

**DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INNOVATION  
COMMITTEE ON CONSUMER POLICY**

**Working Party on Consumer Product Safety**

**CONSUMER PRODUCT SAFETY IN AN ERA OF TECHNOLOGY-DRIVEN PRODUCTS AND  
SUPPLY CHAINS: PROJECT PROPOSAL**

**3D printing and the Internet of Things**

**OECD, Paris  
26-27 April 2017**

*The attached contains a proposal for the development of a WP project on the impact of emerging technology-driven products and markets on consumer product safety. It includes an Annex containing a preliminary draft issues paper focusing on the 3D printing and Internet of Things markets.*

*The draft is for discussion at the WP's 14th meeting where delegations will be invited to discuss:*

- *The proposed scope, process and timeframes for developing the work; and*
- *The attached preliminary draft issues paper: i) indicating whether the document adequately identifies relevant trends, emerging consumer product safety hazards and policy challenges for each market, and ii) pointing to any key points, including country-specific information, which should be reflected in the draft.*

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## NOTE BY THE SECRETARIAT

At its 13<sup>th</sup> meeting in November 2016, the Working Party on Consumer Product Safety (WP) held preliminary discussions on the potential consumer product safety benefits and challenges associated with the emergence of some technology-driven consumer products and markets. These included: i) consumer products manufactured using 3D printing technology; and ii) consumer products connected to the Internet (a subset of the "Internet of Things" (IoT) market). At the session, which was organised as part of the next steps for the WP's work on online product safety (OECD, 2016c), and in follow-up to the OECD's Ministerial on the Digital Economy held in June 2016, in Cancún, Mexico (OECD, 2016d), delegations expressed interest in exploring the issues further over the 2017-2018 biennium.

In follow-up to the meeting, in December 2016, the Korean delegation provided the WP with a voluntary contribution aimed to support the development of a project on the impact of new technologies on product safety policy design and reform. At a WP Bureau teleconference meeting in January 2017, the Secretariat provided preliminary ideas for a possible scope for the project, suggesting that the focus be placed on consumer product safety in the 3D printing and IoT markets. Bureau Members supported the idea and requested the Secretariat to prepare the present draft project proposal, which provides suggestions for the scope, process and timeframes for developing the work. The draft also includes an Annex containing a preliminary draft issues paper aimed at identifying key trends and consumer product safety benefits, as well as the emerging consumer product safety risks and policy challenges that may be associated with 3D printing and the IoT. At its 28 February 2017 teleconference meeting, the Bureau supported the project proposal, which is for discussion at the WP's 14<sup>th</sup> meeting, under item 5b of the draft agenda.

Action requested: At the meeting, delegations will be invited to discuss and agree on the proposed project scope, process, and timeframes. They will also be asked to provide comments on the attached preliminary draft issues paper: i) indicating whether the document adequately identifies relevant trends, product safety hazards and policy challenges for each consumer market, and ii) pointing to any key points, including country-specific information, which should be reflected in the draft.

## CONSUMER PRODUCT SAFETY IN AN ERA OF TECHNOLOGY-DRIVEN PRODUCTS AND SUPPLY CHAINS: PROJECT PROPOSAL

### *3D printing and the Internet of Things*

#### **Introduction**

1. Preliminary research carried out by the Secretariat shows that the potential for the 3D printing and the Internet of Things (IoT) markets to disrupt global supply chains, goods' production and consumer behaviour is significant. Both markets are dynamic ecosystems relying on, and generating, vast amounts of data, through which a variety of consumer goods and services may be designed and produced. While still in their early days, these markets are expected to evolve rapidly, fuelled by growing consumer demand, continued innovation, and competitive product prices. Some predictions further suggest that the combination of 3D printing and the IoT, through the use of embedded sensors, should help to improve product quality and safety controls across supply chains involving 3D printing technology, and, thereby, accelerate growth (ITProPortal, 2016).

2. Consumer trust in both markets will however largely depend on stakeholders' ability to address concerns in a number of areas, such as privacy; security; counterfeiting; consumer protection; as well as consumer product safety, on which this report focuses. In the product safety area, this may prove difficult given: i) the ever expanding range of actors involved the supply chains, such as product and sensor manufacturers, software producers, designers, infrastructure providers, data analytics companies, and consumers, who may neither be aware of the product safety vulnerabilities that the new business models may bring, nor familiar with product safety compliance requirements; and ii) governments and other stakeholders' limited knowledge and understanding to date of the extent to which existing product safety policy frameworks may keep up with the realities of the new markets.

3. As emphasised by EC Commissioner Jourova and Chairman Kaye, of the US Consumer Product Safety Commission (CPSC) at the IoT plenary of the International Consumer Product, Health and Safety Organisation (ICPHSO) held in Brussels in November 2016, whether and how such frameworks may need to be adapted to meet the realities of the transformative global supply chains, without stifling innovation, will require special attention. This may include reviewing how key consumer product safety concepts (such as *consumer*, *product*, *safety*, and *liability*) may be understood in such an environment where products: can become defective and unsafe as a result of digital security incidents; increasingly take, anticipate and predict decisions without human intervention; are sometimes designed and/or produced by consumers.

4. With this in mind, it is proposed that, over the 2017-2018 biennium, the WP develop a project assessing the impact of the 3D printing and IoT markets on consumer product safety, through: i) the development of the preliminary draft issues paper contained in the Annex; ii) the organisation of an expert workshop to examine key issues; and, as appropriate, iii) the development of policy conclusions.

#### **Scope, process and timeframes**

5. It is proposed that the project focus on: i) trends and the product safety benefits associated with 3D printing and IoT products and markets; as well as ii) emerging consumer product safety hazards, and policy challenges. As agreed by the WP Bureau, the project would not cover those 3D printing and IoT-related issues which may have direct product safety implications, but fall outside of the consumer product safety area.<sup>1</sup> The project would be carried out in the following three sequential phases, running from March 2017 through to the end of 2018:

- Phase I (March - November 2017)
  - By end May 2017: Draft issues paper to be further developed by a consultant knowledgeable in product safety and new technologies, in consultation with the Secretariat and the Bureau. Delegations to share in that regard key country-specific information that should be reflected in the paper.
  - By October 2017: Draft issues paper to be finalised, and then presented for discussion and approval at the WP's 15<sup>th</sup> meeting in November.
- Phase II (November 2017 - April 2018)
  - Preparation of an expert workshop to be held at the time of the WP's 16<sup>th</sup> meeting in April 2018; the event will be supported by the WP's issues paper.
- Phase III (April - October 2018)
  - Depending on the maturity of the consumer-IoT and 3D printing markets, as well as stakeholders' understanding and knowledge of key issues, the WP may consider developing policy conclusions.

6. Within the OECD, the project would be drawing on the OECD's horizontal project on *Enabling the Next Production Revolution*, which aims to explore the economic and policy implications of a set of new technologies, including 3D printing and the IoT (OECD, 2016a; OECD, 2017a). It could also feed into the IoT work that is to be developed over the 2017-2018 biennium: i) by the Committee on Consumer Policy; and ii) under the OECD's *Going Digital* horizontal project being led by the Committee for Digital Economy Policy (OECD, 2016d; OECD, 2017b); this will include a work stream on artificial intelligence. It could further be informed by additional 3D printing work to be developed by the OECD's Environment Directorate in 2017, which is likely to include a focus on consumer exposure to toxic chemicals (OECD, 2016e).

7. Outside the OECD, the consumer IoT aspects of the project could be informed by discussions held in this area within the International Consumer Product, Health and Safety Organisation (ICPHSO), the European Union's Alliance for Internet of Things Innovation ("AIOTI"),<sup>2</sup> the European Commission, as well as exploratory work being developed in jurisdictions. Likewise, the 3D printing aspects of the project could draw on work being developed by Technical Committee 261 (ISO/TC/261) of the International Standardisation Organisation's Committee on Consumer Policy (ISO COPOLCO).

## ANNEX

**PRELIMINARY DRAFT ISSUES PAPER ON CONSUMER PRODUCT SAFETY IN AN ERA OF TECHNOLOGY-DRIVEN PRODUCTS AND SUPPLY CHAINS**

*3D printing and the Internet of Things*

**Introduction**

8. Despite fading productivity growth in recent years, new digital consumer markets have emerged globally, driven by the development and diffusion of a range of innovative and evolving technology-driven products and production processes. These include the 3D printing and Internet of Things ("IoT") markets, which are enabled by the confluence of network connectivity, machine to machine interconnection, machine-embedded software, data collection and analysis ("big data"), and cloud computing. Bringing with them profound changes to traditional supply chains, 3D printing and the IoT are among the key enablers of the "next production revolution" (OECD, 2016a; OECD 2017a). The two ecosystems, which are increasingly combined, are generally described as follows:

- 3D printing (also known as "additive manufacturing"), involves the development of tangible goods through the upload of a computer-aided design ("CAD") file to a printer that can build-up material in a layer-upon-layer, 3 dimensional, fashion. As such, the technology disrupts traditional manufacturing by enabling all sorts of goods and parts to be designed digitally and produced anywhere, at any time, and by anyone, including by consumers.
- The IoT refers to an ecosystem where devices and other objects are either directly connected to the Internet or mediated through local or wide area networks. Such devices and objects include sensors and actuators, which, combined with big data analytics and cloud computing, enable autonomous machines and intelligent systems. The data can be used to analyse patterns, to anticipate changes and to alter an object or environment to realise the desired outcome, often autonomously. As such, the IoT enables interactions not only among devices and objects but also with and between individuals in computer aware environments that can avail themselves of new and innovative services (OECD, 2016b; OECD, 2017a).

9. Both the 3D printing and IoT supply chains have in common to be complex ecosystems involving a range of actors, including product and sensor manufacturers, software producers, designers, infrastructure providers, data analytics companies, and consumers. As such, they are expected to revolutionise the way design, manufacturing, and product delivery processes are monitored, analysed and improved to ultimately enhance the quality of products and help to prevent consumer product safety hazards or damage. Ensuring that consumers can benefit from safe 3D printed and IoT-enabled products will be key to build and maintain trust in these emerging marketplaces. Growth will in particular require governments and other stakeholders to enhance cooperation internationally and assess compliance of the new digital business models with existing consumer product safety policy frameworks (Law 360, 2016).

10. As emphasised by EC Commissioner Jourova and Chairman Kaye, of the US Consumer Product Safety Commission (CPSC) at the IoT plenary of the International Consumer Product, Health and Safety Organisation (ICPHSO) held in Brussels in November 2016, whether and how such frameworks may need to be adapted to meet the realities of the transformative global supply chains, without stifling innovation, will require special attention. This may include reviewing how key consumer product safety concepts (such

as *consumer, product, safety, and liability*) may be understood in such an environment where products: can become defective and unsafe as a result of digital security incidents; increasingly take, anticipate and predict decisions without human intervention; are sometimes designed and/or produced by consumers.

### **Objectives of the draft issues paper**

11. This draft aims to provide a preliminary overview of some of the key 3D printing and IoT developments that may have implications for consumer product safety policy design and enforcement. It contains two sections focusing respectively on: key trends, as well as potential product safety hazards, and policy challenges, which may need to be examined and addressed at domestic and international levels. Given the nascent nature of both consumer markets, the draft does not intend to include any policy recommendations; nor does it cover the various IoT and 3D printing policy issues which may have direct product safety implications, but fall outside of the consumer product safety area.<sup>3</sup>

#### **I. Trends in 3D printing and selected IoT products and markets**

12. Measurement of the 3D printing and IoT markets is still in its infancy, and sometimes varies widely from one source to another. Yet, available data and estimates suggest that the IoT and 3D printing are likely to be amongst the most disruptive technologies that will increasingly be used to manufacture a broader range of innovative and complex products, benefiting businesses and consumers alike (WIPO, 2015, p. 99; OECD, 2016e).

#### ***3D printing***

13. 3D printing technology has been around since the 1980s when engineers and industrial designers used it to accelerate their design and prototyping operations. Its popularity has expanded as 3D printing methods using a broader range of raw materials (such as plastic, ceramic, and metal) have been introduced and used by industry in the production of components and finished products in several sectors, such as aviation and aerospace, automobiles, construction, industrial design, medical products, and defense. 3D printing is today applied by businesses to create a range of consumer products, such as fashion, footwear, jewelry, toys, and glasses. It is now within consumers' reach, in both developed and developing economies. While still at a nascent stage, the consumer segment of the 3D printing market is expected to expand rapidly, spurred by a number of emerging factors, including (G. Greatorex, 2015a; OECD, 2016a; OECD, 2017a):

- Growing consumer demand for customised products.
- The possibility for consumers to use a 3D printer at home, in a local store, or to order 3D-printed products online.
- Falling printer and raw material prices. In countries, such as the United Kingdom, recent price reductions in 3D printers have enabled consumers to purchase cheaper machines either as kits, for as little as GBP 400, or as working machines for between GBP 900 and GBP 2 000. In Australia, prices have fallen under AUD 500 (G. Greatorex, 2015a). All these machines can now be configured and used by consumers with little training and experience (P. Reeves and D. Mendis, 2015). A growing number of 3D printers for use by children are today available for sale on online marketplaces for less than EUR 200 in France, and EUR 315 in Japan, as shown in Figure 1 below.<sup>4</sup>
- The rising quality and safety of completed objects. In order to remain competitive, companies will likely try to differentiate their products in various innovative ways, including through

making products more easily reparable, making potentially recalls a lesser issue (Swiss Re, 2015, p. 54).

- Easier and cheaper ways to revise and refine product prototypes, to try out a design, and test and improve their safety level before going into production. Such ability to design and produce cheaper products is expected to enhance the development of new and innovative production and organisational processes, as well as new business models, in both developed and developing economies.
- Increased on-demand and localized production and distribution of products. Such decentralisation of production and distribution should reduce the size of supply chains, allowing better safety risk management and quality controls (WIPO, 2015).

Figure 1. 3D Printers for Use by Children for sale on French and Japanese online marketplaces



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14. In such a dynamic context, global revenues are predicted to increase rapidly and to reach USD 35.4 billion in 2020, representing a forecast compound annual growth rate of 24.1% over the 2015-2020 period (IDC research, 2016). Interestingly, some predictions suggest that the largest share in 3D printing's potential financial impact, which should range between USD 230 and 550 billion per year by 2025, is likely to be derived from growing consumer use (USD 100 to 300 billion) (McKinsey Global Institute, 2013, p. 110).

15. A growing variety of websites today provide designs for 3D printed goods that can be purchased at low cost or are available to download for free. These include not only designs for existing products and spare parts but also innovative designs that can only be created using 3D printing technology (G. Greatorex, 2015a). A number of online platforms have embraced 3D printing promises and offer solutions to consumers, including children. In July 2013, *eBay* released an *iPhone* application allowing consumers to buy and customize 3D printed products. Today, online marketplaces, such as *Amazon* and [Shapeways](#), allow consumers to download digital design files and print their own products either at home, or have their finished 3D-printed product delivered to their door. In the United States, stores like *Staples* and *UPS* allow consumers to 3D print the products that they have designed online at their local stores.

### ***IoT-enabled consumer products***

16. In recent years, a growing range of IoT-enabled consumer products has been commercialised, penetrating many consumer product sectors and driving consumers' interactions with products in their everyday life. Smartphones and apps that can connect several consumer IoT-enabled devices within or outside the home, have played an important role in bringing such products to consumers who are increasingly attracted by the promises of convenience, as well as real time and personalised information (OECD, 2016a). Box 1 provides example of such products, which can be monitored and used remotely.

#### **Box 1. Examples of IoT-enabled consumer product categories**

- Wearables. Described as the most important IoT product category (A. Thierer, 2014), wearables include products such as fitness activity trackers, smart watches, smart glasses, and GPS shoes.
- Smart home appliances, such as smart locks; smart thermostats that can inform consumers of their energy usage and patterns, helping them to drive down their consumption and save energy; connected ovens which allow consumers to set their temperatures remotely; sensors known as “water bugs” which can notify consumers if their basements have flooded; or smart smoke and CO2 detectors; products like *Amazon's Echo* or *Google's Home*, which provide voice control of other home IoT devices like smart lighting, security systems, smart thermostats, and smart HD TVs.
- Childcare equipment, such as baby monitor trackers that send parents information about their baby's vitals to their smartphone.
- Toys, such as those that are based on voice and/or image recognition (e.g. *Hello Barbie*, which is an Internet-connected version of the doll that has real conversations with kids) or app-enabled robots, drones and other mechanical toys.
- Connected cars, which can notify drivers of dangerous road conditions, offer real-time vehicle diagnostics to drivers, or drive autonomously.
- Health monitors, which can allow consumers with serious medical conditions to work with their physicians to manage their diseases, or improve disease prevention (US FTC, 2015).

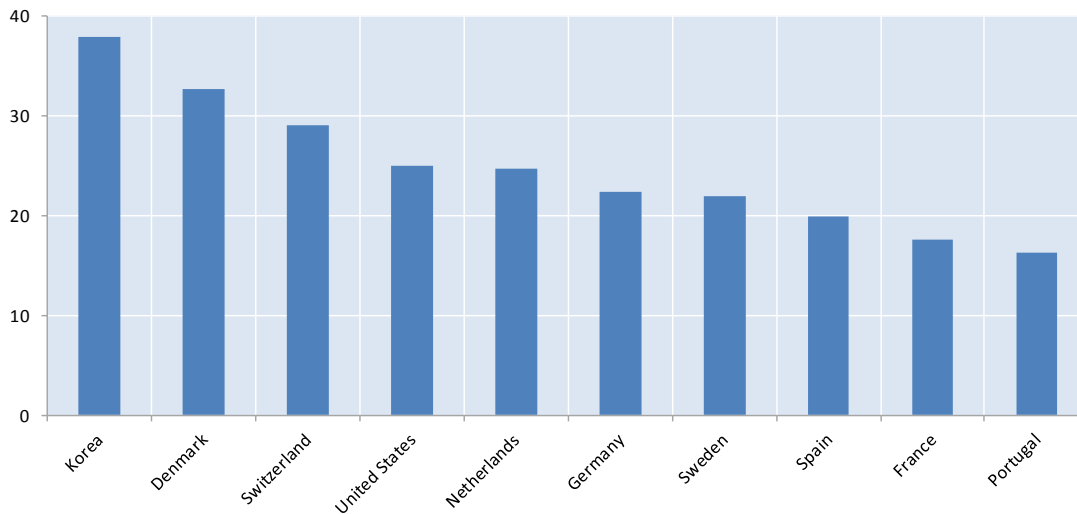


17. The above examples illustrate the diversity of the consumer IoT environment, which some have summarised as follows: "The IoT has three parts: ... the sensors that collect data about us and our environment: smart thermostats, street and highway sensors, and those ubiquitous smartphones with their motion sensors and GPS location receivers. The "smarts" that figure out what the data means and what to do about it. This includes all the computer processors on these devices and -- increasingly -- in the cloud, as well as the memory that stores all of this information. And finally, there are the actuators that affect our environment. The point of a smart thermostat isn't to record the temperature; it's to control the furnace and the air conditioner. Driverless cars collect data about the road and the environment to steer themselves safely to their destinations." (Schneier, B., 2017).

18. The rapid expansion of IoT devices and sensors has generated massive streams of structured and unstructured data, whose analysis today surpasses human intelligence and understanding capabilities. To help unlock the value of such volume of data, find patterns or similarities that can be learned from, and ultimately enable better decisions, the IoT is increasingly being paired with "cognitive computing" or "machine learning" programmes (also referred to as artificial intelligence (AI)<sup>5</sup>). Such machine learning systems can "help companies take the billions of data points they have and boil them down to what's really meaningful" (Wired, 2014b); they can help diagnose problems with products, identify interconnections, adapt products to their environment without the need for human intervention, and provide predictions that learn and improve over time. Connected cars or devices using virtual assistants that can switch on lights or open doors (such as *Amazon's Echo*) are examples of IoT/AI-embedded products.

19. As with 3D printing, measurement of the consumer IoT market is proving difficult, in part due to the complexity of the IoT technology. Available estimates however suggest that in addition to growth in the number of devices that will be connected to the Internet in the coming years, the value of the IoT marketplace should increase rapidly (OECD, 2016b; OECD, 2017a). Such growth should be enabled by a number of factors, such as: process efficiency, customer service, speed of decision-making; cost savings; consistency of delivery across markets; transparency/predictability of costs; and performance in new markets, top the list of companies involved in the IoT market (Vodafone, 2015). Equipping machines with sensors could allow efficiency-enhancing predictive maintenance.

20. The number of devices to be connected to the Internet in the coming years is expected to reach 40.9 billion by 2020 (ABI Research, 2014). Figure 2, whose results are based on *Shodan*, the world's first search engine for Internet-connected devices, provides a snapshot of the top 10 countries with the largest numbers of IoT devices connected to the Internet per 100 inhabitants. Among such existing 363 million of devices, 84 million are registered to China and 78 million to the United States. Korea, Brazil and Germany follow with 18 million connected devices, as well as Japan, Spain, the United Kingdom and Mexico, with 8 million to 10 million devices each (OECD, 2015; OECD, 2017a).

**Figure 2. IoT devices online, top OECD countries, per 100 inhabitants**

Sources: OECD Digital Economy Outlook 2015 (OECD, 2015), based on Shodan, [www.shodanhq.com](http://www.shodanhq.com); and Enabling the Next Production Revolution, Chapter 2: Benefits and Challenges of Digitalising Production (OECD, 2017a).

21. According to a 2015 study commissioned by the European Commission (EC), the market value of the IoT in the EU is expected to reach approximately one trillion euros in 2020 with an estimated increase of connected devices from 1.8 million in 2013 to almost 6 billion in 2020 (IDC EMEA, 2014). Some other forecasts predict that the IoT could contribute USD 10-15 trillion to global GDP over the next 20 years (Evans and Anninziata, 2012).

22. The extent to which the IoT may bring specific product safety benefits is attracting growing attention among governments, businesses and industry alike. Situations where a connected thermostat may be used by a manufacturer to remotely diagnose a fault in a home system, and prevent consumer exposure to a product safety hazard or injury, were for example discussed at the WP's 13<sup>th</sup> meeting and the aforementioned ICPHSO's IoT plenary in November 2016. As noted by the US CPSC at the latter meeting, 2016 has accounted 27 deaths in the United States from children left in a car on their own. Car seats' sensors working *via* Bluetooth should help to prevent such risk by alerting parents in real time, through their smart phone. Participants in the meeting examined additional scenarios where the IoT should allow manufacturers to:

- Better track and trace products and identify hazards across global supply chains.
- Remotely monitor the use of their products, identify and fix product defects through software patches (see Box 2).
- Identify customers using unsafe IoT products and inform them in real time of the need to repair or replace their product.
- Launch a recall in a timely and effective manner (Consumer Reports, 2014). In Japan, in 2017, a study will be launched by the Ministry of Economy, Trade and Industry (METI) to examine the extent to which the IoT may enhance the effectiveness of recalls and be efficiently used to inform consumers about the existence of a recall notification affecting their IoT-enabled devices.<sup>6</sup>

### **Box 2. Examples of software patches**

#### **Nest lab's smoke alarm case (Consumer Reports, 2014)**

In May 2014, Nest Lab discovered that a number of its smoke detectors (*Protect*) that the company had sold in the United States at retailers and on the Nest website between November 2013 and April 2014 were defective. A special feature in its *Protect* alarm, which allowed users to switch it off with a wave of hand, could be activated inadvertently.

In addition to halting sales of the defective products, the company acted quickly on the deactivation of the feature on all relevant smoke alarms that were Wi-Fi-connected. It did so remotely by fixing the defect of a number of the sold products through a software update. For those products that could not be patched remotely (including the smoke detectors that were not Wi-Fi-connected), Nest launched a recall affecting approximately 440 000 *Protect* units.

#### **Tesla's connected car (Wired, 2014a)**

In 2014, the US National Highway Traffic Safety Administration (NHTSA) published a recall announcement alerting the owners of some Tesla's connected cars about fire problems caused by a charger plug that needed to be fixed. The fix was completed through a software update enabling owners to avoid bringing their car back to the company.

## **II. Emerging consumer product safety hazards and policy challenges**

23. With the spread of the IoT and 3D printing markets, a number of product safety hazards and policy challenges may arise that are likely to be magnified by the increased complexity of today's global supply chains. In such a context, product tracking and traceability will become increasingly important for both markets to continue to grow.

### ***3D printing***

#### *Emerging consumer product safety hazards*

24. As discussed above, 3D printing is disrupting global supply chains by: i) enabling the production of goods that may be designed overseas but that are not always physically crossing borders; and ii) bringing into them new entrants into production, such as product designers and consumers, who may act as product designers and/or manufacturers ("prosumers"). Such new actors may however neither be experienced or aware of the potential hazards that may be created by 3D printing, nor familiar with relevant safety principles for product design, and manufacturing hazard reduction. Box 3 provides examples of potential physical and chemicals risk factors that may undermine trust in such new consumer market.

### Box 3. Examples of home 3D printing hazards

- Physical hazards may be created in products (G. Greatorex, 2015b).
  - The quality of raw materials may be variable and not subject to checks.
  - Incorrect parts that may be created for existing products may render them unsafe.
  - Creating new products or customizing existing ones may recreate old hazards that had been fixed by standards and regulations, or create new ones.
- Banned products may be made for home use with limited chance of detection by authorities.
- Consumers may be exposed to chemical hazards (US CPSC, 2017).

Liquid resin: Some types of consumer 3D printing processes rely on the polymerization of a liquid into a solid by ultraviolet or other light. The liquid matrix can be composed of a wide range of compounds that solidify into either rigid or flexible materials. Consumers may be exposed to chemicals or compounds released from the liquid matrix that may cause health effects when used without sufficient ventilation.

- Printing: Some printers may have a heated platform on which the product is produced. The high temperatures of the material and the surfaces on which the products are made may present a burn hazard for consumers. Chemical components that are volatile or semi-volatile likely will be released into the air during printing, creating a potential exposure. Nano and micro-particulates, if present, are also released during printing which may take up to 8 hours or more, depending on the product. If there are impurities contained in the filament, these impurities may also be released.
- Products: Products may deteriorate more quickly or may be made of an inappropriate plastic, resulting in small parts, sharp edges, or particulates that may pose hazards, especially for young children. Printed products may also have uncured polymers or potentially toxic materials.

### *Potential policy challenges*

25. How policy makers will be able to ensure that the normal product safety protections for consumers are not neutralized by the complexity of 3D printing supply chains will require scrutiny. Whether 3D printed products are delivered to consumers in local stores or at their door, or are designed and/or 3D printed by consumers themselves, the new market will raise a complex set of legal issues that will need to be carefully considered.

26. One such key issue is how liability may be possibly allocated among the various 3D printing supply chains actors. As emphasised in the revised 2016 *OECD Recommendation on Consumer Protection in E-commerce* ("the OECD E-commerce Recommendation"), identifying "the appropriate allocation of responsibility for the protection of consumers among relevant e-commerce actors is key to promoting consumer welfare and enhancing consumer trust" (OECD, 2016g). The issue has been for example raised in the EU, where the question of whether Directive 85/374/EEC on Liability for Defective Products (LDP Directive) may apply to a supplier that makes 3D design templates and sells them directly to consumers for 3D printing at home is being examined. Under the EU's strict product liability regime, a product manufacturer can be held liable for harm caused by a defective product without the need to prove a fault; a product is deemed defective if it does not provide the safety which a person is entitled to expect, taking all

circumstances into account, including the presentation of the product, the reasonable use of the product and the moment the product is put into circulation. In a 3D printing context, such EU product liability rules apply to manufacturers of 3D printers as well as manufacturers of 3D printed objects, to the extent that such products are commercialised and sold to the public. The LDP Directive may however not apply in cases where such products or parts have not been put into circulation by the manufacturer himself but have been printed out at home by consumers, either for their own use, or for resale to other consumers (DLA Piper, 2015). In such a case, it will be extremely difficult if not impossible for the injured consumer to determine how to resolve issues and obtain redress. This will involve being able to determine whether the problem that caused the harm was due to, for example, a data error in the uploaded CAD file, a printer defect, or a problem with the quality of the raw material and chemicals used to produce the good. Moreover, as noted in a CCP report on consumer protection and empowerment with intangible digital content products, whether product liability laws may apply to cases where defective "products" are intangible and may not be legally characterised as "goods", such as 3D design software, may complicate the matter (OECD, 2013).

27. Policies frameworks may further need to be reviewed to assess and address the potential environmental health and safety implications of consumer exposure to the chemical toxicity of materials used for home 3D printing (OECD, 2016e). In the United States, the CPSC is exploring such concerns and is in the process of developing voluntary standards in this area (US CPSC, 2017).

28. How to address the above issues has been explored at the international level by the ICPHSO in its 2015 *White Paper on 3D Printing*, which contains a number of recommendations calling on all actors involved in the 3D printing "community" (including designers, producers, suppliers, governments, and consumers) to work together to ensure that consumer product safety is integral to 3D printed product design, manufacturing and education processes. Providing adequate safety-related information disclosures to consumers is regarded as key in a context where consumers may be able to order products or parts or to produce products at home that do not come with packaging to which safety instructions and warnings are attached (ICPHSO, 2015).

29. More recently, the Technical Committee 261 (ISO/TC/261) of the International Standardisation Organisation's Committee on Consumer Policy (ISO COPOLCO) has also been tasked with examining key consumer challenges associated with 3D printing. The group is exploring issues associated with the safety of raw materials, 3D printer use and product outputs. It is considering the development of product safety education and guidance materials suitable for 3D printing designers and producers (ISO COPOLCO, 2016).

### ***IoT-enabled consumer products***

#### *Emerging product safety hazards*

30. Consumer reporting of IoT-related product safety incidents has been to date rather limited. This may be due to the nascent nature of the market, which consumers have not fully embraced yet, or to its complexity, which may leave consumers uncertain about who to turn to in order to resolve issues. Box 4 provides examples of potential product safety hazards that have been identified by the US CPSC (US CPSC, 2017).

**Box 4. Example of product safety hazards that may be raised by the IoT (US CPSC, 2017)**

- **Loss of a safety function**
  - Safety devices, or products connected (either physically, or digitally) to safety devices, may fail to operate or may cause another device to fail to operate under hazard conditions (as illustrated by the *Nest Protect* case described in Box 2).
  - Products connected to the IoT may change their performance through software upgrades that are automatically pushed out over the Internet.
- **Loss of connectivity:** A fault in a device, such as a product serving as a communications hub for a household (e.g. *Amazon's Echo*), may result in the loss of access or control to the Internet or other connected devices in the home.
- **Data Integrity:** In cases where data support a safety function, avoiding data corruption will be imperative.
- **Wearable product hazards:** The close proximity to the body of those products may generate a range of hazards, including:
  - Muscle strain, if a powered exoskeleton moves beyond the range of motion of a user's joint(s).
  - Skin irritation from chemicals contained in the wearable devices.
  - Chemical burns, if a battery leaks a reactive material.
  - Thermal burns, if a wearable battery suddenly discharges its stored energy; or
  - Hearing damage, if an implanted audio device malfunctions or "plays" a signal from another source.

*Potential policy challenges*

31. Governments and industry's examination of the product safety challenges that may arise from the IoT consumer market is at an early stage. As however indicated by EC Commissioner Jourova at the IoT plenary of the ICPHSO's November 2016 meeting, there is today an urgent need for policy makers and other stakeholders to join forces and identify the risks that consumers may face in such a dynamic marketplace. In doing so, stakeholders should bear in mind that while some of the IoT product safety-related challenges are not new (such as liability issues in a complex supply chain), what is new is the challenge faced by manufacturers to ensure product safety controls and management in an environment where their products, which are interconnected with other manufacturers' products, can increasingly take, anticipate and predict decisions without human intervention. Whether and how consumer product safety regulations and standards may in this context effectively address the resulting product safety issues and consumer damages is to be looked at. This will involve reviewing the adequacy of key product safety concepts and definitions, such as "product", "safety", "damage" and "liability," in today's environment where products: can become defective and unsafe as a result of incidents, such as a data breach; or increasingly take, anticipate and predict decisions without human intervention.

32. As with 3D printing, one of the main product safety-related issues raised by the IoT market concerns ways in which liabilities may be allocated among the various actors of the supply chain in the event technology behaves in an unpredictable and unsafe manner, and causes damage. When there is a "product" malfunctioning, it may be difficult to determine the perimeter of the liability of each actor in the IoT supply chain. Software that does not present any defects when commercialised but that creates problems at a later stage, once updated, may raise compliance issues with relevant product safety and

liability regulations and standards. The matter may be even more complex in the case where a product that caused harm used an artificial intelligence system. As such a system relies on massive amounts of data, it will be hard for an injured consumer (as well as for the product manufacturer and other actors in the supply chain) to understand why a product took a specific decision at a specific time. In the case, for example, of an accident involving a car using AI/auto pilot mode, the potential liability of the car manufacturer, who may not be in a position to anticipate how the car will behave in the future, is being questioned by stakeholders. In 2015, *Volvo* indicated their willingness to bear "full liability" in the event that one of their self-driving cars crashes while driving in autonomous mode. Such viewpoint is however currently not widely shared among other connected car manufacturers (Newsweek, 2015). The issue is being examined by the US NHTSA in a case involving the death of a driver of a *Tesla* connected car using an auto pilot mode, which failed to distinguish a white tractor trailer crossing the highway against a bright blue sky (CNN Tech, 2016). More generally, at issue is the ability for consumers and other IoT players to identify the defect that caused damage and the causality between both in an environment where the source of the problem may be linked to, for example, a bug in software or an Internet connection, or to a defect in one or some of the devices used in an IoT ecosystem. Who should bear the burden of proof may in such context prove difficult to determine.

33. Furthermore, as examined in the above 3D printing discussion, the extent to which product liability laws and regulations may apply in an IoT context where a defective "product" may be a mix of hardware, software and services may need to be explored (OECD, 2013).

34. The above questions are being explored by the EC in the context of its work on advancing the EU's Digital Single Market agenda (EC, 2016a). They are also the subject of policy consultations among the EC, the EU's Alliance for Internet of Things Innovation ("AIOTI")<sup>7</sup> and the US Department of Commerce, where focus is being made on the implications of the IoT for the applicability of consumer product safety regulations and standards. In the EU, for example, several general and sector-specific instruments may apply, such as Directive 2001/95/EC on General Product Safety, the LDP Directive, or Directive 2009/48/EC on the Safety of Toys. Under the current review of the LDP Directive, an assessment is being carried out to analyse whether the Directive is fit-for-purpose *vis-à-vis* new technological developments, such as the IoT and artificial intelligence. Focus is being made on determining: i) whether and how existing EU strict liability rules may be applied and how responsibilities may be allocated between the different participants in an IoT ecosystem, and ii) whether IoT-enabled products may be legally characterised as "products" (*i.e.* goods) for the purpose of the Directive (EC, 2016b). The question has also been raised by the European Parliament in a resolution adopted on 16 February 2017, requesting the European Commission to work on the clarification of liability issues, especially for self-driving cars (EP, 2017).

### III. Conclusion

35. The above discussion illustrates the importance for all actors involved in the IoT and 3D printing supply chains to be kept abreast of changes in consumer product safety hazards likelihood and seriousness, and to understand how the concept of *product safety* itself may be changing in such a dynamic and technology-driven environment. As emphasized by the US CPSC at the 2016 ICPHSO IoT plenary, this may require authorities to examine the extent to which work might be needed with i) industry to evaluate and address such changes, and ii) other agencies addressing IoT-related issues in areas such as, privacy and security. Whether and how to regulate both the IoT and 3D printing markets from a consumer product safety perspective will in any event require caution in order to ensure legal certainty and enable continued innovation. This will help to create a culture of "product safety by design" that all actors in the supply chain will need to comply with, as products and their interactions with consumers evolve.

## NOTES

<sup>1</sup> These include intellectual property, trade, competition (e.g. interoperability), privacy and security challenges, issues associated with the 3D printing of dangerous objects (such as guns), counterfeiting, environmental protection, and insurance. With respect to privacy and security, a number of cases and scenarios involving IoT-related data breaches that may or have exposed consumers to physical safety risks and harm have been reported in countries. These include, for example, intruders hacking into a baby monitor system; unauthorized access to data collected by fitness and other devices that track consumers' location over time; the possibility for a thief to remotely access data about energy usage from smart meters to determine whether a homeowner is away from home (US FTC, 2015); or the recording of children's conversations with a connected doll and transfer of the related audio files to a remote server, without parental consent (Cnet, 2017).

<sup>2</sup> The AIOTI is an initiative launched in March 2015 by the EC and IoT industry players to help promote a European strategy for the IoT and develop and support a dialogue and interaction among various IoT players in Europe. It was converted into an EU association in September 2016. More information on the organisation may be found at: [www.aioti.org/](http://www.aioti.org/).

<sup>3</sup> See note 1 above.

<sup>4</sup> In the United States, *Mattel* is working on the production of *ThingMaker*, a 3D printer that will enable children to make their own toys (3ders.org, 2016).

<sup>5</sup> Artificial intelligence's promises, potential limits and risks have been discussed at an [OECD Technology Foresight Forum](#) held in November 2016 (OECD, 2016f).

<sup>6</sup> In 2016, METI explored the societal impact of the IoT, as well as the benefits it may bring to product safety; the work included an examination of the technical aspects of the IoT on the basis of which the 2017 study will be developed.

<sup>7</sup> See note 2 above.



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