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Decent work and digitalization in the chemical and pharmaceutical industries

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Issues paper for the Global Dialogue Forum on Challenges for Decent and Productive Work Arising from Digitalization in the Chemical and Pharmaceutical Industries
(Geneva, 10–12 December 2018)

Geneva, 2018

INTERNATIONAL LABOUR OFFICE, GENEVA

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Background

At its 332nd Session (March 2018) the Governing Body of the International Labour Office decided that the Global Dialogue Forum on Challenges for Decent and Productive Work Arising from Digitalization in the Chemical and Pharmaceutical Industries should take place in Geneva on 10–12 December 2018. The Forum will discuss opportunities and challenges for decent and productive work arising from digitalization and other new technologies in the chemical and pharmaceutical industries, with the aim of adopting points of consensus, including recommendations for future action by the International Labour Organization (ILO) and its Members. With regard to the composition of the Meeting, the Governing Body decided to invite all interested governments and that eight Worker participants and eight Employer participants would be appointed on the basis of nominations made by the respective groups of the Governing Body. Selected intergovernmental organizations and non-governmental organizations would be invited as observers. [1]

[1] GB.332/POL/2, para. 11.

1. The chemical and pharmaceutical industries today

1. Chapter 1 provides a snapshot of the chemical and pharmaceutical industries. The chapter offers an overview of the industries and their structure, presents data on global production and sales, and identifies employment trends and decent work challenges in the industries today.

1.1. Overview and structure of the industries

2. The chemical and pharmaceutical industries are important to the economic development of all ILO member States and are key to the achievement of the 2030 Agenda for Sustainable Development. Providing decent and productive work for workers in the industries relates, in particular, to Sustainable Development Goal 8, to "Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all".

3. Chemical and pharmaceutical products are used everywhere: from manufacturing to make-up, from food production to medicine, and beyond. The two industries are closely linked and the borders between the chemical and pharmaceutical industries, and between other industries, services and agriculture, are becoming increasingly blurred. For the purposes of this Meeting, the ILO defines the chemical and pharmaceutical industries as classified in the United Nations International Standard Industrial Classification of All Economic Activities (ISIC), Revision 4. [1]

4. Both the chemical and the pharmaceutical industries are dominated in terms of sales volume by large domestic enterprises and multinational enterprises (MNEs). Of the two industries, small and medium-sized enterprises (SMEs) have a stronger presence in the chemical industry. For example, in Europe, SMEs account for 96 per cent of the 29,000 publicly traded chemical companies, 37 per cent of jobs and 30 per cent of sales. [2]

5. In the pharmaceutical industry, production is heavily concentrated in a relatively small number of large companies. While large companies also account for the majority of investment in research and development (R&D), SMEs still play a driving role in innovation. In 2017, drug approvals for SMEs in the European Union (EU) and the United States exceeded those of big pharmaceutical companies, representing 51 per cent of all approvals. [3] In the EU, a total of 1,893 SMEs had been registered by the end of 2017, following a steady increase over the last decade from 246 SMEs in 2007. [4] Nevertheless, many new medicines

[1] ISIC Rev.4, classifies chemical manufacture under Division 20, "Manufacture of chemicals and chemical products", including the manufacture of a range of subcategories of chemical products. Pharmaceuticals manufacturing is classified under Division 21, "Manufacture of pharmaceuticals, medicinal chemical and botanical products".

[2] ICIS: "Chemical SMEs defined by numbers", in *ICIS Chemical Business* (Sutton, Surrey), 19 July 2010.

[3] NDA: *Europe vs USA: new drug product approvals in 2017* (2018).

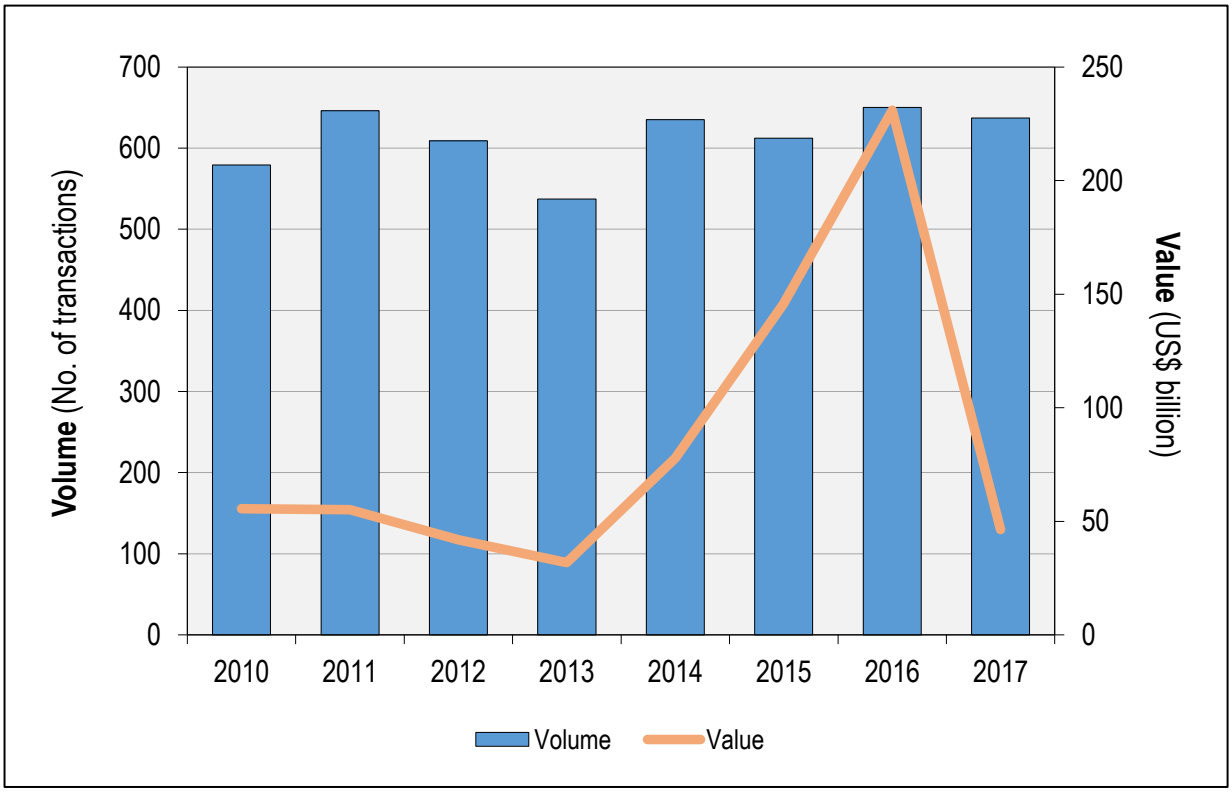
[4] The European Medicines Agency: *SME Office annual report 2017* (London, 2018).

under development by European SMEs do not reach the stage of making marketing authorization applications. [5]

6. Mergers and acquisitions (M&A) have long been used by the companies in the industries in order to grow, change strategic direction or consolidate their operations within different segments of the industry. In the chemical industry, slow sales growth, pressure on profit margins and sluggish capital market returns are among the trends which have driven a record level of M&A in recent years. However, M&A activity appears to have peaked in 2016 (figure 1). In 2017, while the volume of M&A activity was only slightly below that of 2016, a lack of so-called "megadeals" meant a steep decline in the total value of transactions. [6]

7. M&A activity has also been high in the pharmaceutical industry in recent years. While the total number of deals in the industry peaked in 2015, the sum of published deals values reached a high in 2017 due to several large deals (figure 2). [7]

Figure 1. Global chemical merger and acquisitions activity (2010–17)



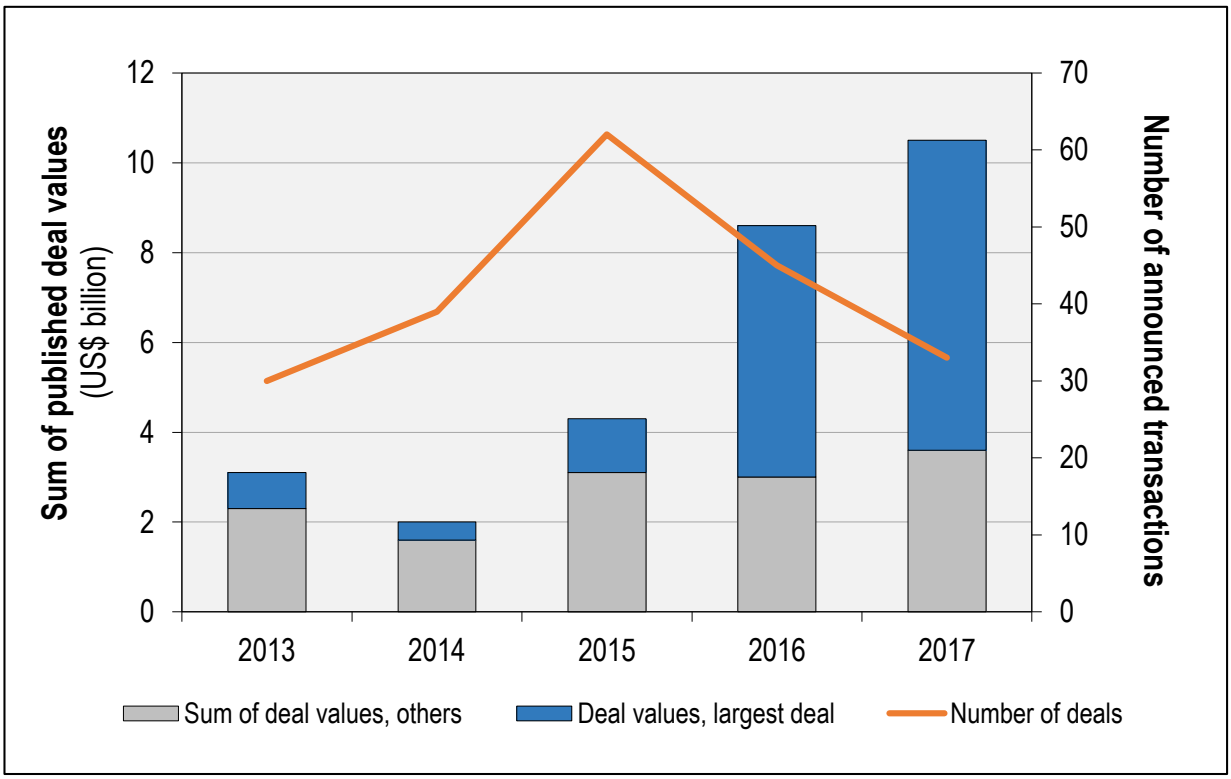
Source: Deloitte: *2018 Global chemical industry mergers and acquisitions outlook: In search of growth* (2018).

[5] S. Milmo: "EMA Increases Support for SMEs", in *Pharmaceutical Technology* (Vol. 41, Issue 8, 2017).

[6] G. Gryzwa et al.: *Managing M&A in chemicals: Meeting the new challenges* (McKinsey & Company, 2018).

[7] Kurmann Partners: *Pharma M&A Report 2018* (Basel, 2018); E. Platt, J. Espinoza and D. Weinland: "Record 'megadeals' push global takeovers beyond $1.2tn", in *The Financial Times*, 29 Mar. 2018.

Figure 2. Global pharmaceutical merger and acquisitions activity (2013–17)



Source: Kurmann Partners: *Pharma M&A report* (2018).

1.2. Global production, sales and world trade

8. According to the United Nations Industrial Development Organization's (UNIDO) *Industrial Development Report 2018*, the manufacture of chemicals and chemical products (including pharmaceuticals) represents 12.6 per cent of the global share of manufacturing value added, making chemicals the second biggest manufacturing industry after food products and beverages. [8]

9. In 2016, total world chemical industry sales were valued at €3,360 billion. World chemical sales almost doubled between 2006 and 2016, with much of this growth taking place in emerging countries. In recent years, however, growth in the industry has slowed, to just 0.4 per cent between 2015 and 2016. [9]

10. Global chemical sales are concentrated among relatively few countries, with the top 30 producers accounting for 91.2 per cent of sales (figure 3). Chemical sales have gradually shifted away from Europe and North America towards Asia. Over the decade to 2016, the EU's share of sales fell by 12.9 percentage points and the share of the countries making up the North American Free Trade Agreement (NAFTA) fell by 8.4 percentage points (figure 4). China now dominates the global market, accounting for 39.6 per cent of sales in 2016. [10]

[8] UNIDO: *Industrial Development Report 2018: Demand for manufacturing: Driving inclusive and sustainable industrial development* (Vienna, 2017).

[9] The European Chemical Industry Council (Cefic): *Facts and figures 2017 of the European chemical industry* (Brussels, 2017).

[10] ibid.

Figure 3. Chemical sales by country: Top ten, 2016

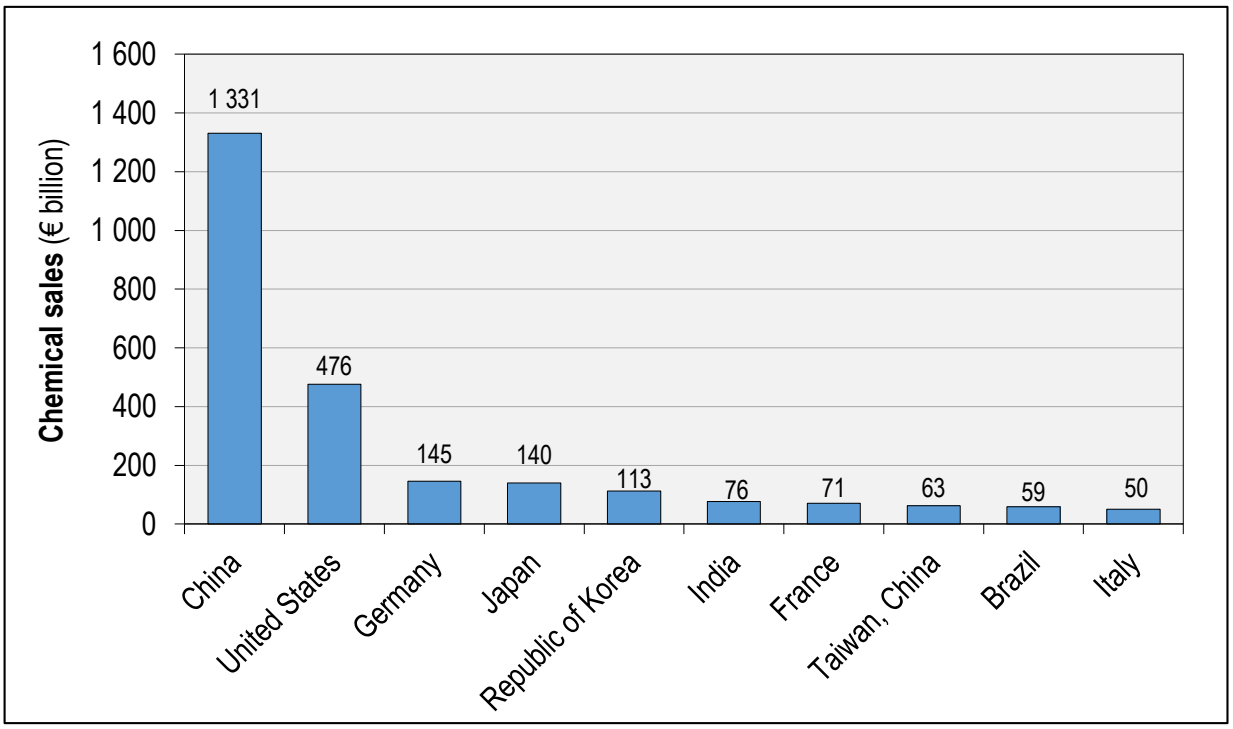
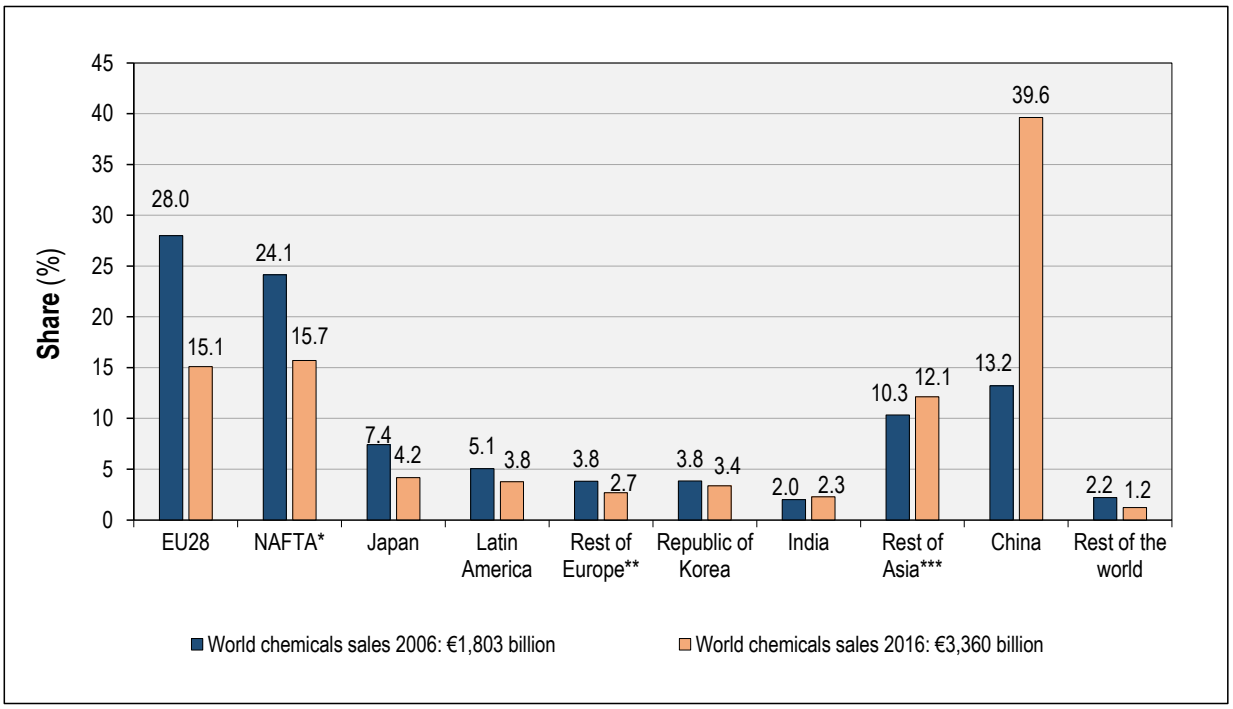


Figure 4. World chemical sales by region and selected countries, 2006 and 2016



* North American Free Trade Agreement covers Canada, Mexico and the United States. ** Rest of Europe covers Norway, Switzerland, Russian Federation, Turkey and Ukraine. *** Rest of Asia excludes China, India, Japan and the Republic of Korea.
Source for figures 3 and 4: European Chemical Industry council (Cefic): *Facts and figures 2017 of the European chemical industry* (Brussels, 2017).

11. In terms of trade, the EU remains the world's largest importer and exporter of chemicals with a 49.1 per cent share of world exports and a 39.8 per cent share of world imports. Other major exporters and importers of chemicals include China, Japan, Switzerland and United States. [11]

Table 1. Top ten exporters and importers of chemicals, 2016 (billion dollars and percentage)

	Value	Share in world exports/imports				Annual percentage change			
	2016	2000	2005	2010	2016	2010–16	2014	2015	2016
Exporters									
European Union (EU28)	895	54.1	55.3	50.5	49.1	1	3	-10	-1
extra EU28 exports	347	18.6	18.4	18.1	19.1	2	2	-5	-1
United States	197	13.7	10.9	11.1	10.8	1	1	-3	-4
China [a]	124	2.1	3.2	5.2	6.8	6	12	-4	-4
Switzerland	96	3.6	4.0	4.3	5.3	5	7	-5	9
Japan	65	6.0	4.8	4.6	3.6	-3	-5	-13	4
Korea, Republic of	59	2.4	2.5	2.9	3.2	3	2	-13	0
Singapore	46	1.6	2.4	2.3	2.5	3	6	-11	-2
India	37	0.7	1.0	1.4	2.0	8	3	-3	2
Canada	34	2.5	2.4	2.0	1.9	1	0	-3	-7
Chinese Taipei	30	1.6	1.8	2.1	1.6	-3	0	-17	-9
Above ten	**1 583**	**88.3**	**88.2**	**86.3**	**86.8**	**–**	**–**	**–**	**–**
Importers									
EU28	758	44.0	45.6	41.7	39.8	1	4	-11	0
extra EU28 imports	204	10.4	10.3	10.4	10.7	2	5	-6	-1
United States	221	12.2	11.4	10.1	11.6	4	6	4	0
China [a]	163	4.9	6.7	8.5	8.6	2	1	-11	-4
Japan	66	4.2	3.3	3.5	3.5	1	-3	-2	6
Switzerland	46	2.1	2.3	2.1	2.4	4	4	-13	10
Canada [b]	43	3.2	2.8	2.4	2.3	1	1	-7	-4
India	43	0.8	1.2	2.0	2.3	4	8	-3	-8
Korea, Republic of	43	2.2	2.1	2.3	2.2	1	1	-8	-2
Mexico [a], [b]	41	2.4	2.1	1.9	2.2	3	6	-6	-4
Brazil [b]	34	1.6	1.3	1.8	1.8	1	0	-16	-10
Above ten	**1 459**	**77.6**	**78.7**	**76.4**	**76.6**	**–**	**–**	**–**	**–**

[a] includes significant shipments through processing zones.

[b] imports are valued f.o.b.

Source: World Trade Organization: *World Trade Statistical Review 2017* (Geneva, 2017), table A19.

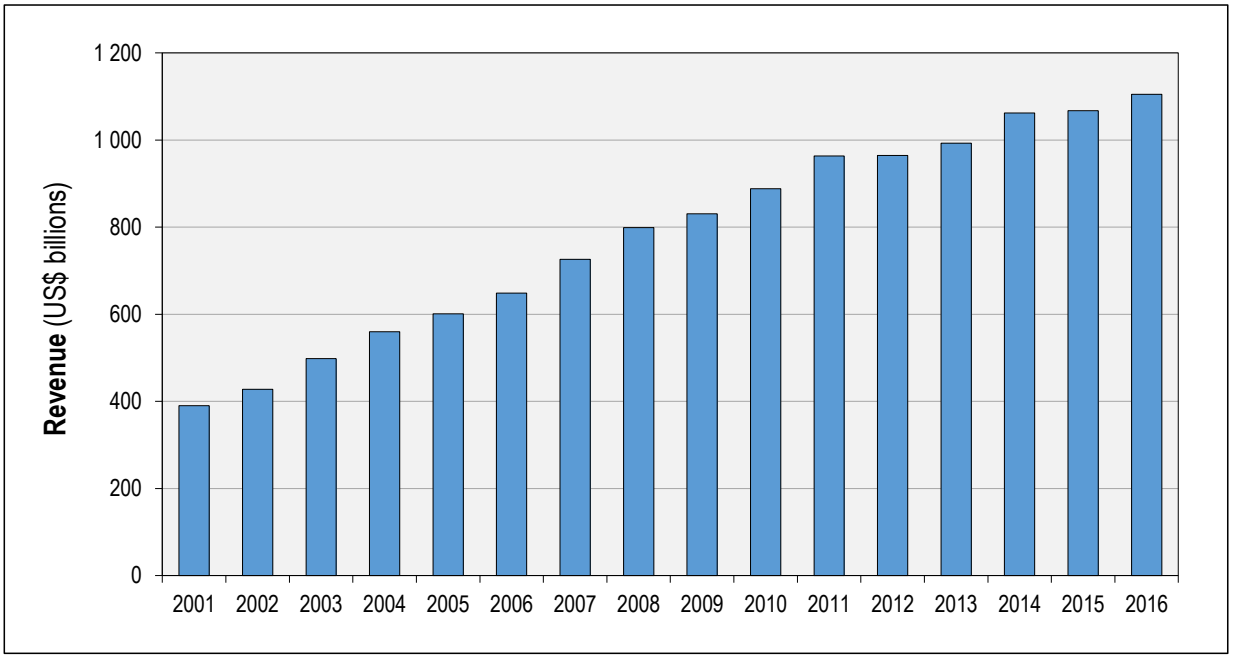
12. The global pharmaceutical market was valued at US$1,105 billion in 2016. Growth in global pharmaceutical sales is generally higher than in the chemical industry, driven partially by growing markets in emerging countries and demographic trends towards ageing populations

[11] World Trade Organization: *World Trade Statistical Review 2017* (Geneva, 2017), table A19.

in developed countries. Despite growth in emerging markets, spending on pharmaceuticals remains heavily concentrated in developed countries, which accounted for 68 per cent of total industry sales revenue in 2016. Moreover, the United States alone accounted for 41.8 per cent of pharmaceutical sales. [12]

13. Pharmaceutical manufacture, import and export are heavily concentrated within the EU, the United States and Switzerland. [13] While only the sixth biggest importer in 2017, China has been a rapidly growing market for pharmaceutical products, growing 67.3 per cent between 2013 and 2017. [14]

Figure 5. Revenue of the worldwide pharmaceutical market, 2001–16 (US$ billions)



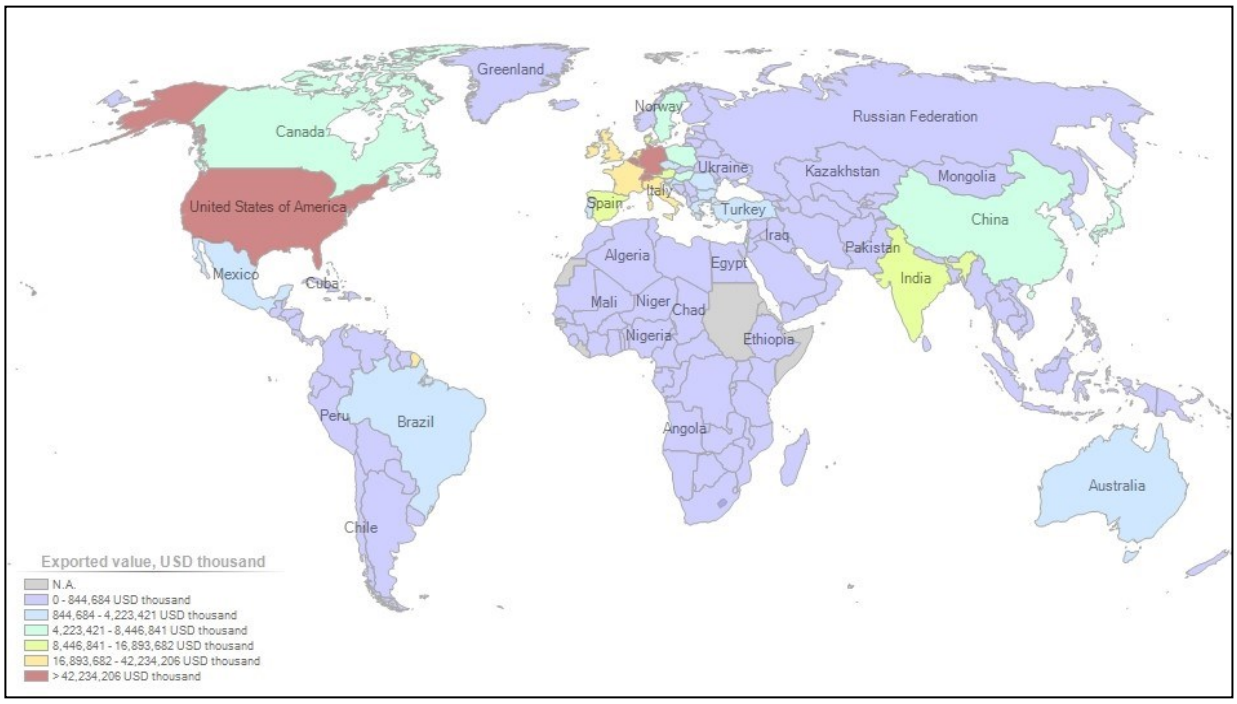
Source: Statista.

[12] EvaluatePharma: *World Preview 2017, Outlook to 2022* (London, 2017); International Federation of Pharmaceutical Manufacturers and Associations (IFPMA): *The pharmaceutical industry and global health: Facts and figures 2017* (Geneva, 2017), p. 52.

[13] ibid.

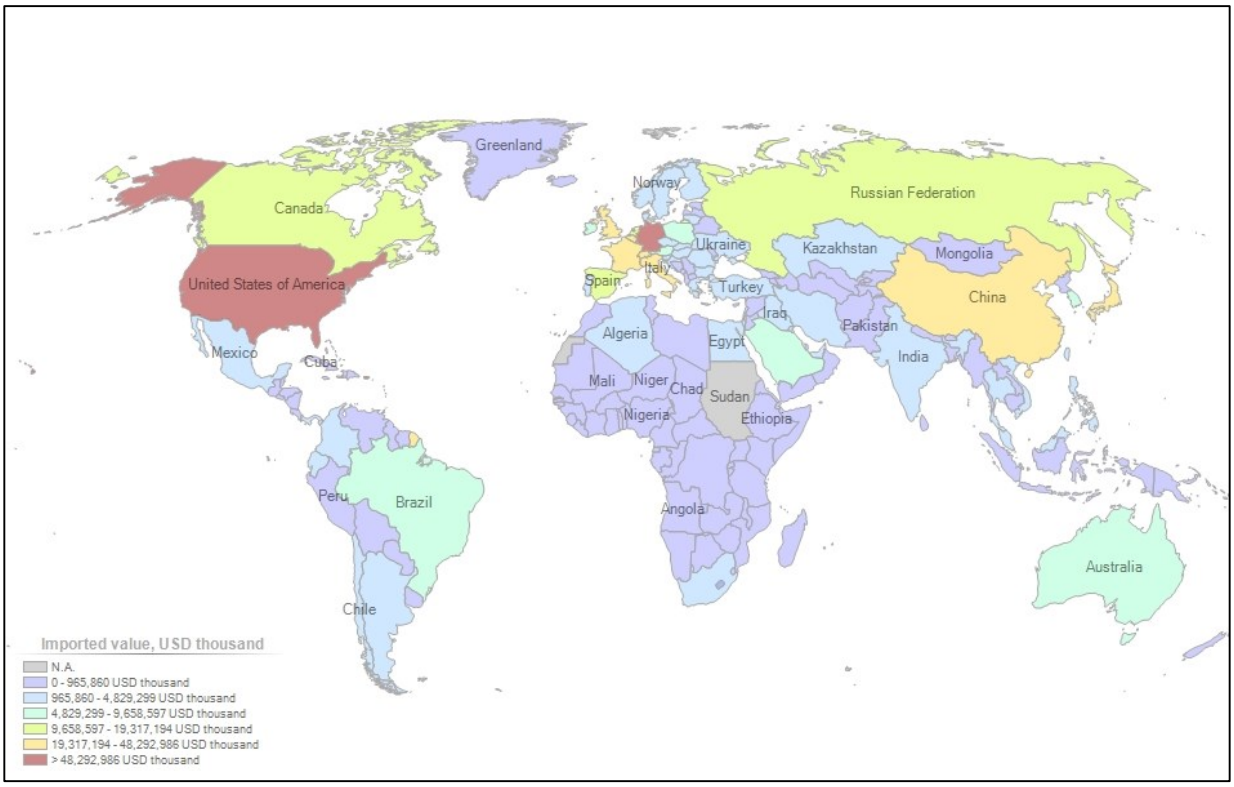
[14] International Trade Centre: *International trade statistics 2001-2017*.

Figure 6. Global exporters of pharmaceutical products, 2001–17



Source: International Trade Centre: International trade statistics 2001–17.

Figure 7. Global importers of pharmaceutical products, 2001–17



Source: International Trade Centre: International trade statistics 2001–17.

1.3. Global employment

14. Global data on employment in the chemical and pharmaceutical industries is scarce. However, the ILO estimated in 2013 that over 20 million people worked in the sectors worldwide. [15] According to the most recently available ISIC Rev.4 data, which provides employment data in the chemical and pharmaceutical industries for between 42 and 69 countries and areas, total employment in the industries in these countries was estimated at over 13 million in 2014. [16]

Table 2. Employment in the chemical and pharmaceutical industries (ISIC Rev.4), selected countries, 2013 and 2014

	2013	Number of countries and areas	2014	Number of countries and areas
ISIC 201: basic chemicals, fertilizers, etc.	5 017 228	70	4 852 646	69
ISIC 202: other chemical products	3 892 896	44	4 041 437	42
ISIC 2100 : pharmaceuticals, medicinal chemicals, etc.	4 142 229	67	4 287 072	68
Grand total	**13 052 353**		**13 181 155**	

Source: UNIDO: INDSTAT 4 2018, ISIC Rev.4.

15. According to the International Federation of Pharmaceutical Manufacturers & Associations (IFPMA), employment in the pharmaceutical industry has increased steadily in recent years, rising by almost 39 per cent over the period 2006–14, and leading pharmaceutical producers have seen significant growth in employment. [17] In 2014, the industry employed over 5 million people worldwide. In the EU, employment increased over 34 per cent between 2000 and 2016, from 554,186 to an estimated 745,000. [18]

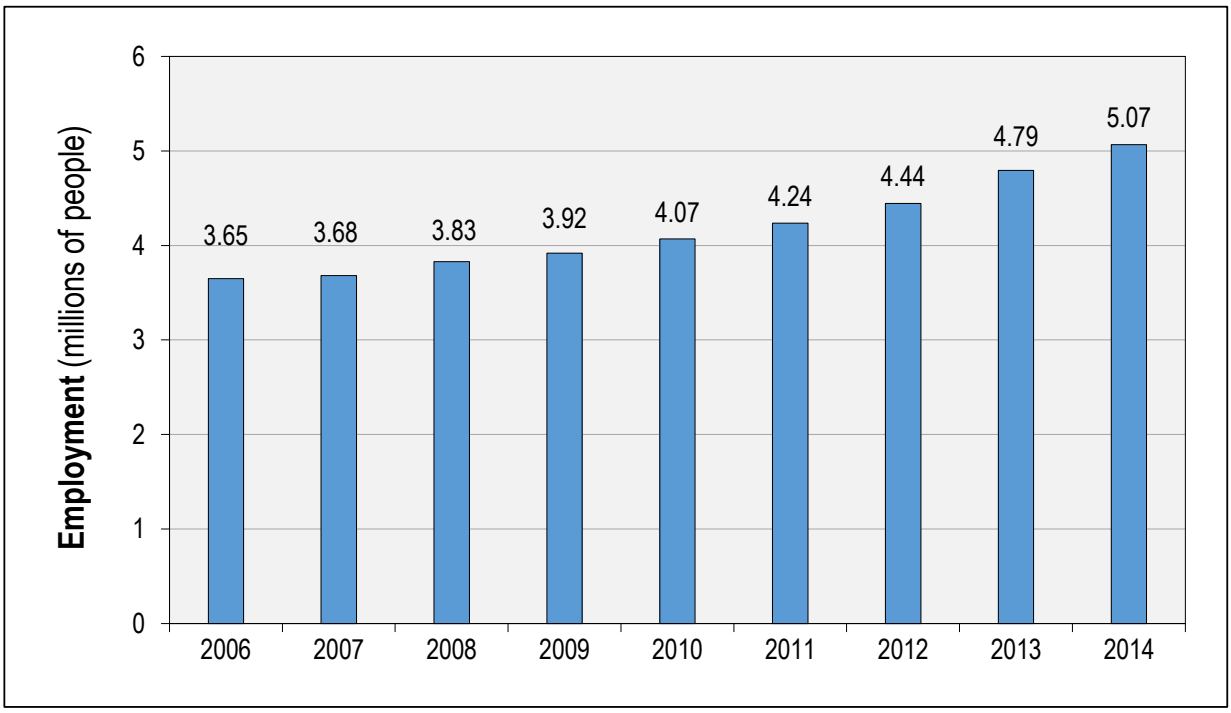
[15] This was estimated in 2010, using UNIDO's Industrial Statistics Database (INDSTAT) 2, ISIC Rev.2, including employment in the chemical, pharmaceutical, and tyre and rubber sectors. ILO: *Promoting decent work in the chemical industry: Innovative initiatives: Issues paper for discussion at the Global Dialogue Forum on Initiatives to Promote Decent and Productive Work in the Chemical Industry (Geneva, 26−28 November 2013)* (Geneva, 2013), para. 11.

[16] UNIDO: INDSTAT 4 2018, ISIC Rev.4.

[17] IFPMA: *The pharmaceutical industry and global health: Facts and figures 2017* (Geneva, 2017).

[18] European Federation of Pharmaceutical Industries and Associations: *The pharmaceutical industry in figures: Key data 2017* (Brussels, 2017).

Figure 8. Employment in the global pharmaceutical industry, 2006–14



Source: IFPMA: *The pharmaceutical industry and global health: Facts and figures 2017* (Geneva, 2017).

1.3.1. Reported decent work challenges in the industries

16. Work in the chemical and pharmaceutical industries is mostly formal and generally requires workers with a high level of education and training. Consequently, wages are generally higher than in other manufacturing industries. At the same time, a number of decent work challenges have been reported in the chemical and pharmaceutical industries. The Conclusions on the Tripartite Meeting on Promoting Social Dialogue on Restructuring and its Effects on Employment in the Chemical and Pharmaceutical Industries (2011) and the points of consensus of the Global Dialogue Forum on Initiatives to Promote Decent and Productive Work in the Chemical Industry (2013) recognized that:

- shortages of workers with the scientific, technical and productive skills required by the chemical and pharmaceutical industries represent a major challenge which demands greater and ongoing investment in vocational education and training (VET) to ensure future sustainability;
- there is a need for structured training and upskilling for employers and workers, including for workers employed by SMEs;
- social protection should be extended to all workers, irrespective of contractual status and enterprise size;
- SMEs require simple guidelines to meet their occupational safety and health (OSH) obligations, without additional burden, to improve risk management and OSH training;
- female participation rates are improving, but there is a need to promote gender equality and work–life balance within the industries;

- where the use of contract and agency labour and other flexible working practices deviates from standard employment contracts, national OSH laws, regulations and good practices must be in place in accordance with international labour standards; and

- the elimination of corruption is an important element in promoting decent and productive work in the industries.

2. Digitalization and other drivers of change

17. The chemical and pharmaceutical industries have undergone considerable change in recent years, shaped by several key megatrends and drivers. This chapter provides a brief discussion of how digitalization and technological change, in addition to other drivers such as globalization, demographics and climate change, are likely to continue to affect chemical and pharmaceutical production, creating new opportunities and challenges for the industries.

2.1. Digitalization

18. Technology has long been a driver of change and progress within the chemical and pharmaceutical industries. In the past, waves of technological change, such as process control, material requirements planning and enterprise resource planning have worked their way through the industries, requiring employers and workers to adapt to new circumstances. When new technologies are introduced, there is often a knock-on impact on the organization of the industries, as well as on the working conditions and the occupations of workers. [1]

19. In the coming years, a range of digital technologies are likely to have a transformative effect on both production and work in the industries. The digitalization of manufacturing industries – elements of which are referred to as "Industry 4.0" [2] – is already under way and has begun to create new possibilities for collaboration, production, organization of companies and the sale of goods and services. [3]

20. Introducing digitalization to chemical and pharmaceutical manufacturing could provide opportunities for employers in terms of improved productivity, efficiency, reduced risk and lower costs. Digitalization and other new technologies are also expected to help promote shorter times to market for new products, enable highly specified product customization and help generate additional revenue streams. [4]

21. Investment in digital technology in the industries is relatively inexpensive, particularly for MNEs, which are used to making large investments in fixed assets. [5] The potential for future investment in this area is also strong: in the chemical industry, only 23 per cent of industry executives rated their companies as "above" or "well above" average in comparison to their competitors. [6] Meanwhile, in the pharmaceutical industry, digitalization has progressed faster in research laboratories than in production plants. The relatively low costs and high

[1] D. A. Crow: "Riding the Waves: The Changing Role of Information Technology in the Chemical Industry", in P. H. Spitz (ed.): *The Chemical Industry at the Millennium: Maturity, Restructuring, and Globalization.*

[2] IndustriALL Global Union: *The Challenge of Industry 4.0 and the Demand for New Answers* (Geneva, 2017).

[3] The Federal Ministry of Labour and Social Affairs of the Government of Germany: *White Paper: Work 4.0: Re-imagining work* (Berlin, 2017).

[4] R. Geissbauer et al.: *Industry 4.0: Building the digital enterprise*, 2016 Global Industry 4.0 Survey (PWC, 2016).

[5] H. Finch: "Embracing the digital revolution", in *ICIS Chemical Business* (28 Nov.–4 Dec. 2016).

[6] J. Chen: "Digitalization to gain momentum: German companies leading digital maturity", in *IHS Chemical Week* (5–12 June 2017).

performance of digital technologies have reached levels that are enabling and even necessitating their adoption throughout the industries. [7] Chemical and pharmaceutical companies have recently announced major investments in digitalization. For instance, the partnership of Evonik Industries with IBM and the University of Duisburg-Essen resulted in the allocation of €100 million in 2017 for the development and testing of digital technologies and the development of digital skills by 2020. [8] A further example is the strategic partnership of Novartis with Google, which aims to develop contact lenses that monitor blood sugar levels to help correct patients' vision. [9]

2.1.1. *Application of digitalization and other new technologies in the industries*

22. In the chemical and pharmaceutical industries, automation is already highly advanced in much of the production process. In the chemical industry specifically, automation technology has been an integral part of production since the industrial revolution and much of the potential for automation has already been realized. [10] Nevertheless, variations exist in the level of automation used, depending on the location, type of production, type of occupation and tasks, and place in the value chain.

23. It is therefore important to distinguish between more "traditional" automation and newer phenomena such as digitalization and other innovative technologies, including cyber-physical systems, advanced sensor technologies, the Internet of Things (IoT), cloud computing, quantum computing, 3D printing, advanced analytics and artificial intelligence. [11] In countries and regions where chemical and pharmaceutical plants are already automated, these technologies may yet have a transformative effect on work in the industries. In certain instances, digital technologies may combine with existing systems to further automate the production process.

24. Digital technologies are not typically implemented in isolation but instead in integrated systems. They often build upon, and are introduced alongside, existing technology. For example, BASF has used digital applications in implementing connected systems and advanced analytics models, for "predictive asset management, process management control, and virtual plant commissioning". At the same time, BASF has also used digitalization to fully automate mass production of highly customized liquid soaps, so that when a customer places an order, radio frequencies inform manufacturing equipment of the desired specifications of the soap and its packaging via wireless connections. [12]

[7] S. Van Thienen et al.: *Industry 4.0 and the chemicals industry: Catalyzing transformation through operations improvement and business growth* (Deloitte, 2016).

[8] Evonik: *Evonik allocates €100 million for digitalization and enters into cooperation with IBM and the University of Duisburg-Essen*.

[9] World Economic Forum: *World Economic Forum White Paper Digital Transformation of Industries: In collaboration with Accenture* (Geneva, 2016).

[10] H. Schuler: "Automation in Chemical Industry" *(Automatisierung in der Chemischen Industrie)* in at-Automatisierungstechnik (54(8/2006)), pp. 363–371.

[11] Van Thienen et al., op. cit.

[12] ibid., see also BASF*: BASF cooperates with partners to introduce online control of complex batch processes* (25 Mar. 2016).

25. This marriage of information technology and operational technology in cyber-physical systems is often referred to as "smart manufacturing". Central to smart manufacturing in chemical and pharmaceutical production is the use of the IoT with advanced sensors in production equipment and the products that they make. This enables real-time information about operational status, the condition of equipment and the products themselves to feed back into the production process. [13] In the pharmaceutical industry smart manufacturing has the potential to enable manufacturers to better track and trace products, recall them in the case of fault, and improve product design and consumer safety. [14]

26. In addition to the manufacturing applications, digitalization could also help chemical and pharmaceutical firms to manage their supply chains, improve visibility in supply chains, and reduce risk to companies and workers. For example, vehicles transporting hazardous substances can be fitted with GPS trackers and sensors measuring the physical properties of the cargo. The system generates alerts when the vehicle nears its destination, is involved in a collision, or when the physical properties of the cargo change, helping to ensure the safe transit of hazardous chemicals. Furthermore, artificial intelligence and advanced analytics tools can be used to help chemical and pharmaceutical companies predict demand patterns and alter their supply chain and manufacturing operations accordingly. [15]

27. Digitalization has an extensive scope, and the range of applications of new technologies is not limited to the cases above. Other examples of new technologies with the potential to impact the sector include the use of 3D printing, which is enabling pharmaceutical companies to manufacture or develop new drugs for which the release profile of the active ingredients is tailored to the needs of the individual patient; or quantum computing, which could help scientists better understand and develop catalysts in the chemical industry. [16] Furthermore, blockchain technology, which is currently being developed in the pharmaceutical industry, can enable pharmaceutical companies to manage supply chains more efficiently by collecting a reliable leger of information on medicines – from where they are manufactured to delivery to the patient. [17]

2.2. Other drivers of change

28. Digitalization and other technological advances should not be seen in isolation, but as part of a broader set of drivers of change and megatrends that will shape the future of productive employment and decent work in the chemical and pharmaceutical industries. These drivers of change include globalization, demographics and climate change.

2.2.1. Globalization

29. Globalization has continued to shape the model of production and consumption in the chemical and pharmaceutical industries in the twenty-first century, as the industries have

[13] Information Technology and Innovation Foundation (ITIF): *Why manufacturing digitalization matters and how countries are supporting it* (Washington, 2018).

[14] Van Thienen et al., op. cit.

[15] ibid.

[16] R. Mullin: "Digitalization time", in *C&EN*, 2 Oct. 2017, pp. 26–30.

[17] C. Guenther et al.: *In blockchain we trust: Transforming the life sciences supply chain* (Accenture, 2018).

expanded into new markets and as supply chains have become more complex and fragmented. Furthermore, globalization has also changed competition and demand for workers in the industries. [18] In recent years, however, globalization has been met with opposing political forces: one driven by the impulse to innovate, digitalize and interconnect more and the other a compulsion to retract and retreat to protective policies. This may have heralded a new era of globalization, one that maintains considerable momentum but is qualified by uncertainty in the political and trade climate. [19]

30. In the chemical industry, globalization has resulted in increased global competition. In particular, new competitors have emerged in Asia, with China dominating the market and India solidifying its place as a major producer (see section 1.2). Overall growth in the market is sluggish, and apart from China, Japan and some emerging countries in Asia, most major chemical-producing countries, including the EU countries and the United States, are experiencing low or negative growth and declining market shares. [20]

31. With many chemical producers experiencing slow growth in their own countries, chemical companies both large and small have looked towards foreign markets to achieve growth or address concerns of competitiveness. This is also one of the key reasons for the growth in global and cross-border M&A activity. [21] Forecasts for future M&A activity range from optimistic – with global economic conditions improving and firms continuing to pursue growth and transformation through M&A – to more cautious estimates that the current M&A cycle may have peaked, with future deals set to become more complex and a growing number of executives expecting a drop in activity. [22]

32. In the pharmaceutical industry, production remains clustered in developed countries – where patents have been filed, where there is access to a highly skilled workforce, and where close relationships have been established with universities for R&D and innovation purposes. At the same time, the pharmaceutical industry has grown in emerging markets, largely as a result of rapid economic growth and expanding health-care sectors. While the short-term outlook of these markets appears uncertain, their value is expected to double from around US$245 billion in 2015 to approximately US$490 billion in 2025. [23] Though the industry is still dominated by United States and European companies, firms such as Sun Pharma from India, Celltrion and Hanmi from the Republic of Korea, Hengrui Pharma and Fosun Pharma

[18] ILO: *Restructuring, employment and social dialogue in the chemical and pharmaceutical industries: Report for discussion at the Tripartite Meeting on Promoting Social Dialogue on Restructuring and its Effects on Employment in the Chemical and Pharmaceutical Industries* (Geneva, 2011), p. 93.

[19] Baker McKenzie: *Globalization 3.0: How to survive and thrive in a new era of trade, tax and political uncertainty* (Chicago, 2018).

[20] Deloitte: *2018 Global chemical industry mergers and acquisitions outlook: In search of growth* (London, 2018).

[21] Deloitte: *2015 Global chemical industry mergers and acquisitions outlook: The momentum continues* (London, 2015).

[22] Deloitte, 2018, op. cit.; A. T. Kearney: *Chemicals Executive M&A Report 2018* (Chicago, 2018).

[23] McKinsey & Company: *What's next for pharma in emerging markets?* (June 2017).

from China, and EMS Pharma from Brazil have aspirations to compete with the current global leaders. [24]

33. Although the future of the world economy is unpredictable, and while the global trading system has come under increasing pressure, it is expected that the chemical and pharmaceutical industries will remain highly globalized, and that production will take place through increasingly complex value chains, organized in high-tech zones or clusters, with emerging markets playing an increasingly important role.

2.2.2. Demographics

34. Changing demographics are likely to influence consumption patterns and demand for products in the industries. Predicting and reacting to these shifts in consumer and business demand provides opportunities and challenges to the industries and their workforces.

35. The United Nations forecasts that the world population will reach 8.6 billion in 2030 and almost 10 billion by 2050. Most of this growth will be attributable to just nine countries [25] which, with the exception of the United States, are all emerging and developing countries. Lower fertility rates are expected to lead not only to a slower pace in population growth, but also an ageing population. Furthermore, the global middle class is expected to grow substantially, from around 3.2 billion people currently to 5.4 billion by 2030. [26]

36. In the pharmaceutical industry, longer life expectancies and urbanization, among other factors, could mean increased demand for treatment for chronic diseases. Meanwhile, changes in lifestyles in emerging markets are expected to lead to greater incidences of non-communicable diseases, such as diabetes and cardiovascular problems. [27]

37. In addition, the industries have experienced ageing workforces. The existing talent-acquisition model for the industry means that graduates are typically recruited from a select few universities. Once hired, graduates are usually developed internally. Mid-career professionals are generally only recruited when specific skill shortages arise. Companies are finding it increasingly difficult to hire new workers and, as mature workers reach retirement age, there is a risk of losing their expertise and skills without passing them on to a new generation of workers. [28]

[24] A. Gautam and X. Pan: "The changing model of big pharma: impact of key trends", in *Drug Discovery Today* (Vol. 21, Issue 3, Mar. 2016).

[25] India, Nigeria, the Democratic Republic of the Congo, Pakistan, Ethiopia, United Republic of Tanzania, United States, Uganda and Indonesia (ordered by their expected contribution to total growth).

[26] United Nations Department of Economic and Social Affairs: *World Population Prospects: The 2017 Revision: Key Findings and Advance Tables* (New York, 2017); United Nations: *Amid Rampant Overconsumption, Responsible Food, Clothing Habits Key to Achieving 2030 Agenda, High-Level Political Forum Hears, as Ministerial Segment Begins* (New York, 2018).

[27] World Health Organization: *Noncommunicable diseases* (June 2018); The World Bank: *How does an Aging Population Affect a Country?* (Washington, 2016).

[28] Deloitte: *The talent imperative in the global chemical industry* (London, 2015); Chemical Industry Journal: *Future-proofing the industry by combatting skills shortages*.

2.2.3. Climate change

38. Climate change has the potential to transform the chemical and pharmaceutical industries as global efforts intensify to adapt to and mitigate its effects. Driven in part by the impact that past industrial accidents have had on the environment and in part by concerns about chemical and consumer safety, the chemical and pharmaceutical industries are already among the most heavily regulated industries. Climate change is likely to have an impact on the type of chemical and pharmaceutical products that consumers demand in the future and to result in additional regulatory demands on producers to reduce the industries' environmental footprint.

39. While many people associate the chemical industry with pollution and environmental issues, there is potential for the industries to greatly contribute to addressing climate change and to provide the materials with which to develop sustainable infrastructure in the future. [29] There is a growing awareness of the environmental issues related to chemical production and a growing demand from the industry and consumers for green and environmentally friendly products and production systems. According to the European Commission's Joint Research Centre, the chemical industry, driven by innovative energy technologies, could cut annual greenhouse gas emissions by 72.5 Mt of CO2, equivalent to a 36 per cent reduction. [30] Likewise, growing concerns about the 8 million metric tonnes of plastic that enters the world's oceans every year is also changing demand and supply in the plastics industry. [31]

40. While the ecological footprint of the pharmaceutical industry is generally lower than that of the chemical industry, much can still be done to reduce emissions in production, and many pharmaceutical firms have made commitments to do so. Moreover, climate change, increasing global temperatures, extreme weather events and natural disasters pose significant public health risks. In addition to these direct risks, higher temperatures and changes in precipitation have indirect consequences, including increased prevalence of vector-borne diseases such as malaria and dengue, and water-borne diseases such as cholera. These factors are likely to drive an increased demand for pharmaceutical products. [32]

[29] IndustriALL Global Union: *IndustriALL Global Union Sectoral Sustainability Report* (Geneva, 2016).

[30] A. Boulamanti and J. A. Moya: *JRC science for policy report: Energy efficiency and GHG emissions: Prospective scenarios for the Chemical and Petrochemical Industry* (European Commission, Brussels, 2017).

[31] A. H. Tullo: "Fighting ocean plastics at the source", in *Chemical and Engineering News* (Vol. 96, Issue 16, April 2016).

[32] N. Watts et al.: "Health and climate change: policy responses to protect public health", in *The Lancet* (Vol. 386, Issue 10006, 2015), pp. 1861–1914; Pharmaceutical Technology: *How can the pharma industry fight climate change?* (13 Mar. 2016).

3. Challenges and opportunities for decent and productive work

41. This chapter examines how digitalization and technological change are generating opportunities and challenges for decent and productive work in the chemical and pharmaceutical industries. Many of the issues discussed in the chapter are already challenging the industries today, while others might be faced by the industries in the near future or looking further ahead. By understanding these issues, governments, employers and workers may better prepare themselves to manage the challenges of digitalization and seize the opportunity to shape the future of work in the industries.

3.1. Employment

3.1.1. Jobs lost, jobs gained and jobs remaining

42. Literature on the impact that digitalization will have on jobs in the industries is scarce. However, the studies published to date on the impact of digitalization on jobs in the wider economy, and in manufacturing in general, provide insights into how the industries might be affected. At the centre of the debate is the trend that middle-skilled tasks and occupations, in addition to lower-skilled activities, could increasingly be automated. This includes tasks ranging from bookkeeping to product testing – "routine" tasks which may already be declining in significance within the industries. [1]

43. In recent years, studies have prompted renewed concerns that technological change might generate widespread unemployment or even create a "jobless future". [2] In a much-cited study, Frey and Osborne estimated that 47 per cent of total employment is at risk of computerization, generating considerable debate on the threat of automation to employment. [3] Using Frey and Osborne's methodology, the ILO estimated that 56 per cent of jobs are at risk in ASEAN-5 countries (Cambodia, Indonesia, the Philippines, Thailand and Viet Nam) within the next 20 years, although the risk of employment reduction due to automation differs widely across the countries. [4]

44. More conservatively, the Organisation for Economic Co-operation and Development (OECD) estimated that 9 per cent of jobs in member countries are at high risk of automation and that while there is a low risk of complete automation, a significant share (between 50 and 70 per cent) of automatable tasks are threatened. [5] McKinsey & Company estimated that while only 5 per cent of jobs may be automated entirely, 60 per cent of jobs contain at least

[1] The Federal Ministry of Labour and Social Affairs of the Government of Germany: *White Paper: Work 4.0: Re-imagining work* (Berlin, 2017).

[2] M. Ford: *Rise of the robots: Technology and the threat of a jobless future* (Basic Books, New York, 2015).

[3] C. B. Frey and M. A. Osborne: "The future of employment: how susceptible are jobs to computerisation?", in *Technological Forecasting and Social Change* (Vol. 114, 2017), pp. 254–280.

[4] J.-H. Chang and P. Huynh: *ASEAN in transformation – The future of jobs at risk of automation,* ACT/EMP Working Paper No. 9 (ILO, Bangkok, 2016).

[5] M. Arntz et al.: *The risk of automation for jobs in OECD countries: A comparative analysis* (OECD, Paris, 2016).

30 per cent of constituent activities that could readily be automated. [6] On balance, the literature suggests that technological change is likely to substitute or complement certain tasks, rather than replace entire occupations. Also, the fact that a task *might* be automatable does not necessarily mean that it *will* be automated, due to the costs and practicalities involved. Furthermore, the adoption of new technology is likely to be uneven across countries and regions, particularly between developed and developing countries.

45. As a whole, manufacturing sectors typically have a high potential for automation, as many of the component work tasks are easily automated. [7] However, as discussed in section 2.1.1, the chemical and pharmaceutical industries are already relatively advanced as far as the automation of low-skilled and medium-skilled jobs is concerned, particularly in developed economies. In developing countries, where significant numbers of workers are still employed in areas such as packaging and shipping, low-cost and low-skilled jobs might still be at risk from automation. By way of example, in Viet Nam, Duc Gian Chemical & Detergent Powder JSC recently replaced almost 90 per cent of its workforce with robots. [8] Furthermore, there may be scope for additional advanced digitalization in the industries, particularly for large MNEs operating in developed countries.

46. While low-skilled and medium-skilled workers might be threatened, higher skilled workers typically benefit the most from technological innovations and especially from new information technologies. In their aforementioned report on the risks of automation, the OECD suggests that low-qualified workers are likely to bear the brunt of the adjustment costs and that their jobs are more likely to be automated than those of more highly qualified workers. [9]

3.1.2. Skills and human resources development

47. Digitalization is expected to have profound and diverse impacts on the demand for skills in the future. [10] It is important that tripartite constituents in the chemical and pharmaceutical industries manage skills and skills shortages in order to ensure that workers and employers are best placed to benefit from the opportunities arising from digitalization.

48. Building a skilled workforce for the future involves a combination of attracting and developing new talent, reskilling existing employees through training programmes and redesigning work to minimize skills shortages between workers' capacities and employers' needs. [11] Skills shortages – which have long been identified as a challenge by employers in

[6] J. Manyika et al.: *A future that works: Automation, employment, and productivity* (McKinsey Global Institute, McKinsey & Company, 2017).

[7] J. Manyika et al.: *Jobs lost, jobs gained: Workforce transitions in a time of automation* (McKinsey Global Institute, McKinsey & Company, 2017), p. 12.

[8] IndustriALL Global Union: *The Challenge of Industry 4.0 and the Demand for New Answers* (Geneva, 2017) p. 25.

[9] Arntz et al., op. cit.

[10] ILO: *Skills policies and systems for a future workforce,* ILO Issue Brief (Geneva, 2018).

[11] G. Karacay: "Talent Development for Industry 4.0", in A. Ustundag and E. Cevikcan (eds): *Industry 4.0: Managing the Digital Transformation* (Springer, Cham, 2018), p. 123.

the industries – can threaten both the competitiveness of the industries and the employability of their workers. [12]

49. Furthermore, there is a growing gap in the need for and availability of skills across countries, due to greater investment in education and training in some countries than others. Alongside the uneven adoption of new technologies, skills gaps threaten to reinforce existing inequalities within and between regions. [13]

50. In order to fulfil the requirements of the chemical and pharmaceutical industries, there will be continued demand for workers qualified in science, technology, engineering and mathematics (STEM) disciplines and, in the increasingly digitalized industries, the demand for information and communications technology (ICT) skills is also likely to be more pronounced. [14] The chemical and pharmaceutical industries have typically relied on VET systems to provide workers with these skills. Yet established education and training systems in developed countries mean that there is currently too high a share of medium-skilled workers, and too low a share of high-skilled and STEM-qualified workers. [15]

51. Education is currently primarily directed towards students who are not yet in employment. Innovative initiatives between schools, universities, private-sector training institutes, and employers' and workers' organizations should be encouraged, in order to invest resources in skills development to meet the needs and aspirations of present and future workers, as well as the industries' changing demands. General education and VET must also stress the skills required for a just transition. Apprenticeships can provide a practical means to fill the gaps between education systems and industry needs. [16]

52. The risks of growing polarization and displacement for workers in the industries may also be addressed by bolstering the resilience of workers through reskilling and upskilling opportunities throughout their lifetimes. Currently, access to training remains highly dependent on the type of employment contract, and therefore it is often the case that those who need lifelong training the most are the ones who have the least access to it. Consequently, governments, employers and workers may consider a sustainable approach to provide workers with long-term career training.

53. Furthermore, the ageing workforce in the industries presents an additional challenge for skilling and reskilling workers. Future-oriented approaches to skills, education and training should account for the strengths and weaknesses of older workers in order to best fill the

[12] See, for example: A. M. Thayer: "Pharma Firms See a Lack of Needed Skills", in *Chemical & Engineering News* (Vol. 91, Issue 6, 11 Feb. 2013), p. 7.

[13] IndustriALL Global Union: *The Challenge of Industry 4.0 and the Demand for New Answers* (Geneva, 2017).

[14] Foresight, United Kingdom Government Office for Science: *What type of future workforce will the UK need?* (London, 2013), pp. 4–14.

[15] ibid.

[16] See Social Partner Dialogue of the European Chemical Industry, European Chemical Employers Group and European Mine, Chemical and Energy Workers' Federation (EMCEF): *Biannual Working Programme 2005 / 2006 of the Social Partner Dialogue of the European Chemical Industry; ECEG/EMCEF/Cefic Common Declaration on "Framework conditions for a sustainable chemical industry in Europe"*.

skills shortages in the industries. However, this alone will only provide a short-term solution. [17]

54. Human resources development systems help people to find and retain jobs and help firms to obtain the skilled workers they need. The ILO Human Resources Development Recommendation, 2004 (No. 195), recommends that member States should, based on social dialogue, formulate, apply and review national human resources development, education, training and lifelong learning policies which are consistent with economic, fiscal and social policies. Human resources development systems should be well thought out and integrated, rather than piecemeal collections of policies and programmes. Most importantly, the human resources development system should be closely tied to employment policies and programmes.

55. SMEs have long been identified as drivers of innovation within both the chemical and pharmaceutical industries (see section 1.1). Nevertheless, digitalization and technological change present a special challenge for SMEs in the industries. A study of the German manufacturing industry suggested that, while SMEs in the country are aware of the challenges of digitalization, their readiness and capability to adapt to the challenges of digitalization depends upon their size – the smaller SMEs are, the more likely they are to suffer, rather than benefit, from the industry-wide changes brought about by digitalization. [18]

56. To ensure that SMEs remain a job creation engine in the industries and a provider of decent and productive work, well-designed SME policies in line with national circumstances are required. These should "align with sound macroeconomic policies, strategies aimed at improving enforcement and compliance, education and skills policies and promotion of social dialogue, freedom of association, collective bargaining and social protection". [19]

57. Governments can take a number of actions to help build an enabling environment for SMEs in the industries. These include simplifying overly complex regulations for SMEs; improving SMEs' access to finance through appropriate measures, such as loan guarantees and start-up grants; clustering, networking, linking into technology platforms, and value chain and local economic development to address the lack of scale and scope of SMEs; addressing decent work challenges in the industries; public investment in infrastructure as well as in education, training and technology; and supporting the formalization of SMEs in line with the Transition from the Informal to the Formal Economy Recommendation, 2015 (No. 204). [20]

58. Employers' and workers' organizations can also play an important role in promoting SMEs in the industries, by increasing the representation of SMEs and their workers in both types of organizations, by improving social dialogue and by assisting their members with collective bargaining. The social partners should strengthen services that are beneficial to

[17] IndustriALL Global Union: *The Challenge of Industry 4.0 and the Demand for New Answers* (Geneva, 2017).

[18] L. Sommer: "Industrial revolution – Industry 4.0: Are German manufacturing SMEs the first victims of this revolution?", in *Journal of Industrial Engineering and Management* (Vol. 8(5)), 2015, pp. 1512–1532.

[19] ILO: Resolution concerning small and medium-sized enterprises and decent and productive employment creation (Geneva, 2015).

[20] ibid.

their members in SMEs and engage with governments to assess and improve the enabling environment. [21]

3.1.3. Gender and gender mainstreaming

59. While data is scarce on the number of women employed in the chemical and pharmaceutical industries, female labour market participation remains low, although the rate varies from one country to another. According to UNIDO INDSTAT 4 2018, ISIC Rev.4, the female labour market participation rate in the sector represented by ISIC 201 – basic chemicals, fertilizers, etc. – was: 29.99 per cent in Kazakhstan in 2015 (30.54 per cent in 2012); 27.40 per cent in China in 2015 (26.26 per cent in 2013); 26.42 per cent in Viet Nam in 2015 (28.32 per cent in 2012); 24.90 per cent in Mexico in 2015 (25.68 per cent in 2012); and 20.51 per cent in Malaysia in 2014 (20.91 per cent in 2012). In the sector represented by ISIC 2100 – pharmaceuticals, medicinal chemicals, etc. – the female participation rate was 46.99 per cent in China in 2015 (45.43 per cent in 2013) and 4.58 per cent in India (5.03 per cent in 2012).

60. Available data suggests that despite industry efforts and apparent improvements, female participation in the industries is relatively low. Studies also indicate that women in STEM professions face more frequent discrimination and sexual harassment than men, and often find gender discrimination an impediment to career success. [22]

61. In the industry, the number of women in leadership roles has steadily increased. Nevertheless, in 2017 only 13.7 per cent of executives and 18.6 per cent of directors in the United States, and 31.6 per cent of directors in the EU, were women. [23] A 2017 Accenture study stated that high-performing companies in the chemical industry have a higher percentage of women in their workforce, both as board members and at the management level. [24]

62. The 2008 ILO Declaration on Social Justice for a Fair Globalization states that the pillars of the Decent Work Agenda are inseparable, and that gender equality should be considered cross-cutting in the Decent Work Agenda. Gender equality is at the heart of decent work and must be of a holistic nature. This means, for instance, enhancing equal employment opportunities in the industries through measures to improve women's access to education, skills training and health care, through work–family balance measures, and by providing workplace-level incentives for the provision of childcare and parental leave. [25]

3.2. Social protection and conditions of work

63. Digitalization, other technological advances and globalization have led to growing diversification in working arrangements. Changes in working arrangements in the chemical

[21] ibid.

[22] C. Funk and K. Parker: *Women and men in STEM often at odds over workplace equity* (Pew Research Center, Washington, 2018).

[23] A. H. Tullo: "Women in the chemical industry 2017", in *Chemical and Engineering News* (Vol. 95, Issue 36, 2017).

[24] K. Walczyk et al.: "Future workforce in chemicals: How high performers extend talent efforts beyond employees", in *Accenture*, 27 June 2017.

[25] ILO: Resolution concerning gender equality at the heart of decent work (Geneva, 2009).

and pharmaceutical industries can affect workers' access to social security. Some categories of workers may be excluded by law from social security coverage altogether. New and emerging forms of work made possible by digitalization may not provide the same level of social protection as existing forms of work. Social protection systems and measures are important for ensuring decent and productive work in these increasingly digitalized industries. [26]

3.2.1. Changes in work organization

64. Digitalization and automation have facilitated the proliferation of new and emerging forms of employment, including work on digital platforms, and in some countries have led to the proliferation of on-call employment or other forms of temporary and part-time employment, as well as dependent self-employment and temporary agency work, frequently referred to as non-standard forms of employment. [27]

65. In the chemical and pharmaceutical industries, for a number of years workers and their organizations have expressed concern over the growing use of outsourcing and contract labour, as well as other new and emerging forms of employment. [28] In developing and transition countries, over 40 per cent of chemical and pharmaceutical companies use temporary labour, and temporary workers make up over 20 per cent of workers per firm on average. [29]

66. The digitalization process involves both greater machine-to-machine and machine-to-human communication and includes the mass collection of big data. Companies are using technology to prevent conflicts of interest, insider trading, public sharing of sensitive information or other potential risks that could harm the company's reputation. While there are obvious efficiency benefits to the manufacturer and the consumer, digitalization also means changes for workers – worker productivity, for example, is likely to be more closely monitored and analysed. This has given rise to the concern that digitalized production may encroach upon the privacy of workers with invasive surveillance practices. Therefore, laws and practices need to be improved to ensure that production is carried out in accordance with a worker's expectation of privacy and personal autonomy. [30]

[26] ILO: *Innovative approaches for ensuring universal social protection for the future of work* (Geneva, 2018).

[27] C. Behrendt and Q. A. Nguyen: *Innovative approaches for ensuring universal social protection for the future of work,* ILO Future of Work research paper series, research paper 1 (ILO, Geneva, 2017).

[28] ILO: *Restructuring, employment and social dialogue in the chemical and pharmaceutical industries: Report for discussion at the Tripartite Meeting on Promoting Social Dialogue on Restructuring and its Effects on Employment in the Chemical and Pharmaceutical Industries* (Geneva, 2011).

[29] ILO: *Non-standard employment around the world: Understanding challenges, shaping prospects* (Geneva, 2016).

[30] IndustriALL Global Union: *The Challenge of Industry 4.0 and the Demand for New Answers* (Geneva, 2017); IndustriALL Global Union: *IndustriALL Global Union's World Conference on "Industry 4.0: Implications for Trade Unions and Sustainable Industrial Policy" 26–27 October 2017, Geneva, Switzerland*, "Action Plan" (Geneva, 2017).

3.2.2. Working-time arrangements

67. Everyday work and life has already undergone profound changes in the twenty-first century due to the emergence of new ICT and globalization. ICT allows for workers to connect with network servers and colleagues anytime, anywhere, while a globalized world often demands that workers be available outside traditional working hours. [31] At the same time, the changing structure of family life has meant that many workers are demanding more flexible working arrangements.

68. In the chemical and pharmaceutical industries, working-time arrangements such as telework/ICT-based mobile work and flexitime are already being used. However, digitalization, through the increased ability to control production remotely, or the ability to access big data via the cloud, may further facilitate and/or necessitate flexible working-time arrangements.

69. Telework and other flexible work arrangements can allow workers to find a better balance between their working lives and other commitments, and promote the inclusion in the labour market of older workers, workers with family responsibilities, people with disabilities and other vulnerable groups. However, the uncoupling of work from traditional working spaces also allows work to encroach upon spaces previously reserved for personal life. This erosion of the borders between work and leisure can intensify work- and time-related stress. [32]

70. Governmental initiatives and national, sectoral or profession-based collective agreements are important for providing a framework that creates the space for arrangements that address the needs and concerns of both workers and employers. [33] Consideration may also be given to the ILO Employment Relationship Recommendation, 2006 (No. 198). [34]

3.2.3. Migrant workers

71. In the chemical and pharmaceutical industries, the need for high-skilled and STEM-educated workers can drive a demand for migrant labour. For example, a 2014 study in the United States estimated that migrant workers constituted 17 per cent of the United States pharmaceutical workforce. Among those working in R&D in pharmaceuticals, around a third of employees were migrant workers. Furthermore, of the R&D workforce, 37 per cent of chemical/material scientists, 25 per cent of chemical technicians and 23 per cent of chemical engineers were migrant workers. [35] While recruiting migrant labour can be beneficial to companies, it can also result in a brain drain in origin countries (the permanent loss of highly

[31] Eurofound and ILO: *Working anytime, anywhere: The effects on the world of work* (Luxembourg, 2017).

[32] ibid., p. 3.

[33] ibid.

[34] ILO: *General Survey concerning working-time instruments: Ensuring decent working time for the future* (Geneva, 2018).

[35] S. Michel and J. Witte: *Immigrants working for U.S. pharmaceuticals* (Institute for Immigration Research, George Mason University, Fairfax, 2014).

qualified nationals). At the other end of the skills spectrum, where migrant workers are recruited into low-skilled jobs, this can often lead to concerns of decent work challenges. [36]

3.2.4. Occupational safety and health

72. Digitalization could allow for the industries' most hazardous tasks to be carried out by robots and/or controlled remotely, providing an opportunity to improve the work environment and worker safety. Workers, particularly young workers, are currently exposed to OSH hazards, such as safety hazards, physical hazards, biological hazards, chemical hazards and ergonomic hazards. [37] Many of the OSH risks associated with digitalization are still unknown, but it is likely that digitalization and technological change will involve new machinery and in turn new OSH challenges. In addition, there are concerns related to stress and to physical and psychosocial risks. [38]

73. Member States are requested to formulate, implement and periodically review a coherent national policy on occupational safety, occupational health and the working environment. [39] The national policy concerning the protection of workers, the public and the environment against the risk of major accidents shall, where practicable, promote the use of the best available safety technologies. [40] In this context, the Committee of Experts on the Application of Conventions and Recommendations stated that it is critical to address emerging workplace hazards and risks by continuously building and strengthening a preventative safety and health culture. [41] The term "a preventative safety and health culture" is defined as "a culture in which the right to a safe and healthy working environment is respected at all levels, where government, employers and workers actively participate in securing a safe and healthy working environment through a system of defined rights, responsibilities and duties, and where the principle of prevention is accorded the highest priority". [42]

3.3. Fundamental principles and rights at work and international labour standards

74. States have the duty to ensure that the fundamental principles and rights at work and ratified international labour standards protect and are applied to all workers, including in the chemical and pharmaceutical industries. Freedom of association ensures that workers and employers in the industries can organize to efficiently negotiate work relations. Combined

[36] ILO: *The future of labour supply: Demographics, migration, unpaid work*, The Future of Work Centenary Initiative, Issue Note Series 2 (Geneva, 2016).

[37] ILO: *Improving the Safety and Health of Young Workers* (Geneva, 2018).

[38] P. V. Moore: *The Threat of Physical and Psychosocial Violence and Harassment in Digitalized Work* (ILO, Geneva, 2018).

[39] Occupational Safety and Health Convention, 1981 (No. 155), Article 4(1).

[40] Prevention of Major Industrial Accidents Convention, 1993 (No. 174), Article 4(1) and (2).

[41] ILO: *General Survey on the occupational safety and health instruments concerning the promotional framework, construction, mines and agriculture: Working together to promote a safe and healthy working environment* (Geneva, 2017), para. 380.

[42] Promotional Framework for Occupational Safety and Health Convention, 2006 (No. 187), Article 1(d).

with strong freedom of association, sound collective bargaining practices ensure that employers and workers have an equal voice in negotiations and that the outcome will be fair and equitable. Collective bargaining allows both sides to negotiate a fair employment relationship and prevents costly labour disputes. [43]

75. Digitalization will challenge the social partners in the industries to engage in collective bargaining in order to increase job security and employability for both experienced and young workers. Expanding the coverage of collective bargaining to all workers at the national level is key for tripartite constituents to be able to shape the future of work in the industries.

3.4. Social dialogue

76. Social dialogue is vital to meeting the challenges of digitalization in the chemical and pharmaceutical industries. From job transformation to new skills requirements, and from new and emerging forms of employment to changing requirements in OSH, social dialogue can help the industries prepare for industrial challenges and facilitate the promotion of decent and productive work in the industries.

77. The extent of national-level social dialogue within the industries varies from country to country. Nevertheless, employers and workers in the industries, and governments, recognize its importance to help create an enabling environment to ensure decent and productive work. [44]

78. As a result of globalization and the increasing geographical dispersion of production, social dialogue may become more and more difficult to organize. Social dialogue across national borders can help to address mismatches between the scope of activities of global actors (such as MNEs), which are increasingly transnational, and of social actors (including trade unions, social movements and non-governmental organizations), which remain largely embedded at the national level. [45] The role of governments in providing enabling legal and regulatory environments for dialogue between the social partners will become increasingly important.

79. Good examples of cross-border social dialogue initiatives in the industries include the European Works Councils and the European Commission's sectoral social dialogue committees. In the European Works Councils, workers are represented and consulted by management on decisions that can affect their working conditions. [46]

[43] See http://www.ilo.org/global/standards/subjects-covered-by-international-labour-standards/collective-bargaining/lang--en/index.htm.

[44] See Conclusions on the Tripartite Meeting on Promoting Social Dialogue on Restructuring and its Effects on Employment in the Chemical and Pharmaceutical Industries (Geneva, 24–27 October 2011); Global Dialogue Forum on Initiatives to Promote Decent and Productive Work in the Chemical Industry – Points of consensus (Geneva, 26–28 November 2013).

[45] K. Papadakis (ed.): *Shaping global industrial relations: The impact of international framework agreements* (Geneva, 2011).

[46] The social partners at the EU are the IndustriALL European Trade Union and the European Chemical Employers' Group (ECEG). The current work programme has looked at the impacts of digitalization, sustainable employment and career development, and training and lifelong learning among other issues. For more information see ILO: *International Framework Agreements in the food retail, garment and chemical sectors: Lessons learned from three case studies* (ILO/SECTOR, Geneva, 2018), p. 54.

80. Furthermore, in 2011 the International Chemical Employers' Labour Relations Committee and IndustriALL Global Union signed an agreement to exchange information concerning labour relations and emerging issues in the chemical industry. This agreement to promote global social dialogue should remain critical to promoting industrial peace and stability and boosting economic progress. [47]

81. A further important tool to promote cross-border social dialogue is the use of international framework agreements (IFAs), otherwise known as global framework agreements (GFAs). IFAs are voluntarily concluded between MNEs and global union federations, and consist of general principles, elements of collective bargaining, and dispute prevention and resolution. In the industries, one GFA has been negotiated to date, between Solvay and IndustriALL Global Union. The GFA makes reference to the ILO fundamental principles and rights at work and other ILO Conventions, [48] and includes a universal minimum benefits package for all Solvay workers, including parental leave, medical coverage, disability insurance and life insurance. [49] As digitalization is expected to grow in the industries in the coming years, it will be essential to include the impacts of digitalization in such agreements.

[47] See the declaration: *Starting Global Dialogue in the Chemical Industry*.

[48] The Workers with Family Responsibilities Convention, 1981 (No. 156), and the Workers' Representatives Convention, 1971 (No. 135).

[49] ILO: *International Framework Agreements in the food retail, garment and chemical sectors: Lessons learned from three case studies* (ILO/SECTOR, Geneva, 2018); IndustriALL Global Union and Solvay: *Global framework agreement on social responsibility and sustainable development between Solvay Group and IndustriALL Global Union* (2017).