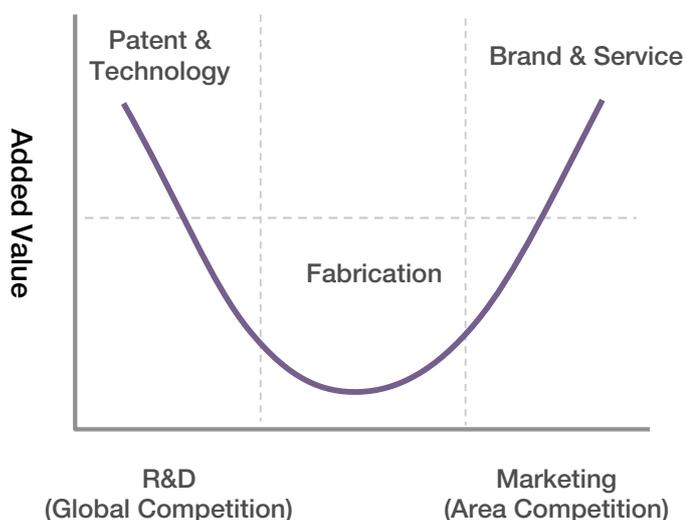
- **CAPABILITIES:** In an advanced stage, maintaining and improving competitiveness in light of declining comparative advantages (e.g. global competition) becomes a priority. This stage tends to be innovation driven. Since innovation is a key factor in creating value in manufacturing, a supportive environment must be developed. This requires an **ADVANCED MANUFACTURING APPROACH** (convergence of corporate, government and social interests) which aims to develop capabilities.



## Establishing a common framework: Global Value Chains

The setting of GVCs and their related commodity flows has led to a change in the respective value of research and development (R&D), fabrication and marketing. New forms of competition are emerging, as different segments of the value chain require different capabilities. A large proportion of manufacturing output has shifted towards the developing world, particularly the relatively large and dynamic emerging economies. However, the actual fabrication or production stages of GVCs are becoming relatively standardized and subject to lower economic returns, while the pre-production (e.g. R&D and design) and post-production (e.g. marketing and logistics) segments are where relatively high levels of added value are concentrated.

Figure 4: Generic Smile Curve in a Value Chain



Source: Global Agenda Council on the Future of Manufacturing

Therefore, a GVC offers three main dimensions over which competition may take place:

- **COMPETITION OVER CONCEPTS:** In a global production and consumption market, R&D, branding and design (creating a product) can be a significant component of the competitiveness and added value of a commodity chain. This requires specific scientific, technical and design (aesthetic) capabilities.
- **COMPETITION OVER PROCESSES:** The manufacturing function of many corporations has been hollowed out by the process of globalization, in which manufacturing accounts for one of the least valuable activities, particularly if it takes place within an outsourcing and offshoring framework. Such a framework can significantly lower conventional input costs such as labour and raw materials. The massive increase of low cost manufacturers has led to a high level of competitiveness in fabrication, reducing profit margins as well as the overall levels of contribution to value added (in the national accounts).
- **COMPETITION OVER MARKETS:** In the logistics segment (making a specified product available on markets), distribution, marketing and sales/after sales services (such as customer support) are the activities which generate the most added value.

Most GVCs are also connected, like a network, through common capabilities and knowledge. For example, economic activities that use Computer Aided Design (CAD) systems effectively can apply it to the textiles value chain, while it can also be applied to automotive components manufacturing.

Manufacturing capabilities are defined in terms of institutions, capital, infrastructure, technology and skills. Manufacturing can help focus those capabilities and enhance them. More broadly, “People who know about design, marketing, finance, technology, human resource management,

*operations and trade law must be able to interact and combine their knowledge to make products. These same products cannot be made in societies that are missing parts of this capability set”.*<sup>2</sup>

Manufacturing standards can also partially reflect the capabilities embedded in a GVC and within countries. Thanks to their concrete applications, they contribute to a common practical language, providing a common and transparent mirror of the capabilities acquired by companies. Indeed, manufacturing standards are not just an opportunity for producers and suppliers in developing countries to be linked with GVCs, but are also a reflection of the capabilities which countries have developed, and that allow them to comply with such standards.

### Upgrading value chains by building capabilities

Value chains can be considered from two axes: functions (horizontal axis) such as procurement, fabrication and distribution, and the level of added value per unit of output (vertical axis) that is derived from each of these functions. Through their economic development paths, countries usually improve their competitiveness within GVCs through **FUNCTIONAL**, **PRODUCT** and **PROCESS** upgrading. While functional upgrading involves the development of a wider array of activities over different segments of the value chain, product upgrading focuses on designing, fabricating and distributing higher value (more sophisticated) products. Process upgrading focuses on improving the fabrication and distribution chain through capital investments.

There are usually four functional upgrading stages:

- **FABRICATION** (1; value chain entry): In this basic stage the manufacturer provides simple fabrication processes, often using imported inputs (parts and raw materials). This is usually to take advantage of lower labour costs and has occurred particularly in export-oriented economies. The basic fabrication is either the outcome of

outsourcing and offshoring investments made by multinational corporations or the setting of domestic firms subcontracting on their behalf.

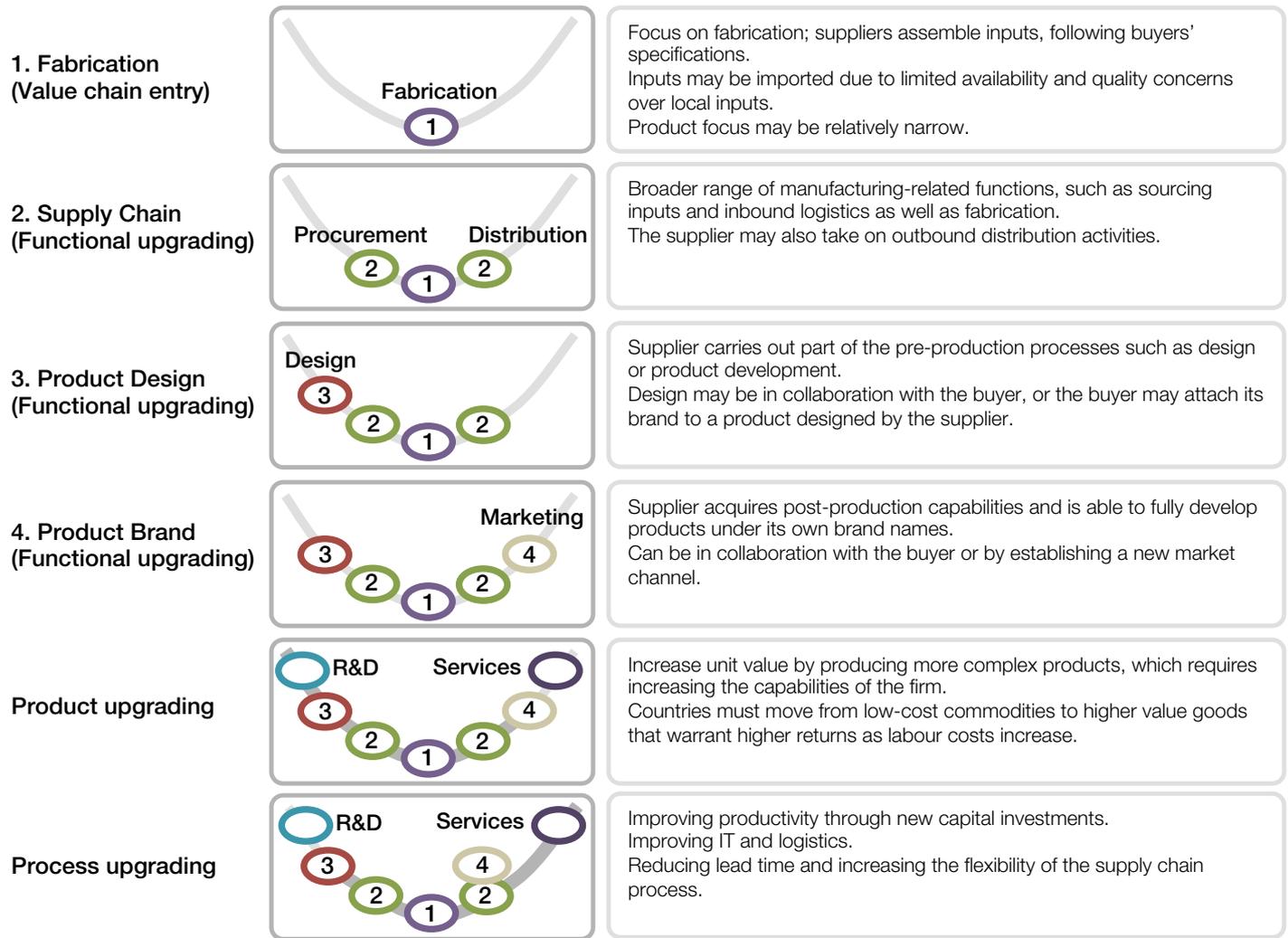
- **SUPPLY CHAIN** (2; functional upgrading): The manufacturer is involved in a broader range of activities. This can involve moving upstream along the supply chain, such as for the procurement of parts and raw materials. The manufacturer is therefore building its own network of suppliers and is able to have better control over the quality, quantity and frequency of inputs. This can also involve moving downstream along the supply chain to assume tasks such as packaging and shipping to the buyer.
- **PRODUCT DESIGN** (3; functional upgrading): In this case, the manufacturer assumes the additional pre-fabrication activities, namely design or product development.
- **PRODUCT BRAND** (4; functional upgrading): At this stage, a manufacturer is able to develop their own products and sell them on regional or global markets. This particularly involves the development of recognized brands.

In addition to the four main stages of functional upgrading, two additional forms of upgrading can be added on:

- **PRODUCT UPGRADING**: Eventually, a manufacturer becomes able to undertake the fabrication of increasingly complex products and also develops additional capabilities to innovate.
- **PROCESS UPGRADING**: The main goal at this stage is to improve productivity through new fabrication methods, which commonly involve capital investments (e.g. fabrication equipment). Additional supply chain strategies can be developed so that fabrication becomes highly responsive (with lower lead times) and more flexible.



Figure 5: Upgrading the Value Chain



Source: GAdapted from Fernandez-Stark, K., Frederick S. and Gereffi G. *The Apparel Global Value Chain: Economic Upgrading and Workforce Development*. Durham, NC: Duke University Center on Globalization, Governance and Competitiveness, February 2011. [http://www.cggc.duke.edu/pdfs/2011-11-11\\_CGGC\\_Ex.Summary\\_Apparel-](http://www.cggc.duke.edu/pdfs/2011-11-11_CGGC_Ex.Summary_Apparel-)



Each manufacturing sector relies upon a combination of factors for the location of a new facility or for its daily operations. The most common factors relate to labour, resources, infrastructure (e.g. utilities and transport) and market access. Standards relate to issues such as the quality, interoperability, consistency, reliability, safety and security of those factors. The exploitation of these factors and their related standards involves costs such as input (e.g. labour and raw materials), regulatory (e.g. taxation) and distribution costs. Locations with low labour standards may have cheap input costs, but are likely to lack the capabilities to perform tasks of higher added value. Reaching standards that are suitable to a wider set of manufacturing activities is an important goal for countries in order to develop and expand their manufacturing base.

## Chapter 2.

# The State of Global Manufacturing and the Competitive Industrial Performance Index



# Value Added and Exports: Learning from History

## Manufacturing Value Added

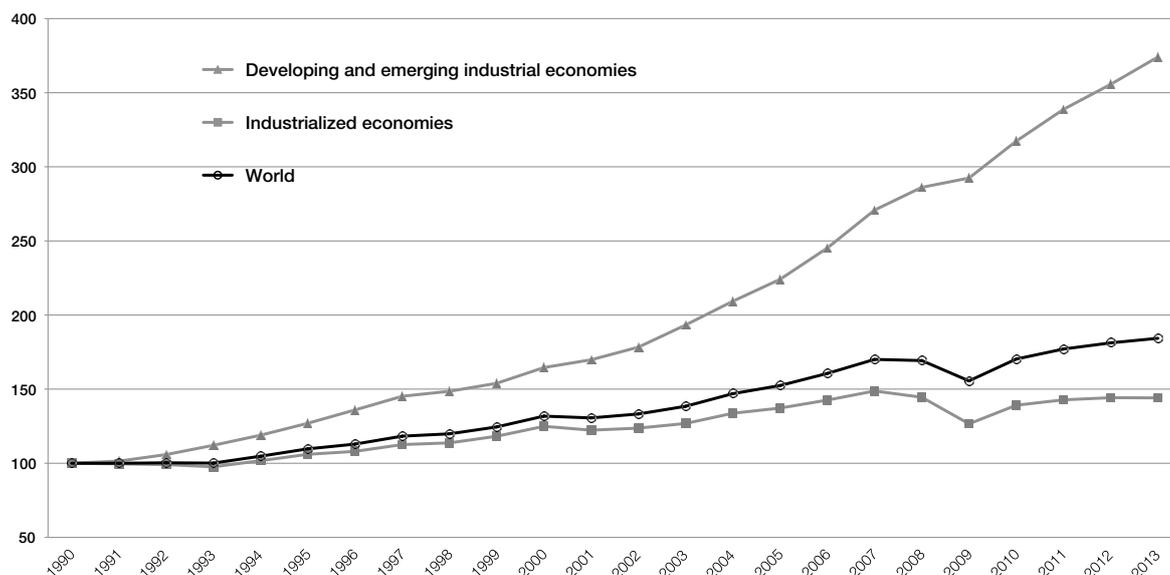
Since the start of this century, industrializing economies accounted for a growing share of the world's manufacturing value added (MVA). This trend is the result of a gradual shift of production from industrialized to industrializing countries to benefit from cheaper labour, largely improved infrastructure and lower social costs. This has also favoured the growth of industrializing countries' domestic markets for industrial goods due to higher incomes and a fast-rising middle class.

The world's MVA reached an all-time high of \$12,000 billion in 2013 (16.4% of global GDP), recovering fully from the

sharp contraction of 2008 to 2009 caused by the global economic and financial crisis (Figure 6). MVA's share in GDP in industrialized countries fell from 16.1% in 1990 to 14.7% in 2013, while it rose from 16.4% to 20.8% in industrializing countries.

Between 1993 and 2013, global MVA increased 2.5 times, averaging 3.1% real annual growth. While MVA expanded on average by a mere 2.0% in real terms per year in industrialized countries (below their 2.1% annual GDP growth rate for the period), it rose more than three-fold in industrializing countries, at an annual real rate of 6.2% and faster than their 5.1% a year GDP growth rate.

**Figure 6: Growth Trend in World MVA: 1990-2013 at Constant 2005 US\$ (1990=100)**



Source: UNIDO Statistical Database and UNIDO estimates, 1990-2013, [www.unido.org](http://www.unido.org)

The outcome of rapid growth rates in industrializing countries was a near-doubling in their share of the world MVA, from 19.6% in 1993 to 35.5% in 2013. This was accompanied by a corresponding retreat of industrialized countries from the world's manufacturing scene, underscoring the structural changes taking place in both groups.

These long-term trends conceal a change in pattern around the turn of the century. From 1993 to 2003, the annual growth of world MVA averaged 3.3%, whereas from 2003 to 2013 it averaged 2.9%. Accompanying this seemingly minor difference was the acceleration in MVA growth in industrializing countries, from an average annual 5.6% between 1993 and 2003 to 6.8% between 2003 and 2013.

This surge partially offset the deceleration in MVA growth in industrialized economies, which fell from an average annual 2.7% to 1.3% over the same periods.

## International production networks

A feature of the current organization of manufacturing is the increased use of international production networks to carry out different stages of the production process across borders. This is made possible by large scales of production, advances in technology (especially micro-electronics) and affordable transport costs. The result of this production sharing has been a larger increase in trade than the

corresponding increase in MVA. In 2012, world manufactured exports were estimated at \$13,887 billion, growing faster than manufacturing GDP over 2008-2012 (see Table 1).

**Table 1: World Exports by Main Product Category, 2007-2012 (US\$ billion and %)**

Category	2007	2008	2009	2010	2011	2012	Average growth rate 2004-2008 (%)	Average growth rate 2008-2012 (%)
<b>Manufactured</b>	10,890	12,156	9,561	11,612	13,668	13,887	15.7	3.4
<b>Primary</b>	2,152	2,772	1,945	2,469	3,336	4,106	21.8	10.3
<b>Other</b>	168	217	213	250	346	376	16.3	14.8
<b>World trade</b>	13,210	15,146	11,719	14,331	17,350	18,369	16.6	4.9

Source: UNIDO Statistical Database estimates on the basis of COMTRADE, 2007-2012, [www.unido.org](http://www.unido.org)

Industrialized economies have the bulk of the world's manufactured exports, but industrializing countries have been increasing their world share since the late 1990s. Manufactured exports from industrialized countries grew just 1.3% annually between 2008 and 2012, reaching \$9,456 billion in 2012, as they struggled to recover from the dip in economic activity brought about by the 2008 financial crisis. Manufactured exports from industrializing countries grew

8.6% annually over the same period, to an estimated peak of \$4,431 billion in 2012. The higher long-term dynamism of industrializing economies is also reflected by the increase in their share in world manufactured exports, from 14% in 1997 to 32% in 2012, due mainly to the expansion in exports from large industrializing countries such as China and India (see Table 2).

**Table 2: World Manufactured Exports by Income Group, 2007-2012 (US\$ billion and %)**

	1997	2007	2008	2009	2010	2011	2012	Average growth rate 2004-2008 (%)	Average growth rate 2008-2012 (%)
<b>World</b>	4,499	10,890	12,156	9,561	11,612	13,668	13,887	13.31	3.38
<b>Industrialized economies</b>	3,858	8,185	8,971	6,949	8,265	9,609	9,456	11.21	1.32
<b>Industrializing economies</b>	641	2,705	3,185	2,612	3,347	4,059	4,431	20.49	8.60

Source: UNIDO Statistical Database estimates on the basis of COMTRADE, 1997-2012, [www.unido.org](http://www.unido.org)



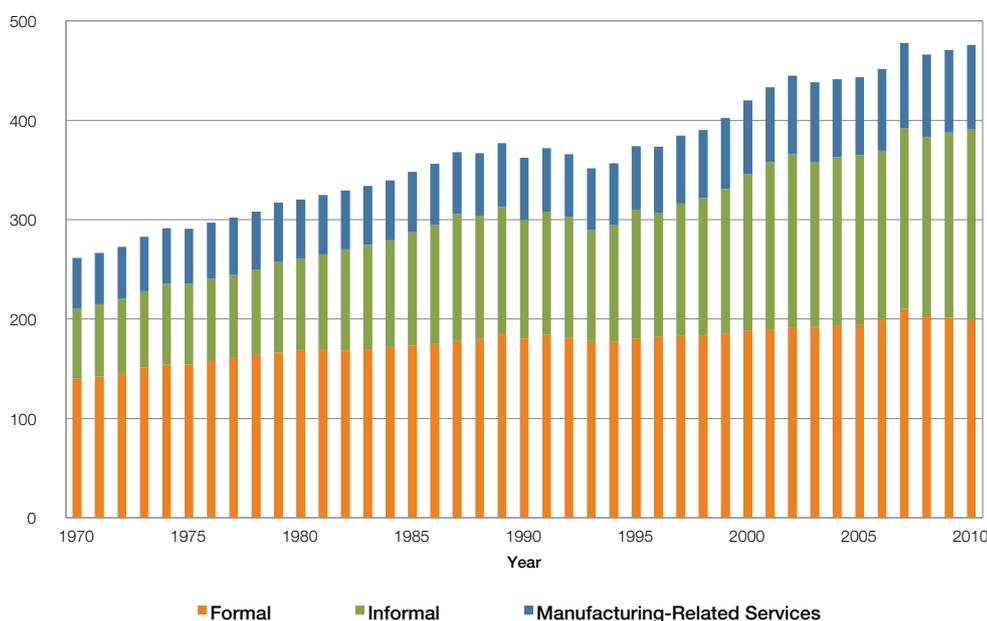
# Manufacturing Employment Trends

## Global Trends

Global manufacturing employment stood at 476 million in 2010, up from an estimated 262 million in 1970, and growing at an average annual rate of 1.5% (Figure 7). Employment grew steadily between 1970 and 1989, but fell drastically between 1990 and 1994 due to the demise of the Soviet

Union, which lost around 12.5 million formal manufacturing jobs between 1990 and 1994, nearly two-thirds of all job losses during that period. After this point, manufacturing employment continued to recover until the global financial crisis of 2008, which was responsible for the loss of more than 11 million manufacturing jobs in developed countries, the majority of job losses worldwide during 2008 and 2009.

**Figure 7: World Manufacturing Employment by Type, 1970-2010 (million)**



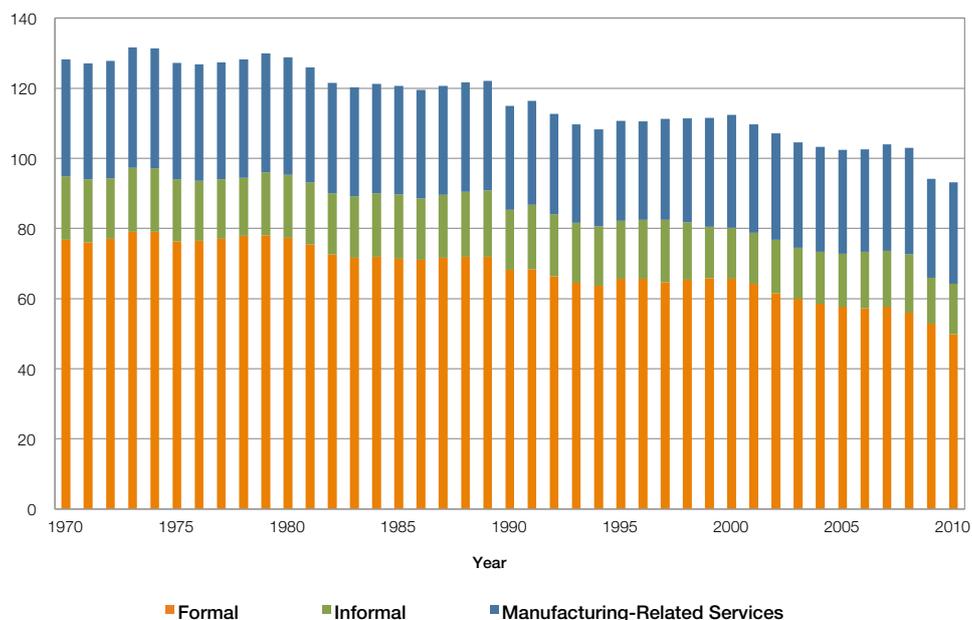
Source: UNIDO statistical databases, (UNIDO, 2013), Industrial Development Report 2013, Sustaining employment Growth: The Role of Manufacturing and Structural Change, Vienna (updated for 2010), [www.unido.org](http://www.unido.org).

While increasing in absolute terms, the share of manufacturing employment in total employment decreased from 18.7% to 16.6% between 1970 and 1990. Since then, however, relative employment has remained fairly stable. A distinctive characteristic in manufacturing employment has been the growing share of informal employment, which increased from 27.1% to 39.9% between 1970 and 2010. Formal employment dropped from 53.4% to 42% during the same period. Informal manufacturing jobs include not only workers who are not fully protected by labour legislation (such as minimum wages, limits on working hours and safety and health standards), as in the traditional definition of informal employment, but also jobs in small and medium enterprises (under 10 employees) and the self-employed.

## Developed countries

Loss of manufacturing jobs in developed countries account for the bulk of the reduction in the share of manufacturing employment in total employment. Manufacturing employment fell from 128 million jobs in 1970 to 93 million jobs in 2010. Figures for manufacturing employment in developed countries, however, are unduly affected by the global financial crisis, as manufacturing employment should return to over 100 million jobs, as manufacturing activity recovers in Europe and the US. In share terms, manufacturing employment in developed countries fell from 37.8% of developed country total employment in 1970, to 19.5% in 2010. Manufacturing employment in developed countries represents around 3.2% of global employment.

**Figure 8: Developed Countries' Manufacturing Employment by Type, 1970-2010 (million)**



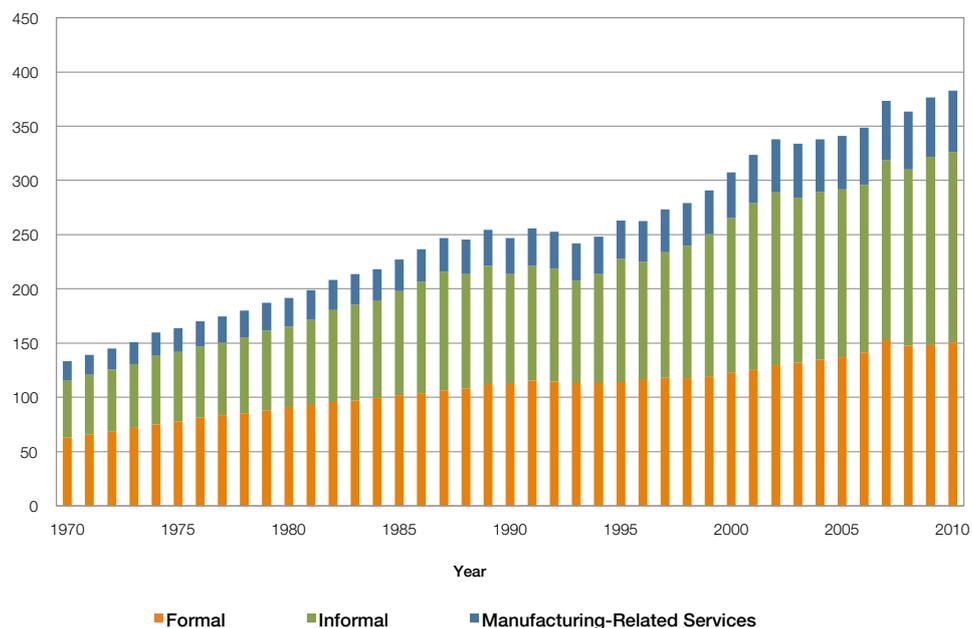
Source: UNIDO statistical databases, (UNIDO, 2013), Industrial Development Report 2013, Sustaining employment Growth: The Role of Manufacturing and Structural Change, Vienna (updated for 2010), www.unido.org.

A key trend in developed country manufacturing employment has been in the share of manufacturing related services (MRS) employment. The share of MRS in manufacturing employment in developed countries increased from 26.1% in 1990 to 31.2% in 2010. In the chemical industry, for example, between 1995 and 2007, total employment remained at around 8.7 million workers. In 1995, formal and informal manufacturing employment accounted for 56.2% of the total employment by the industry. By 2009, this share had dropped to around 44.7%, with the remainder being accounted for by R&D, training, transport, wholesaling and retailing and real estate and leasing costs.<sup>3</sup>

### Developing countries and economies in transition

Compensating for the loss of manufacturing employment in developed countries has been the rapid rise of manufacturing employment in developing countries and economies in transition. By 2010, 383 million jobs had been created, while in 1970 manufacturing employment in developing countries only accounted for 133 million jobs (Figure 9). The share of manufacturing employment in total employment in developing countries increased by 4.5% since 1970, reaching 16% in 2010. Today, developing countries' manufacturing employment accounts for around 13.3% of global employment. Taking into account the unemployed, manufacturing employment increased from 11.6% of the labour force in 1970 to 15% in 2010.

**Figure 9: Developing Countries and Economies in Transition Manufacturing Employment by Type, 1970-2010**



Source: UNIDO statistical databases, (UNIDO, 2013), Industrial Development Report 2013, Sustaining Employment Growth: The Role of Manufacturing and Structural Change, Vienna (updated for 2010), www.unido.org.

Increased manufacturing employment in developing countries has been accompanied by growing informal employment (Figure 9). Between 1970 and 2010, informal employment trebled in developing countries, mainly after 1990 as a result of the structural adjustment programmes

and liberalization in former Soviet bloc economies. In India, informal manufacturing employment (the largest worldwide), can be three to four times formal manufacturing employment, while in Indonesia informal employment is twice that of formal manufacturing employment.

## The Competitive Industrial Performance Index

### Benchmarking Industrial Competitiveness

Shifts in the relative position of industrialized and emerging industrial economies in manufacturing value added and industrial exports are accounted for, to a significant extent, by changes in individual countries' industrial competitiveness. UNIDO assesses and benchmarks industrial competitiveness through its Competitive Industrial Performance (CIP) index (see box below). Industrial competitiveness is defined as the capacity of countries to increase their presence in international and domestic markets whilst simultaneously developing industrial sectors and activities with higher value added and technological content.<sup>4</sup>

### Box: Global Manufacturing Indexes

In recent years, several indexes were developed to assess the competitiveness of the manufacturing sector. Among the three most notable:

- COMPETITIVE INDUSTRIAL PERFORMANCE INDEX (CIP) (A UNIDO index): This is composed of 8 indicators assessing industrial performance through an economy's ability to produce and export manufactured goods competitively. Each indicator is weighted on a scale of 0 to 1. This represents an objective index of the current competitiveness and manufacturing potential of 142 countries around the world.
- GLOBAL MANUFACTURING COMPETITIVENESS INDEX (GMCI): Based on a global survey of 550 CEOs, the GMCI ranks the competitiveness, on a scale of 1 to 10, of 40 individual components agglomerated in 10 categories. Each component is weighted according to the importance of the variable and the respondent. It is a subjective index based upon managerial perception, and used to justify current practices.
- GLOBAL COMPETITIVENESS INDEX (A World Economic Forum index). This measures both the microeconomic and the macroeconomic foundations of national competitiveness. It is a weighted average of components grouped into "12 pillars of competitiveness" on a scale of 1 to 7, and represents an extensive mix of objective and subjective criteria. It underlines that competitiveness is a proxy for economic, social, and technological development.

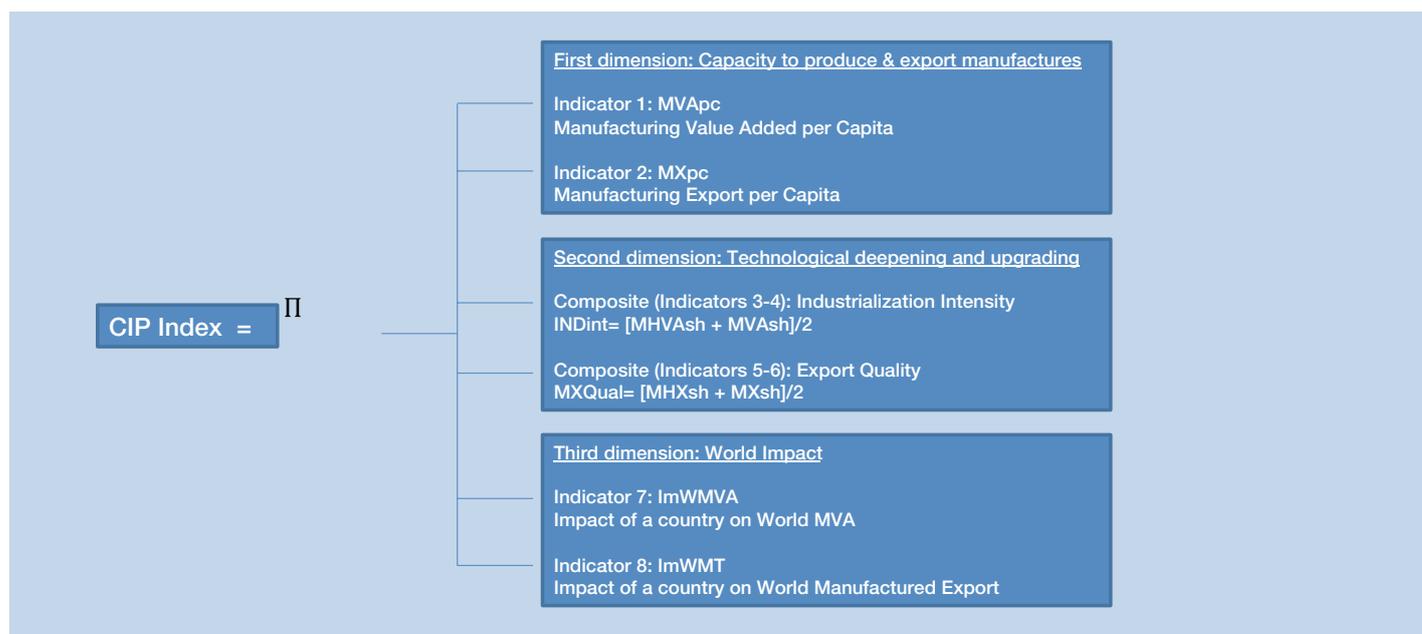
Source: UNIDO *Competitive Industrial Performance Report 2012/ 2013*, [http://www.unido.org/fileadmin/user\\_media/Services/PSD/Competitive\\_Industrial\\_Performance\\_Report\\_UNIDO\\_2012\\_2013.PDF](http://www.unido.org/fileadmin/user_media/Services/PSD/Competitive_Industrial_Performance_Report_UNIDO_2012_2013.PDF)



The CIP index today consists of eight sub-indicators grouped along three dimensions of industrial competitiveness. The first dimension relates to country capacity to produce and export manufactures, and is captured by their Manufacturing Value Added per capita (MVApc) and their Manufactured Exports per capita (MXpc). The second dimension covers levels of technological deepening and upgrading within a country. To proxy for this complex dimension, two composite sub-indicators, industrialization intensity and export quality, have been constructed. The degree of industrialization intensity is computed as a linear aggregation of Medium- and High-tech Manufacturing Value Added share of total Manufacturing Value Added (MHVAsh) and the Manufacturing Value Added share in total GDP (MVAsh). Country export quality is obtained as a linear aggregation of the Medium- and High-tech Manufactured Export share in total manufactured exports (MHXsh) and the Manufactured Export share in total exports (MXsh). Finally, the third dimension of competitiveness entails country impact on world manufacturing, both in terms of the value added share in World Manufacturing Value Added (ImWMVA) and in World Manufactures Trade (ImWMT). The CIP index is a composite index obtained through a geometric aggregation of these six sub-indicators, to which equal weights have been assigned. Source: UNIDO *Competitive Industrial Performance Report 2012/ 2013*, [http://www.unido.org/fileadmin/user\\_media/Services/PSD/Competitive\\_Industrial\\_Performance\\_Report\\_UNIDO\\_2012\\_2013.PDF](http://www.unido.org/fileadmin/user_media/Services/PSD/Competitive_Industrial_Performance_Report_UNIDO_2012_2013.PDF), summarizes the configuration of the CIP index.?

Figure 10 summarizes the configuration of the CIP index.

**Figure 10: Components of the Competitive Industrial Index**



Source: UNIDO *Competitive Industrial Performance Report 2012/ 2013*, [http://www.unido.org/fileadmin/user\\_media/Services/PSD/Competitive\\_Industrial\\_Performance\\_Report\\_UNIDO\\_2012\\_2013.PDF](http://www.unido.org/fileadmin/user_media/Services/PSD/Competitive_Industrial_Performance_Report_UNIDO_2012_2013.PDF)

### TRENDS IN INDUSTRIAL COMPETITIVENESS

Trends in industrial competitiveness over the last 22 years are shown in Table 3. Countries are listed according to the 2012 World Industrial Competitiveness rankings, and subdivided into quintiles (by colour) for ease of reference, delineating the Top, Upper Middle, Middle, Lower Middle and Low competitive countries.

#### Industrial competitiveness

In 2012, the most industrially competitive nations (those in the top quintile) included a varied set of economies. The top five most industrially competitive countries are Germany, Japan, the United States (US), the Republic of Korea (ROK) and China. Each are among the most industrialized countries in the world, and jointly accounted for more than 58% of world MVA. Germany's ranking is due to its high level of industrial exports, while Japan's industrial competitiveness is supported by its large manufacturing base, high-tech exports, as well as enhanced manufacturing per capita. Industrial competitiveness in the US also arises from its large manufacturing base, although this is more aimed at the domestic market as compared to Japan or any other developed country. The US alone accounts for 20% of world MVA. ROK has a competitive manufacturing sector based on a high share of medium- and high-tech industries.

China's position in the ranking is due to its high share in global trade, although low MVA per capita and export indicates that manufacturing lags behind from a value added perspective. Over the last 15 years, China increased its share of manufacturing exports by 11 percentage points to 16% of global manufacturing trade, and is today the largest exporter in the world. China is also beginning to position itself as a high-tech manufacture exporter. China's manufacturing industry has become the largest sector in the

economy and today it accounts for more than one-third of GDP and more than 16% of global MVA, second only to the US.

The top quintile also includes Switzerland, Singapore and the Netherlands, on account of very large exports per capita and, in particular, high-tech exports. Other members of the top quintile are mainly European Union transition economies, such as the Czech Republic, Poland, Slovakia and Hungary. This is due to their export orientation, although this is more focused on the European market. The list is completed by Mexico, Malaysia, and Thailand whose competitiveness arises from their participation in global value chains. Altogether, countries in the top quintile account for almost 83% of the world MVA.

The upper middle quintile includes some of the most populated countries in the world, including Brazil, India, Indonesia, Philippines, Russian Federation, South Africa, and Turkey. The Philippines and Indonesia have a strong production and export performance in high-tech products, while the Russian Federation and South Africa have high MVA per capita but low manufacturing exports due to their dependence on foreign sales of natural resources. India and Brazil each account for more than 1.6% of global MVA.

The middle quintile includes populated countries such as Iran, Egypt, and Bangladesh but also includes some less populated nations, such as Costa Rica, Oman, Iceland and Uruguay. Countries in the lower middle and low quintiles include less developed countries by income, and account for approximately 0.7% of world MVA. Their level of industrialization, on average, is less than one-third of that of the countries included in the middle quintile.

**Table 3: Competitive Industrial Performance Country Ranking, Selected Years**

Country	2012	2010	2005	2000	1995	1990
Germany	1	1	1	2	2	1
Japan	2	2	2	1	1	2
United States of America	3	3	3	3	3	3
Republic of Korea	4	4	6	11	13	17
China	5	7	18	22	26	32
Switzerland	6	5	9	13	7	7
Singapore	7	6	10	9	11	12
Netherlands	8	9	11	14	10	9
Ireland	9	11	12	10	17	19
Belgium	10	12	5	8	8	8
China, Taiwan Province	11	13	13	12	12	14
Italy	12	8	4	4	4	4
France	13	10	7	6	6	6
United Kingdom	14	14	8	5	5	5
Austria	15	16	16	17	15	11
Sweden	16	15	15	15	14	13
Canada	17	17	14	7	9	10
Czech Republic	18	19	22	24	28	25
Spain	19	18	17	16	16	15
Finland	20	20	19	18	19	18
Mexico	21	22	21	19	21	31
Poland	22	24	27	33	36	51
Denmark	23	21	20	20	18	16
Malaysia	24	23	23	21	20	30
Slovakia	25	27	33	41	43	37
Thailand	26	25	25	25	27	38
Hungary	27	26	24	27	38	34
Israel	28	28	26	23	23	23
Australia	29	29	28	26	25	24
Turkey	30	30	30	34	33	39
Norway	31	31	29	29	22	21
Russian Federation	32	36	36	35	35	27
Slovenia	33	32	31	31	32	28
Romania	34	34	37	43	42	36
Portugal	35	35	32	28	24	22
Brazil	36	33	34	32	30	29
Belarus	37	38	45	49	50	46
Argentina	38	37	42	42	39	44
Indonesia	39	40	41	39	41	52
Lithuania	40	43	46	54	58	55
Saudi Arabia	41	41	38	48	48	45
South Africa	42	39	40	40	37	41
Qatar	43	42	54	52	49	48
India	44	44	53	55	53	63
Estonia	45	50	49	53	62	59
New Zealand	46	45	39	37	34	35
United Arab Emirates	47	47	50	56	61	81
Luxembourg	48	46	35	30	31	26
Chile	49	48	47	51	47	56
Greece	50	49	43	44	40	40
Ukraine	51	52	51	57	54	42
Viet Nam	52	55	68	80	90	94
Philippines	53	54	44	38	51	50
Croatia	54	51	48	47	45	33
Trinidad and Tobago	55	53	63	65	76	83
Bulgaria	56	56	58	62	52	43

Country	2012	2010	2005	2000	1995	1990
Peru	57	60	67	73	72	78
Costa Rica	58	59	57	50	70	73
Tunisia	59	58	59	58	56	62
Latvia	60	61	64	68	71	57
Kazakhstan	61	69	71	83	73	69
Oman	62	63	87	74	88	104
Iran (Islamic Republic of)	63	57	75	89	92	92
Kuwait	64	64	65	66	63	72
Malta	65	68	56	45	44	49
Colombia	66	62	60	60	55	54
Morocco	67	66	66	63	65	67
Iceland	68	67	62	59	57	60
Bahrain	69	75	74	69	64	71
Egypt	70	70	81	75	82	84
El Salvador	71	71	69	82	84	80
Pakistan	72	73	70	72	68	74
Serbia	73	72	73	77	69	53
Hong Kong SAR	74	65	52	36	29	20
Jordan	75	74	76	95	91	89
Guatemala	76	77	72	78	77	79
Bangladesh	77	78	89	90	94	102
Sri Lanka	78	80	77	67	75	93
Uruguay	79	79	82	71	66	64
Botswana	80	83	78	76	86	86
Venezuela (Bolivarian Republic of)	81	76	55	46	46	58
Mauritius	82	84	79	64	60	61
The f. Yugosl. Rep. of Macedonia	83	82	84	81	79	65
Bosnia and Herzegovina	84	86	91	97	96	96
Ecuador	85	88	93	92	93	101
Lebanon	86	81	83	91	85	91
Algeria	87	85	92	84	87	77
Brunei Darussalam	88	87	85	94	83	85
Swaziland	89	89	80	70	67	68
Cambodia	90	94	98	102	119	122
Honduras	91	92	99	100	113	113
Cyprus	92	90	95	88	74	66
Côte d'Ivoire	93	91	86	87	95	87
Cuba	94	93	90	79	80	75
Jamaica	95	96	94	86	78	70
Georgia	96	95	100	106	121	97
Nigeria	97	97	112	139	130	131
Bolivia (Plurinational State of)	98	98	108	99	104	106
Albania	99	99	123	117	123	110
Bahamas	100	101	96	96	126	127
Armenia	101	105	97	110	108	100
Syrian Arab Republic	102	100	115	131	110	121
Fiji	103	107	102	98	98	95
Cameroon	104	103	110	111	106	98
Senegal	105	104	105	103	107	111
Barbados	106	102	101	93	89	90
Suriname	107	109	122	126	99	88
Kenya	108	106	106	113	103	107
Gabon	109	108	107	108	115	116
Congo	110	110	114	127	128	133
Paraguay	111	112	111	104	102	114

Country	2012	2010	2005	2000	1995	1990
Papua New Guinea	112	114	120	119	111	117
Azerbaijan	113	113	104	109	97	76
Zambia	114	115	119	115	124	126
Republic of Moldova	115	120	109	114	105	99
Mongolia	116	117	124	124	118	119
State of Palestine	117	119	113	105	101	109
Panama	118	118	117	101	100	105
Belize	119	122	118	107	109	115
United Republic of Tanzania	120	121	131	132	136	135
Mozambique	121	133	130	136	137	137
Ghana	122	125	121	122	116	118
Kyrgyzstan	123	124	126	121	117	103
Uganda	124	131	138	140	138	145
Madagascar	125	123	128	118	131	128
Tajikistan	126	127	125	123	120	112
Yemen	127	126	129	137	134	134
Nepal	128	128	127	120	122	130
China, Macao SAR	129	129	88	61	59	47
Saint Lucia	130	130	133	129	125	124
Malawi	131	132	139	133	133	132
Niger	132	136	135	130	127	129
Haiti	133	135	134	128	135	108
Rwanda	134	138	142	143	144	143
Bermuda	135	134	132	144	144	145
Iraq	136	137	141	125	129	125
Central African Republic	137	139	137	134	132	136
Gambia	138	141	144	142	139	140
Burundi	139	140	143	144	142	138
Ethiopia	140	142	145	144	144	142
Eritrea	140	142	145	141	143	144
Tonga	140	142	145	144	144	145
Benin	N/A	N/A	136	138	140	141
Dominican Republic	N/A	N/A	61	85	81	82
Lesotho	N/A	111	103	112	114	120
Nicaragua	N/A	116	116	116	112	123
Burkina Faso	N/A	N/A	140	135	141	139

Source: UNIDO statistical databases, UNIDO (forthcoming) The Competitive Industrial Performance Index 2014, Vienna

## Changes in industrial competitiveness

Long-term changes in industrial competitiveness for the top quintile can be seen in Figure 11. These figures suggest that a rapid and cumulative process of increasing industrial competitiveness was already being experienced by Poland, China and the ROK before the turn of the century.

The most impressive change in competitiveness among the top quintile countries for CIP ranking occurred in Poland, which has improved its rank by 29 positions since 1990, becoming the 22nd most competitive industrial country in the world by 2012. The second most important change was the improvement of China, which gained 27 positions over the same period and leads the BRICS countries (Brazil, Russia, India, China and South Africa) in global

competitiveness. Indeed, the competitiveness gap between China and the other BRICS countries widened by a significant margin during the time span; China overtook the Russian Federation and established a 27 position difference in ranking between the two. The ROK and Thailand registered notable increases of 13 and 12 places, respectively, and major long-term changes in the ranking were also observed in European Union manufacturing-led export countries such as the Czech Republic, Ireland and Hungary.

While the above countries gained positions, others dropped significantly in the industrial competitiveness ranking, most notably Austria, Denmark and Sweden. Among these, Denmark declined the most in competitiveness, sliding 7 positions mainly due to the loss of export market shares.

Overall, despite the significant gains and losses in country rankings over time, the three top positions in industrial competitiveness have not changed significantly since the early 1990s and have been shared intermittently by the three major western industrial powerhouses, Germany, Japan and the United States.

For countries outside the top quintile, significant long-term reductions in industrial competitiveness were identified in Macao SAR, Hong Kong SAR and Luxembourg due to severe processes of deindustrialization and the shift to services. Portugal also suffered contractions in industrial competitiveness as manufacturing exports fell. Russia slid five positions to 32nd place, reflecting reductions in its capacity to innovate. By contrast, Turkey gained 9 positions in competitive performance, due to an increasing share of manufacturing exports. By 2012, Turkey was 30th out of 142 countries in the ranking.

Economies whose industrial competitiveness has only improved since the turn of the century include Slovakia, which has gained 16 positions in the world ranking since 2000. Significantly, Slovakia's competitive improvement is due to an increase in per capita exports, a benefit from its entry into the European Union. Switzerland, one of the most competitive nations in 2012 (6th), improved 7 places between 2000 and 2012, recovering significantly from lost ground in the previous decade thanks to a major drive to promote industrial exports. The Netherlands also jumped from 14th to 8th in the list of most competitive economies due to a growing share of high-technology industries.

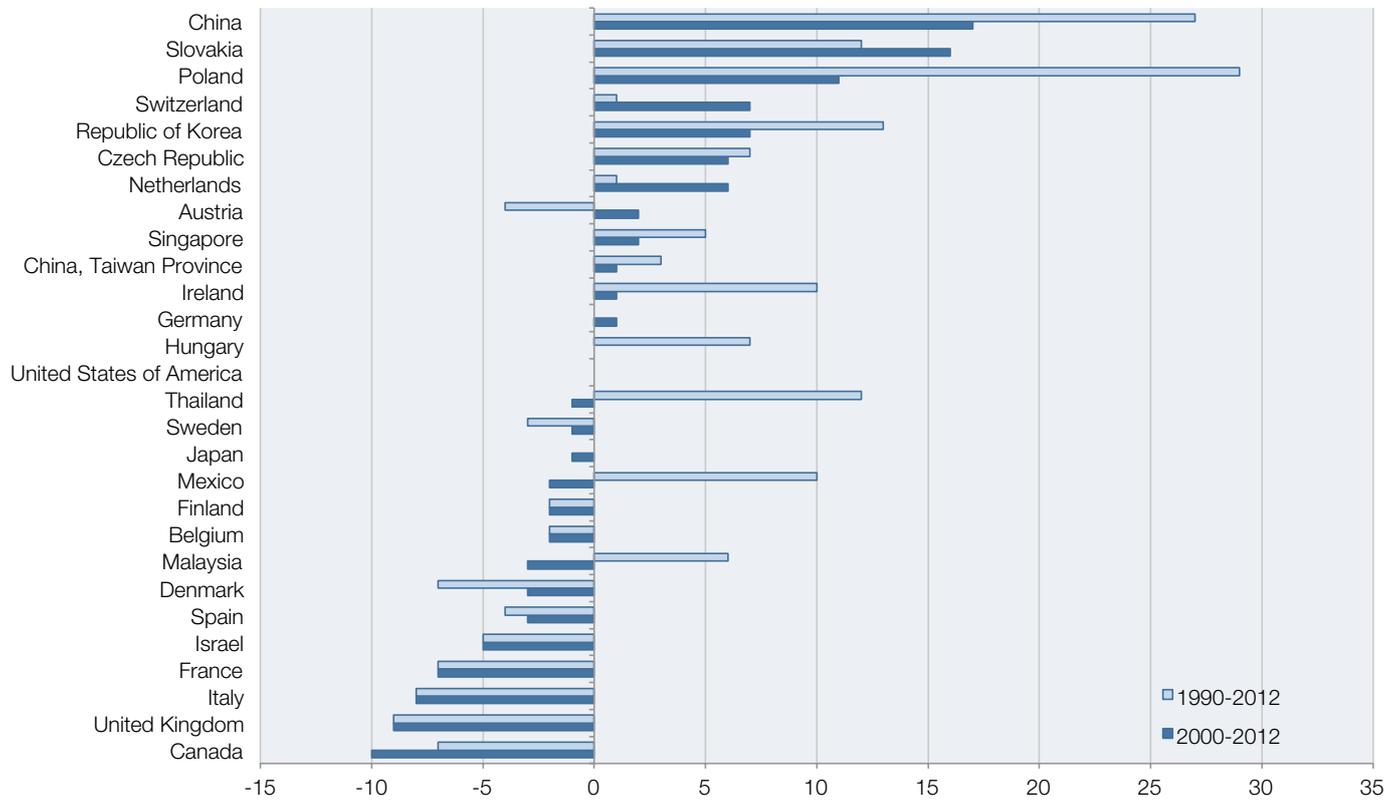
A decline in industrial competitiveness since 2000 was observed in Canada, the United Kingdom, Italy and France, losing between 10 and 7 positions each. Among the largest emerging industrial economies, Mexico was unsuccessful in enhancing value added in its exports and fell back slightly in the industrial competitiveness ranking to 21st position. Malaysia also dropped from 21st to 24th position, reflecting a lack of progress in entering knowledge-based industries, which is beginning to undermine its industrial competitiveness.

Other countries that improved greatly between 2000 and 2012 but were not among the top quintile performers are Nigeria, Iran and Vietnam, which rose by 42, 28 and 26

places, respectively (see Table 3). Nigeria's improvement was based on the structural change towards more advanced industries and higher manufacturing exports, while the changes in Iran and Vietnam were linked to a shift towards high-tech industries. Improvements in competitiveness were also observed in Kazakhstan, Albania, Peru and Lithuania, which gained 22, 18, 16 and 14 places, respectively.

Lithuania's improved competitiveness was achieved on the back of rising manufacturing exports and a growing high-tech manufacturing sector. Improvements in Kazakhstan, Albania and Peru involved the expansion of their industrial activity.

**Figure 11:** Changes in the Competitive Industrial Index in Top Quintile Countries, 1990-2012, 2000-2012



Source: UNIDO statistical databases, UNIDO (forthcoming) The Competitive Industrial Performance Index 2014, Vienna

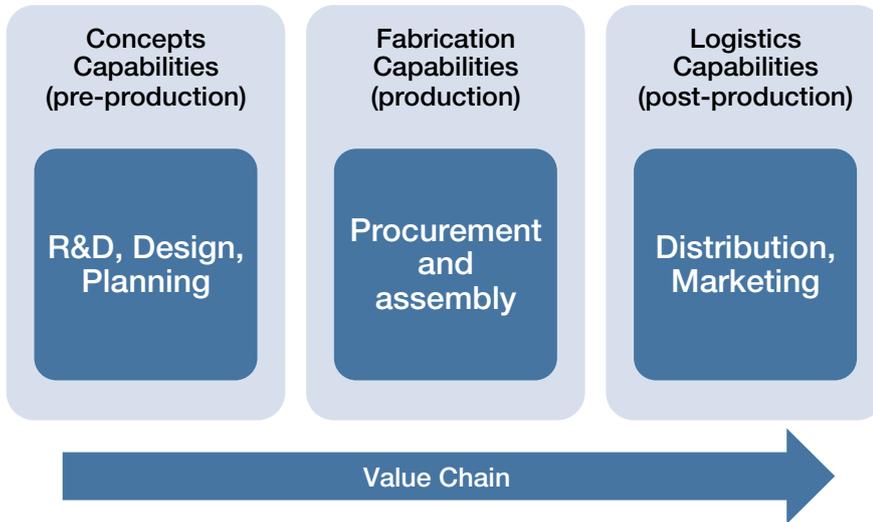


## Developing a Global Manufacturing Capabilities Indicator

Moving a step further than competitiveness, manufacturing capabilities underline the ongoing ability of the manufacturing sector to generate output (produce), create added value,

innovate, remain competitive and comply with standards. To assess these capabilities, a Global Manufacturing Capability Indicator (GMCI) that focuses on the value chain is proposed (Figure 12).

**Figure 12:** The Components of a Global Manufacturing Capabilities Indicator

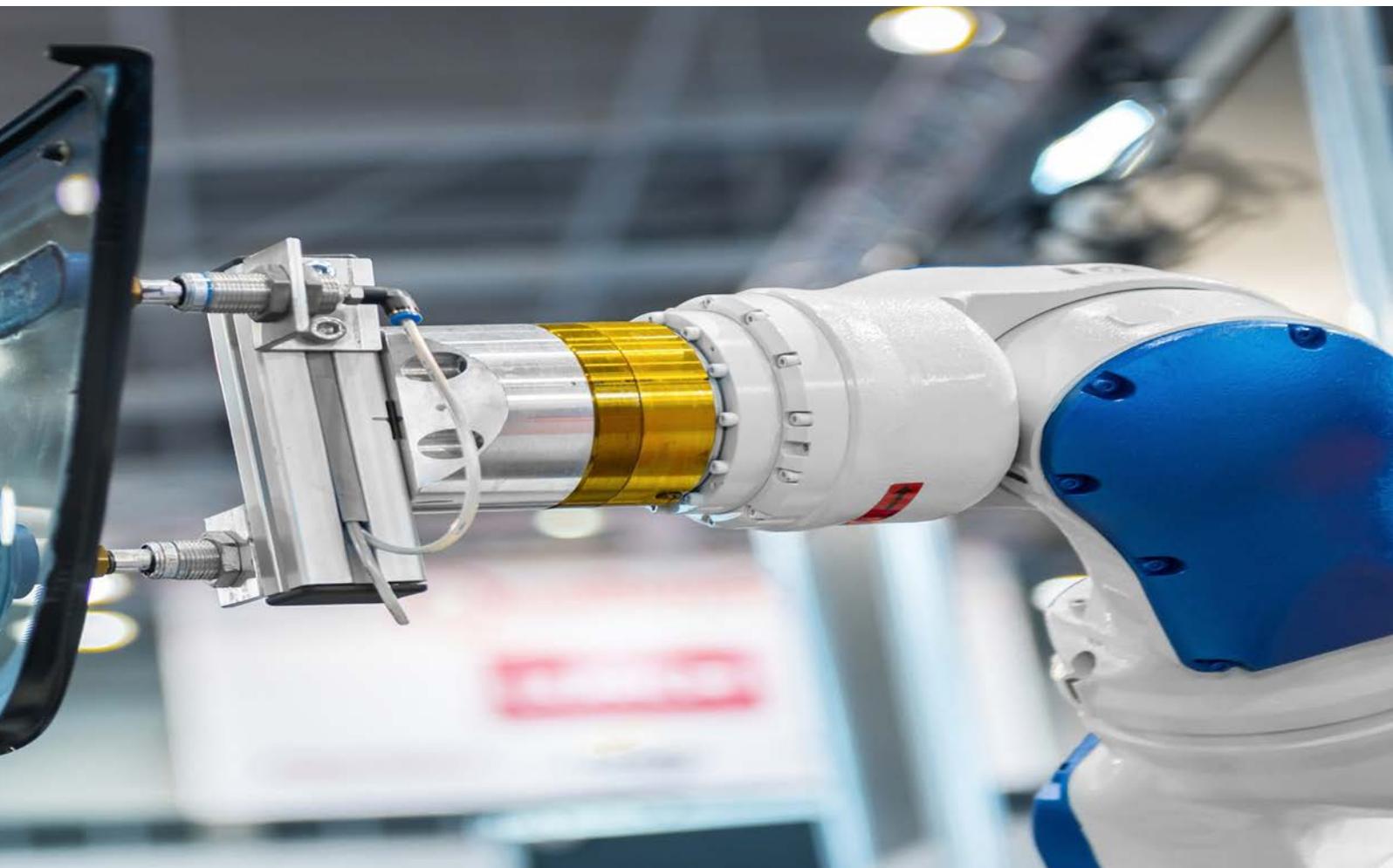


Source: Global Agenda Council on the Future of Manufacturing



The GMCI is composed of three main dimensions that can be assessed and ranked independently.

- **CONCEPTS CAPABILITIES:** The ability of a nation to undertake the tasks related to all the steps leading to the creation of the concepts of a product and its supporting technology. This involves the conventional tasks of R&D, design and production planning. A high ranking will be linked with strong innovative capabilities.
- **FABRICATION CAPABILITIES:** The ability of a nation to undertake the tasks related to the procurement and assembly of parts and finished goods. A high ranking will be linked with strong production capabilities, both quantitatively and qualitatively.
- **LOGISTICS CAPABILITIES:** The ability of a nation to undertake the tasks linked with providing parts and finished goods to the market. A high ranking will be linked with strong distribution capabilities in terms of efficiency and reliability.





**Chapter 3.  
Focus on Global Value Chains.  
The Case of the Apparel Industry<sup>5</sup>**

# The Apparel Industry

## Trade Regulation and Market Evolution

The apparel industry can be an important catalyst for national development, as an entry point for countries to pursue export-oriented industrialization: barriers to entry and fixed cost requirements are low, and the sector relies on employing low-skilled labour in large numbers. The expansion of this sector has played a critical role in the economic development of many low-income countries, which today account for three-quarters of the world's clothing exports. Formal employment in the sector totals over 25 million in low- to mid-income economies.<sup>6</sup>

A GVC view is critical to understanding the industry and its workings, and potential entrants can benefit from understanding their potential for joining and moving up that Value Chain. This note summarizes the impact of recent trade regulation and the resulting global shifts in production, as well as the value chain structure and governance, and firm/country strategies for upgrading and workforce development.

In recent years, the apparel industry has experienced two shocks that have intensified international competition in the sector. The first shock was regulatory: the Multi-Fibre Arrangement (MFA), which established quotas and preferential tariffs on apparel and textile items imported by the United States, Canada, and many European nations from the early 1970s, was phased out by the World Trade Organization (WTO) between 1995 and 2005. The second crisis was economic: the global recession that began in 2008 dampened demand in the United States and other advanced industrial economies between 2008 and 2009, and led to production slowdowns and plant closures in most apparel-exporting economies.

## From Concentration to Dispersion

Trade restrictions under the MFA contributed to the international dispersion of the apparel supply chain. The MFA system was designed to protect the domestic industries of the United States and the European Union (EU) by limiting imports from highly competitive suppliers. Its effect was a steady dispersion of production from countries affected by quotas to nearby, and eventually further away, countries without quota restrictions. By the late 1990s, the MFA quota system had contributed to the introduction of apparel assembly not just in Bangladesh, Vietnam, and other Asian countries but also in countries such as Kenya and Lesotho. Other trade preferences, such as the Caribbean Basin

Initiative and Central America Free Trade Agreement (CAFTA), provided additional duty incentives in the US for production in the Caribbean and Central America.

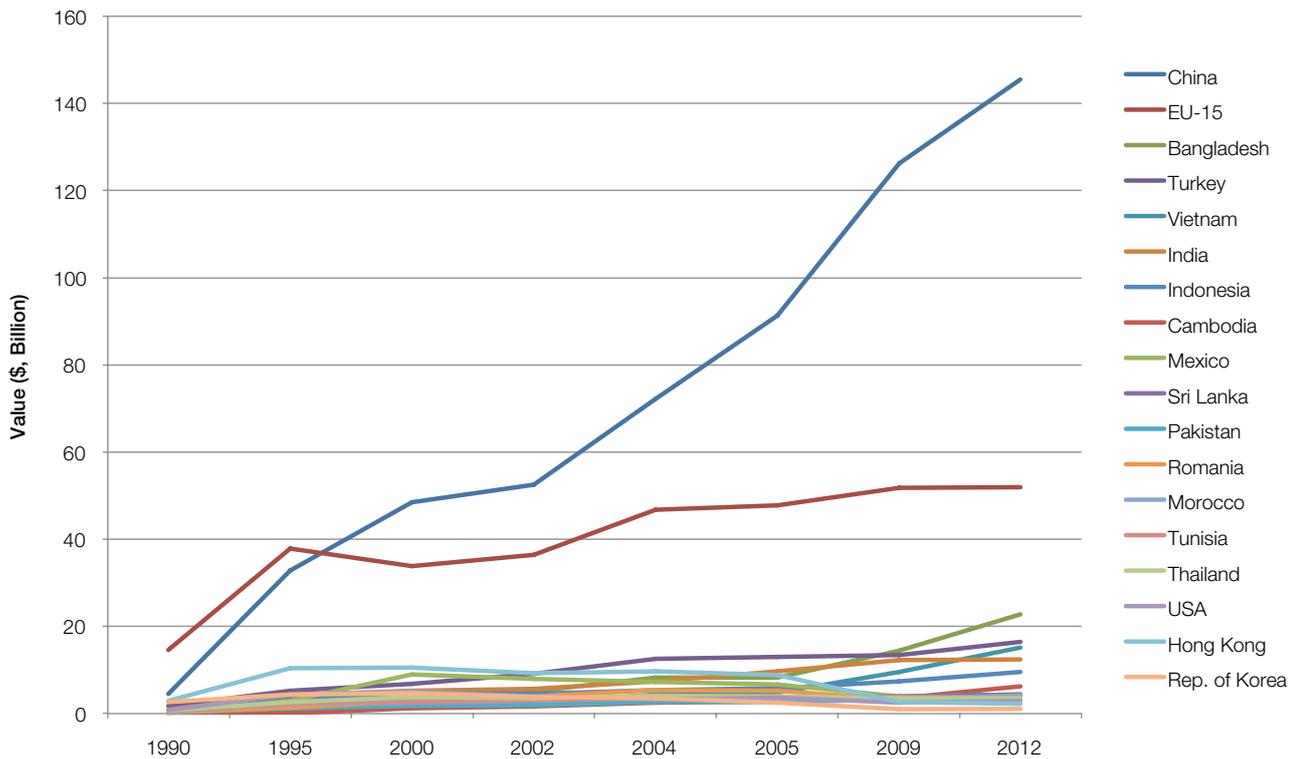
As a result, during the MFA, the main end markets (US and EU-15) tended to remain fixed, however the countries supplying these high-income economies varied with MFA quota rules. Apparel exporters maintained ties with key US and European markets based on the quotas they were allocated.

This system was disrupted by the demise of MFA in 2005 and the global economic recession. The elimination of quotas and safeguards coincided with the economic crisis (2008 to 2009) resulting in a consolidation among a limited number of large apparel exporters, while many smaller exporters were no longer competitive and were effectively cut out of the chain. The economic crisis reinforced many of the trends occurring after the phase-out of quotas. China, Bangladesh, Vietnam and Indonesia are increasing their market shares in North America and the European Union, primarily at the expense of near-sourcing options such as Mexico and the Central American and Caribbean suppliers to the United States.

## Shifting Global Geography in the Apparel Value Chain: The Dominance of China

In the post-MFA market, there has been a dramatic consolidation among the leading exporters and increasing dominance of China as the leading global producer. In 1995, the top 15 exporters accounted for 79% of all trade, and by 2012 this had increased to 87%. Among the top five, concentration increased from 60% in 1995, to 71% in 2012 (taking EU-15 as a whole). Figure 13 shows the top 10 apparel exporting countries' export values from 1990 to 2012. China has been the world's top apparel exporter since 1995.

Figure 13: Top 10 Apparel Exporters, 1990-2012 (US\$ billion)



Note: EU-15 value includes intra-EU trade.  
Source: UNCOMTRADE (HS 61 & 62), Top 10 based on 2012 statistics.

The main apparel exporting countries can be placed into the following categories. Those with increasing or stable market share:

- **CHINA.** The clear winner in the global apparel export race during the past 20 years. Between 1995 and 2012, China's share of global apparel exports increased from 21.5% to 41%, representing an increase in value from \$33 billion to \$145 billion.
- **GROWTH SUPPLIERS.** Overall, these countries have increased global market share since the early 1990s and through the economic crisis: Bangladesh, Vietnam, Indonesia, Pakistan, and Cambodia.
- **STEADY SUPPLIERS.** Turkey, India, and Sri Lanka. These countries increased export values until the effects of the economic crisis were felt in 2009, but managed to maintain relatively stable global market shares throughout the quota phase-out and recession.

Those with declining market share:

- **DECLINING SUPPLIERS.** EU-15, Tunisia and Morocco. Export values have increased, but global market share has declined since 2005.
- **DECLINE WITH QUOTA PHASE-OUT.** These countries experienced declines during the MFA/Agreement on Textiles and Clothing quota phase-out (1995 to 2005) that have continued during the crisis: United States, Canada, Mexico, Dominican Republic-CAFTA, Thailand, Romania and Poland.

- **PAST-PRIME SUPPLIERS.** These countries were once leading apparel exporters, but their global market shares have been decreasing since the early 1990s: Hong Kong, South Korea, Taiwan, and the Philippines.

The next phase of adjustment in the industry is coming from China's rapidly increasing wages, as increases of 20% per year are threatening the industry's competitiveness. This is playing out through two simultaneous trends: shifting of Cut, Make and Trim (CMT) production to lower cost Asian countries, and heightened competitive pressure on the Chinese industry to upgrade more rapidly to maintain competitiveness. This shift of production away from China could potentially benefit new entrants able to provide a competitive combination of low labour costs and effective international logistics, together with a policy environment favourable to export manufacturing.

### Apparel GVC Governance and Production Structure: A Buyer-Driven Commodity Chain

The apparel industry is the quintessential example of a buyer-driven commodity chain, marked by power asymmetries between the suppliers and global buyers of final apparel products. Global buyers have the greatest leverage in the value chain, and largely determine what is to be produced, where, by whom, and at what price. These lead firms outsource manufacturing to a global network of contract manufacturers in developing countries. Lead firms include retailers and brand owners and are typically headquartered in the leading markets: Europe, Japan, and the US. These firms tend to perform the most valuable activities in the apparel value chain, design, branding, and

marketing of products, and in most cases, they outsource the manufacturing process to a global network of suppliers. Like all global industries, the apparel value chain relies on international standards to coordinate the activities of suppliers. By the turn of the century, most lead firms had implemented private standards and codes of conduct based

on cost, quality, timeliness, and corporate responsibility in terms of labour and environmental standards. Factory performance is measured regularly, and delivery, quality, and price are tracked over time. It is common for firms to be certified by multiple buyer brands, such as Walmart, Ralph Lauren, Target, and The Gap.<sup>7</sup>

## Upgrading the Apparel Value Chain

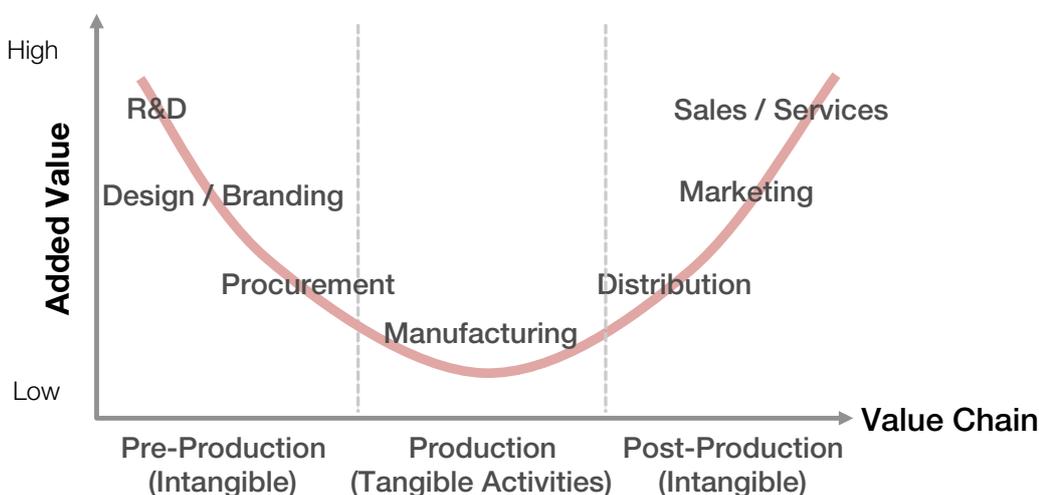
The structure of the apparel value chain can be portrayed as a “smile curve” in which the highest value-added activities are in the pre-production (R&D and design) and post-production (brand marketing, logistics, services) stages of the production process (Figure 14). The actual production of clothing, where most of the jobs are created, has become highly competitive, concentrated, and subject to constant cost pressures. This is true for many mature manufacturing sectors, where production activities have become relatively standardized, and competition among numerous suppliers is intense.

The main stages of economic upgrading in the apparel value chain are:

1. **ASSEMBLY/CUT, MAKE AND TRIM (CMT):** Apparel manufacturers cut and sew woven or knitted fabric or knit apparel directly from yarn.

2. **ORIGINAL EQUIPMENT MANUFACTURING (OEM)/FULL PACKAGE/FREE ON BOARD (FOB):** The apparel manufacturer is responsible for all production activities including the CMT activities as well as finishing. The firm must have upstream logistical capabilities including procuring (sourcing and financing) the necessary raw materials, piece goods and trim needed for production.
3. **ORIGINAL DESIGN MANUFACTURING (ODM)/FULL PACKAGE WITH DESIGN:** A business model that focuses on adding design capabilities to the production of garments.
4. **ORIGINAL BRAND MANUFACTURING (OBM):** A business model that focuses on the branding and sale of own-brand products.

**Figure 14:** Smile Curve of Value-Added Stages in the Apparel Value Chain



Source: Adapted from Fernandez-Stark, Frederick and Gereffi. “The Apparel Global Value Chain: Economic Upgrading and Workforce Development”

Developing countries enter into the lowest segments of the value chain due to various advantages, including favourable trade agreements, low-cost labour and proximity to end markets.

To upgrade into higher segments of the value chain, other factors become more relevant. These include: the presence of a domestic or regional textile industry; large textile and apparel manufacturers in the country; and, in the case of upgrading into design and branding, a strong commitment to industry growth by both the public and private sectors, in order to develop the necessary talent and establish a national brand.

### Workforce development

The majority of workers are concentrated in the production-related segments of the value chain (CMT or OEM), and historically they have been mainly young, female workers with limited education. Only 3% to 4% of total factory workers are not involved in assembly line positions, such as production planners, engineers, mechanical technicians and operations support.<sup>8</sup> However, while the required formal skill level is relatively low in the CMT segment of the value chain, this rises rapidly as countries upgrade into higher value stages, as workers with more advanced skills are needed to support new functions such as logistics, finance, design and marketing.

In those segments of the apparel value chain focused on manufacturing, the private sector has played the leading role in workforce development, and most firms offer internal training for entry-level employees. Successful workforce development for ODM and OBM stages in the apparel value

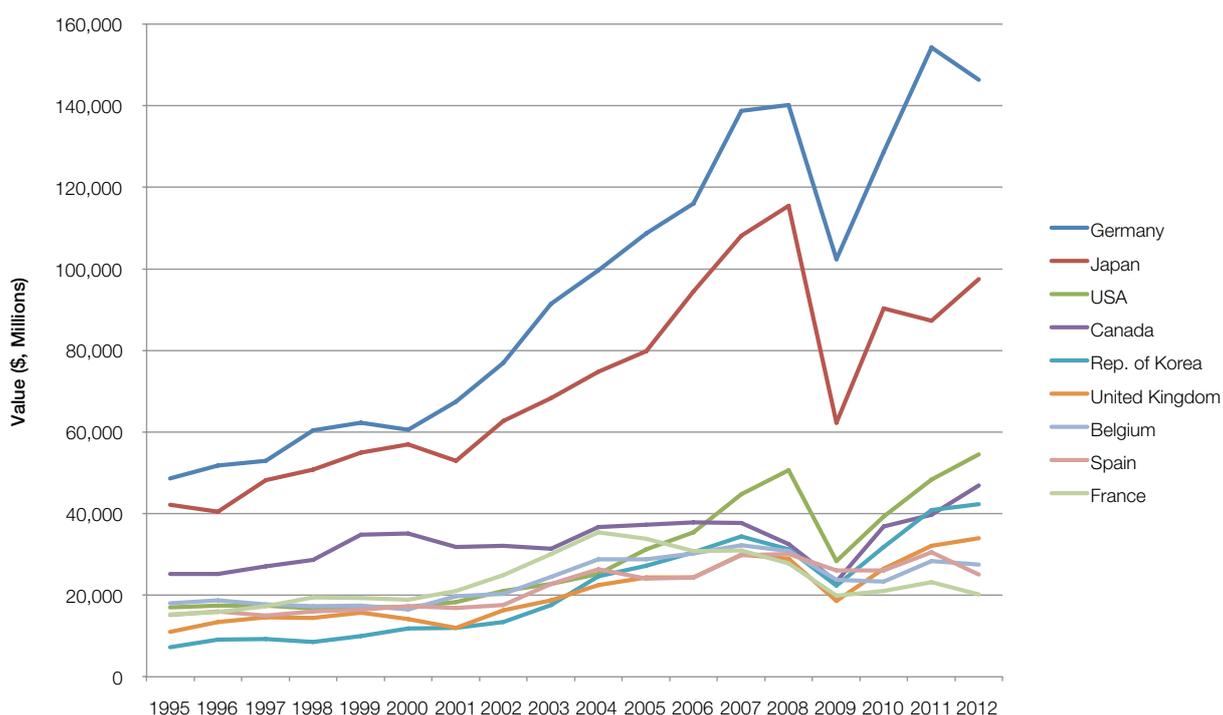
chain has leveraged knowledge in the developed world, through engaging foreign universities in successful apparel countries to help design curriculums for local programmes, and hiring foreign consultants to help develop talent in-house. Fostering collaboration with successful training institutions in the developed world can speed up firm-level learning for upgrading, rather than relying solely on learning through experience.

### Upgrading paths

The typical path for upgrading from CMT operations has been to move to more integrated operations in OEM, ODM, and ultimately OBM models described above. However, this involves a commitment from government, industry and support institutions, and in most cases has also meant the establishment of a domestic textile industry. In two countries where the industry has upgraded to higher stages of the apparel value chain (Turkey and Sri Lanka), there is significant stakeholder coordination, along with some public-private partnerships to support workforce development. These alliances include private firms, industry associations, educational institutions and the private sector to improve the quality of skills.

The last five years have been filled with many new challenges in the global apparel value chain. However, the industry is constantly adapting to changes in competitiveness among the major supplier countries, with upward wage cost pressure in China now signalling a potential shift of production to lower cost countries and the further upgrading of Chinese industry into higher value added market segments.

Figure 15: Automotive Exports, Selected Countries, 1995-2012



Source: UNCOMTRADE, SITC Rev. 3 Code 781, Exports to the World.

## Box: Capability Requirements in Global Auto Industry

Depending on their role and function in the automotive value chain, the main actors value different capabilities.

**ASSEMBLERS.** Increasing scale required assemblers to spread the costs of vehicle design and branding. Innovation and design capabilities remain critical as the first movers in new markets can gain important rents while other companies catch up. Some companies, such as Ford, appear to believe that core competences lie more in branding and finance, and they are outsourcing parts of manufacturing. Others, such as Toyota, maintain an emphasis on manufacturing excellence and competence.

**GLOBAL MEGA-SUPPLIERS.** These firms supply major systems to the assemblers. They are sometimes referred to as “Tier 0.5” suppliers, because they are closer to the assemblers than the first-tier suppliers (see below). These companies need to have global coverage, in order to follow their customers to various locations around the world. They need design and innovation capabilities in order to provide “black-box” solutions for the requirements of their customers. Black-box solutions are solutions created by the suppliers using their own technology to meet the performance and interface requirements set by assemblers.

**FIRST-TIER SUPPLIERS.** These are firms, which supply directly to the assemblers. Some of these suppliers have evolved into global mega-suppliers. First-tier suppliers require design and innovation capabilities, but their global reach may be more limited.

**SECOND-TIER SUPPLIERS.** These firms will often work to designs provided by assemblers or global mega-suppliers. They require process-engineering skills in order to meet cost and flexibility requirements. In addition, the ability to meet quality requirements and obtain quality certifications (ISO9000 and increasingly QS9000) is essential for remaining in the market. These firms may supply just one market, but there is some evidence of increasing internationalization.

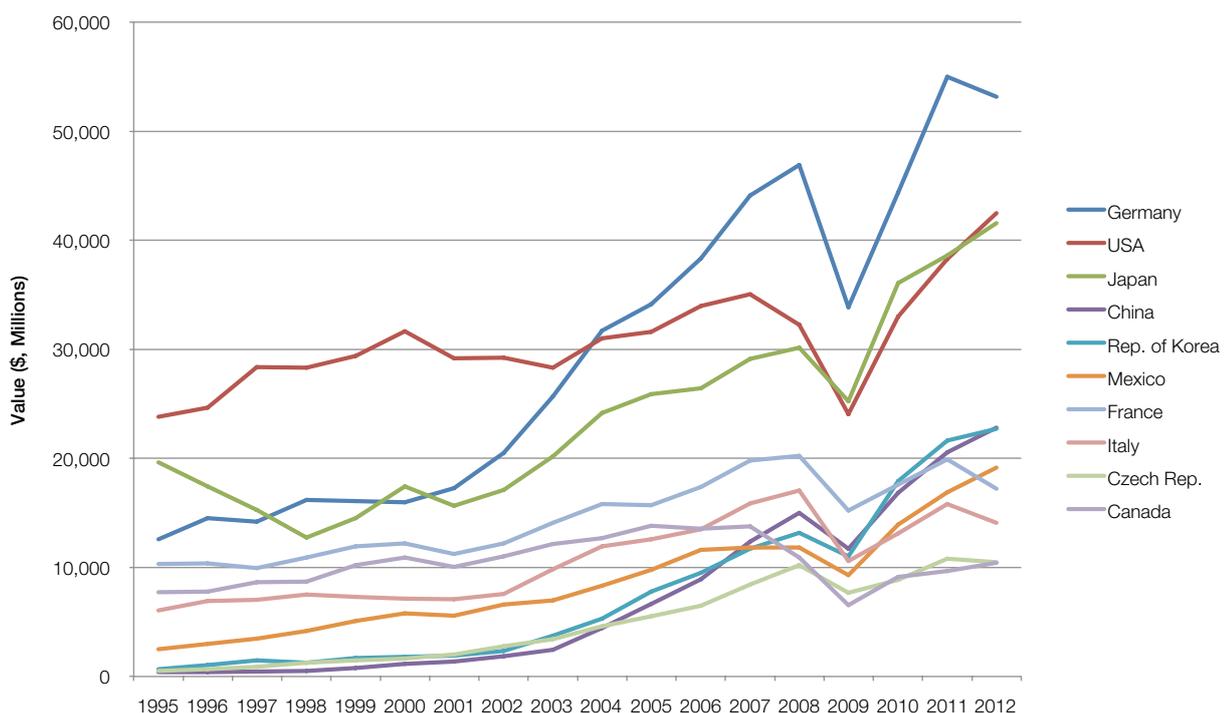
**THIRD-TIER SUPPLIERS.** These firms supply basic products. In most cases, only rudimentary engineering skills are required. Skill levels and investments in training are thus limited. At this point in the chain, firms compete predominantly on price.

**AFTERMARKET.** A further important segment of the automotive value chain is the market for replacement parts. This is the sector that many firms in developing countries first moved into, even before local assembly sectors were developed. Nowadays, there is an international trade in aftermarket products. Firms in this section compete predominantly on price. Access to cheaper raw materials and process engineering skills is important. Innovation is not required because designs are copied from the existing components, but reverse engineering capability and competence to translate designs into detailed drawings are important.

Figure 15 and Figure 16 depict the most important exporters of automobiles and automotive parts in the world. Although countries such as China, Mexico and the Czech Republic are not among the largest exporters of automobiles, they are significant providers of parts for the global auto industry.

Source: The Global Automotive Industry Value Chain. 2003. Vienna: UNIDO.

**Figure 16: Automotive Parts Exports, Selected Countries, 1995-2012**



Source: UNCOMTRADE, SITC Rev. 3 Code 781, Exports to the World.

**Conclusion.**

**Transforming Manufacturing  
Capabilities through a Global  
Multistakeholder Initiative**



# Emerging Trends

## A Reactive Sector

The global manufacturing landscape is being transformed by major drivers related to market forces, general capabilities, resources and policy (Figure 17). However, the manufacturing sector tends to be reactive: it reacts to events taking place, particularly for large established firms. This underlines the need to move towards a prospective and strategic approach, which considers drivers of change in manufacturing and how these drivers will pan out over the next decade.

Figure 17: Drivers of Change in Manufacturing

<b>Market Forces</b> <ul style="list-style-type: none"> <li>– Growth in emerging markets</li> <li>– Demographic shifts</li> </ul>	<b>Capabilities</b> <ul style="list-style-type: none"> <li>– Digitalization &amp; automation</li> <li>– Production costs</li> <li>– Improved logistics</li> </ul>
<b>Resources</b> <ul style="list-style-type: none"> <li>– Energy costs</li> <li>– Natural resources</li> </ul>	<b>Policy</b> <ul style="list-style-type: none"> <li>– Environmental regulations</li> <li>– Trade agreements</li> <li>– Industrial policy</li> </ul>

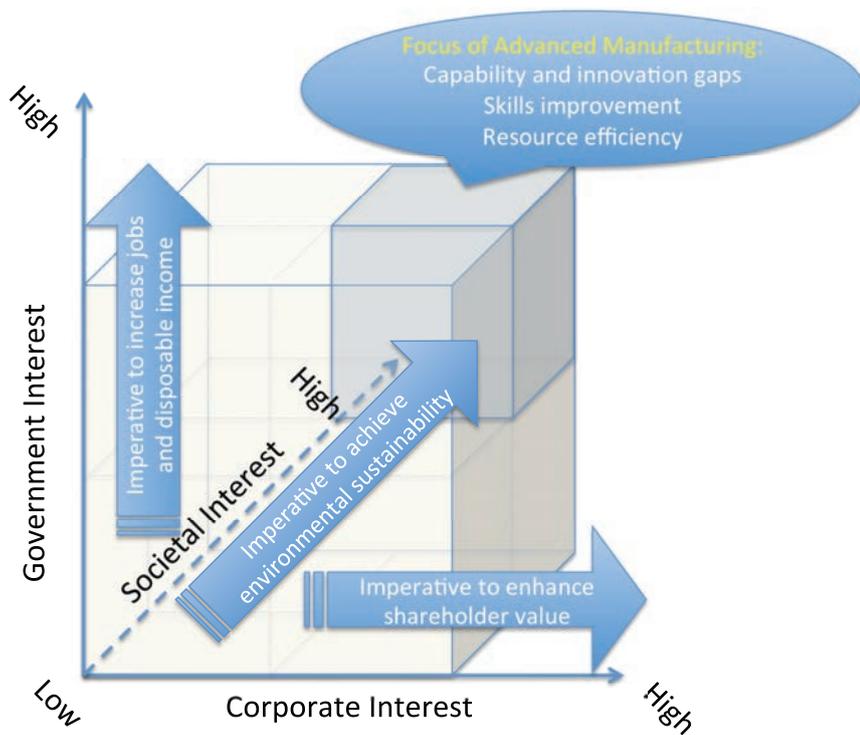
Source: Global Agenda Council on the Future of Manufacturing

## Key Drivers

Although the drivers of change involve multiple issues related to market, technological, economic and political factors, the following are among the most salient:

- Demographic shifts related to the **AGEING OF THE POPULATION** which will change consumption patterns as well as the labour market.
- **SKILL GAPS** between developed and developing economies, and between skills provided by educational systems and those sought by the market.
- **AUTOMATION AND ROBOTIZATION** will continue their ongoing diffusion within the manufacturing system. From its niche role of undertaking repetitive, intensive and often dangerous tasks, automation is reaching a level where robots can jointly be used with workers along an assembly line. This expanded division of labour opens up new venues for productivity improvements, as the flexibility and adaptability of human labour can be combined with the precision and repetitiveness of robots.
- **NEXT GENERATION TECHNOLOGY** will bring in a different set of manufacturers, as new technologies are usually brought forward by new firms. New forms of manufacturing are expected to emerge, particularly in the nanotechnology and 3D printing sectors.
- In emerging markets, **NEW SUPPLIERS** are emerging and a **CONSOLIDATION** is being observed in several segments of the manufacturing sector. For instance, Chinese OEMs and suppliers are becoming increasingly active players in the global market.
- OEMs will be adapting to **LOCAL MARKET CONDITIONS AND REGULATIONS**, such as input costs and environmental regulations. This adaptation is aimed at minimizing input costs and maximizing market potential.

**Figure 18:** Factors of Convergence and Divergence between Manufacturing Stakeholders



Source: Global Agenda Council on the Future of Manufacturing

## Factors of Convergence

Manufacturing remains a critical activity for the economic and material well-being of nations, but the drivers of the manufacturing ecosystem have been transformed by innovations and the setting of global value chains. Skills and talent improvement, innovation development, industrial policy and resource efficiency are factors which are in the common interest of government, the private sector and society. These four areas will be critical to further addressing convergence of interests and thus achieving greater coherence and comprehensive advanced manufacturing approaches and capabilities.

### Skills and talent development

A skilled and adequately educated workforce is always in demand. As future manufacturing demands more advanced skills, the competition for highly skilled and well-educated talents will intensify. This underlines a paradox between on-going global demographic growth and the capabilities of education systems to provide relevant skills. The key to filling the anticipated skills gap is through collaboration in public and private partnerships, where the public education system is able to provide knowledge and skills that the private sector can expand on through their own programmes. It is important, however, to underline that it is not the role of the public sector to provide specialized technical and vocational skills. The main purpose is to reach an acceptable level of alignment between education (public) and training (private).

### Capability development and innovation ecosystems

With today's global connectivity, the amount of time for which companies are able to maintain competitive advantages has been greatly compressed. Therefore, countries need to support a sustainable ecosystem for innovations if they are to continue to lead competition. The stakes can be high, as early innovators are often able to capture (or create) a dominant market share, secure appropriateness and extract substantial value before competition can effectively position itself with comparable products. The interests of the private sector, society and government can be aligned to create such systems. It must be noted that there is increasing concern that prevalent trends in Intellectual Property (IP) regimes may be going too far to protect patents and could be throttling the diffusion and application of knowledge, as well as distorting competition. While these concerns are more acutely expressed in some industries, such as the pharmaceutical and the high-tech industries, questions are being raised about their generalization to other industries. Therefore, any projection of the factors that will advance manufacturing globally will also have to keep these issues in mind.

### Industrial policies, institutions and governance

It is critical for states to recognize and understand the relationship between economic prosperity and the advancement of manufacturing capabilities. When a nation progresses towards more advanced manufacturing capabilities, it enables the production of more diverse and sophisticated products by using more advanced equipment and processing technologies. Thus, it opens the door for growth of jobs that demand higher skill levels at higher

wages. This will in turn enable the nation to establish its own capabilities to innovate and set new economic development opportunities. This calls for the implementation of industrial policy where governments try to influence the competitiveness of their manufacturing sectors. These policies may include tax credits for innovation and R&D, access to credit and grants, public-and-private partnerships for workforce and infrastructure development, and assistance or incentives for exports. Regulations also play an important role, as they impact many elements of input costs, including working conditions, critical infrastructure availability and ownership of land. The creation and use of government policies has been intensified in recent years among both advanced and emerging economies. Even in the US, where the term “industrial policy” is politically contentious, federal and state policies are being developed to promote manufacturing.

As part of such policies, an increasing number of trade agreements (global, regional, multilateral and bilateral) have promoted the development of manufacturing worldwide. These agreements allow developed nations to access production hubs and overseas markets in developing nations. At the same time, developing nations also benefit from the access to advanced production technologies and expanded markets. However, these trade agreements also intensify competition from global corporations over existing national manufacturers.

Access to sustainable energy supply, particularly renewable sources of energy, will shape the future of manufacturing. Rising energy costs will have a significant impact on strategic decisions concerning the location of manufacturing sites as well as the development of supply chains due to expected price volatility in transportation and logistics costs. The development of advanced manufacturing systems takes place in a context of global energy transition where alternative sources will play a greater role.

## Factors of Divergence

The unintended consequences of not adopting an advanced manufacturing strategy can lead to a divergence between corporate, government and social interests. Factors of divergence should be addressed in more depth through public-private dialogue and other mechanisms.

### Market demand and productivity imperatives

The growth of global manufacturing is strongly fuelled by market demand and global competition for investments. China’s impressive manufacturing transformation in the last 15 years has been largely stimulated by FDI to support the consumption needs of North America and Europe. However, short-term labour costs and productivity improvement decisions have also led to a pattern of de-industrialization in OECD countries. The narrowing of labour wages between developed and developing economies may also impact this pattern. Wage rate growth in developed economies is expected to remain low, particularly in the near future, due to economic and demographic conditions, while the wage rate growth in developing economics is expected to continue at a much faster pace. Given this enduring trend of a narrowing of the wage gap between developed and developing economies, corporations will make strategic decisions for locating future manufacturing sites based less on wage differences, and more on the proximity to consumer market centres and other supply chain considerations.

### Business innovation and disruptive technology development

As global competition intensifies, corporate decision-makers are constantly searching for new business innovations to gain competitive advantage in their product offering, marketing, sales and services. An additional aspect of uncertainty is the development of potentially disruptive technologies that may fundamentally transform manufacturing competitiveness. It is critical for manufacturing firms to anticipate such transformations in business innovation and disruptive technology development, in order to take full advantage of the opportunities offered by these transformations, as well as understand the associated implications.

### Access to material resources and investment in infrastructure

As global manufacturing consumes more and more material resources, particularly materials with limited supply, the volatility of resource prices and availability will force companies to rethink alternative material supplies and improve the efficiency of material use. It is essential for manufacturing firms to establish a robust strategy for reliable access to material resources. Future growth in manufacturing will also depend on efficient infrastructure support, including IT, transportation, energy and utility supply, import/export procedures, etc. In many developed



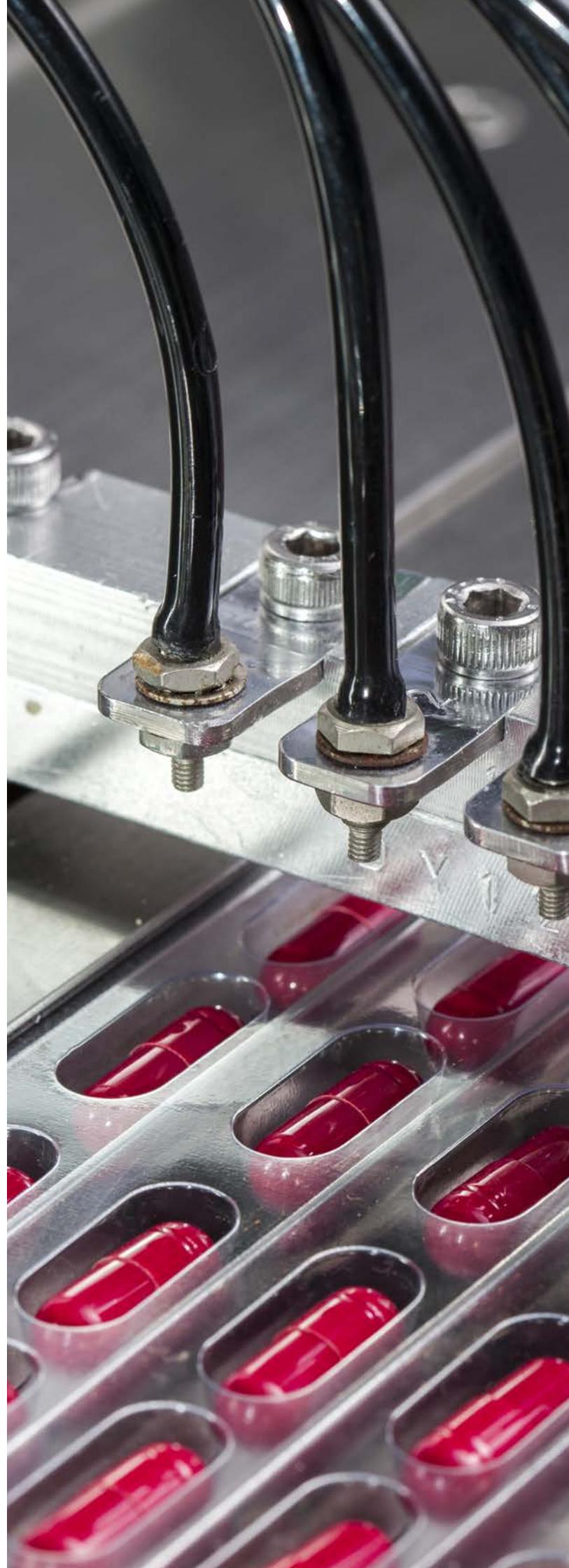
nations, infrastructure is nearing or has reached the end of its life cycle and needs to be upgraded, while early developing nations lack investment to build adequate infrastructure to set up manufacturing operations. A few emerging economies, particularly China, have invested heavily in modernizing their infrastructure to support the growth of manufacturing. The global infrastructure landscape thus remains highly diversified in terms of its capability to support manufacturing.

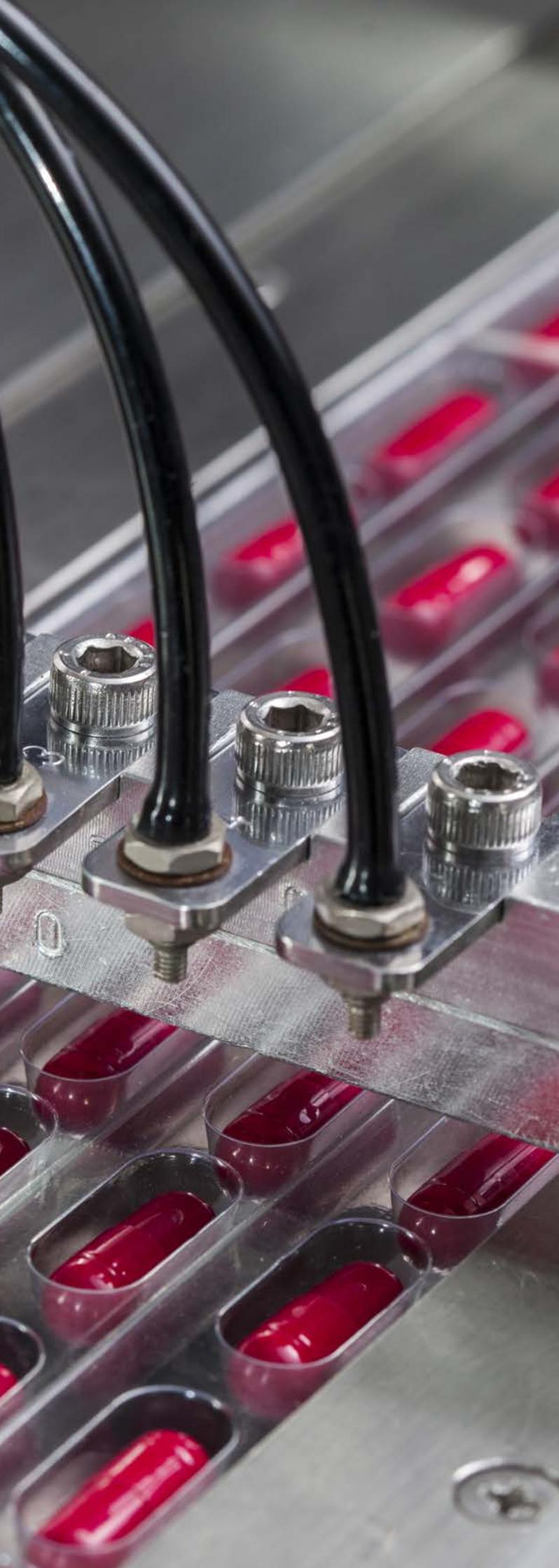
### Currency exchange

Increasing currency volatility, particularly in relation to the US dollar, affects competitiveness and supply chain strategies. Operating within the jurisdiction of a strong currency, imported raw materials become less expensive, while exported goods will be more expensive on global markets and therefore less competitive. Many companies start to strategically locate production closer to the intended markets. For instance, a strong Japanese Yen drives many Japanese manufacturing companies to relocate their manufacturing activities outside Japan. Similarly, strong Australian dollars significantly affect Australian ore and coal resources. On the other hand, while a low currency can be seen as a boost in the competitiveness of exports on global markets, it is also linked with higher input costs and inflationary pressures on wages and the cost of living.

### The short and long terms

The trade-off between long-term capabilities and short-term returns remains a key challenge in aligning stakeholder interests. Countries trying to align both public and private sector incentives – whether through industrial policy or not – tend to have better long-term capabilities. However, alignment between the public and private sectors takes time because of the complexity in identifying and addressing capability gaps. Beyond quarterly corporate result imperatives and elections, consistent, longer-term alignment on the direction to take is essential. A typical example is outsourcing that can trigger short-term profits for the firms but can ultimately deprive a country of some of its core capabilities. Simply put, the path towards the development of capabilities should be a marathon (consistent in the long term), not a sprint (volatility of goals and strategies).





# The Need for a Global Manufacturing Capabilities Initiative

## A platform for global manufacturing exchange

Relationships between the public sector and the manufacturing sector (mostly private) are complex and subject to contention, as public policy and corporate strategies are often not aligned. Furthermore, corporations may have a common goal without being aware of it, particularly if they are involved in different parts of the world or in different value chains. It has been underlined that a lack of dialogue between government and industry can lead to a regulatory backlash, imposing constraints on its efficiency and competitiveness. Governments are challenged in providing an environment that fosters innovation and develops capabilities. Manufacturers are challenged by technological innovations that require a new set of capabilities to remain competitive, as well as a highly complex multinational regulatory framework.

A credible intermediary is needed to begin a manufacturing dialogue with government so that policies on competitiveness and capabilities are aligned. As such, the World Economic Forum Global Agenda Council on the Future of Manufacturing is calling for the setting up of a Global Manufacturing Capabilities Forum (GMCF). This forum would aim to identify and mitigate manufacturing issues, ranging from outsourcing strategies to building a common set of capabilities across GVCs. This would help policy-makers understand the complex processes and structures of current advanced manufacturing systems.

Such a Forum would be under the umbrella of UNIDO, and would include representatives of all relevant international organizations, policy-makers and the private sector. The Forum would be supported by expert working groups, who would advise both policy-makers and companies on how to enhance their manufacturing capabilities.

The objective of each meeting would be to get further countries to endorse global manufacturing standards and metrics, and to work towards common strategies for specific GVCs.

## Joint World Economic Forum – UNIDO Declaration

In November 2013, the World Economic Forum, under the auspices of the Global Agenda Council on Advanced Manufacturing,<sup>9</sup> and UNIDO issued a joint declaration in Abu Dhabi for the establishment of a Global Manufacturing Capabilities Forum.

## Box: The Abu Dhabi Joint Declaration

WHEREAS the United Nations Industrial Development Organization (UNIDO), as a specialized agency of the United Nations, has the primary responsibility in promoting industrial development in the developing countries and in countries with economies in transition;

WHEREAS the Global Agenda Council Network of the World Economic Forum is a unique, global community of over 1,500 premier thought leaders who are the foremost experts in their fields of academia, business, government, international organizations and society. 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;

WHEREAS the Global Manufacturing Capabilities Forum (GMCF) is a joint initiative between UNIDO and the Advanced Manufacturing Global Agenda Council of the World Economic Forum that aims to identify, analyze, discuss, and propose solutions as well as serve as a platform to address global manufacturing issues and business challenges, including questions related to global value chains and/or regional developments, and to examine policies for building manufacturing capabilities at the global level;

WHEREAS the Director of UNIDO's Development Policy, Statistics and Strategic Research Branch and the Senior Director and Head of the World Economic Forum's Network of Global Agenda Councils (hereinafter, the "Signatories") wish to record their intentions and objectives for cooperation between UNIDO and the Global Agenda Council on Advanced Manufacturing of the World Economic Forum regarding the GMCF;

NOW THEREFORE the Signatories declare:

1. Their intention to facilitate close cooperation between UNIDO and the Advanced Manufacturing Global Agenda Council of the World Economic Forum regarding the GMCF, with the objective of supporting manufacturing capabilities and job creation;
2. Their intention, subject to the availability of financial resources and the programme of work of UNIDO, to promote cooperation between UNIDO and the Advanced Manufacturing Global Agenda Council of the World Economic Forum, inter alia, in order to:
  - Promote their collaboration regarding the GMCF and make efforts to involve other institutions such as the World Bank (IFC), UNCTAD and the OECD as initial partners to join the GMCF,
  - Take the leadership in the organization of meetings of the GMCF, which should be held twice a year in Vienna,
  - Elaborate a joint UNIDO-World Economic Forum Global Manufacturing Capabilities Monitoring Report in order to assess the global state of manufacturing capabilities,
  - Launch the GMCF initiative during the UNIDO General Conference in December 2013 in Lima, Peru.
3. Their desire to identify suitable projects relating to the above areas of cooperation on an annual basis in accordance with the respective policies, procedures, rules and regulations of UNIDO and the Advanced Manufacturing Global Agenda Council of the World Economic Forum. If financial resources are not available, the Parties shall consult on the most appropriate ways to obtain these resources;
4. Their intention to review the progress of their cooperation regarding GMCF each year following the signing of this Joint Declaration and to decide then on any further measures that may be desirable to enhance that cooperation.



## Endnotes

<sup>1</sup> Hausmann, R., Hidalgo, C. A., Bustos, S., Coscia, M., Chung, S., Jimenez, J., Simoes A., and Yildirim, M. A. *The Atlas of Economic Complexity: Mapping Paths to Prosperity*. Cambridge, MA: Puritan Press, 2011.

<sup>2</sup> Ibid.

<sup>3</sup> These estimations for MRS employment in developed and developing countries do not include other “induced” employment arising, on the demand side, from net increases in income received by workers and their multiplier effects and, on the supply side, from additional production linkages and knowledge spillovers that may arise in an economy (UNIDO, 2013) Industrial Development Report 2013, Sustaining employment Growth: The Role of Manufacturing and Structural Change, Vienna (update for 2010), “www.unido.org.”. Were these to be included, the impact of manufacturing on employment would be much larger.

<sup>4</sup> For a detailed account of methodology and trends in UNIDO’s CIP index see *The Industrial Competitiveness of Nations: Looking back, forging ahead*. 2013, Vienna: UNIDO.

<sup>5</sup> Focus on Global Value Chains: The Case of the Apparel Industry, 2013. Gereffi, G. and Frederick, S. Center on Globalization, Governance & Competitiveness (CGGC), Duke University, Durham, NC, US. This brief is a companion piece to the World Economic Forum note on Global Value Chains, to provide a concrete example from the apparel industry. It draws on several published articles: Gereffi, G. “Economic and Social Upgrading and Workforce Development in the Apparel Global Value Chain”, in *International Labor Brief*, Korea Labor Institute, 2013; Frederick, S. and Gereffi, G. “Upgrading and Restructuring in the Global Apparel Value Chain: Why China and Asia Are Outperforming Mexico and Central America”, in *International Journal of Technological Learning, Innovation and*

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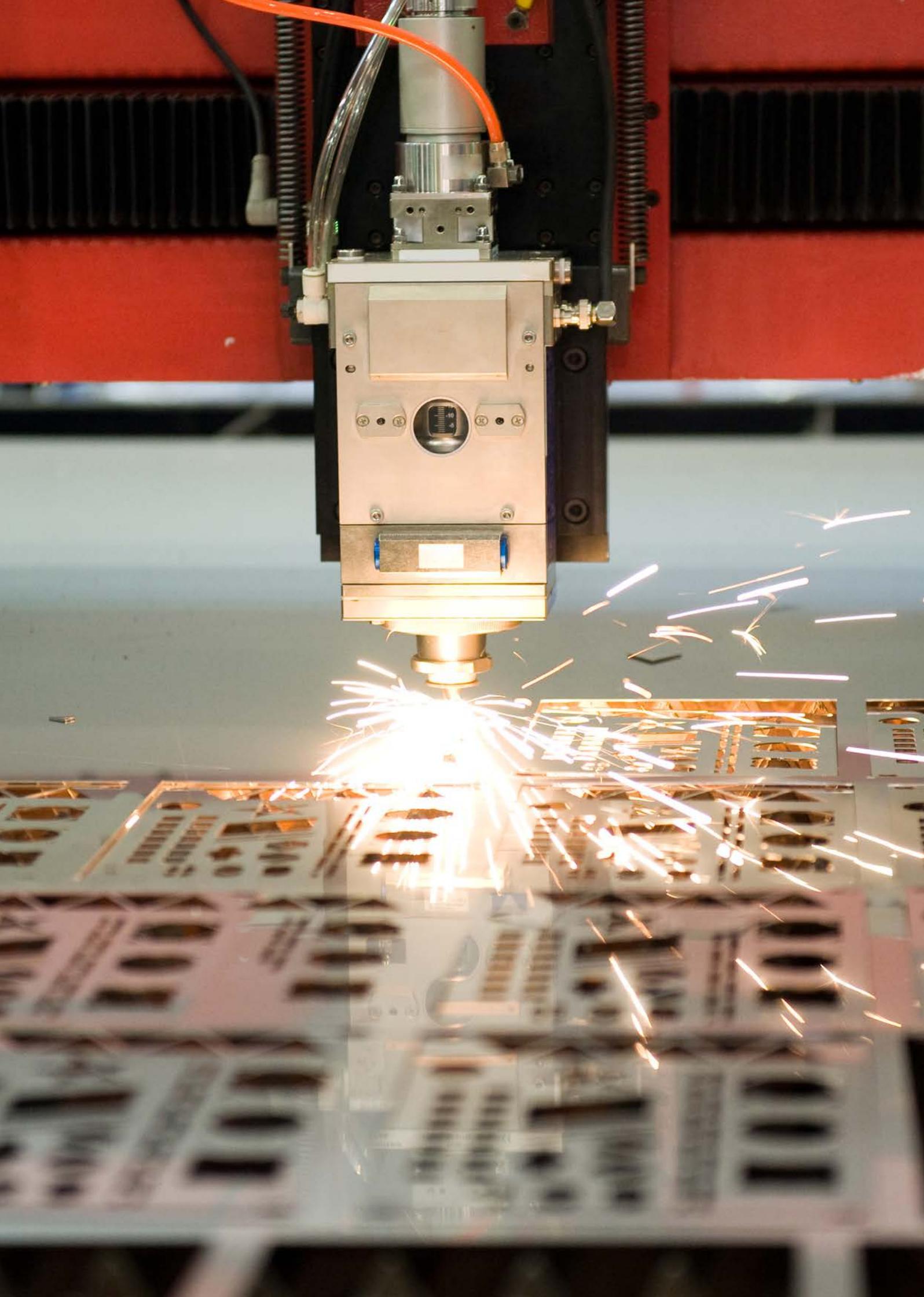
<sup>6</sup> *Promoting Fair Globalization in Textiles and Clothing in a Post-MFA Environment*. 2005. Geneva: International Labour Organization, ILO (2005), [http://www.ilo.org/wcmsp5/groups/public/---ed\\_dialogue/---sector/documents/meetingdocument/kd00003.pdf](http://www.ilo.org/wcmsp5/groups/public/---ed_dialogue/---sector/documents/meetingdocument/kd00003.pdf).

<sup>7</sup> Fernandez-Stark, K., Frederick, S. and Gereffi, G. “The Apparel Global Value Chain: Economic Upgrading and Workforce Development”. Durham, NC: Center on Globalization, Governance & Competitiveness, Duke University, February 2011. [http://www.cggc.duke.edu/pdfs/2011-11-11\\_CGGC\\_Ex.Summary\\_Apparel-Global-Value-Chain.pdf](http://www.cggc.duke.edu/pdfs/2011-11-11_CGGC_Ex.Summary_Apparel-Global-Value-Chain.pdf).

<sup>8</sup> *Cambodia Garment Industry Workforce Assessment: Identifying Skills Needs and Sources of Supply*. 2006. Arlington, VA: Nathan Associates Inc. Report prepared for the United States Agency for International Development (USAID).

<sup>9</sup> In 2014, the Global Agenda Council on Advanced Manufacturing was replaced by the Global Agenda Council on the Future of Manufacturing.









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