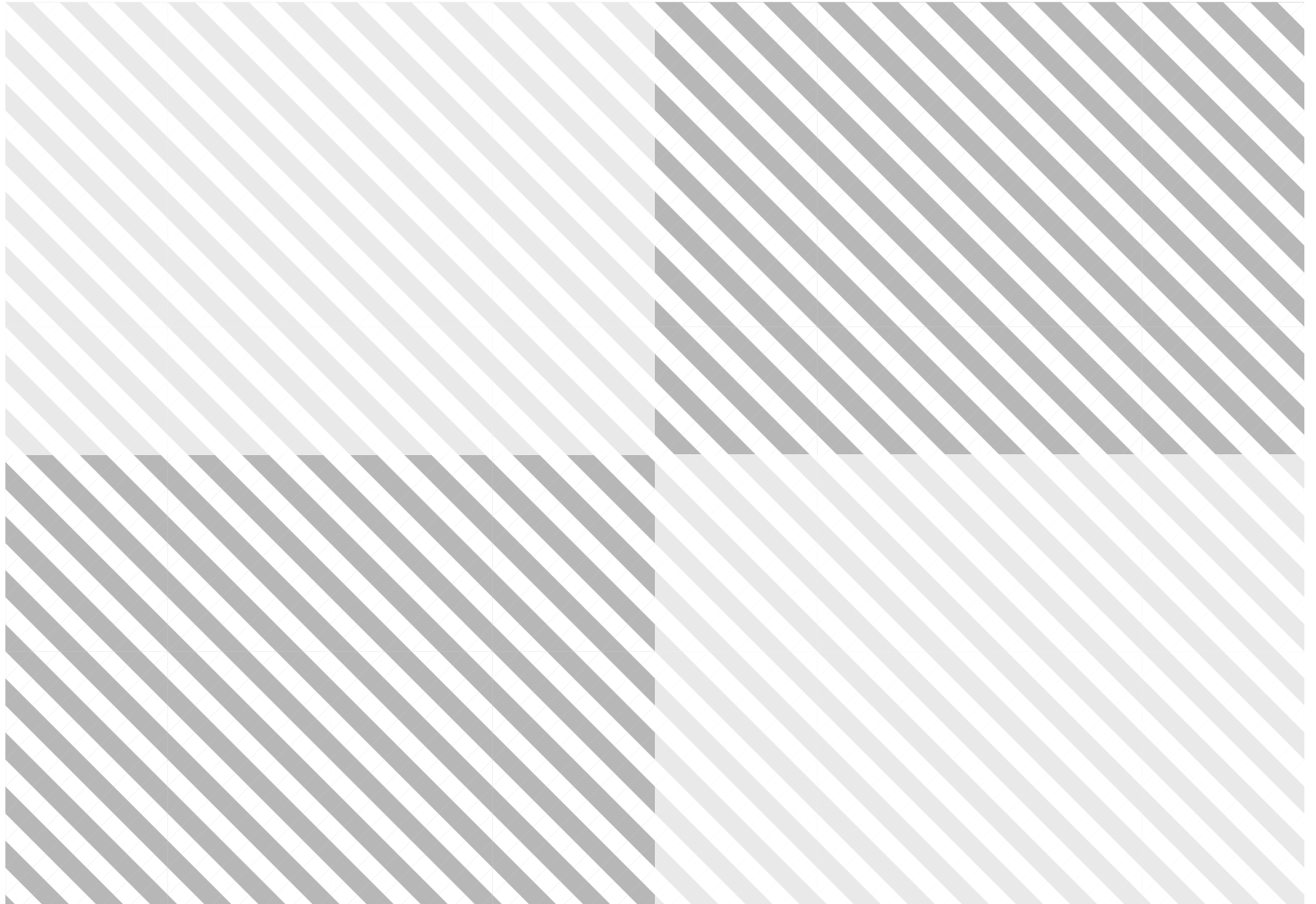


White Paper

# Readiness for the Future of Production: Country Profiles

In collaboration with A.T. Kearney

March 2017



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# Preface



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This World Economic Forum white paper presents a benchmarking framework to assess the readiness of countries for the future of production. It is proposed in the context of the Forum's System Initiative on Shaping the Future of Production, launched in 2016, which seeks to better understand transformations in global and local production systems and to provide a platform for pilots and collaborative efforts that stimulate innovation, sustainability and employment.

The Forum defines the world of production as the full chain of activities to “source-make-deliver-consume-reintegrate” products and services, from origination, product design, manufacturing and distribution to customers and consumers, incorporating principles of the circular economy and reuse. Production fundamentally impacts economic structure at global, regional, national and local levels, affecting the level and nature of employment, and today is inextricable from environmental and sustainability concerns, considerations and initiatives. Collectively, the sectors of production have been the source of economic growth in developed and developing nations alike, a major source of employment for a rapidly evolving and increasingly skilled workforce, and they continue to be the dominant focus of innovation and development efforts in most countries.

The nature of production is undergoing unprecedented change as new technologies transform cost structures, make new business models and methods of production available, and bring entirely new products and services to market. Building on its competence in global benchmarking, notably in competitiveness, human capital, trade facilitation and digital readiness, the World Economic Forum in collaboration with A.T. Kearney have developed a proposal for a new benchmarking framework to help countries assess the extent to which they are “ready” or well positioned to shape and benefit from the changing nature of production. It aims to bring new perspectives and generate responsive and responsible choices.

This tool is designed to help decision-makers identify priorities for national policy development and public-private cooperation, and to track progress and monitor results by means of a proposed methodology. The framework will be finalized and a cross-country database established in the course of 2017, with a first version to be presented at the Forum's Annual Meeting of the New Champions in June 2017.

# Executive summary

As the Fourth Industrial Revolution gathers momentum, decision-makers from the public and private sectors are confronted with a new set of uncertainties regarding the future of production and the best way to respond and leverage emerging technologies. The speed and scope of change add a layer of complexity to the already challenging task of formulating and implementing industrial strategies that promote productivity and inclusive growth.

The objective of the country profiles is to provide a country-level summary and comprehensive view of key levers (factors and institutions) required to effectively transform production systems in the light of rapidly emerging technologies related to the Fourth Industrial Revolution, such as the internet of things, artificial intelligence, virtual reality, robotics and 3D printing. The changing nature of production, with blurring boundaries between manufacturing and services, requires new frameworks to organize our understanding of the factors that can help to shape local production systems purposefully in a globalized world.

The purpose of the tool is therefore to catalyse structured dialogue between ministers of industry, trade, science and technology, and economic development and their business leaders interested in having a concise, yet comprehensive mechanism to understand, monitor and track the particular issues relevant for production transformation in the context of the Fourth Industrial Revolution. Initially, users will be the governments participating in the Forum System Initiative on Shaping the Future of Production through the Stewardship Board, the Global Future Council for the Future of Production and the Steering Committee of the initiative.

The country profiles will show several types of indicators with two characteristics: indicators can be inputs or outputs; and they can come from statistical sources or surveys.

The input variables relate to current investments and actions that will lead to future conditions that facilitate the incorporation of emerging technologies into production systems (future orientation). Examples include future production-oriented education. The outcome indicators refer to current conditions that affect the impact and speed of adjustment of the investments and actions and can determine path-dependence of change. For example, the current structure of production could determine how easily you can move to other areas of the product space.

The factors covered include five drivers identified through consultations with academic experts, practitioners and business leaders: innovation and technology; human capital and skills; regulation and governance; sustainability and natural resources; global trade and investment; structure of production; and consumer trends.

The final product will be a set of country profiles that summarizes the issues related to future production and can lead to structured dialogue, planning and vision-building between stakeholders. The benchmarking of countries will rely on archetypes depending on the current structure of production and consumer trends, as well as the investments and actions undertaken to lay the ground for the future. Recognizing the diversity of growth paths and development experiences, and the varied challenges faced by countries in different stages of development, the tool is not prescriptive but rather descriptive, allowing users to decide their industrial strategy based on comparable and reliable indicators.

# Introduction

“We are at the beginning of a global transformation that is characterized by the convergence of digital, physical and biological technologies in ways that are changing both the world around us and our very idea of what it means to be human. The changes are historic in terms of their size, speed and scope.”<sup>1</sup> Production is not absent from these transformations. On the contrary, it is at the core.

This transformation – the Fourth Industrial Revolution – is defined by the transition to new systems that are being built on the infrastructure of the digital revolution. As these individual technologies become ubiquitous, they will dramatically alter the ways in which we produce and consume. The fundamental and global nature of this revolution also poses new threats related to the disruptions it may cause.

In particular, as new technologies become available and disrupt interconnected regional and global value chains, new business models will be required to cope with this change and benefit from the transformations in production and cost structures. The disruption of production systems will require new sets of capabilities and multistakeholder strategies. The purpose of this white paper is to present the framework of a capabilities assessment tool that will serve governments, businesses and civil society as they understand the changes brought about by the Fourth Industrial Revolution.

The country readiness profiles build on previous work analysing the evolution of manufacturing<sup>2</sup> and recent work that explores the likely trajectories of five salient emerging technologies that are already defining new production systems. It also builds on the factors identified in a scenarios analysis as a determinant in the process of reaching different possible outcomes.

These profiles will allow countries to benchmark their capabilities along several key drivers, monitor progress, identify policy priorities and build multi-stakeholder agendas to improve the conditions that will allow the required transformation of production systems.

This diagnosis and monitoring tool complements other benchmarking reports produced by the World Economic Forum. Most notable of these are the *Future Preparedness Framework*, the *Global Competitiveness Report*, the *Global Information and Technology Report* and the *Global Enabling Trade Report*.

The framework presented is part of a broader effort that includes a technology foresight series exploring the likely evolution of some of the most salient emerging technologies, a scenarios exercise mapping possible outcomes of the Fourth Industrial Revolution on production, and a vision of what this future should look like. Together, all these analyses will provide information and guidance for action-oriented toolkits to shape the future of production.

# The changing nature of industrial policy

The need for an assessment tool of this type comes in the wake of renewed interest in industrial strategies in both emerging and advanced economies. The recent history of global production and industrial policies can help understand the intellectual and policy debates calling for new instruments for benchmarking and dialogue.

The interaction of new technologies and falling transaction costs, including tariffs and other barriers to trade, ignited a process of international vertical disintegration of production beginning in the 1990s, with previously local production chains being torn apart and individual tasks and intermediate inputs being relocated across the globe. Outsourcing and offshoring created new trading patterns and foreign direct investment flows. According to the most recent firm-level trade theories, firms can be characterized according to the different business models of international production they choose. These depend critically on their productivity levels, with the less productive firms producing – outsourcing or integrating – domestically, and the most productive firms outsourcing and investing internationally.<sup>3</sup>

This process was accelerated by the entry of China and other emerging countries into the World Trade Organization in 2004, and the increased participation in global trade that this represented. An abundance of labour in China reduced the global share of returns going to workers in favour of capital. It also created incentives to further take advantage of the possibilities of delocalization, and transformed trade into a system of trading in tasks and intermediate goods, rather than trading in final goods.<sup>4</sup> This process created what is now known as global value chains.<sup>5</sup>

As production dispersed across jurisdictions, the weight of manufacturing in gross domestic product (GDP) fell. This effect magnified the tendency for manufacturing to lose weight in total GDP as countries develop<sup>6</sup>. Adding to the structural changes in manufacturing location, the commodities boom increased the weight of oil and mining in total trade and GDP for resource-rich countries, further depressing the share of industrial production. In emerging countries, the increase in foreign direct investment attracted by high commodity prices and low interest rates following the recession of 2009 appreciated local currencies and further accentuated the decline of manufacturing.

Manufacturing output is recovering slowly in the industrialized world and in emerging markets. However, world trade remains depressed. As the possibilities of monetary stimulus wear off, and with technology and innovation playing an important role in growth, advanced production faces the challenge of a decline in the openness that had fuelled innovation and growth.<sup>7</sup>

The changes occurring in production processes suggest that there may be a vertical reintegration of production chains, with blurring lines between services and manufacturing, and new unforeseen business models shaping production. Additionally, falling productivity and the apparent paradox of fast technological progress not showing up in productivity measures suggest there is an urgent need to understand and actively shape the future of production, so as to ensure that new technologies result in higher productivity and faster growth.<sup>8</sup> Transforming production effectively in the context of fast technological change is one way to identify those new growth sectors that are capable of reigniting wealth, creating employment and addressing the current backlash against globalization.

In this context, both academics and policy-makers have turned their attention to the possibilities of modern industrial strategy, or productive development policies. The recent literature seeks to define parameters for public-private collaboration on modern industrial policies,<sup>9</sup> identifying market failures and appropriate government responses within adequate institutional frameworks.

Providing analytical and benchmarking tools to understand the factors and conditions that enable firms and countries to adapt to new technologies, transform production systems and increase productivity to improve growth rates is crucial. It enables successful identification of priorities and the design of effective industrial strategy based on multistakeholder structured dialogue, incorporating the lessons learned from past (and in many cases failed) attempts to stimulate industrial production.

## A new paradigm for public-private partnership in production

The debate on the scope of government policy and the desirability of policies towards production has shifted after an apparent consensus regarding the undesirability of active policies. After many failed experiences in Africa, Latin America and other emerging markets in the 1960s and 1970s, followed by the reluctance of policy-makers to implement sector-specific policies during the 1990s, a new consensus is starting to emerge. This consensus building will be more urgent in the context of the Fourth Industrial Revolution and the opportunities and challenges that it represents for advanced and emerging economies.

The main challenge will be to avoid the political economy pitfalls of old industrial policies. Political capture, rent-seeking, time-inconsistent policies and the asymmetries of information between policy-makers and firms have increased the prevalence of government failures. These frequently proved to be more damaging than the market failures they were called in to solve.<sup>10</sup>

Some successful experiences in South-East Asia prompted new research, analysing the conditions, institutions and factors that could contribute to the successful implementation of industrial policies. This research, which led to what is now being referred to as new industrial policies or modern industrial policies, included a more nuanced and sophisticated list of possible market failures, among them coordination failures and a recognition of the importance of institutions to deal with the political economy problems of implementation.

Hausmann and Rodrik (2006) have emphasized the impossibility of not having an industrial strategy in the presence of a government making policy decisions.<sup>11</sup> They argue that any type of policy decision will entail some sort of effect on the productive sector, so decisions should be more deliberate; we are “doomed to choose”. Lin and Monga (2010), following Lin’s work on new structural economics, explore the role of the state in structural transformation.<sup>12</sup> Chang (2009) also proposes to move beyond the “corner solutions” and to engage in a new dialogue about the role of governments in the process of development and, in particular, manufacturing.<sup>13</sup>

Recognizing the possible pitfalls of industrial policies does not, therefore, imply that we should not have any type of industrial strategy, but rather that we need to account for the conditions that lead to successful implementation of these policies and fruitful public-private collaboration towards that end. We need new productive policies for an imperfect world.<sup>14</sup> The return of the policy discussion, both in academic and non-academic circles,<sup>15</sup> and the



need to cope with secular stagnation and the impact of technological change, has prompted several review reports by the World Bank, the Inter-American Development Bank, the Economic Commission for Latin America and the Caribbean and the International Labour Organization, among others.<sup>16</sup>

The changing nature of production will also have an important impact on development paths and presents fresh questions for emerging countries. Having a new framework for industrial strategy will therefore also be essential for broader development strategies, competitiveness, human capital policy, trade policy, and regulation and governance. Furthermore, the transformation of production in the context of the Fourth Industrial Revolution opens new possibilities for emerging countries to skip traditional development paths and speed growth and poverty reduction.<sup>17</sup>

Making these contributions operational and materializing the institutional environments conducive to successful production policies is a priority to which this framework seeks to contribute.

# Methodology

## Definition

Readiness for the Future of Production measures the factors that enable the successful adoption of emerging technologies in production. It covers the underlying structure of production and consumption that conditions the effect of five drivers identified as critical enablers for firms to successfully transform, and for the production tissue of a country to incorporate new technologies and shift production functions accordingly.

## Objectives

The output of the readiness tool will be a set of country profiles benchmarking economies and allowing decision-makers to identify the most pressing issues that require investment and action to respond to the Fourth Industrial Revolution. Likewise, by identifying the current conditions critical to future readiness, the country profiles will allow stakeholders to have a sense of the speed of change and the effect of investments in the critical levers identified. The country profiles have three main objectives: to establish a consistent framework on which to measure country readiness for the future of production; to identify levers for leaders to improve country readiness for the future of production; and to facilitate dialogue, monitoring and agenda-setting.

**Measure country readiness:** How can countries better understand their readiness for the future of production? The country profiles aim to ground thinking about the future in an analysis of countries' current level of preparedness to take advantage of production opportunities on the horizon. The Readiness Framework identifies the drivers of readiness and the metrics by which we can measure performance for each driver. Its flexible design allows countries to establish a baseline understanding of their position in the present, while also allowing them to deep-dive into certain areas and learn from the experience of peer countries. This data-driven approach helps leaders to analyse the level of readiness of a given country.

**Identify policy levers:** Country profiles are designed to help government leaders and policy-makers prepare and transition effectively to future realities. They illuminate country positions and, in so doing, highlight their strengths and weaknesses. The profile results and the framework highlight the main levers of policy that enable the future of production. The strategy adopted by countries will be their own, but this framework can serve as a catalyst for action.

**Establish a common framework:** Countries are highly diverse in terms of economic development, regulatory environments and political systems. Consequently, the production industry profiles of countries are widely divergent. Therefore, in terms of readiness for the future of production, it is necessary to develop a clear framework

that can be used by a variety of countries at various development stages. This country profile framework seeks to establish consistent, objective criteria that can be used as a tool for analysis and a starting point for meaningful global dialogue on the future of production. It is our hope that the framework will enable leaders to speak a common language, informed by as unbiased a perspective as possible, and on what is an increasingly complex topic.

## Construction of the framework

The output variable is the capability to effectively incorporate emerging technologies into production processes and value chains. The drivers, metrics and indicators measure the inputs required to achieve this goal.

To construct the framework and select the indicators, we use the following methodology:

1. Comprehensive literature review to arrive at the nearly 70 indicators chosen for the country profiles. This includes a review of materials pertaining to manufacturing trends, projections, industry trade data, global databases and the World Economic Forum Executive Opinion Survey.
2. A working group of more than 20 countries and industry leaders convened to discuss the future of production and has provided input throughout the development of the profiles.
3. Further consultation with academic experts, policy-makers and practitioners outside of the Future of Production working group.
4. Definition of an aggregation method along the drivers.

## Sources

The framework draws on quantitative data reported by national statistics agencies to international organizations including the World Bank, the United Nations Industrial Development Organization (UNIDO), the United Nations Conference on Trade and Development (UNCTAD), the Organisation for Economic Co-operation and Development (OECD); data collected by think-tanks and international advocacy groups; and the Executive Opinion Survey, described below, administered by the World Economic Forum.

### Executive Opinion Survey questions

The Executive Opinion Survey, a proprietary instrument of the World Economic Forum, is the longest running and most extensive survey of its kind. It captures the perception of business leaders around the world on a broad range of topics, such as appetite for entrepreneurship, the extent of the skills gap and the incidence of corruption. The questions serve to capture qualitative concepts for which data is not available from the traditional sources of statistics.

The survey is administered by the Forum and conducted at national level by the Forum's network of partner institutes. Partner institutes are recognized research or academic institutes, business organizations, national competitiveness councils or other established professional entities and, in some cases, survey consultancies. These institutes have networks able to reach out to the business community and have a firm commitment to improving the competitiveness conditions of their economies.

The indicators derived from the surveys are used to calculate the Global Competitiveness Index and other World Economic Forum indices, such as the Networked Readiness Index, the Enabling Trade Index, the Travel and Tourism Competitiveness Index, the Gender Gap Index, the Human Capital Index as well as *The Inclusive Economic Growth and Development Report* and regional competitiveness studies.<sup>18</sup>

The entire survey, in the context of the Global Competitiveness Index, will be used to determine necessary conditions. However, a selection of questions will be used explicitly in the country profiles.

## Preliminary Framework

The country profiles present the structure of production and consumption, a snapshot of what production looks like at any point in time, and the set of five drivers of future production (Figure 1).

### Outputs

The framework presented will be tested against a number of outcomes that indicate technological diffusion. Technologies can be transferred either via capital that embeds new technologies, instruction manuals and codes, or people with knowledge of these new technologies. Testing the correlations and striving to find causal links between the drivers and a set of proxy variables for technological diffusion will help validate the framework and identify differences across technologies.

Some of the possible outcome variables to document include:

1. Productivity differences across countries within the same industry
2. Productivity differences across countries
3. Direct measures of technological diffusion such as:
  - a. Trade in capital with embedded technologies
  - b. Changes in regulations, learning curriculums and other codified technologies
  - c. Migration of people with different know-how
4. Changes in the structure of production
5. Changes in patterns of consumption



## Structure of production and consumption

What a country produces is a reflection of its structure of production, i.e. its unique set of conditions and capabilities. Several measures to characterize the structure of production have been proposed:

- Economic complexity
- Forward/backward linkages
- Participation in global value chains
- Density/discovery factors
- Consumer trends

This dimension is based on the building blocks of the recent literature on economic complexity developed in Hidalgo et al. (2007).<sup>19</sup> The density and discovery factors of this framework describe a new product's proximity to a given country's current set of products, and hence the availability of the shared capabilities required to make the transition towards new products.

Consumer trends are included to reflect the fact that introducing new technologies for production requires consumers to be willing to demand those products, and that having a domestic market for new products makes it easier for firms to incorporate these production methods and transform their business models (See Appendix, Figure 1).

### Drivers of production

The drivers of future production were identified through a consultation process with the Steering Committee of the Initiative as well as bilateral consultations with academic experts members of the Global Future Council. Through a series of workshops, we started identifying indicators and concepts that were driving changes in production systems. Steering Committee members identified the most relevant indicators from a database provided by the World Economic Forum. The framework came together through iterations of this process, desk research, and meetings

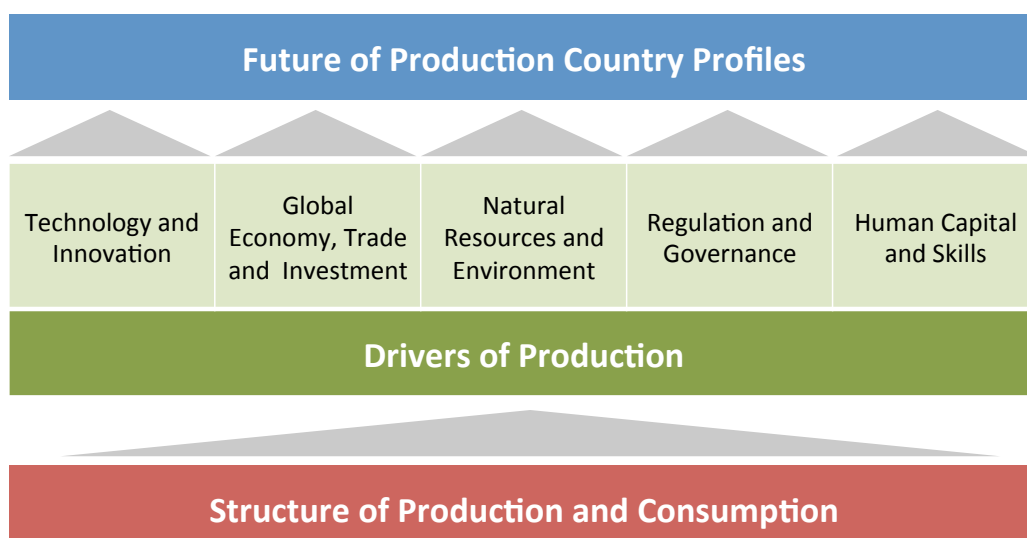
of the Steering Committee and the Annual Meeting of the Global Future Councils 2016 in Dubai, where the framework was discussed.

The current version captures the consensus, and although preliminary at the indicator level, presents our best understanding of the drivers of production at a driver and concept level.

The five drivers included are:

1. Innovation and technology: The conditions that allow firms to innovate and adopt new technologies will be critical in the process of transforming production in line with the Fourth Industrial Revolution. It will be crucial to have capabilities in innovation and the necessary infrastructure to adopt new technologies. This dimension will also consider the required public sector inputs into the innovation process.
2. Human capital and skills: Manufacturing will be more knowledge-intensive than ever before. An educated and agile workforce and labour market institutions that facilitate efficient matching of talent and vacancies are needed to succeed.
3. Regulation and governance: Regulation can either encourage technology adoption or be a powerful impediment. Capacity of governments to enact and implement smart regulations is a constraint on the ability of the private sector to respond to change.
4. Natural resources and sustainability: Environmental sustainability will be an imperative and clean production a competitive advantage. The successful use of new technologies and their incorporation into production will be limited by resource availability and by sustainability imperatives.
5. Global economy, trade and investment: Open and global trade underpins the future of manufacturing. Foreign direct investment (FDI) is critical as it provides both necessary capital and knowledge transfer between countries. Trade will define how firms can benefit from larger markets and source the best intermediate inputs available.

Figure 1: Framework structure



## Drivers and Metrics

This section describes each of the drivers identified in greater detail, and lays out the significant number of metrics which would be used to calculate the Driver. (See Appendix).

### Innovation and technology

Innovation and technology comprise the main driver of productive transformation. The speed of change brought about by the Fourth Industrial Revolution will make the ability to innovate and transfer technology across borders and between academia and industry ever more important.

This driver measures the conditions for innovation and technology with metrics of research intensity, industry activity, availability and usage of information and communication technology (ICT), and the sophistication of the country's manufacturing sector. Each of these metrics comprises three to five sub-metrics, equally weighted, that together provide a view of the health and potential of the economy to capitalize on technological innovations (See Appendix, Figure 2).

1. Research intensity measured by research and development (R&D) spend, patents filed in basic science, science, technology, engineering and maths (STEM) patents filed in more than three countries, and state of the country's innovation cluster development and distribution of patent ownership.
2. The scale of the impact of a country's researchers and the quality of patents.
3. Industry activity measured by gross fixed capital formation, new businesses registered and high- and medium-high technology manufactures are a measure on investment in intangibles.
4. Availability and use of ICT measured by business usage of ICT, average internet speed, mobile phone connections and affordability of ICT.
5. Sophistication measured by industrial robots per 1,000 employees, robots/million man hours, knowledge-intensive employment, size of digital universe (by country), number of 3D printers registered and number of firms engaged in disruptive technologies.
6. Collaborative innovation: The role of start-ups in the process of idea generation and the interaction between large firms and start-ups in the process of innovation.
7. Uptake of five key emerging technologies: measures the investments specifically on artificial intelligence, advanced analytics, wearables, 3D printing and the internet of things.

Many new concepts and ideas related to the process of innovation and productive transformation are not being measured consistently or systematically across countries. This framework, and the continued dialogue it will serve to promote, will provide an opportunity to identify these data needs. Some will be covered by questions from the

Executive Opinion Survey. Two recent ideas related to innovation include:

1. Collaborative innovation: The role of start-ups in the process of idea generation and the interaction between large firms and start-ups play an important role in the process of innovation.
2. Uptake of emerging technologies: This indicator measures investments specifically on artificial intelligence, advanced analytics, wearables, 3D printing and the internet of things.

### Human capital and skills

Human capital and skills are complementary to other factors of production entering into production processes. In particular, they are complementary to technology. Given skill-biased technical change, updating skills and human capital is an essential driver of the transformation of production.

Human capital and skills are measured by education outcomes, agility and adaptability, inclusivity, labour force skills and migration. Each of these metrics comprises two to five sub-metrics that together help to identify the relative intellectual strengths of a country, and the readiness of talent for the future of advanced manufacturing (See Appendix, Figure 3).

1. Education outcomes measured by score of universities, quality of maths and science education, PISA performance and adult literacy rates.
2. Agility and adaptability measured by on-the-job training, availability of engineers and scientists, labour market flexibility, culture and creative services, and goods exports.
3. Inclusivity measured by female labour market participation rate, income mobility and unemployment rate.
4. Labour force skills measured by population with tertiary degree, population with secondary education and employment in the manufacturing sector.
5. Migration measured by tertiary inbound mobility ratio and net migration.

### Regulations and governance

The regulatory and governance framework can either facilitate or slow down the successful adoption of emerging technologies into production. If regulation is responsive to changing business environments and production processes, it can lay the rules that can increase the speed of adoption and solve conflicts inherent in the changing nature of production systems.

Regulation and governance are measured by the quality of institutions, digital security and data privacy, innovation incentives and barriers to trade. Each of these metrics comprises two to five sub-metrics that together provide a sense of the flexibility of a country's policies to changes in technology, as well as support for new business development (See Appendix, Figure 4).

1. Quality of institutions measured by Corruption Perceptions Index, the World Justice Project Rule of Law Index, safety and security, quality of bureaucracy and regulatory efficiency.
2. Digital security and data privacy measured by intellectual property (IP) protection, secure internet servers and software privacy rate as a percentage of software installed.
3. Scope of government online services (e-governance).
4. Innovation incentives measured by total tax rate and open markets.
5. Barriers to trade measured by burden of customs procedures, applied tariff rate and intensity of local competition.
6. Antitrust and IP enforcement.

### **Natural resources and sustainability**

Natural resources and sustainability requirements will shape the type of technologies that are adopted and the direction of innovation. Changes in natural resource availability as well as the recognition of externalities in the use of natural resources will induce changes in the way we produce.

Natural resources and sustainability are measured by energy inputs and costs, sustainable practices, air and climate, and water. Each of these metrics comprises two to five sub-metrics that together provide a sense of a country's environmental health and the potential for regulation on manufacturing practices to encourage sustainability (See Appendix, Figure 5).

1. Energy inputs and costs are measured by the level of primary energy used as a percentage of GDP (energy intensity) and energy imports, as well as alternative and nuclear energy.
2. Sustainable practices are measured by the recycling rate, unsound disposal rate, environmental risk exposure and ISO 14000 applicants.
3. Air and climate are measured by trends in carbon intensity, average exposure to fine particulate matter, and fine particulate matter exceedance.
4. Water is measured by baseline water stress and wastewater treatment.
5. Land-planning regulation.

### **Global economy, trade and investment**

International trade and investment are one of the main drivers of the changing geography of production and the choice of globalized production processes composed of articulated tasks dispersed across jurisdictions. Changes in transaction costs, including communication and transport costs, and their interaction with technology, human capital, regulation and governance and natural resources and sustainability, will shape this geography. Likewise, changing conditions for global trade will be a driver of the choice of technologies and production methods globally and locally.

The conditions of global trade and investment are measured by features of infrastructure, trade performance, investment and quality. Each metric comprises two to five sub-metrics that take into account the country's economic strength vis-à-vis its peer nations, as well as its growth potential (See Appendix, Figure 6).

1. Economy is measured by logistics performance and infrastructure quality.
2. Trade is measured by trade as a share of GDP, index number of industrial production, index value of manufacturing value added, goods exports as a percentage of GDP, and FDI stocks and flows.
3. Investment is measured by Greenfield investments and FDI inflows.
4. Certification and accreditation are measured by number of International Organization for Standardization (ISO) certificates in industrial sectors and ISO 9000 permits.

# Reading the country profiles

The framework presented above provides a set of indicators pertaining to the current structure of production and consumption and the main drivers of future production. The framework suggests a dynamic relationship between the current structure of production and the drivers of future production and within the drivers of future production. The current structure of production and consumption conditions the effects of the drivers, and the drivers interact to generate changes in that structure.

The indicators will be presented individually and aggregated to allow for action-driven interpretation of the data.

The structure of production and consumption and the set of drivers can be summarized in the country profiles using a Cartesian plane representation as in Figure 2. Countries will be classified in four archetypes: fast movers, global leaders, followers and at-risk economies.

Fast movers are countries that carry the legacy of a nascent structure of production (low density, unsophisticated production networks) but whose strong performance on the underlying drivers of future production places them in a position to quickly catch up with more advanced countries. Global leaders have both robust structures of production and consumption and are leaders in the five drivers of future production. Followers carry the both the legacy of a nascent structure of production and consumption and display weakness among the drivers of future production.

Finally, at-risk economies are those that lead in terms of their current structure of production, with robust and sophisticated production and consumption, but are falling behind on the transformations required for future production.

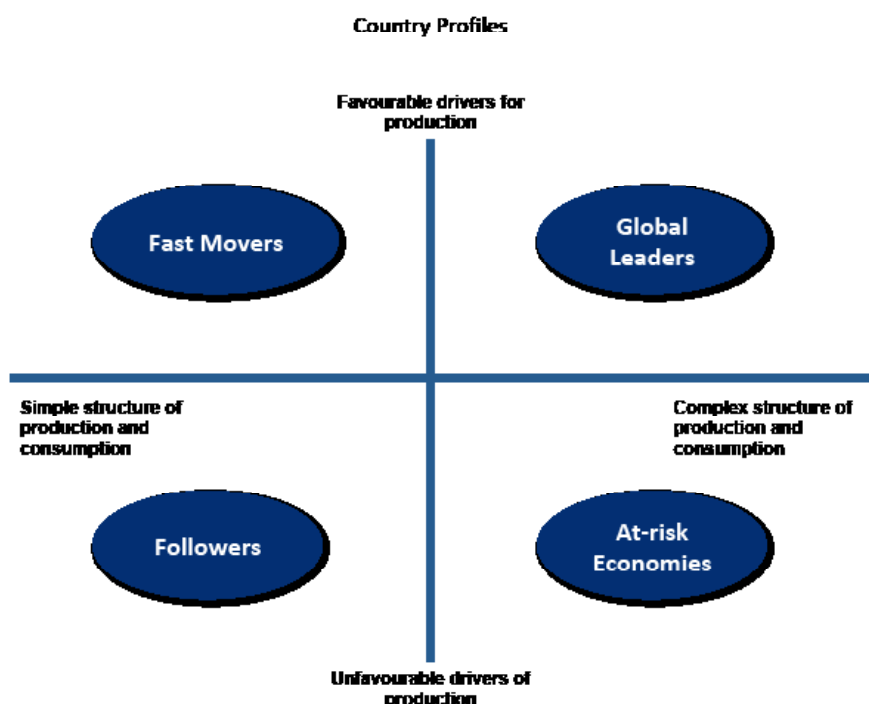
The position of countries in any of these four quadrants can be attributed to a combination of factors. The framework will allow stakeholders to identify the main issues in their countries and determine priorities for public-private collaboration and industrial strategies.

## A framework for industrial strategy and using the country profiles to define actionable agendas

The Readiness for Future Production framework described in this briefing note should lead to two types of impacts:

1. Structured multistakeholder dialogue for the identification of strategic priorities, actionable agendas and monitoring of progress in the context of specific projects.
2. The establishment of institutions facilitating a permanent dialogue within a system that promotes coordination within government and between government and the private sector.

Figure 2: Country profile interpretations



The framework and resulting country profiles are not prescriptive in terms of what decision-makers should do or how they should prioritize. Instead, they provide elements of analysis to inform multistakeholder dialogue and agenda-setting that must be interpreted with the aid of theory and used within the political and policy constraints of each country.

Ultimately, the country profiles will help to guide public-private discussions and agenda-building. Questions to be asked when using the framework include:

1. How can countries identify priorities on which to work?
2. How does my country compare with countries of reference (within my country archetype)?
3. Which horizontal and vertical interventions are required to make progress?
4. What type of interventions, public goods provision or market interventions, are required in each dimension to make progress?

Answering these questions can serve as the starting point for a modern industrial strategy agenda.

## Next steps

Implementation of the framework requires administration of the survey and compilation of statistical data for each indicator. Framework implementation and a report analysing the results will be among annual knowledge products aimed at helping to shape multistakeholder dialogue and policy, and monitor and track progress. Additionally, to complement the analysis, case studies describing specific country experiences will illustrate the role played by each of the dimensions, metrics and indicators.

To complement the quantitative information provided by the country profiles, the initiative will produce case studies jointly with Steering Committee members on the industrial strategies implemented by different countries. These case studies will help to interpret the country profiles, understand country idiosyncrasies and learn how to use the country profiles to map production development paths.

# Endnotes

- <sup>1</sup> See <http://reports.weforum.org/global-competitiveness-index/box-1-the-fourth-industrial-revolution/> based on Schwab, K. (2016) *The Fourth Industrial Revolution*.
- <sup>2</sup> See: *The Future of Manufacturing: Opportunities to drive economic growth*, available at [http://www3.weforum.org/docs/WEF\\_MOB\\_FutureManufacturing\\_Report\\_2012.pdf](http://www3.weforum.org/docs/WEF_MOB_FutureManufacturing_Report_2012.pdf)
- <sup>3</sup> Helpman, E. (2011) *Understanding Global Trade*, Cambridge: Harvard University Press, available at <http://scholar.harvard.edu/helpman/publications/understanding-global-trade>
- <sup>4</sup> Ibid
- <sup>5</sup> For a concise introduction to the policy issues of global value chains, see: <https://www.oecd.org/sti/ind/global-value-chains.htm>.
- <sup>6</sup> See for example, Buera, F. and Kaboski, J. (2012) Scale and the Origins of Structural Change, *Journal of Economic Theory*, 147: 684–712.
- <sup>7</sup> See *Global Competitiveness Report 2016–2017* for more details: <http://reports.weforum.org/global-competitiveness-index/>
- <sup>8</sup> For an explanation of the productivity paradox and possible hypotheses, see <http://reports.weforum.org/global-competitiveness-index/box-2-the-global-productivity-slowdown-five-hypotheses/>.
- <sup>9</sup> For recent contributions, see IDB's *Rethinking Development Policies*, available at <http://www.iadb.org/en/research-and-data/dia-development-in-the-americas-idb-flagship-publication,3185.html?id=2014>; *Transforming Economies: Making Industrial Policy Work for Growth, Jobs and Development* (ILO), available at [http://www.ilo.org/global/publications/books/WCMS\\_242878/lang--en/index.htm](http://www.ilo.org/global/publications/books/WCMS_242878/lang--en/index.htm); and the references in *The Atlas of Economic Prosperity*, available at <http://atlas.cid.harvard.edu/>.
- <sup>10</sup> For analysis of the sources and mechanics of government failures, see Baldwin, R. and Robert-Nicoud, F. (2009) *Industrial policy: Why Governments Pick Losers*, The Magazine for Economic Performance; Glaeser, E. (2012) *The Political Risks of Fighting Market Failures: Subversion, Populism and the Government Sponsored Enterprises*, National Bureau of Economic Research; Grossman, G. and Helpman, E. (2002) *Interest Groups and Trade Policy*, Princeton University Press; Kruguer, A. (1990) Government Failures in Development, *The Journal of Economic Perspectives*; Robinson, J. (2009) Industrial Policy and Development: A Political Economy Perspective, World Bank ABCDE conference, Seoul; Tullock, G. (2005) *The Rent Seeking Society: The Selected Works of Gordon Tullock*, Vol. 5.
- <sup>11</sup> Hausmann, R. and Rodrik, D. (2006) Doomed to Choose, Industrial Policy as Predicament, John F. Kennedy School of Government.
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- <sup>13</sup> Chang, H-J. (2009) Industrial Policy: Can We Go Beyond an Unproductive Confrontation? Annual World Bank Conference on Development Economics.
- <sup>14</sup> Hodler, R. (2009) Industrial Policy in an Imperfect World, *Journal of Development Economics*, 72, 85–93.
- <sup>15</sup> For examples of policy-oriented contributions, see Rodrik, D. (2008) Normalizing Industrial Policy, Commission on Growth and Development Working Paper No. 3, and Rodrik, D. (2004) Industrial Policy for the Twenty-First Century, United Nations Industrial Development Organization.
- <sup>16</sup> See [http://www.ilo.org/wcmsp5/groups/public/-dgreports/---dcomm/---publ/documents/publication/wcms\\_242878.pdf](http://www.ilo.org/wcmsp5/groups/public/-dgreports/---dcomm/---publ/documents/publication/wcms_242878.pdf); <https://publications.iadb.org/handle/11319/6633>; and <http://siteresources.worldbank.org/DEC/Resources/84797-1104785060319/598886-1104951889260/NSE-Book.pdf>.
- <sup>17</sup> This issue is being studied in more depth by the World Economic Forum Global Future Council on Production.
- <sup>18</sup> A full description of the survey is available at <http://reports.weforum.org/global-competitiveness-index/the-executive-opinion-survey-the-voice-of-the-business-community/>.
- <sup>19</sup> Hidalgo, C., Klinger, B., Barabási, A-L. and Hausmann, R. (2007) The product space conditions the development of nations, *Science* 317: 482-7



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# Acronyms

ECI	Economic Complexity Index
EDB	Eurasian Development Bank
EIU	Economist Intelligence Unit
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GII	Global Innovation Index
GITR	Global Information Technology Report
ICT	Information and communication technology
IDC	International Data Corporation
IFR	International Financing Review
ILO	International Labour Organization
IMF	International Monetary Fund
IP	Intellectual Property
ISO	International Organization for Standardization
ITU	International Telecommunications Union
OECD	Organisation for Economic Co-operation and Development
PCI	Product Complexity Index
PISA	Programme for International Student Assessment
QS	QS University Rankings
R&D	Research and development
STEM	Science, technology, engineering and maths
TBD	To be defined
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
GCI	Global Competitiveness Index
WIPO	World Intellectual Property Organization
WJP	World Justice Project
WTO	World Trade Organization
Yale EPI	Yale University Environmental Performance Index

# Appendix

This appendix presents the preliminary structure and components of the framework, indicating the indicators and sources for each element of the framework, and including those from statistical agencies and those from the Executive Opinion Survey.

## Structure of production and consumption

**Figure 1:** Structure of production and consumption metrics

Metric	Sub-metric	Data source
Structure of production	Economic complexity	Economic Complexity Index
	Forward / backward linkages	UNIDO/World Bank
	Participation in global value chains	WTO
	Density / discovery factor	Atlas of Economic Complexity
Structure of consumption	Willingness to try new goods and services	Survey
	Openness to new ways of production	Survey
	Consumer tastes and data availability	TBD

### *Executive Opinion Survey (production)*

1. In your country, how widespread are well-developed and deep clusters (geographic concentrations of firms, suppliers, producers of related products and services, and specialized institutions in a particular field)? [1 = non-existent; 7 = widespread in many fields]
2. On what is the competitive advantage of your country's companies in international markets based? [1 = primarily based on low-cost labour or natural resources; 7 = primarily based on unique products and processes]
3. In your country, how sophisticated are production processes? [1 = not at all – production uses labour-intensive processes; 7 = highly – production uses latest technologies]
4. In your country, how broad is companies' presence in the value chain? [1 = narrow, primarily involved in individual steps of the value chain (e.g. resource extraction or production); 7 = broad, present across the entire value chain (e.g. including production and marketing, distribution, design, etc.)]

### *Executive Opinion Survey (consumption)*

1. In your country, to what extent are people exposed to ideas from outside their environment/community? [1 = not at all; 7 = to a great extent]
2. In your country, how widely are virtual social networks used (e.g., Facebook, Twitter, LinkedIn)? [1 = not used at all; 7 = used extensively]
3. In your country, to what extent are internet content and services tailored to the local population (e.g. in the local language, meeting local demand)? [1 = not at all; 7 = to a great extent]
4. In your country, how well do companies treat customers? [1 = poorly/mostly indifferent to customer satisfaction; 7 = extremely well/highly responsive to customers and seek customer retention]
5. In your country, to what extent does the active population possess sufficient digital skills (e.g. computer skills, basic coding, digital reading)? [1 = not at all; 7 = to a great extent]

## Innovation and technology

**Figure 2:** Innovation and technology metrics

Metric	Sub-metric	Data source
Research intensity	R&D, % spend of GDP	World Bank
	Patents filed, basic science	WIPO
	State of cluster development	GII
	STEM patents filed in 3+ countries	WIPO
Industry activity	Gross fixed capital formation	UNIDO
	New businesses registered	World Bank
	High- and medium-high tech manufacturers	GII
Availability and use of ICT	Business usage of ICT (i.e. proportion of businesses using computers, Internet)	UNCTAD
	Average internet speed, bits/s	Cisco / Akamai
	Mobile-cellular telephone connections	ITU
	Affordability of ICT	GII
Sophistication	Industrial robots per 1,000 employees	IFR
	Knowledge-intensive employment, %	GII
	Size of digital universe	IDC
	# 3D printers in country	3DHubs.com
	# firms engaged in disruptive technologies	OECD

### Executive Opinion Survey

- In your country, to what extent are property rights, including financial assets, protected? [1 = not at all; 7 = to a great extent]
- In your country, to what extent is intellectual property protected? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do businesses adopt the latest technologies? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do people collaborate and share ideas within a company? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do companies collaborate in sharing ideas and innovating? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do business and universities collaborate on R&D? [1 = do not collaborate at all; 7 = collaborate extensively]
- In your country, to what extent do businesses use ICT for transactions with other businesses? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do businesses use the internet for selling their goods and services to consumers? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do people have an appetite for entrepreneurial risk? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do new companies with innovative ideas grow rapidly? [1 = not at all; 7 = to a great extent]
- In your country, to what extent does senior management delegate authority to subordinates? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do companies encourage employees to generate new ideas? [1 = not at all; 7 = to a great extent]
- In your country, to what extent does ICT enable new business models? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do companies embrace risky or disruptive business ideas? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do companies invest in R&D? [1 = do not invest at all in R&D; 7 = invest heavily in R&D]
- In your country, to what extent do companies turn ideas into commercially successful new products, services or business models? [1 = not at all; 7 = to a great extent]
- In your country, how reliable is the electricity supply (lack of interruptions and lack of voltage fluctuations)? [1 = extremely unreliable; 7 = extremely reliable]
- In your country, to what extent does ICT enable new organizational models (e.g. virtual teams, remote working, telecommuting) within companies? [1 = not at all; 7 = to a great extent]

## Human capital and skills

**Figure 3:** Human capital and skills metrics

Metric	Sub-metric	Data source
Education outcomes	Score of universities	QS
	Quality of maths and science education	WEF GCI
	PISA performance	OECD
	Adult literacy rates	UN
Agility and adaptability	On-the-job training	WEF GCI
	Availability of engineers and scientists	WEF GCI
	Labour market flexibility	World Bank EDB
	Cultural and creative services and goods exports, % GDP	GII
Inclusivity	Female labour market participation rate	ILO
	Income mobility	World Bank
	Unemployment rate, 10-year trend	World Bank, ILO
Labour force skills	Population with tertiary degree, %	UN
	Population with secondary education, %	UN
	Employment: Manufacturing / total population	ILO
Migration	Tertiary inbound mobility ratio	GII– UNESCO
	Migration, net (inflows and outflows)	UN

### Executive Opinion Survey

- In your country, to what extent do companies invest in training and employee development? [1 = not at all; 7 = to a great extent]
- In your country, how do you assess the quality of vocational training? [1 = extremely poor/ among the worst in the world; 7 = excellent/ among the best in the world]
- In your country, to what extent do graduating students from secondary education possess the skills needed by businesses? [1 = not at all; 7 = to a great extent]
- In your country, to what extent do graduating students from university possess the skills needed by businesses? [1 = not at all; 7 = to a great extent]
- In your country, how do you assess the quality of primary schools [1 = extremely poor/ among the worst in the world; 7 = excellent/ among the best in the world]
- In your country, to what extent is the internet used in schools for learning purposes? [1 = not at all; 7 = to a great extent]
- In your country, how do you assess the style of teaching? [1 = frontal, teacher based, and focused on memorizing; 7 = encourages creative and critical individual thinking]
- In your country, to what extent is the internet used in schools for learning purposes? [1 = not at all; 7 = to a great extent]
- In your country, how do you assess the quality of scientific research institutions? [1 = extremely poor/ among the worst in the world; 7 = extremely good/ among the best in the world]
- In your country, to what extent can companies find people with the skills required to fill their vacancies? [1 = not at all; 7 = to a great extent]
- To what extent does your country retain talented people? [1 = not at all – the best and brightest leave to pursue opportunities abroad; 7 = to a great extent – the best and brightest stay and pursue opportunities in the country]
- To what extent does your country attract talented people from abroad? [1 = not at all; 7 = to a great extent – the country attracts the best and brightest from around the world]
- In your country, how restrictive are regulations related to the hiring of foreign labour? [1 = highly restrictive; 7 = not restrictive at all]
- To what extent are early childhood programmes (health and education for children aged 0-5) widespread and affordable in your country? [1= not at all; 7= to a great extent]

## Regulation and governance

**Figure 4:** Regulations and governance metrics

Metric	Sub-metric	Data source
Quality of institutions	Corruption Perceptions Index	Transparency International
	Rule of Law Index	WJP
	Safety and security	EIU
	Quality of bureaucracy	World Bank
	Regulatory efficiency	Index of Economic Freedom
Digital security and data privacy	IP protection	GITR
	Secure internet servers	GITR
	Software privacy rate, % software installed	GITR
Innovation incentives	Total tax rate, % of profits	GITR
	Open markets	Index of Economic Freedom
Barriers to trade	Burden of customs procedures	WEF GCI
	Applied tariff rate	GII
	Intensity of local competition	WEF GCI

### Executive Opinion Survey

- In your country, how burdensome is it for companies to comply with public administration requirements (e.g. permits, regulations, reporting)? [1 = extremely burdensome; 7 = not burdensome at all]
- In your country, to what extent does the government ensure a stable policy environment for doing business? [1 = not at all; 7 = to a great extent]
- In your country, how easy is it for private businesses to challenge government actions and/or regulations through the legal system? [1 = extremely difficult; 7 = extremely easy]
- To what extent does the government have a clear implementation plan for using ICT to improve your country's overall competitiveness? [1 = not at all – there is no plan; 7 = to a great extent – there is a clear plan]
- How developed are your country's laws relating to the use of ICT (e.g. e-commerce, digital signatures, consumer protection)? [1 = not developed at all; 7 = extremely well developed]
- In your country, how successful is the government in promoting the use of ICT? [1 = not successful at all; 7 = extremely successful]
- In your country, how easy is it for companies to obtain information about changes in government policies and regulations affecting their activities? [1 = extremely difficult; 7 = extremely easy]
- In your country, to what extent do government officials show favouritism to well-connected firms and individuals when deciding upon policies and contracts? [1 = show favouritism to a great extent; 7 = do not show favouritism at all]
- In your country, to what extent do fiscal measures (subsidies, tax breaks, etc.) distort competition? [1 = distort competition to a great extent; 7 = do not distort competition at all]
- In your country, how common is illegal diversion of public funds to companies, individuals or groups? [1 = very commonly occurs; 7 = never occurs]
- In your country, how fast is the legal framework of your country adapting to digital business models (e.g. e-commerce, sharing economy, fintech, etc.)? [1=not fast at all; 7=very fast]



## Natural resources and sustainability

**Figure 5:** Natural resources and sustainability metrics

Metric	Sub-metric	Data source
Energy inputs and costs	Energy intensity level of primary energy, % GDP PPP	World Bank
	Energy imports, % of energy use	World Bank
	Alternative and nuclear energy, % of total energy use	World Bank
Circular economy	Recycling rate	Waste Atlas (D-Waste)
Sustainable practices	Unsound disposal rate	Waste Atlas (D-Waste)
	Environmental risk exposure	Yale EPI
	ISO 14000 applicants / GDP PPP \$bn	GITR
Climate	Trend in carbon intensity per kWh	Yale EPI
	Fine particulate matter exceedance	Yale EPI
Air	Average exposure to fine particulate matter	Yale EPI
Water	Baseline water stress	WEF GCI
	Wastewater treatment	Yale EPI

### *Executive Opinion Survey*

1. How do you assess the stringency of your country's environmental regulations? [1 = very lax/among the worst in the world; 7 = among the world's most stringent]
2. In your country, how do you assess the quality of the natural environment? [1 = extremely poor/among the worst in the world; 7 = among the world's most pristine]
3. In your country, how do you assess the enforcement of environmental regulations? [1 = very lax/among the worst in the world; 7 = among the world's most rigorous]

## Global economy, trade and investment

**Figure 6:** Global economy, trade and investment metrics

Metric	Sub-metric	Data source
Trade infrastructure	Logistics performance	World Bank
	Infrastructure quality	WEF GCI
Trade performance	Trade as share of GDP	World Bank
	Index number of industrial production	UNIDO
	Index value, manufacturing value added	UN National Accts.
	Goods exports as % GDP	IMF
Investment	Greenfield investments	UNCTAD
	FDI stocks and flows, % GDP 10-year trend	UNCTAD
	FDI Inflows, % GDP 10-year trend	UNCTAD
Certification and accreditation	# of ISO certificates in industrial sectors	ISO
	ISO 9000/GDP PPP \$bn	ISO

### *Executive Opinion Survey*

1. To what extent does foreign direct investment bring new technology into your country? [1 = not at all; 7 = to a great extent]
2. In your country, on what basis do buyers make purchasing decisions? [1 = based solely on the lowest price; 7 = based on sophisticated performance attributes]
3. In your country, how successful are domestic companies at building international brands? [1 = not successful at all; 7 = extremely successful]
4. In your country, how successful are companies in using marketing to differentiate their products and services? [1 = not successful at all; 7 = extremely successful]
5. In your country, to what extent do non-tariff barriers (e.g. health and product standards, technical and labelling requirements, etc.) limit the ability of imported goods to compete in the domestic market? [1 = strongly limit; 7 = do not limit at all]
6. In your country, how efficient are customs procedures (related to the entry and exit of merchandise)? [1 = extremely inefficient; 7 = extremely efficient]
7. In your country, how restrictive are rules and regulations on foreign direct investment? [1 = extremely restrictive; 7 = not restrictive at all]
8. In your country, to what extent do taxes reduce the incentive to invest? [1 = to a great extent; 7 = not at all]



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