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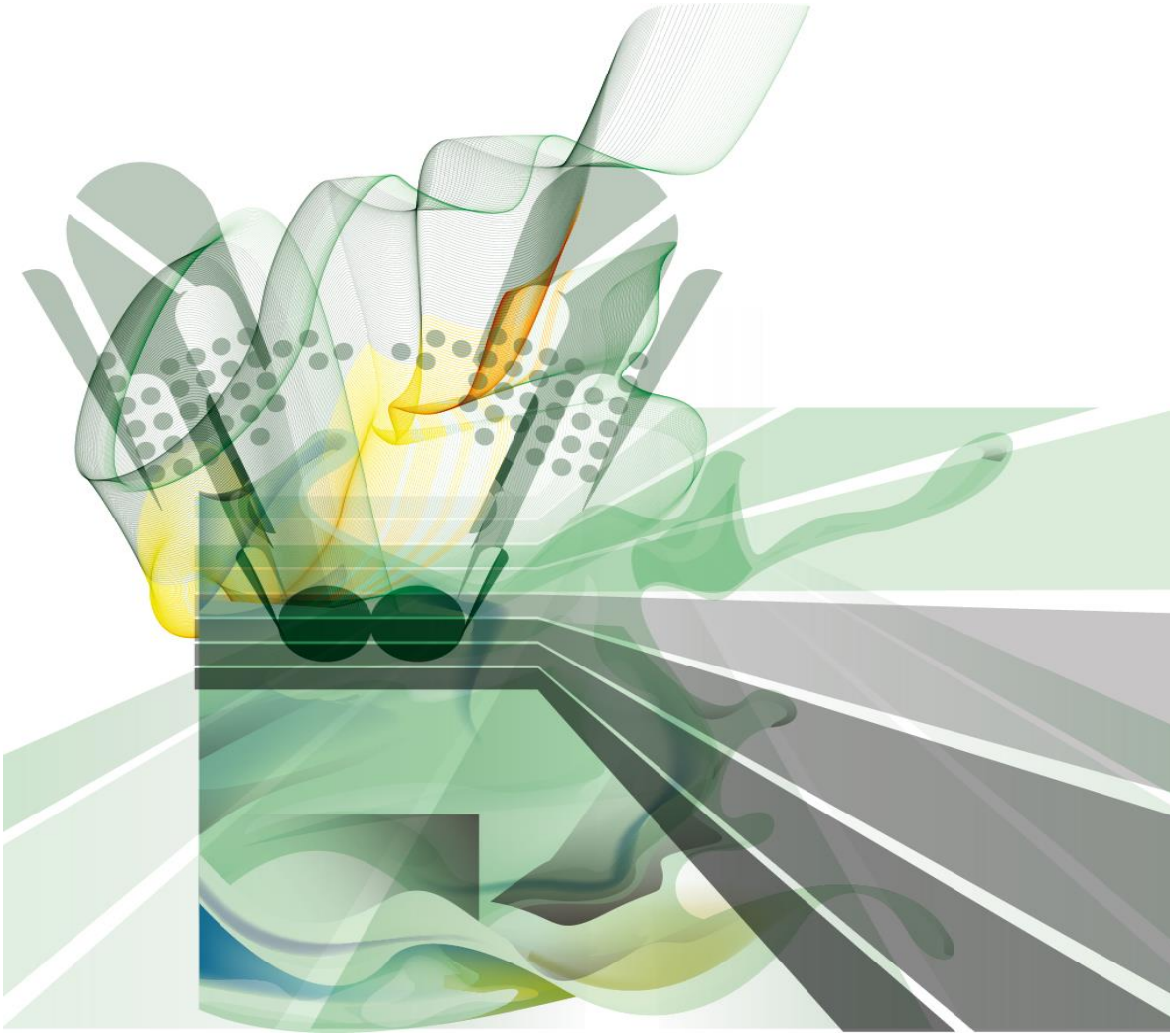

Intellectual Property Infringement and Enforcement
Tech Watch Discussion Paper 2020

Prepared by The European Observatory on Infringements of Intellectual Property Rights, EUIPO, with support from the Impact of Technology Expert Group

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DISCLAIMER

The views expressed in this discussion paper do not represent any official position of the EUIPO. This discussion paper is a compilation of contributions from members of the Observatory Impact of Technology expert group and guest experts from academia, the EUIPO Digital Transformation Department (DTD) and the Observatory that participated in a workshop held at the EUIPO on 30-31 January 2020. Members of the expert group that did not attend the workshop have subsequently been given the opportunity to contribute. It should be noted that the views expressed in this discussion paper can be attributed to all participants in the workshop, the expert group as a whole or to any single contributing expert.

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1. FOREWORD

Tech Watch encompasses looking to the future but with a firm understanding of the past and present and awareness of the impact of technology in society, on businesses and in our lives. Hopefully, this discussion paper and possible future editions will contribute to a more comprehensive understanding of the complexity of emerging and disruptive technologies and provoke consideration of the impact of these technologies in the future on infringement of intellectual property (IP) as well as the protection and enforcement of IP.

2. EXECUTIVE SUMMARY

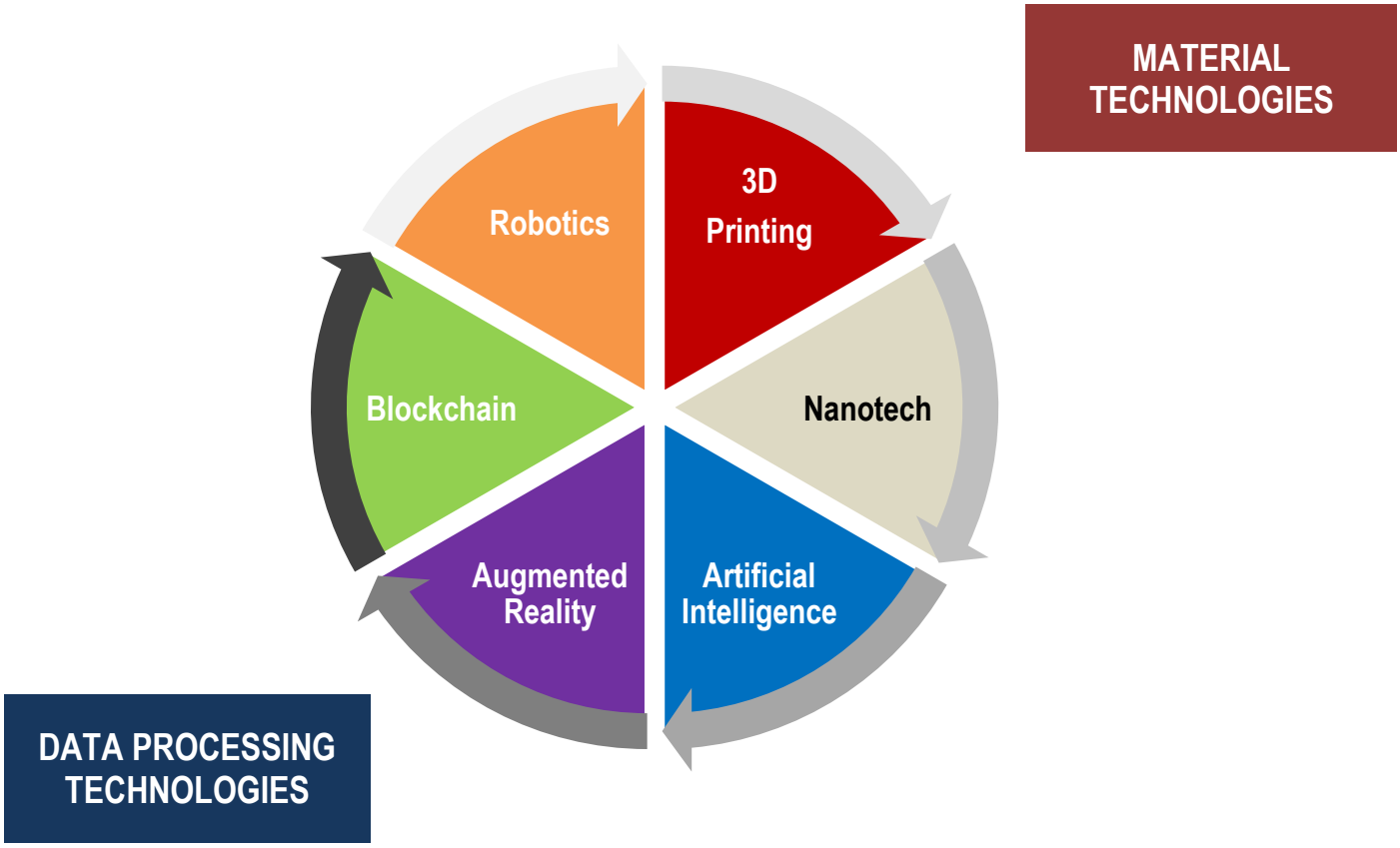
The EUIPO, through the European Observatory on Infringements of Intellectual Property Rights (Observatory), develops tools and promotes best practices to enhance the protection of intellectual property (IP), which is a critical asset for companies and individuals. Emerging and disruptive technologies have, over the last 30 years, become increasingly important as regards IP protection but they are also used as tools to infringe IP as well as instruments to enforce IP.

To strengthen the work of the Observatory as regards emerging and disruptive technologies, an Impact of Technology expert group was established in 2019 to:

- support the work of the Observatory involving technological issues;
- identify new technologies with the potential to impact IP protection, infringement and enforcement;
- define possible use cases and carry out studies or launch initiatives to better understand these impacts;
- raise stakeholders' knowledge about technological developments with potential to impact IP protection, infringement and enforcement.

The second task has been named 'IP Infringement and Enforcement Tech Watch'. In the first meeting of the expert group in April 2019, a methodology on which to base the Tech Watch was developed and in the first Tech Watch workshop of the expert group, held in January 2020, the methodology was used to analyse six different technologies.

Figure I. The Six Technologies Analysed in the First Tech Watch Workshop

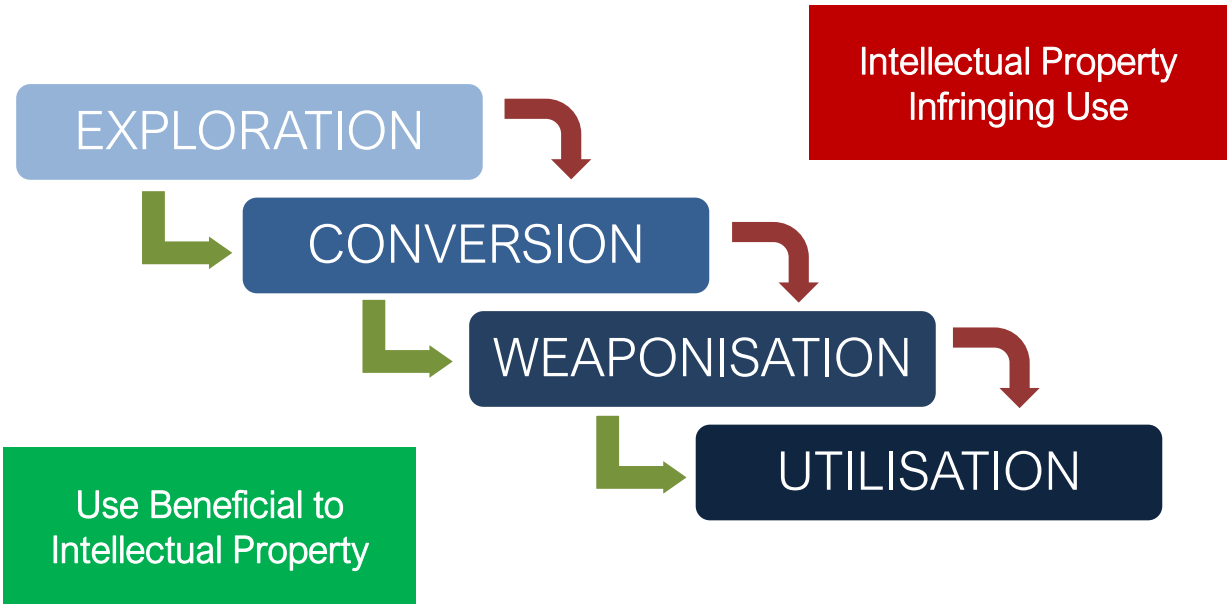


During the workshop, the methodology evolved into 'The Intellectual Property Tech Chain'. The methodology distinguishes between four steps in the application of a new technology:

- **exploration**: exploring the technology to ascertain whether it could be applied to protect, infringe or enforce IP;
- **conversion**: converting the technology to enable it to achieve the identified goal;
- **weaponisation**: finalising the development of the application;
- **monetisation**: using the application to protect, infringe or enforce IP.

The methodology builds on the idea that to understand the impact of a new technology it is not only the technology itself that is important but also the market situation relevant to the technology, its social significance and related legal issues. Additionally, the methodology takes into consideration that all emerging and disruptive technologies have the potential to be used in ways that are beneficial to IP but they are also being used as tools for IP infringement.

Figure II. Simplified Version of 'The Intellectual Property Tech Chain'



In the first Tech Watch workshop held in January 2020 the expert group, together with guest experts from academia, the EUIPO DTD and the Observatory, discussed the six technologies as regards the following issues:

- key features of the technologies;
- identification of essential information resources;
- impact of the technologies on society, the economy and world trade;
- IP protection use cases;
- threats and challenges for IP;
- investigative and enforcement opportunities.

From the discussions in the workshop, 10 significant horizontal points presented by one or more of the experts can be identified.

(1) The six technologies are all rapidly evolving and have not yet reached their full potential.
(2) All the technologies will, in varying degrees and forms, have a significant impact on labour, the economy and world trade.
(3) Predictions about the application of the technologies often range from potential significant improvement of the living conditions for humanity (e.g. better quality products and services) to major threats and dystopian visions (e.g. in relation to unemployment or mass surveillance).
(4) A key characteristic of all the technologies is the potential for the automation of processes, including as regards the production of goods and setting up and administering of governmental and commercial activity.
(5) All of the technologies raise questions about the protectability of innovation and creativity related to the technologies themselves, e.g. protectability of innovation and creativity made by artificial intelligent systems or the protectability of files used as a basis for 3D printing.
(6) Some technologies (most notably artificial intelligence and blockchain technology) can make IP protection more effective and provide higher-quality registration and documentation systems.
(7) All of the technologies can be applied by IP infringers to either make production, marketing and distribution of counterfeits more effective (e.g. cheaper production with use of robots, use of local 3D printing facilities for production purposes and more appealing presentation of products using augmented reality) or be used in other IP infringing ways (e.g. blockchain-based alternative domain name system without the possibility of trade mark owners enforcing their rights or copyright infringement in augmented reality applications).
(8) Most of the technologies (maybe with 3D printing as an exception) can be used as tools for IP enforcement (e.g. protection of supply chain integrity, easier product individualisation and identification of counterfeits, improve investigations by law enforcement, make customs risk analysis more effective or enhance effectiveness of notice and takedown procedures).
(9) For all the technologies it is characteristic that they represent new evidential opportunities and challenges for legal systems, due to the complexity of the technologies, the enormous amount of generated data and also the high level of reliability of the information.
(10) OVERALL OBSERVATION: all of the technologies have already shown themselves to be important emerging and disruptive technologies impacting businesses, the economy, government administration and the daily lives of many human beings and have proved to pose potential challenges and/or opportunities for IP.

Members of the expert group that did not attend the workshop have also been given the opportunity to contribute to this discussion paper. The intention is to update the paper following each workshop of the Impact of Technology expert group. In future workshops additional emerging technologies will be analysed and, occasionally, those analysed previously will be revisited to ensure the paper maintains its relevance.

3. GLOSSARY AND ABBREVIATIONS

Technical terms used in this Discussion Paper		
Term	Abbreviation	Short simplified explanation
Android		A robot or other artificial being resembling a human being.
Artificial Intelligence	AI	Data processing imitating functions of the human brain.
Augmented Reality	AR	Data processing technology that applies different gadgets to add virtual elements to the physical world.
Augmented Virtuality	AV	Data processing technology that applies different gadgets to add substantial amounts of virtual elements to the physical world.
Automated Content Recognition	ACR	Applications of different technologies but most often applying artificial intelligence with the aim of identifying content in an automated way.
Big Data		The technology connected to processing and analysing large amounts of data.
Blockchain		A method for decentralised recording of data in an immutable encrypted ledger maintained in a peer-to-peer (P2P) network.
Distributed Ledger Technology	DLT	In this paper used synonymously with the term 'blockchain'.
Domain Name System	DNS	The domain name system (DNS) is an information system in which internet domain names are located and translated into internet protocol (IP) addresses for easy access to internet resources.
Enhanced Reality		Data processing technology that applies different gadgets to virtually enhance items in the physical world.
Intellectual Property	IP	Copyright and related rights as well as industrial rights (e.g. trade marks, designs, patents, plant variety rights and geographical indications), and trade secrets.
Internet of Things	IOT	System of interrelated computing devices that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
Intellectual Property Right	IPR	Copyright and related rights as well as industrial rights (e.g. trade marks, designs, patents, plant variety rights and geographical indications).
Mixed Reality	MR	Data processing technology that applies different gadgets to mix virtual elements with items in the physical world.
Nanotech		Nanotechnology (nanotech) is the manipulation of matter on an atomic, molecular and supramolecular scale.
Nanotubes		Application of nanotech in the form of tubes made of carbon with a diameter measured in nanometres (a nanometre is 0.000000001 m).
Open-source intelligence	OSINT	Data collected from publicly available sources to be used in an intelligence context.
Robotics		The field of science and engineering dealing with the creation, design, construction, monitoring, control and use of programmable and often intelligent machines.
Virtual Reality	VR	Data processing technology that applies different gadgets to create a completely virtual environment.

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6. INTELLECUAL PROPERTY TECH WATCH

6.1 The European Observatory on Infringements of Intellectual Property Rights

0001 Aim of the Observatory

Building upon the success in managing the European Union trade mark and registered Community design, the European Union Intellectual Property Office (EUIPO) now also covers matters relating to IP enforcement. Following a proposal by the Commission, which was backed by the European Parliament and the Council, the European Observatory on Infringements of Intellectual Property Rights (Observatory) was fully entrusted to the EUIPO on 5 June 2012. The Observatory develops tools and promotes best practices to enhance IP([1]) protection, which is a critical asset for companies and individuals. The Observatory is a platform-based body that brings the public and private sectors as well as civil society and international organisations together in a dynamic network. Through this work, the Observatory monitors, aggregates and reports on trends and crucial information to assist policy makers, authorities and any other stakeholders engaged in protecting and enforcing IP rights.

Picture 1: The EUIPO Campus in Alicante, Spain

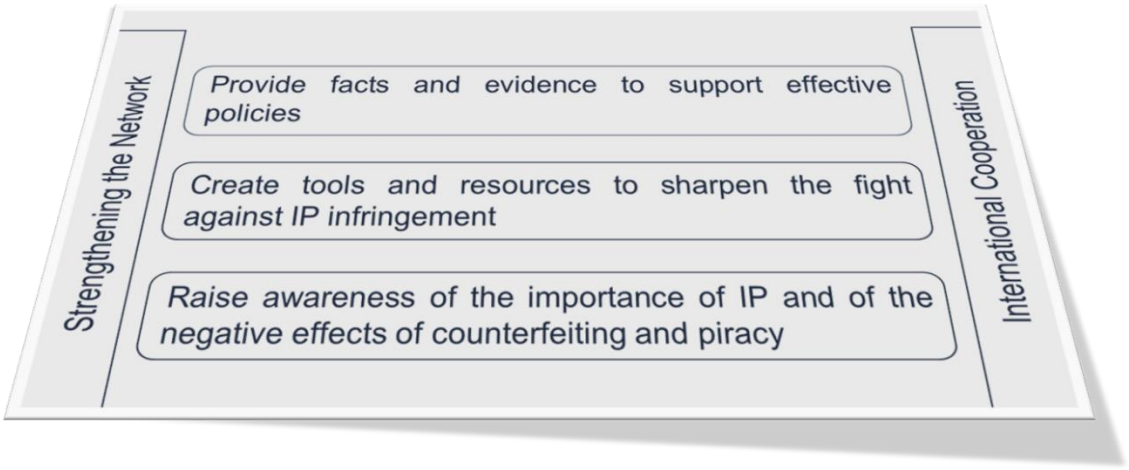
0002 Core activities of the Observatory

The Observatory's core activities are:

- raising public awareness;
- delivering specialised enforcement training;
- developing systems to gather, analyse, report and exchange key information on the scope and scale of and trends in counterfeiting and piracy in the EU;
- providing evidence-based data to enable EU policymakers to shape effective IP enforcement policies and to support innovation and creativity.

([1]) In this paper the terms 'intellectual property' and 'intellectual property rights' cover copyright and related rights as well as industrial rights (e.g. trade marks, designs, patents, plant variety rights and geographical indications), and trade secrets.

Figure III. The Tasks of the Observatory



0003 Importance of disruptive and emerging technologies for IP

Emerging and disruptive technologies have, over the last 30 years, become increasingly important as regards IP protection but they are also used as tools to infringe IP as well as instruments to enforce IP. Consequently, it was decided that the Observatory should strengthen the collection and analysis of information about these technologies and their impact on IP. One of the initiatives to enable this has been establishing the Impact of Technology expert group.

6.2 The Impact of Technology Expert Group

6.2.1 Concept behind the Observatory Expert Groups

0004 Aim of and representation in the Observatory Expert Group

The six expert groups of the Observatory assist the implementation of Observatory projects in focused and specialised areas and are made up of experts selected after review of applications from interested experts made based on a public communication. The experts represent themselves and not a particular organisation or institution. Insofar as possible, the expert groups are balanced as regards specific expertise, geographical coverage and gender. Balance is also sought to cover both counterfeiting and piracy issues. A particular expert group will exist only as long as its work is still required; on the other hand, new expert groups can be created as the need arises.

6.2.2 Establishment of the Impact of Technology Expert Group in 2019

0005 First meeting of the Expert Group on 11 April 2019

The Impact of Technology expert group was established in February 2019 and the first meeting took place on 11 April 2019. The aim of the expert group was twofold:

- to support the work of the Observatory involving technological issues;
- to identify new technologies with the potential to impact IP protection, infringement and enforcement, define possible use cases and carry out studies or launch initiatives to understand these impacts better and raise stakeholders' knowledge about technological developments with the potential to impact IP protection, infringement and enforcement.

0006 The various types of expertise represented in the Expert Group

The group's almost 20 expert members have at least some of the following characteristics:

- experience in monitoring new technologies and their impact on IP protection, infringement and enforcement; and/or
- high-tech investigation experience (e.g. private investigations, OSINT, law enforcement, cross-border collection of evidence); and/or
- technical expertise within:
  - alternative or enhanced realities (e.g. mixed reality, gaming, e-sport, VR, AR); and/or
  - database technologies, advanced data collection and analytics (e.g. algorithms, API, DLT, private and public administration, machine learning, big data, cloud); and/or
  - online payments (e.g. payment settlements, online banking, virtual currencies); and/or
  - malicious online activities (e.g. malware, phishing); and/or
  - advanced industrial-production and tracing technologies (e.g. RFID, standardisation technologies, 3D printing, robotics, autonomous products, IOT, drones, energy efficiency).

6.2.3 First Tech Watch Workshop, 30-31 January 2020

0007 The workshop set-up

On 30-31 January 2020 the first Tech Watch workshop took place where experts from the Impact of Technology expert group during four rounds discussed selected groups of technologies with guest experts from academia, the EUIPO DTD and the Observatory. This highly dynamic set-up allowed collaborative and engaging discussions, where the members of the expert groups and experts from academia moved from one technology to another in each round, while members of the EUIPO staff remained with the technology in which they had special expertise. In each round the participants were given information on key characteristics of each technology and were challenged with provocative talking points.

Picture 2: Snapshot I from the Workshop

0008 The selected technologies

The workshop was organised around four groups of technologies with some examples given on the application of the technologies:

(1) Robotics, 3D printing and nanotech

- production and use of physical robots;
- stereolithography and digital light processing;
- fused deposition modelling;
- selective laser sintering and melting;
- electronic beam melting;
- laminated object manufacturing;
- manipulation of matter on atomic, molecular and supramolecular scale;
- nanotubes.

(2) Artificial intelligence (AI), incl. automated content recognition (ACR) and big data

- advanced algorithms;
- machine learning;
- deep learning;
- neural networks;
- technology used to identify digital content;
- analyses of large data sets and extraction of relevant data.

(3) Mixed, augmented or enhanced reality

- mixed reality;
- augmented reality;
- enhanced reality.

(4) Blockchain and distributed ledger technology (DLT)

- cryptocurrencies and cryptoassets;
- smart contracts;
- autonomous organisations.

0009 The four rounds of discussion

The workshop revolved around four rounds of discussion for each group of technologies. In each round a number of discussion prompts were provided:

- Round 1: impact on society, the economy and world trade

  - sharing economy;
  - mass unemployment;
  - economic inequality;
  - unequal access to data;
  - process effectiveness;
  - mass surveillance;
  - quality of goods and services;
  - new ways of producing and distributing goods;
  - automation.

- Round 2: protection of IP

  - new IPRs to be developed;
  - application and examination procedures;
  - documentation of IP;
  - automation.

- Round 3: technology used to infringe IP

  - mass scale online and offline infringement;
  - 3D printed infringement;
  - augmented infringement;
  - crime committed by robots, algorithms and decentralised autonomous organisations (DAOs);
  - open decentralised marketplaces and other services without notice and takedown;
  - automation.

- Round 4: technology used to enforce IP and investigate IP crime

  - even if the concept is great, it might not work in practice;
  - better equipment for customs, market surveillance and police authorities;
  - OSINT;
  - faster judicial cooperation and procedures;
  - more or less dependable and transparent evidence;
  - product individualisation;
  - better or worse notice and takedown procedures;
  - automation.

00010 Preparation of the first edition of the Discussion Paper

The notes from the meeting have been shared with the members of the Impact of Technology expert group, including those who could not attend the event and those from academia and the EUIPO. The experts then provided comments to the draft that has resulted in this final version of the discussion paper. The intention is to update the discussion paper following each workshop of the Impact of Technology expert group. In future workshops additional emerging technologies will be analysed and, occasionally, those analysed previously will be revisited to ensure the paper maintains its relevance. To limit the document's exponential growth, all entries will be kept succinct, to the point and not overburdened with detail. To ensure the paper does not become outdated, it will avoid references to specific products or services and keep descriptions on a general level. References to reading materials will also focus on sources of a more permanent nature with descriptions that do not quickly outdate.

Picture 3: Snapshot II from the Workshop

6.2.4 *Future work of the Expert Group*

00011 Adding more technologies

The expert group will continue work with Tech Watch and the following technologies are envisaged to be discussed:

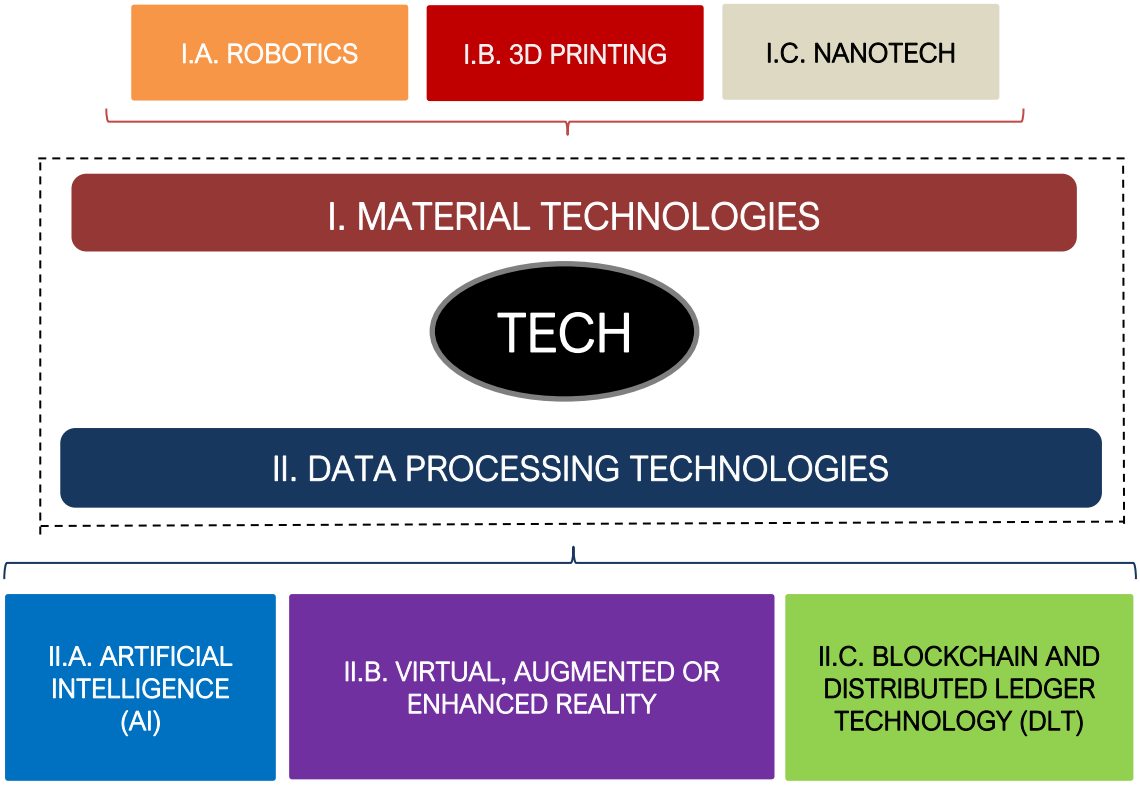
- quantum computing;
- internet of things (IOT) and 5G;
- OSINT tools to track cryptocurrency and smart contracts.

6.3 Typology of Key Emerging Technologies

00012 A simplified typology of technologies

Before the first workshop of the Impact of Technology expert group, a typology of technologies was developed for practical reasons to enable a simple and easily understandable overview of specific technologies with major relevance for IP protection, infringement and enforcement. The simplified typology distinguishes between 'material technologies' and 'data processing technologies' but it is important to note that the technologies cannot always be clearly separated. On the contrary, most of the physical technologies will depend on data processing and vice versa. Moreover, the separation between subcategories of the main types of technologies are just indicative. For example, there is often an AI element in robotics, important data processing applications will include both AI and blockchain technology, and 3D printing will depend on the use of electronically processable files.

Figure IV. Emerging Technologies Discussed in the First Tech Watch Workshop Held 30-31 January 2020 and Analysed in this Discussion Paper



00013 The technologies in focus

The technologies in focus were selected due to their significant impact on IP infringement and application in IP protection and enforcement. Questions of the patentability of new innovations, policy making, and purely legal issues were not taken into consideration in the selection of the technologies.

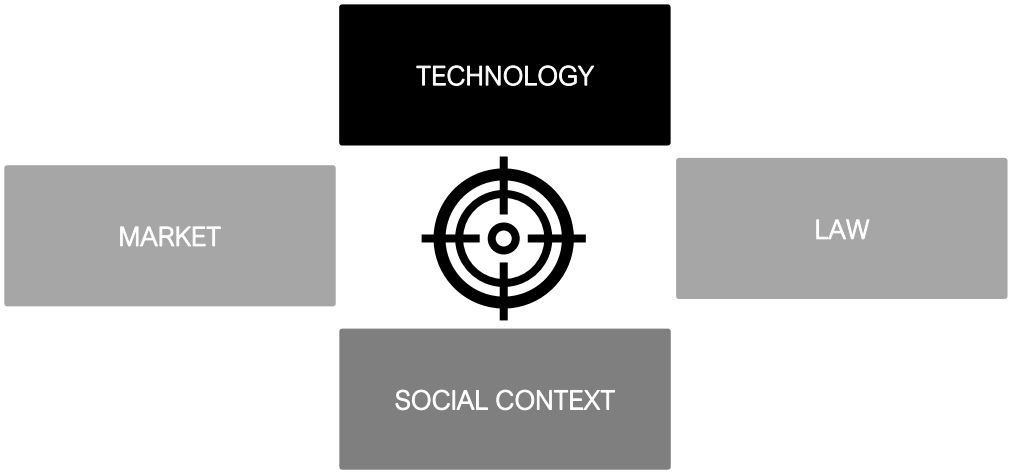
6.4 Tech Watch Methodology

6.4.1 The Lawrence Lessig Code Theory

00014 Discussion of the relevance for the Expert Group of the code theory

In the first meeting of the expert group, the theory of Lawrence Lessig presented in 'Code and Other Laws of Cyberspace' from 1999 ([2]) was introduced and has subsequently served as a loose basic idea behind the work of the expert group. The code theory (also often known as 'the pathetic dot theory') is a theory that helps understand internet regulation and describes how human online activity is regulated by law, social norms, and the market mechanism but most importantly the technical infrastructure of the internet (the latter-named 'code'). The theory has been applied by the expert group in the sense that all tech impact on IP should be considered from these four angles: (1) the market (2) the law (3) social context, and (4) the technology itself.

Figure V. Adaptation of the Code Theory ([3])



6.4.2 The relationship Between IP and emerging technologies

00015 Metaphors

In addition to the code theory, two metaphors have played a vital role in the development of the Tech Watch methodology applied by the expert group.

([2]) Lawrence Lessig: 'Code and Other Laws of Cyberspace', 1999, Basic Books (and updated in 'Code Version 2', 2006, Basic Books).

([3]) This adaptation of the theory was made by EUIPO staff before the first meeting of the expert group.

00016 Yin & Yang metaphor

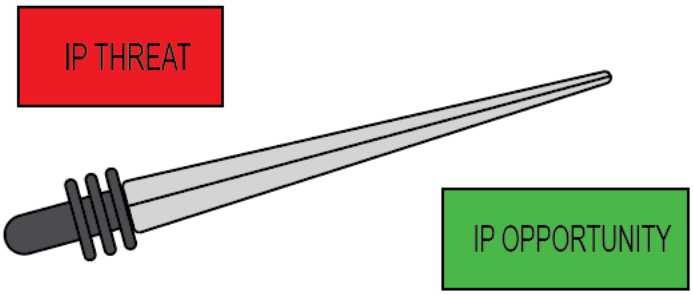
The yin & yang metaphor indicates that the application of a technology to infringe IP and to protect and enforce IP to some extent contains some of the same elements. It also suggests that there can be weaknesses in each way of applying technologies that can be exploited by the other side.

Figure VI. The Yin & Yang Metaphor

00017 Double-edged sword metaphor

Lastly, the double-edged sword metaphor indicates that most – if not all – emerging technologies can be a threat as well as an opportunity for IP protection and enforcement.

Figure VII. The Double-Edged Sword Metaphor



00018 Five areas of interest between IP and new emerging technologies

When combining the Lawrence Lessig code theory with the yin & yang metaphor and the double-edged sword metaphor, the expert group was able to suggest early on that the relationship between IP and a new emerging technology would have at least five areas of interest.

1. The need for companies developing new solutions based on an emerging technology to protect their IP and avoid infringing the IP of others.
2. How other IP rights holders can use solutions based on the emerging technology in their own efforts to protect and enforce their IP.
3. How the emerging technology can be applied by governments in measures made available for the protection of IP, e.g. registration systems for trade marks and patents.
4. How IP infringers can apply new technologies as tools with the aim of infringing the IP of others.
5. How law enforcement agencies, prosecution services and other governmental agencies can apply new technologies to investigate and prosecute IP crime and carry out other acts of IP enforcement.

Figure VIII. Areas of Interest for IP in Regards to Emerging Technologies

6.4.3 *The Tech Watch methodology of the Impact of Technology Expert Group*

00019 The First Tech Watch methodology

During the first meeting of the Impact of Technology expert group, an original Tech Watch methodology was developed. The methodology provided a way to analyse the development of any application of a new technology with the aim of infringing IP or to be used for protection and/or IP enforcement. The methodology divided the development of any application into four separate steps:

- **exploration**: exploring the technology to ascertain whether it could be applied to infringe or protect/enforce IP;
- **conversion**: converting the technology to enable it to achieve the identified goal;
- **weaponisation**: finalising the development of the application;
- **monetisation**: using the application to infringe IP or protect/enforce IP.

For each application the methodology distinguished between a proactive or a reactive approach. A proactive approach would focus on applications developed with the aim of achieving a specific goal without being in response to a specific threat. A reactive approach would focus on applications developed in response to a specific threat.

Figure IX. Original Tech Watch Methodology

	Proactive Approach	Reactive Approach
Exploration		
Conversion		
Weaponisation		
Monetisation		

00020 Amendments to the methodology

In the workshop held on 30-31 January 2020, the methodology was tested. The four-step methodology proved an effective way to describe application development but the distinction between a proactive and reactive approach did not show itself to be useful. Based on this experience, the methodology has been amended to reflect the double-edged sword metaphor. The new updated methodology has maintained the four distinct steps from the original methodology but is now described as 'The Intellectual Property Tech Chain' (4). However, the last step is now described as utilisation and not monetisation to emphasise that an application of a new technology doesn't necessarily have to be applied in order to generate a monetary income.

(4) Inspired by the Lockheed Martin '7-step Cyber Kill Chain', used to analyse advanced persistent cyber intrusion threats, https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html.

00021 'The Intellectual Property Tech Chain'

'The Intellectual Property Tech Chain' then distinguishes between applications of new technologies with the aim of infringing IP and those being applied in a way that is beneficial to IP. This methodology proved itself more suited to analysing the technologies discussed in the workshop, which is clearly reflected in this discussion paper.

Figure X. Updated Tech Watch Methodology

The Intellectual Property Tech chain	Intellectual Property Infringing Use	Use Beneficial to Intellectual Property
Exploration	Exploring the use of the technology in production of IP infringing goods and any other IP infringing activity, incl. IP crime	Exploring the beneficial use of the technology in production of goods, delivery of services, IP protection and enforcement of IP, incl. investigation of IP crime
Conversion	Conversion of the technology into use in production of IP infringing goods and any other IP infringing activity, incl. IP crime	Conversion of the technology into a use beneficial to production of goods, delivery of services, IP protection and enforcement of IP, incl. investigation of IP crime
Weaponisation	Final creation of a functioning application of the technology to be used in production of IP infringing goods and any other IP infringing activity, incl. IP crime	Final creation of a functioning application of the technology beneficial to production of goods, delivery of services, IP protection and enforcement of IP, incl. investigation of IP crime
Utilisation	Utilising a functioning application of the technology in production of IP infringing goods and any other IP infringing activity, incl. IP crime	Utilising a functioning application of the technology in a way beneficial to production of goods, delivery of services, IP protection and enforcement of IP, incl. investigation of IP crime

7. MATERIAL TECHNOLOGIES

7.1 Robotics

00022 Quote from Isaac Asimov's novel *'Robot Visions'*

In a properly automated and educated world, then, machines may prove to be the true humanizing influence. It may be that machines will do the work that makes life possible and that human beings will do all the other things that make life pleasant and worthwhile.

Asimov, Isaac, *Robot Visions*, Byron Preiss Visual Publications, Inc., US, 1990.

7.1.1 The technology in a nutshell

00023 Examples of the technology to begin the workshop discussion

A few examples of the technology were given to the experts to start the discussion:

- production of physical robots;
- use of physical robots.

00024 Robotics – an ever-evolving technology

The experts discussed robotics technology and suggested that the characteristics of science and engineering dealing with robotics is the creation, design, construction, monitoring, control and use of programmable and often intelligent machines. Although a number of experts suggested that robotic technology has not yet reached its full potential, the technology is evolving rapidly and successfully and is undoubtedly revolutionising every aspect of our lives and work. Medicine, architecture, transport, education, engineering, archaeology and aeronautics, are just some of the areas that benefit from innovation within this technological field.

Picture 4: A Conceptual Image of a Generic, Blue and White Robot Holding a Vacuum Cleaner Doing Household Cleaning Chores in a Bedroom

00025 Relation between robotics, 3D printing and Nanotech

Robotic technology, 3D printing and nanotech are, according to a number of experts, closely related and will be even more interdependent in the future. 3D printers could be used to print nanorobots, nanotech could be applied to mark files for 3D printing, and 3D printing could be utilised to make nanomaterials or use them as filaments. However, these exponential advances are changing the world faster than ever and represent a significant challenge for a society used to developing linearly. The technological breakthroughs are disrupting established patterns not only in society but also in the economy and are consequently increasing the digital divide between developed and emerging countries; large and small companies; and the young and old. Nevertheless, several positive effects were identified by some of the experts. The three technologies can provide significant benefits in the area of sustainability and the circular economy. At the moment, different types of plastic are essential for 3D printing as well as nanotech, where it is applied as a conductor. Nevertheless, as these technologies develop, the implementation of environmentally friendly materials, such as plant-based filaments (soy, seaweed, eucalyptus, algae, bamboo, recycled paper, etc.), biodegradable filaments and recycled building materials could considerably reduce the waste and minimise the environmental impact. 3D printing would also contribute to the reduction of waste and pollution, as there is no need for the locally or at-home printed products to be packed or transported.

7.1.2 Information resources

00026 Suggested reading

The experts suggested the following general sources of more information:

- https://en.wikipedia.org/wiki/Robotics;
- C. Andrew Keisner, Julio Raffo and Sascha Wunsch-Vincent, Breakthrough Technologies – Robotics, Innovation and Intellectual Property, Economic Research Working Paper No. 30, 2015, WIPO;
- C. Andrew Keisner, Julio Raffo and Sascha Wunsch-Vincent, Breakthrough Technologies – Robotics and IP, WIPO magazine, December 2016, WIPO.

7.1.3 Impact on Society, the Economy and World Trade

00027 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

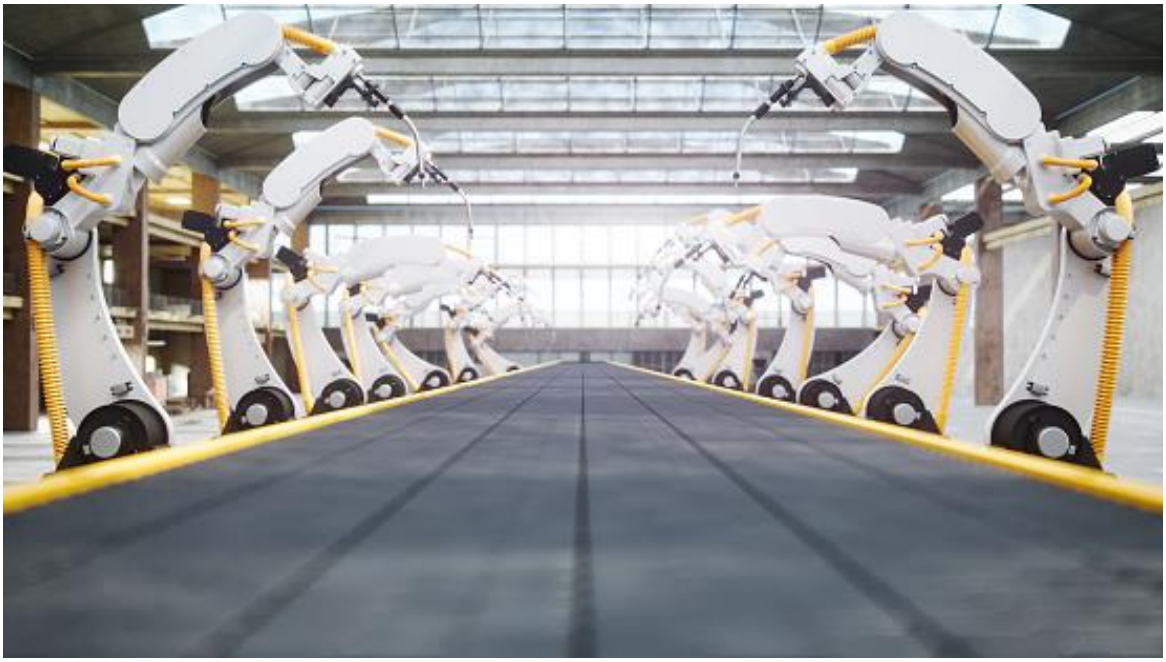
- mass unemployment;
- economic inequality;
- process effectiveness;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

00028 Robotics effect on many aspects of human life

It was suggested during the discussion that robotics technology already influences many aspects of both the workplace and home environment. Furthermore, it has the potential to positively transform lives and work practices, raise efficiency and safety levels and provide enhanced levels of service. It was emphasised by some experts that the development of robotic technology has drastically changed the labour market and could lead to social polarisation. According to a number of experts, these changes

could potentially disturb the social and economic balance on a national and international level in terms of unemployment, crime, education and world trade and are currently especially visible in developing countries. Nevertheless, these changes also affect society on an individual level. Technological dependence and the transfer of physical and mental tasks to machines could result in a significant loss of knowledge and skills. Practical experience obtained through apprenticeships could be lost which, consequently, would diminish the quality of the work and products. It was noted by some experts that the use of robots could create new, high-paying jobs that require skilled workers. While it is true that robots are replacing low-skilled workers and automating the tasks that they perform, robots and automation are requiring jobs that focus workers on higher-value work. However, robotics could lead to sustained periods of time with a large fraction of people not working. A rise in unemployment would lead to a lack of consumer spending, which could, in turn, put companies at risk.

Picture 5: Interior of a Modern Automated Factory with Robotic Arms and Conveyor Belt



00029 Robotics – a democratic technology?

According to some experts, a growing number of people have access to the technologies that enable the creation of new products without the need to have a vast educational background or experience. The democratisation of technology undoubtedly leads to more rapid developments and innovation within the industry; however, it also raises a series of issues regarding the liability and quality of the products made by amateur developers. These elements have a big impact on innovation, versatility and creativity, but also give rise to a number of questions on how to effectively protect and enforce IPR.

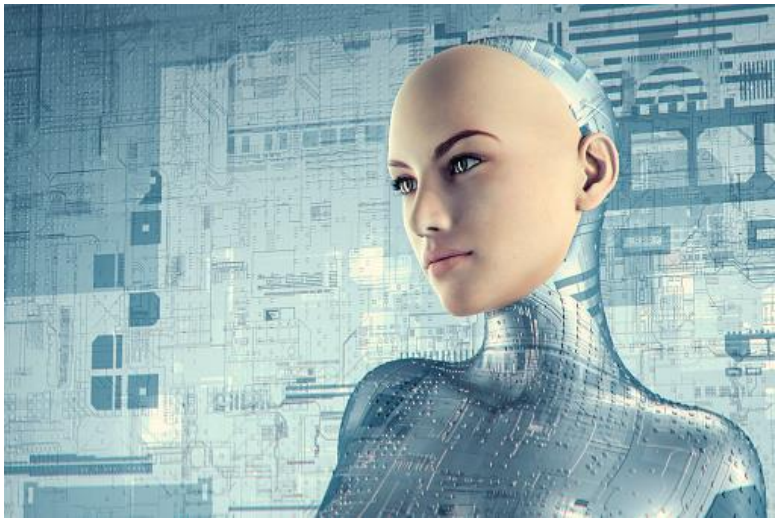
00030 Various key sectors use of robotics

Robotics are widely used in manufacturing, assembly and packing, transport, earth and space exploration, surgery, weaponry, laboratory research and the mass production of consumer and industrial goods. They are also employed for jobs that are considered too dirty, dangerous or dull to be suitable for humans. In these various industries and sectors, robotics already underpins employment. According to some experts, the proper use of robotics increases the productivity of industry and leads to:

- enhanced product quality;
- higher product output;
- reduction of production costs;
- growth in labour productivity;
- shift from manual jobs to jobs requiring critical thinking;
- increase in gross domestic product (GDP).

Picture 6: Close-up of Robotic Arm Holding a Tomato

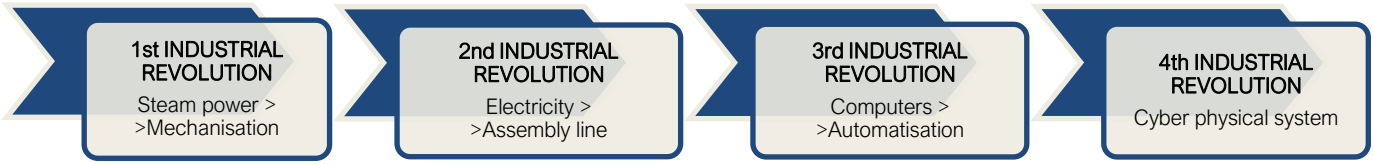
Picture 7: Futuristic Female Cyborg



00031 Effect on world trade

Some experts addressed the issue of the impact on world trade and it was suggested that robotics has been one of the drivers that has enabled global-scale manufacturing; thus, globalisation has become successful under the economic, technological, political, social and cultural influences of robotics on a worldwide scale. The pace of goods production has ramped up to satisfy the increasing demand for commercial products. The labour market has also changed due to the unstoppable fact that robots have been replacing human labour since the inception of the first industrial revolution, as presented in the figure below.

Figure XI. Industrial Revolutions



7.1.4 IP protection use cases

00032 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology, and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

00033 A few suggested use cases

Some experts suggested a number of use cases for robotic technology as regards IP protection, to include the following.

1. Protection of end-products for differentiation (robots themselves).
2. Protection of robotics platforms, both proprietary (competitive) software and hardware developments.
3. Protecting the final products as the result of the robot's work. In future, robots are likely to produce new solutions to problems and in so doing create intangible outputs that could, at least in theory, be perceived as IP.

00034 Robots as inspiration for creative works

It was indicated by some experts that robots (and androids) have been a source of immense inspiration for authors, musicians, movie makers and video game producers. And those creative works have inspired scientists and industrialists to develop and utilise robotics (and other new technologies).

Figure XII. Examples of Robots and Androids in Popular Culture

Frankenstein, novel by Mary Shelley. UK: Lackington, Hughes, Harding, Mavor, & Jones, 1818
Metropolis, motion picture directed by Fritz Lang. Germany: Universum Film A.G., 1927
I, Robot, novel by Isaac Asimov, USA: Gnome Press, 1950
Do Androids Dream of Electric Sheep?, novel by Philip K. Dick. USA: Doubleday, 1968
Westworld, motion picture, directed by Michael Crichton. USA: Metro-Goldwyn-Mayer Studios, 1973
We are the Robots, song performed by Kraftwerk. Germany: Kling Klang (EMI), 1978
Hey! Rise of the Robots, song performed by The Stranglers. UK: United Artists, 1978
Blade Runner, motion picture directed by Ridley Scott. USA: Warner Bros, 1982
Terminator, motion picture directed by James Cameron. USA: Orion Pictures, 1984
Transformers, cartoon series. USA: First-run Syndication, 1984
RoboCop, motion picture directed by Paul Verhoeven. USA: Orion Pictures, 1987
Robot Visions, collection of short stories by Isaac Asimov. USA: Byron Preiss Visual Publications, 1990
Ghost in the Shell, anime directed by Mamoru Oshii. UK-Japan: Kodansha, Bandai Visual and Manga Entertainment, Production I.G., 1995
Paranoid Android, song performed by Radiohead. UK: Parlophone Capitol, 1997
Matrix, motion picture directed by the Wachowski Brothers. USA: 1999
Steel Battalion, video game. Japan: Capcom, 2002
Battlestar Galactica, television series. USA: Sci-Fi Network, 2004
Robots (The Humans Are Dead), song performed by Flight of the Conchord. USA: Sub Pop, 2008
Bioshock, USA: 2K Games, 2008
Wall-E, animated motion picture directed by Andrew Stanton. USA: Pixar Animation Studios, 2008
A.I. Artificial Intelligence, motion picture directed by Steven Spielberg. USA: Warner Bros., Dreamworks, Amblin Entertainment, 2011
Westworld, television series. USA: HBO, 2016
Crier's War, novel by Nina Varela. USA: Quill Tree Books, 2019

00035 Specific copyright protection issues

Some experts emphasised that the issue of copyright protection is relevant to robotics in several respects. Copyright protection is especially an issue in the area of software codes that have been 'reduced to writing' and are believed to be unique and original. In practice, robotics companies typically use copyright enforcement to prevent others from copying or simply accessing their computer code. Another example where copyright protection could be used for robotics but is not common practice in the industry is for a unique aesthetic design, such as a design pattern on a robot. It was emphasised by some experts that it is generally accepted within most countries that circumventing an electronic barrier in order to gain access to copyrightable computer code is a violation. This is particularly important for the robotics industry because most robotics companies employ electronic barriers to restrict access to their robots' computer code.

00036 Automated created works and innovations

Some experts introduced the issue that robots can already, and in the future even more so, produce new solutions to problems and in so doing create intangible outputs that could, at least in theory, be perceived as IP. This could raise interesting questions as to the boundaries of the current IP system. Do objects, software code or other assets created autonomously by a robot qualify for IP protection? If so, how? And who would own these IP rights? The producer? The user of the robot? The robot itself? Autonomous robot creation and the question of who owns IP rights in creations produced by robots will surely be a matter of much future discussion. These questions are also raised in regards to other technologies, for example, AI.

Picture 8: Automatic Robot Mechanical Arm is Working in Temporary Storage in a Distribution Warehouse

7.1.5 Threats and challenges for IP

00037 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale online and offline infringement;
- crime committed by robots, algorithms and decentralised autonomous organisations (DAOs);
- automation.

00038 Counterfeiting perspective

From a counterfeiting perspective, some experts suggested that robotics allows the easy replication of items and therefore facilitates the illegal production of goods. There is no doubt that robots are facilitating infringement by making product reproduction faster, more broadly available and more easily accessible to the regular consumer. However, these types of infringement are conceptually not very different from the ones currently known. Hence, for the time being, these cases can be examined by applying the already existing law and enforcement measures.

00039 Trade secret issues

The technological complexity of robotics systems means, according to some experts, that trade secrets are often the first option for companies seeking to protect their innovations. The experts identified a number of reasons for this:

- few people have the expertise to reverse engineer these complex systems;
- highly expensive robots are very difficult to get hold of, making reverse engineering practically impossible or at least not economically feasible.

00040 Effect of employee mobility in the robotics sector

In the robotics sector employee mobility is high, so many companies apply restrictive covenants when employees move to competitors. Uncertainties surrounding the patentability of software in different jurisdictions could further tilt the balance in favour of trade secrets. Next to patents, industrial designs that protect a robot's appearance – its shape and form – also play an important role in improving the marketability of products and helping firms appropriate the returns on their R&D investments.

7.1.6 Investigative and enforcement opportunities

00041 Prompts for workshop discussion

The experts were asked to identify some potential opportunities in the use of the technology for investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- automation.

00042 Law enforcement use of robotics

According to some experts, robotics can be used by law enforcement in collaboration with AI, through the use of drones and IR cameras to identify illicit products.

00043 Customs use of robotics

This technology, as noted by a number of the experts, can also be used in customs authorities using lots of small or nanorobots to inspect the goods in a container and find products for inspection. One of the biggest issues customs officers face on a daily basis is the amount of imported parcels that need to be checked. This time-consuming and costly process could in the future be carried out by small robots or drones. These devices should be able to fly inside a container and be equipped with AI and cameras/scanners that would detect counterfeit goods. These improvements would result in shorter response times; a higher number of checked containers, which would consequently resolve limited storage space issues; and more effective distribution of the workforce. The robots could also be equipped with other types of sensors, such as thermo and smell sensors, similar to the ones used to determine the quality of the air and trained to recognise the signals that the objects would transmit indicating the goods are original products.

7.2 3D Printing

00044 Quote from *'3D printing the rise of the 3rd industrial revolution'*

The multitude of benefits that 3D printing can bring to the world should of course be weighed against its perils. Some commentators have written about how the technology could be used to undermine governments, while others fear that it may bring about the end of capitalism and incite revolutions across the globe.

Council, Aaron, with Petch, Michael, *3D Printing the Rise of the 3rd Industrial Revolution*, gyges3d.com, US, 2014.

7.2.1 The technology in a nutshell

00045 Examples of the technology to begin the workshop discussion

A few examples of the technology were given to the experts to start the discussion:

- stereolithography and digital light processing;
- fused deposition modelling;
- selective laser sintering and melting;
- electronic beam melting;
- laminated object manufacturing;
- programmable matter and 4D printing.

00046 3D printing – an emerging technology

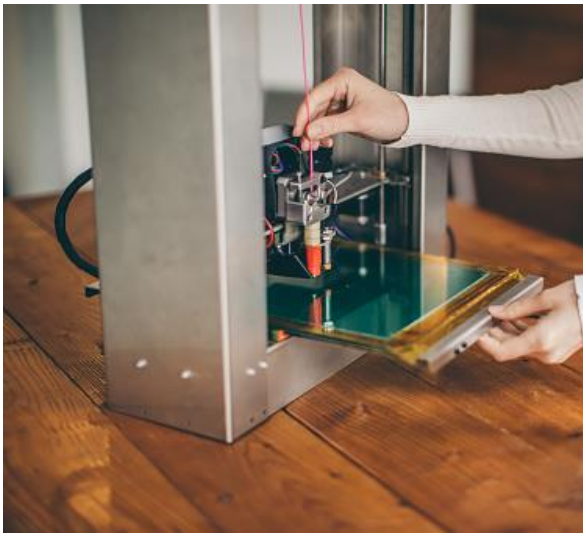
Although a number of experts were of the view that 3D technology has not yet reached its full potential, the technology is evolving rapidly and successfully and is undoubtedly revolutionising every aspect of our lives and work. Medicine, architecture, transport, education, engineering, archaeology and aeronautics, are just some areas that benefit from innovation within this technological field. A key advantage of 3D printing is the ability to produce very complex shapes or geometries.

Picture 9: 3D Printer

00047 The 3D printing process

Some experts explained that the 3D printing process builds a three-dimensional object from a computer-aided design (CAD) model, usually by successively adding material layer by layer (i.e. additive manufacturing). The term '3D printing' originally referred to a layer-by-layer process that deposits a binder material onto a powder bed with a printer. Recently, the term has encompassed a wider variety of additive-manufacturing techniques and processes such as electron-beam additive manufacturing and selective laser melting. Earlier, 3D-printing techniques were considered suitable only for the production of functional or aesthetic prototypes but more recently, due to enhanced production precision, repeatability and material range, 3D-printing processes are considered viable as a true industrial-production technology.

Pictures 10 -11: 3D Printing Process



7.2.2 *Information resources*

00048 Suggested reading

The experts suggested the following general sources of more information:

- https://en.wikipedia.org/wiki/3D_printing;
- https://www.europol.europa.eu/newsroom/news/do-criminals-dream-of-electric-sheep-how-technology-shapes-future-of-crime-and-law-enforcement;
- Stefan Bechtold, 3D printing and the intellectual property system, Economic Research Working Paper No. 28, 2015, WIPO;
- https://www.3dprintingmedia.network/ways-3d-printing-impacting-world/;
- Dinusha Mendis, Mark Lemley and Matthew Rimmer (ed.), '3D Printing and Beyond: Intellectual Property and Regulation', 2019, Elgar;
- Harvard Business Review, 2017, 3D Printing Gives Hackers Entirely New Ways to Wreak Havoc;
- Fruehauf, J., Hartle, F., Al-Khalifa, F., 2016, 3D Printing: The Future Crime of the Present;
- https://www.netopia.eu/netopia-report-3d-printing-technology-and-beyond/;
- EC Study on The Intellectual Property Implications of the Development of Industrial 3D Printing, 2020, authored by Dinusha Mendis, Jan Bernd Nordemann, Rosa Maria Ballardini, Hans Brorsen, Maria del Carmen Calatrava Moreno, Julie Robson and Phill Dickens.

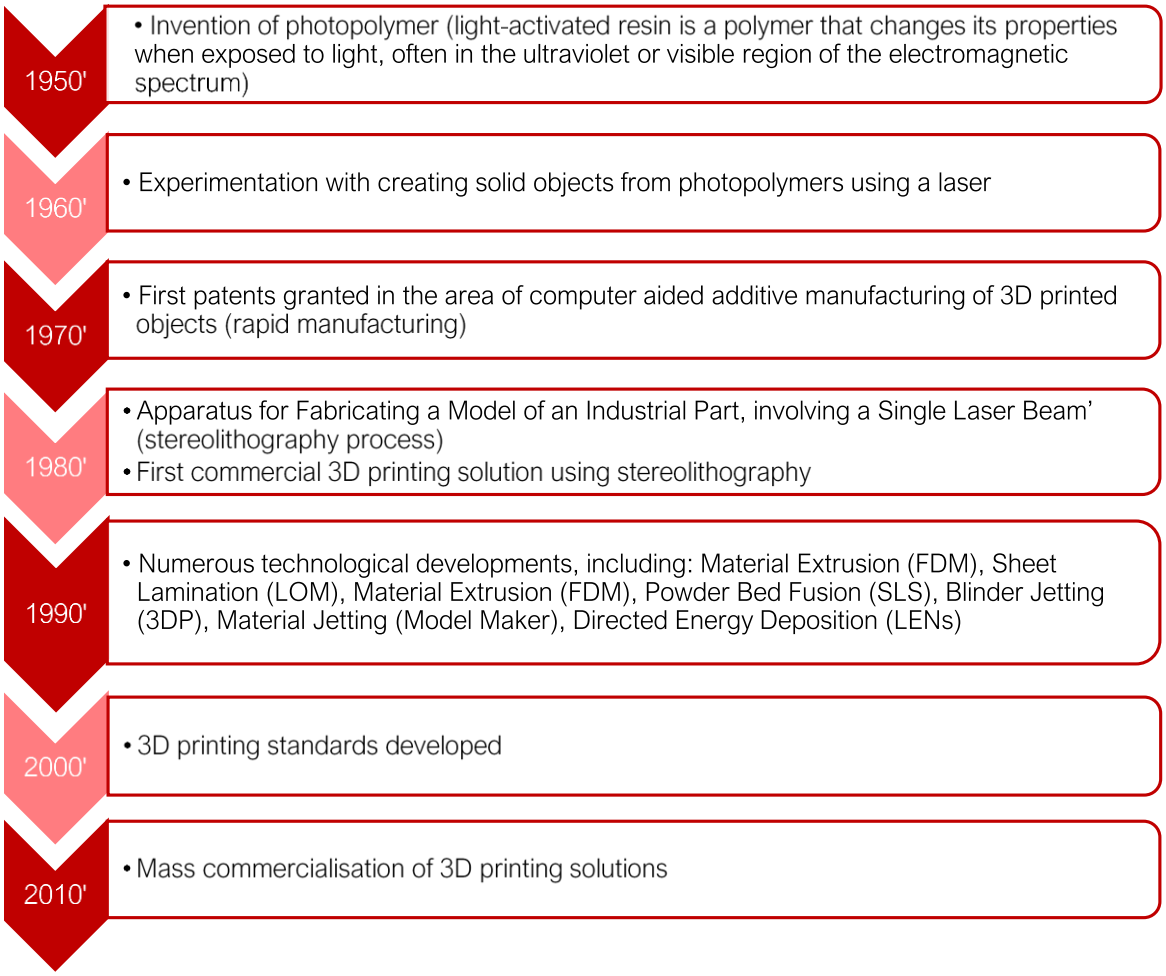
7.2.3 *Impact on Society, the economy and World Trade*

00049 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

- sharing economy;
- mass unemployment;
- economic inequality;
- process effectiveness;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

Figure XIII. The History of 3D Printing



00050 Effect on production and distribution of goods

One main effect as well is the ability to produce, in a standardised and serialised way, customised products based on demand (i.e. less waste). Serialisation and customisation may seem to be opposed concepts but 3D printing actually combines them. In other words, a 3D printing production line can now produce 'series' of unique items instead of identical goods. In the area of 3D printing, three main business models can be identified: (1) commerce, lease or exploitation mode of the 3D printers as well (2) commerce of the CAD files, and (3) commerce of the printed products. The development of 3D printing can have a dramatic effect on the labour market as the production of goods can be more decentralised. The democratisation of the technology undoubtedly leads to more rapid development and innovation within the industry; however, it also raises a series of issues regarding the liability and quality of the products made by amateur developers. In regards to distribution, 3D printing can affect supply shortages and reduce the need for packaging and transport. 3D printing could thus result in less world trade of goods but there will still be the need for trade in raw materials and components used in 3D printers. There could also be an effect on tax revenue and there could come a call for making the digital blueprint the taxable item.

00051 Environmental Impact

It was emphasised by some experts that 3D printing could have potential positive effects in regards to environmental issues:

- reduction of waste due to less packaging, packing and distribution;
- reduction of pollution and CO_2 emissions due to less transportation of goods;
- on-demand production and less need for stocking goods;
- weight reduction through cost-effective geometry optimisation of parts.

7.2.4 IP protection use cases

00052 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

00053 IP and 3D printing – a multidimensional issue

Some experts suggested that the protection of IP in 3D printing technology is a multidimensional issue affecting virtually every area of IP law (including copyright, patent law and design law), since the printing process has various elements that to various degrees can be protected:

- the 3D printing machines;
- the materials;
- the CAD file formats;
- the CAD files themselves;
- the printed products.

00054 Digital rights management (DRM) and traceability

Many industrial companies that are using 3D printing in the production process are collaborating with different organisations with a view to finding feasible solutions for the protection of 3D printing machines. One of the areas currently being studied by the manufacturers of 3D printing machines is the

implementation of a DRM system into the printers. In this regard, the 3D printing technology would follow the steps taken by the music, book and movie industries as a means to prevent unauthorised copying or use. Many companies are also looking into establishing traceability solutions for printing machines in order to ensure integrity at every step of the process.

00055 Control of CAD files

Recognition tools, such as fingerprinting, hashing or watermarking could be used for tracking the CAD files that can also be encrypted and reinforced with a licencing system, which would determine the number of copies that can be printed from a certain model, as well as the terms and conditions of its commercial use. The permission to print a certain 3D model can also be restricted by the use of serial numbers. In this way, a determined file could only be printed on a machine with a determined serial number. Following this methodology, each file would contain an embedded identifier impossible to eliminate or alter. A number of experts were of the view that the tracking system of the files is a beneficial addition to the protection given by the registration of the design, since, should the model be distributed online illegally, the owner could trace the source and use this as grounds to file a claim.

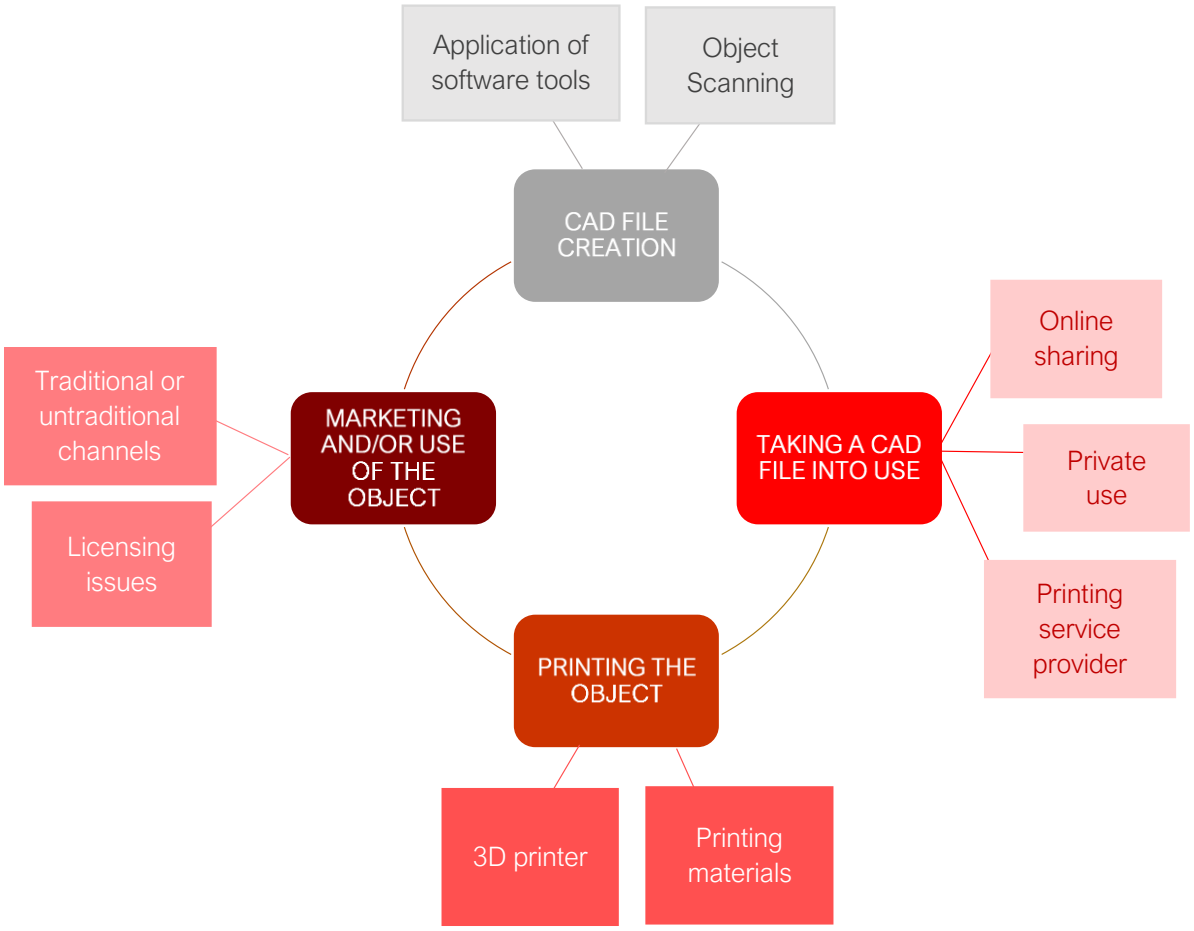
00056 Legal challenges

It was noted by some experts that in most cases existing IP laws could be applied to the new technologies. Nevertheless, some amendments, or maybe even a new type of IPR, might be needed as regards the creation or modification of living organisms using nanotech or 3D printing. However, IPR protection of these technologies will be ineffective without adequate reinforcement, which could be achieved by implementing watermarks or certificates. Since the issue of standardisation raises similar challenges for standards organisations and IP organisations the establishment of cooperation between these institutions would be highly valuable. The unique characteristics of the 3D printing process generate a number of questions that the courts will inevitably need to address in the future, for instance, who owns an object conceived by one individual, digitally modelled by another and printed by a third? Is there a need to establish a new type of IPR to regulate 3D printing with biomaterials, such as living tissue?

00057 The consumer-related issues

On the assumption that 3D printing evolves into a widely spread consumer technology, consumers could turn into creators of designs and products. Consequently, they will not interact with IP just as end-users but, above all, as owners of IP rights, which will require more awareness-raising campaigns to instruct them on owning and managing IPR. The democratisation of 3D printing technology raises a series of questions regarding the safety and ownership of the final product in the event of unauthorised modifications to the CAD files. In the event of injury or material damage or an IP-related dispute caused by a substandard product, does liability lie with the owner of the 3D printer who made the product, with the designer who created the file, with the provider of the printing material or with the maker of the 3D printer? Some experts suggested that the principles of this system coincide largely with the principles applied to ‘do it yourself’ guidebooks and products. One of the possible regulatory solutions would be the implementation of a licencing agreement containing the terms and conditions of use that would regulate the materials, the resolution and consequently, the quality of the final product.

Figure XIV. The IP Implications of the Development of Industrial 3D Printing



7.2.5 *Threats and challenges for IP*

00058 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale online and offline infringement;
- 3D printed infringement;
- automation.

00059 3D printing and counterfeiting

From a counterfeiting perspective, 3D technology allows the easy replication of items and therefore facilitates the illegal production of goods. As 3D printing evolves in the future and the quality of the materials increases, the printed products can become close to identical to the mass manufacturing versions. In this regard, 3D printing could lead to a higher amount of IP infringement as it would be more difficult to detect whether the products are original or counterfeit. The risk would increase even more with the dissemination of 3D printers able to print with gold, silver and other high-value materials. However, these types of infringement are conceptually not very different from the ones currently known. Hence, for

the time being, these cases can be examined by applying the already existing law and enforcement measures. However, despite the wide range of possibilities that the 3D printing technology offers to counterfeiters, the current situation is not as worrying as it seems at first sight. A number of experts indicated that IP infringers generally are looking at fast and cheap solutions. 3D printing will undoubtedly advance and improve, but for the time being it is still too slow and too expensive for large-scale counterfeiting.

00060 Some unresolved issues in regard to IP infringements

Some experts were of the view that 3D printing raises a number of unanswered questions and legal challenges concerning IPR. To what extent can a file be modified not to be considered an infringement? In the event of infringement, who should be held accountable; the designer of the CAD file, the owner of the machine that printed the product or the end-user? These (and other) issues could according to some of the experts be resolved leveraging on the experience and methodology used in the case of illegal TV providers, where legal actions are being taken against the distributors of illegal sources, not the users even if they can in principle be liable but the issue will probably be highly contested. Moreover, due to the mass proliferation of 3D printers and unencrypted CAD files, the large number of users and high degree of anonymity, infringers could be difficult to identify. Some experts pointed out that the experience from copyright enforcement in regard to intermediaries could be an inspiration also in the area of sharing of CAD files used to produce illicit products. They suggested that this question needs further scrutiny.

7.2.6 Investigative and enforcement opportunities

00061 Prompts for workshop discussion

The experts were asked to identify some potential opportunities for the use of the technology for investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- automation.

00062 Use of 3D printing as a tool for enforcement of IP

Some experts subscribed to the view that 3D printing hardly offers any benefits as regards enforcement and is seen rather as a threat. This is due to the fact that 3D printing in essence frees the travel of 'know-how' through cyberspace and as such there can be no restrictions of movement of the final constructed physical goods.

00063 Relevance for customs control

Customs' scanning processes could be improved by implementing 3D and penetration scanners adapted to large-scale objects or by applying nanotech. However, customs' controls could focus on inspecting, detecting and controlling the distribution of the primary and popular materials used for 3D printing (e.g. plastic pellets). This is expected nevertheless to drop as the world adopts a circular economy paradigm where materials are recycled and locally sourced.

00064 Determining originality of 3D objects using nanochips

Some experts indicated that nanocodes could be integrated into the CAD files and used to track the 3D printed objects. Then, originality could easily be determined in controls carried out by the authorities.

7.3 Nanotech

00065 Quote from Matt Spire's novel 'Caligatha'

Many, many rules had begun to bend at the hand of nanotechnology, gene therapy, robotics, artificial intelligence. This produced a lot of good, and a lot of bad. This trade-off has always plagued us. When you make waves, you produce peaks and troughs.

Spire, Matt, *Caligatha,* Deadprism, US, 2015.

7.3.1 The technology in a nutshell

00066 Examples of the technology to begin the workshop discussion

A few examples of the technology were given to the experts to start the discussion:

- manipulation of matter on atomic, molecular and supramolecular scale;
- nanotubes.

00067 The nanotech science

Nanotechnology (nanotech) is the manipulation of matter on an atomic, molecular and supramolecular scale. One of the first applications of the technology had the aim of precisely manipulating atoms and molecules for the fabrication of larger products. Currently nanotech refers to a whole area of scientific and industrial research that deals with the special properties of matter which occur below a given size. Nanotech includes fields of science, for example, surface science, organic chemistry, molecular biology, semiconductor physics, energy storage, microfabrication and molecular engineering. Applications of the technology range from extensions of conventional device physics to completely new approaches based upon molecular self-assembly, from developing new materials with dimensions on the nanoscale to direct control of matter on the atomic scale. Future applications of nanotech will be developed to create revolutionary new materials and devices.

Picture 12: Conceptual Illustration of Medical Nanoparticles

00068 Nanotech – a powerful emerging technology

Although a number of experts indicated that nanotech has not yet reached its full potential, the technology is evolving rapidly and successfully and could undoubtedly revolutionise many aspects of our lives and work. Medicine, architecture, transport, education, engineering, archaeology and aeronautics, are just some areas that benefit from innovation within that as well as other technological fields, including robotics and 3D printing.

Picture 13: Colourful Abstract Data Flowing Chromatic Holographic Dynamic Waves

00069 Carbon nanotubes

One important application of nanotech is, according to some experts, carbon nanotubes, which are tubes made of carbon with a diameter measured in nanometres (a nanometre is 0.000000001 m). Nanotubes already have a wide range of uses, and look set to become crucial to several industries, for example, electronics, strengthened materials, medicine and diagnostics. Carbon nanotubes could become a major traded commodity with the potential to replace some conventional raw materials.

7.3.2 Information resources

00070 Suggested reading

The experts suggested the following general sources of more information:

- https://www.nano.gov/you/nanotechnology-benefits;
- https://en.wikipedia.org/wiki/Nanotechnology;
- https://en.wikipedia.org/wiki/Societal_impact_of_nanotechnology;
- https://ec.europa.eu/jrc/en/research-topic/nanotechnology;
- Lisa Larrimore Ouellette, Economic growth and breakthrough innovations: a case study of nanotechnology, Economic Research Working Paper No. 29, 2015, WIPO.

7.3.3 Impact on Society, the economy and World Trade

00071 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

- sharing economy;
- mass unemployment;
- economic inequality;
- process effectiveness;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

Picture 14: Graphene Nano Material Processing in Graphene Processing Factory

00072 Impact of nanotech

According to some experts, nanotech raises many of the same issues as any other new emerging technology, including concerns about the toxicity and environmental impact of nanomaterials, and their potential effects on global economics, as well as speculation about various doomsday scenarios (e.g. in respect to nanoweapons and bioweaponry). If nanotech is going to revolutionise manufacturing, health care, energy supply, communications and defence, then it will as emphasised by a number of the experts also transform the labour market, the medical profession, the transportation sector and energy infrastructure. All of these developments could lead to significant social disruption.

7.3.4 *IP protection use cases*

00073 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

00074 Potential issues concerning IP protection

The experts identify some potential issues concerning nanotech and IP protection:

- protection of manufacturing processes;
- protection of the nanotechnology products;
- protection of nanodevices, nanomaterials and nanotools;
- protection of nanobiotechnology to modify human or living beings' genes.

7.3.5 *Threats and challenges for IP*

00075 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale online and offline infringement;
- automation.

00076 Effect on counterfeiting

The commercialisation of nanotech-based products has, on the one hand, been relatively modest, due to its complexity and costliness. Nevertheless, current research activities demonstrate extraordinary potential, which raises a question as to whether the infringement of nanomaterials will increase when this technology becomes widely applied and economically profitable.

7.3.6 *Investigative and enforcement opportunities*

00077 Prompts for workshop discussion

The experts were asked to identify some potential opportunities for the use of the technology in investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- more or less dependable and transparent evidence;
- product individualisation;
- automation.

00078 Intelligent materials

Creation of nanomaterials such as fibres or threads to develop 'intelligent materials' that can be used to create new products with authenticity embedded. As the production of these nanomaterials can only be exclusively produced by certain companies, it would be complicated for forgers to create similar fake products. These 'intelligent materials' may also change their physical shape to hold invisible information at simple sight that may code some information about the product, which forgers cannot detect or even alter.

00079 Nanotech and robotics in combination

Some experts expressed the view that nanotech and robotics in combination could provide a positive impact on investigative and enforcement procedures once they reach their full potential, which is why further investigations in the application of these technologies are welcome.

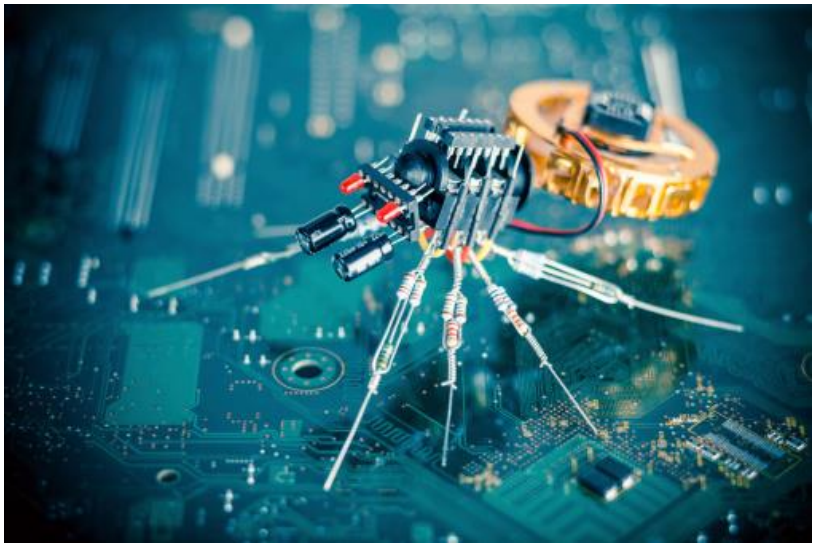
00080 Customs application of Nanotech

Some experts suggested that customs' scanning processes could be improved by applying nanotech. Special intelligent nanomaterials holding embedded information about the authenticity of the product would act as a type of embedded radio-frequency identification (RFID) sensor and transmit the coded data when being scanned and could serve as an effective recognition method.

00081 Counterfeiting resistant products

Contrary to watermarks or holograms, which can be counterfeited, nanomaterials are significantly more challenging and, above all, more expensive to counterfeit. The impossibility to remove them, unlike chips and SIM cards, makes them ideal components for labelling. These materials would be able to emit a signal and could serve as tracking devices. Assuming that the counterfeiters would not make the effort to embed nanomaterials in the falsified products, some experts indicated that the counterfeit goods would be easily recognised by the lack of the aforementioned elements. This system would not only be beneficial for customs, but also for consumers as a universal app could be developed for scanning the goods and verifying whether they are original products. Another possible solution that nanotech enables is the DNA spray. The spray is based on an invisible liquid embedded with a unique code and microdots that glow up under UV light and can be easily traced. As nanotech becomes more widely available and cheaper, anti-counterfeiting might face challenges as seen with other technologies, for example, holograms.

Picture 15: Electronic Spider Working on a Motherboard



8. DATA PROCESSING TECHNOLOGIES

8.1 Artificial Intelligence (AI)

00082 Tagline from the motion picture *'A.I. Artificial intelligence'*

David is 11 years old. He weighs 60 pounds. He is 4 feet, 6 inches tall. He has brown hair. His love is real. But he is not.
Journey To A World Where Robots Dream And Desire.
This Is Not A Game.
This summer, discover the next step in evolution.
Do not speak the seven-word activation code unless you mean it.

Tagline from *A.I. Artificial Intelligence*, motion picture directed by Steven Spielberg, Warner Bros, Dreamworks, Amblin Entertainment, 2011.

8.1.1 The technology in a nutshell

00083 Examples of the technology to begin the workshop discussion

A few examples of the technology were given to the experts to start the discussion:

- advanced algorithms;
- machine learning;
- deep learning;
- neural networks;
- technology used to identify digital content;
- analyses of large data sets and extraction of relevant data.

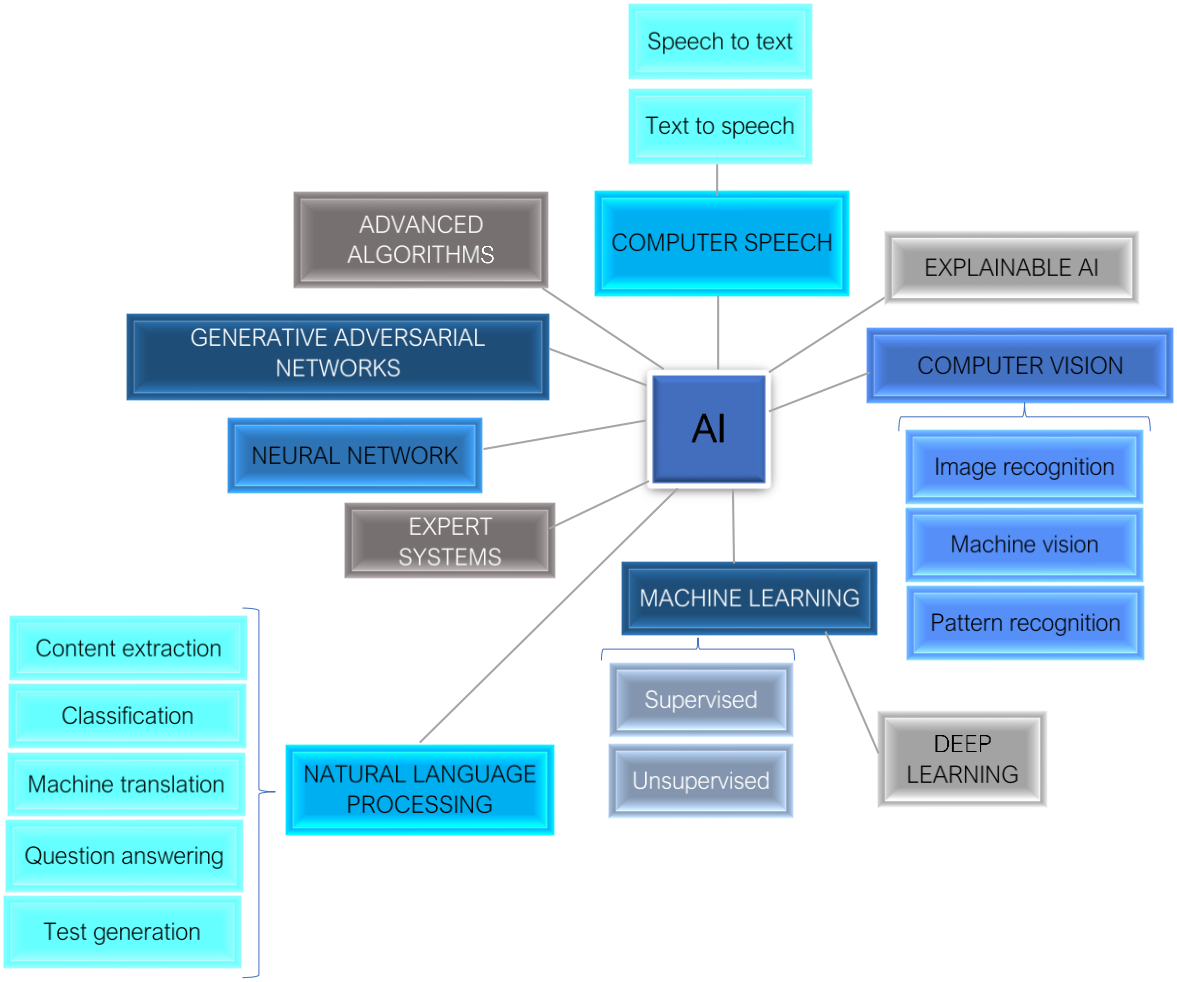
00084 Artificial intelligence – a multitude of different technologies

In most cases, the fundamental AI models ([5]) represent a mathematical description of how the input data is going to be processed and what kind of input is expected from the model for given performance evaluation criteria. Thus, artificial intelligence (AI) systems are primarily advanced learning systems. By applying AI, a machine can learn to perform a task previously performed by a human with limited or no human intervention. AI encompasses a wide range of very diverse techniques, including:

- advanced statistics-based machine learning algorithms and multi-task learning algorithms;
- deep learning often executed in a multiple layer neural network (a computer framework imitating the human brain);
- prediction models to support decision making and other kinds of probabilistic reasoning that combines deductive logic with probability theory.

([5]) E.g. artificial neural networks, Bayes networks, hidden Markov models and support vector machines.

Figure XV. Concepts of Artificial Intelligence (AI)



00085 Key features

A number of the experts pointed out that the key features of these technologies are efficiency, promptness in new developments, usefulness, cost reduction in products, user-friendliness, good investment opportunities, employment transformation, general improvement in quality of life and major improvements in fields such as mobility, media, security, health and education.

00086 Applications of artificial intelligence

Artificial intelligence can be used as a part of almost endless exploratory data analysis (aiming to understand what data represents):

- computer vision (including automated content review and characterisation);
- big data analysis (including automated consumer recommendations);
- creation of virtual worlds (together with augmented or virtual reality technologies), music composition, style imitation or content restoration;
- automated content recognition (ACR): Audio, video, semantics, text, picture and speech recognition;
- making robots better functioning (together with robotics technology).

8.1.2 *Information resources*

00087 Suggested reading

The experts suggested the following general sources of more information:

- https://en.wikipedia.org/wiki/Artificial_intelligence;
- https://en.wikipedia.org/wiki/Adversarial_machine_learning;
- https://www.europol.europa.eu/newsroom/news/do-criminals-dream-of-electric-sheep-how-technology-shapes-future-of-crime-and-law-enforcement;
- https://www.actuaries.digital/2018/09/05/history-of-ai-winters;
- Adam Greenfield, Radical Technologies: The Design of Everyday Life, 2017, versobooks.com;
- WIPO Technology Trends 2019 – Artificial Intelligence, 2019, WIPO;
- Ryan Abbott, The Artificial Inventor Project, WIPO Magazine, December 2019;
- https://ec.europa.eu/futurium/en/ai-alliance-consultation;
- https://www.educba.com/importance-of-artificial-intelligence/;
- http://www.europarl.europa.eu/RegData/etudes/BRIE/2019/637967/EPRS_BRI(2019)637967_EN.pdf;
- https://ec.europa.eu/digital-single-market/en/big-data;
- University of Oxford, 2018, The Malicious Use of Artificial Intelligence: Forecasting, Prevention, and Mitigation;
- Vinge: A note on artificial intelligence and intellectual property in Sweden and the EU, 22 April 2020, available on lexology.com;
- https://www.elementsofai.com/eu2019fi;
- Towards Responsible AI Innovation, Second Interpol-Unicri Report on Artificial Intelligence for Law Enforcement, 2020, http://unicri.it/in_focus/files/UNICRI-INTERPOL_Report_Towards_Responsible_AI_Innovation.pdf
- https://www.wipo.int/edocs/mdocs/mdocs/en/wipo_ip_ai_2_ge_20/wipo_ip_ai_2_ge_20_1_rev.pdf.

8.1.3 *Impact on Society, the economy and World Trade*

00088 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

- sharing economy;
- mass unemployment;
- economic inequality;
- unequal access to data;
- process effectiveness;
- mass surveillance;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

00089 Impact in general

AI will have a major impact in society, the economy and world trade. These new technologies will modify societies in matters of safe transport, mobility, security, health, media content recognition, the quality of the services offered and, last but not least, employment.

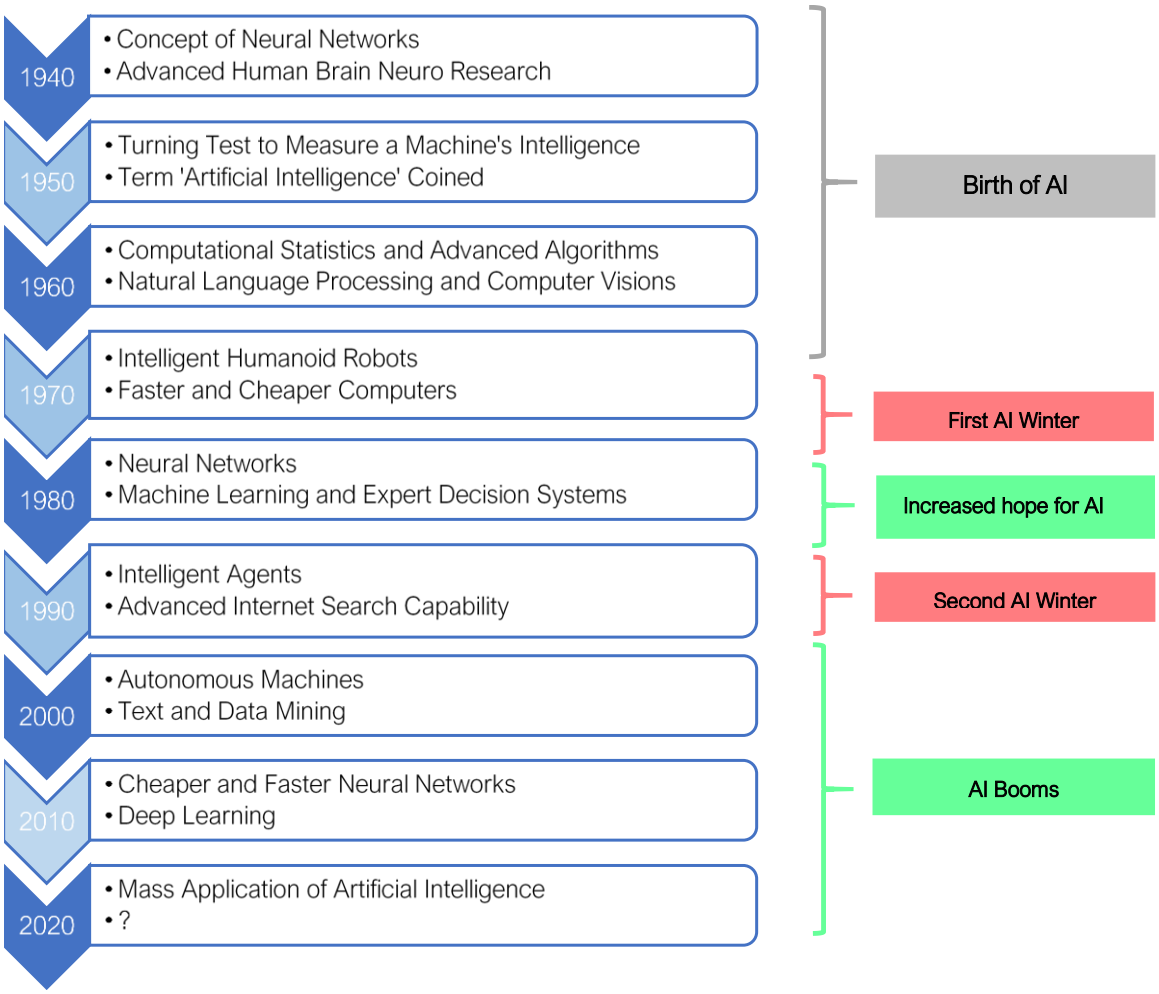
00090 AI impact on the economy

In terms of the economy, it was the view of some experts that humanity will most likely experience the exploitation of ever-cheaper resources for training AI, increased competitiveness and productiveness of traditional enterprises applying AI and the development of completely new business models. Concerning world trade, overall production capacity might increase due to AI-driven, completely automated production and less wasteful systems leading to more affordable, customised products that can be delivered faster.

00091 AI impact on employment

It was emphasised by some experts that many people currently accept low-paid jobs with offline and online tasks. These jobs are unchallenging and consist of repetitive simple duties and assignments. Due to AI, many such jobs will disappear creating a transformation of the workplace. On the other hand, there will be a high demand for people to create and give training on AI solutions. Some of the experts pointed out that many AI predictive statistics applications rely on data input which requires extensive manual labour for preparation, in contrast to the idea that AI can make sense of disorganised data.

Figure XVI. The History of AI



00092 AI related legislation in the future

Some experts were of the view that some changes in legislation will most likely be required in regard to how data can be used in AI solutions. The fundamental rights of human beings will, however, have to be respected in regard to all use of the technologies. AI also raises issues of legal responsibility and consequences in the event of accidents caused by AI-driven decisions. It was suggested by experts that international legislative initiatives will be needed. Either way, privacy and fundamental rights protection is essential. Thus, some experts were of the view that an updated legal environment that addresses AI challenges in various fields is needed, taking into account the rapid development in AI technology. In regard to the use of AI results as evidence in court, some experts mentioned that the Daubert standards ([6]) could be used to establish the reliability of the evidence in courts to avoid erroneous decisions. Some experts raised the issue of liability of the providers of AI solutions and suggested this might require regulation.

00093 Access to data – a big challenge for AI

Some experts emphasised that a major issue for the implementation of AI is ensuring that smaller businesses have fair access to data controlled by bigger companies. AI only works in a controlled environment and its effectiveness relies on access to relevant data more than having the best algorithms.

00094 Positive and negative impacts of AI

Most of the key features identified by the experts were considered positive and already known to some extent, but some experts also underwrote the fact that progress in AI can be seen as a convenient example of the double-edged sword metaphor. However, whether a certain impact of the technologies is considered positive or negative will often be subjective and they depend on the perception of the experts that develop them and the technology's manufacturers. The evolution of AI technology will take some time. Therefore, it was the view of some experts that humanity must prepare for the consequences, both positive and negative, which includes taking a close look at the ethical perspective of AI and social responsibility in the use of AI. The most plausible usage of AI in current state of the art is so-called decision support and recommendation systems.

8.1.4 IP protection use cases

00095 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

00096 New challenges for IP protection

It was the view of some experts that two issues were of special interest to IP protection: creation and transformation. It is complicated to distinguish between something considered to be original or new or something that has already been created or made. It is, according to some experts, difficult to establish what originality or transformation means in the context of AI. A machine might be able to create something *à la manière de* or *à la façon de*. The fact that a machine is able to create content based on already existing content easily imposes a threat. Many experts also pointed out that it has to be determined if and

([6]) In United States federal law, the Daubert standard is a rule of evidence regarding the admissibility of expert witness testimony applied in US federal law.

how AI-generated inventions and completely original works should be protected under patent and copyright law. While copyright is based in the life of the author, the question about the possibility of a machine owning the rights of these creations arises. A machine never dies, but who owns these rights then? If databases of copyrighted works were used to train the AI originally, what are the implications for these original works?

00097 Use of AI in examination of trade mark applications

According to some experts AI-based applications can help both the application process and the examination process a great deal, reducing the overall time of trade mark registration and leading to less oppositions. There are already tools using image search technology that help users ascertain whether their logo could be in conflict with existing trade marks. Natural language processing (NLP) is being used to find the best match for their goods and services for trade marks avoiding any possible classification deficiencies and lead to a more precise classification of goods and services. Using AI tools, users would be able to know whether their trade marks could be in conflict with already existing trade marks taking into account the visual, aural and conceptual similarities. All this could help users file their trade mark quickly and correctly, avoiding deficiencies in the examination process. AI tools would also help examiners make quicker and better decisions using AI tools, therefore letting them focus on more complicated tasks and drop routine simple tasks. Machine-learning techniques can help detect defective work, maintain consistency and support examiners in their learning path. In addition, machine translation will reduce the cost of manual translations of trade mark details and also the time it takes to get translations.

8.1.5 Threats and challenges for IP

00098 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale online and offline infringement;
- crime committed by robots, algorithms and decentralised autonomous organisations (DAOs);
- automation.

00099 New challenges for IP

A number of the experts stated that IP faces new challenges due to the rapid development of AI, primarily as regards the protection of IP rights and understanding to what extent certain actions result in IP infringement. For instance, AI can be used to remove watermarks used to protect digital content. AI can also be used in risk analysis aimed at optimising infringement because the infringers can monitor enforcement efforts and figure out how to counter them for illegal purposes. Another problematic use of AI would be in 'smart imitations', which means calculating the grey areas where an applicant can produce an infringing design or use a business identifier but with all likelihood avoid liability. Lastly, if enforcement becomes more run by AI, infringers calculate the response to their activities by themselves applying AI. IP infringers will potentially be able to defeat the ACR systems, for example, with slight alterations of content calculated by competing AI or by using a generative adversarial network (GAN).

000100 Prevention of illegitimate use of data

Another concern is that third-party providers supply algorithms and AI capabilities to everyone. As AI models most often represent a mathematical description of how input data is going to be processed and what kind of input is expected from the model for given performance evaluation criteria, illegitimate usage prevention lies in how AI solutions providers will control usage of those models against given customer data. This also applies to the safety of the data itself. Perhaps, there can be keyword-/visual-recognition to raise a red flag in the event of such usage. However, this might not be possible when dealing with

processed numerical anonymised data. It should be noted, however, that most AI is open-source technology, so that the maximum number of people can benefit from it and work on it and critically oversee it. The more people using it, publishing their code and inspecting others' code, the better.

000101 Deceptive IP registration system

Machine learning was given by some experts as an example of an AI-generated threat to IP. The more automation we go towards, the riskier it becomes. Infringers can trick and deceive the system. Interesting questions include: to what extent do infringers have access to all these technologies? Do they have the resources to do this? It is public data: all trade marks are public, all designs are public. One might be able to create a model, check similar ones and deceive the system so that one's system (the fake system) is recognised as the real system.

000102 Bypassing automated functions

It was noted by some experts that the more automation developed in IP, the more prone it will be to attack through adversarial machine learning, since infringers might be able to determine the means to bypass automatic checks with the help of powerful AI tools. The greatest challenge for these technologies lies in balancing the veracity of the recognised content, the data resources to enforce these systems and the strength to withstand variations in content.

000103 Flooding the IP system with original works or designs

It was stated by some experts that AI could be used to generate large amounts of designs and original literary, musical or artistic works. Such designs and works could flood the IP systems making it difficult to ascertain what should be protected and what is a future infringement.

000104 AI – a bigger opportunity than threat

It was the view of a number of experts that AI will provide more new means of protecting and enforcing IP than it will create opportunities for infringers. AI can be applied for a good cause and there is more use to protect IP rather than to carry out criminal attacks. Besides, AI can be efficient in improving IP protection, so the investment is worthwhile. However, threatening IP may still – in many cases – be easier to do manually or wilfully (with a clear and direct intent in mind) rather than through the development of sophisticated AI tools that can require a significant amount of time, resources and investment but this could change as AI becomes cheaper and more easier to use.

8.1.6 Investigative and enforcement opportunities

000105 Prompts for workshop discussion

The experts were asked to identify some potential opportunities for the use of the technology for investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- OSINT;
- faster judicial cooperation and procedures;
- more or less dependable and transparent evidence;
- product individualisation;
- better or worse notice and takedown procedures;
- automation.

000106 AI – an opportunity for IP enforcement

Some experts stated that there are some investigative and enforcement related opportunities in AI. In fact, investigation and implementation of this technology is a continuous process. For some companies, the technology is already being applied as regards IP enforcement. Either way, the algorithms will continuously get better and the applications will undoubtedly improve over time (e.g. by adding keywords and images for AI and machine learning). Nevertheless, amelioration and refinement of these technologies must take place in order to reach major achievements in the field under discussion.

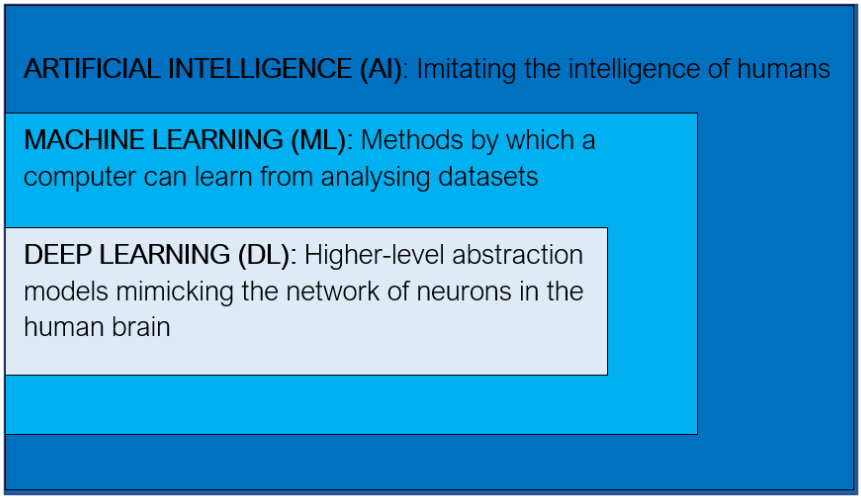
000107 Detecting potential infringements

As a matter of fact, there are AI-based tools used to identify similar trade marks, designs and patents. These AI tools can also be applied to check an existing copyright. This application of the technology provides a rapid manner that allows it to corroborate whether a new IP rights claim has any conflict with the existing one. GANs could be used to find paths and calculate distances between two designs to establish the 'closeness' of an infringing design to a given one.

000108 Applying machine learning in e-commerce

Some experts discussed the practical application of machine learning. There are already online marketplaces that have adopted machine learning to fight counterfeiting. They use feature extraction from the text description of the product and they intervene with ACR implementations. If this technology becomes too effective in the marketplace, the IP infringement moves somewhere else, for example, social media. Breakthroughs in e-commerce are therefore an iterative process.

Figure XVII. AI Machine and Deep Learning



000109 Customs risk analysis

Some experts mentioned that AI can be applied in customs risk analysis. AI's efficiency is remarkable, since it is able to process or verify unusually large amounts of data in a relatively short period of time. An AI agent is therefore capable of analysing and tracing similarities – such as specific characteristics within millions of individual shipments – to identify or even predict the occurrence of IP infringement.

000110 Detecting cybersquatting

It was also mentioned by some experts that AI can reinforce IP in terms of finding patterns regarding the creation or details of suspicious domain names and taking initiatives to stop the activities of these domains once this suspicion is verified.

000111 AI in copyright enforcement

It was suggested by some experts that AI could significantly improve existing tools that are designed to fight copyright infringement. Many online sharing platforms already use ACR tools to verify contents uploaded by their users (videos, music, pictures, texts, etc.). They often rely on fingerprinting solutions, which check uploaded files against a reference database of protected works to find out if the uploaded content is recognised and has to be blocked or monetised, for instance. AI techniques can be integrated into these ACR tools to make them smarter (e.g. to guess if uploaded content seems suspicious or should, on the contrary, fall under fair use). AI can also make ACR tools more robust and more efficient (e.g. to enable content recognition even if uploaders try to modify the original content in an attempt to deceive the fingerprinting tool). For businesses (particularly in the creative industries), monetising the content, being able to match the content, identifying the rights holder, paying the rights and being able to show advertising on this content, are the most important aspects.

000112 AI combined with Blockchain technology

Some experts were of the view that different types of risk analysis could benefit from a combination of AI and blockchain technology. As DLTs become established, an ever-increasing amount of information is stored in them. At the same time, the immutability feature of blockchains make them ideal for investigations as information is immutable. However, since blockchains are repositories of large volumes of data, it is likely to require AI and machine learning algorithms to weigh in and assist in the data-mining tasks, for example, in relation to risk analysis and the detection of suspicious trends or patterns. On the flip side, blockchains could be used to support the transparency and explanatory challenges that face AI. In other words, dedicated DLTs can be used to capture an AI's decisions and state transitions when arriving at a particular decision. A number of experts concluded that AI can establish patterns and generate reports describing this.

000113 AI used in cybersecurity

Some experts emphasised that AI systems are being developed to protect IT infrastructure through cybersecurity measures, which help circumvent IP theft attempts, for example. However, attackers are also creating AI systems to get into the protection. AI systems always have information coming in as huge sets of data and they can establish correlations that no human could ever have spotted.

000114 AI as a mirror of human knowledge

Some experts emphasised that AI technology is like a mirror of human knowledge and capability. While AI is neutral by definition, it is still trained by humans, and humans can be biased. Some experts expressed this as machines learn from data based on human behaviour, so biasing should be removed from the data before it is given to machines for training. Therefore, AI is often limited by the knowledge and vision of the persons in control of the application. On the other hand, humans cannot completely rely on machines, although they can enhance speed and effectiveness. Nonetheless, in the end it is all subject to risk tolerance. What levels of risk in AI applications are acceptable? Some experts gave the example of malfunctions of ACR. These are generally due to the fact that the human did not programme the AI properly. AI can make mistakes that humans have not thought about. One of the main challenges for IP is having a technology that is not biased.

8.2 Virtual, Augmented or Enhanced Reality

000115 Quote from Tim Cook

I do think that a significant portion of the population of developed countries, and eventually all countries, will have AR experiences every day, almost like eating three meals a day. It will become that much a part of you.

Leswing, Kif, 'Apple Cook thinks augmented reality will be as important as eating three meals a day', *Business Insider*, 3 October 2016, https://www.businessinsider.com/apple-ceo-tim-cook-explains-augmented-reality-2016-10?IR=T, last accessed 6 May 2020.

8.2.1 The technology in a nutshell

000116 Examples of the technology to begin the workshop discussion

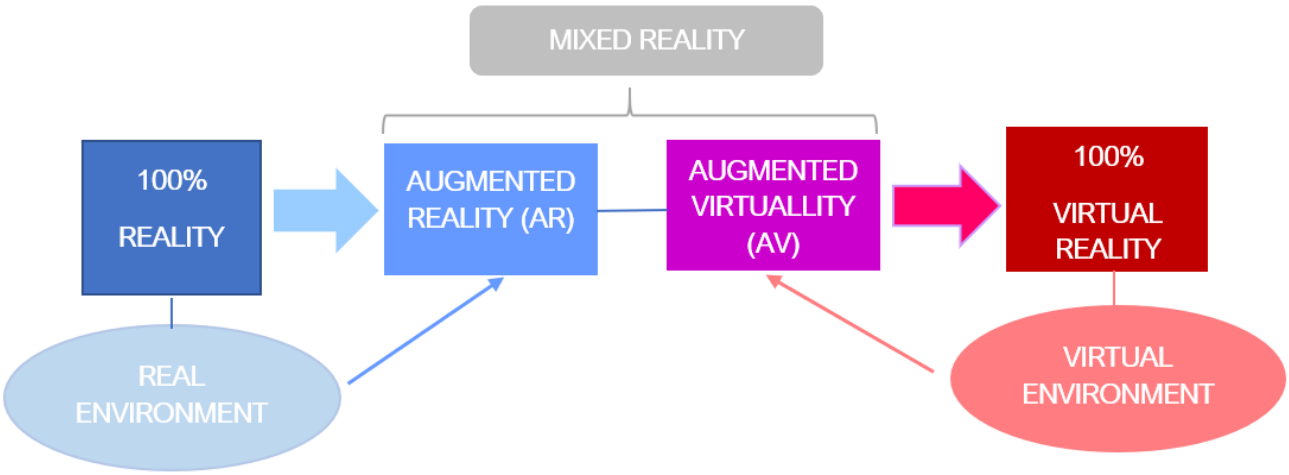
A few examples of the technology were given to the experts to start the discussion:

- mixed reality;
- enhanced reality;
- augmented reality.

000117 Mixed reality

This chapter mainly focuses on different aspects of mixed reality, not pure virtual reality itself to the same extent. The term 'augmented reality' (AR) is used throughout this chapter to represent the different variations of mixed reality.

Figure XVIII. Mixed Reality



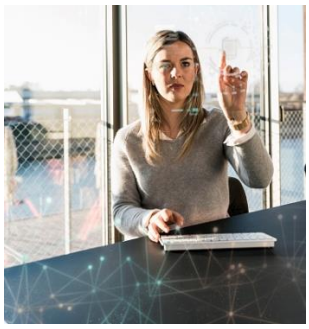
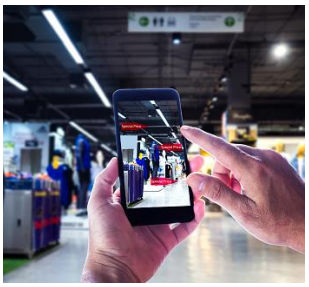
000118 Augmented reality is soon a part of ordinary life for everyone

It was the view of a number of the experts that the incorporation of AR into the daily life of most human beings is only a matter of time. In that context, it is important to differentiate between VR and AR: the former implies a fully immersive experience in the virtual environment, while the latter combines real and virtual objects in a physical space, thus creating a mixed reality. On the basis of this differentiation, AR can have a wide number of beneficial applications in education, communication, investigation, prosecution, sports, healthcare, marketing or entertainment, inter alia. However, just like any other technology, AR can also be used with criminal intent, which raises new challenges for judges, authorities and policymakers.

000119 Devices necessary for augmented reality (AR)

One of the main characteristics of AR nowadays is that it requires a device for it to be perceived, for example, mobile phones, projectors or wearable items such as VR glasses and headphones. In the future, the gadgets may be reduced to contact lenses or even to neuronal links that allow for brain interactions, accompanied by sensors that enhance other senses.

Pictures 16-18 Augmented, Mixed Reality Devices

		
AUGMENTED REALITY		
Combines real and virtual objects in a real environment (graphics and audio)	**Runs interactively and in real time** (explicit v implicit interaction)	**Registers (aligns) real and virtual objects with each other** (in 3D space)

8.2.2 Information resources

000120 Suggested reading

The experts suggested the following general sources of more information:

- https://en.wikipedia.org/wiki/Augmented_reality;
- Adam Greenfield, 'Radical Technologies: The Design of Everyday Life', 2017, versobooks.com;
- Woodrow Barfield and Marc Jonathan Blitz (ed.), 'Research Handbook on the Law of Virtual and Augmented Reality', 2018, Elgar;
- a number of free-of-charge online seminars are available on: https://www.coursera.org/courses?query=augmented%20reality.

8.2.3 *Impact on Society, the Economy and World Trade*

000121 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

- sharing economy;
- mass unemployment;
- economic inequality;
- process effectiveness;
- mass surveillance;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

000122 Different strategies in applying augmented reality (AR)

It was mentioned by some experts that certain sectors already apply AR as a proactive measure, for instance, to have a competitive advantage or to completely revolutionise an industry, while others use it in a reactive manner, as in criminal investigation. Notwithstanding, the content of this technology is not very varied so far due to the huge effort required for its creation and to the small number of companies producing it. Be that as it may, AR is here to stay and evolve as value shifts from physical products to virtual items. This could trigger a shift in all levels of the economy, powered by the emergence and implementation of 5G technology. Some experts suggested that currently there is not enough bandwidth to enable a smooth functioning of AR, but 5G could be the trigger that will speed up AR development and provide the possibility of higher-quality and better rendered AR.

000123 Augmented Reality (AR) – the technology that can tie the other emerging technologies together

According to some experts, the world could be heading towards a future where virtual assets will be the most valuable possessions that most people own. It took centuries to initiate the first industrial revolution, only a few decades to start the second and it has been a matter of time to experience a third and fourth, or other subsequent 'revolutions' that happen sooner each time and will heavily impact the economy and lives of all human beings. In the current environment and with the fast evolution of technology, AR will, according to some experts, change the way humans think, behave and live their lives. It was suggested by some experts that AR is not mature yet, but it could be the technology that will tie all the other emerging and disruptive technologies together. Robotics, 3D printing, nanotech, AI, blockchain technology, etc. could thus work together with AR to create completely new ways for humans to live their lives.

000124 Change in ways of human interaction

It was the view of some experts that AR is about to change our way of interacting with others, and not only in the field of entertainment. Gaming was one of the first industries to embrace AR, and its increasing accuracy will eventually immerse the player into an almost perfectly rendered environment. Nevertheless, it was noted by some experts that this poses considerable threats to users, who may be overly absorbed in the artificiality. What is more, this could lead to confusion of virtual and real elements and even result in physical harm. In fact, some users of AR solutions have already experienced injuries while playing on the street by bumping into objects or tripping over obstacles.

000125 Gaming

Gaming has a broad and growing audience, with part of it developing addiction for some games. Some experts introduced the term 'neurocognitive capitalism', meaning the creation of players' brain dependency of artificial worlds through patterns that cause the segregation of dopamine, often with the

help of AI. Some experts suggested that this would be especially relevant in environments where ownership can be monetised. Some experts mentioned that in the coming era of AR and with the improvement of its realistic rendering, addiction levels may increase, with a subsequent impact on money flow. Additionally, theft cases of digital items that hold a strong emotional (and economic) value to the players have already been registered, some of them ending up in court. Some experts disagreed on the issue of the suggested addiction effect on players and stated that it is not possible to control players with games. Instead, players take games and do unexpected things with them. The game belongs to the player, not the other way around.

Picture 19: Hand Holding Tablet Using AR Application to Check Relevant Information about the Spaces Around a Customer in Tokyo

000126 Virtual events

We already have holograms in concerts as background decoration or the digital representation of musicians, and the next step may be that consumers can attend concerts from home ([7]), a trend that could expand into other entertainment and cultural industries. Many people might prefer to attend events from home if the quality and intensity of the overall experience is the same as attending in person. This could, according to some experts, lead to the disruption of whole industries, which would impact on both the economy (transportation, travel and catering, etc.) and the environment.

000127 Virtual shopping

As pointed out by some experts, virtual marketplaces and shops are already a reality. AR can be used as a powerful tool to facilitate legitimate sales (e.g. mirrors in physical shops that allow clients to visualise how each item of clothing would fit without needing to put the garment on). According to some experts, virtual marketplaces and shops are a rising force, to the point that some brands have opened stores in some of the most popular virtual worlds. This was in answer to consumer demand and to fight the IP infringers that were filling the market needs. Use of AR in virtual marketplaces and shops points towards

([7]) Though probably more pure virtual reality than augmented reality.

a reduction of apparel samples and inventory, thus avoiding unnecessary waste. It could also lead to a higher-quality design of clothes and apparel. A number of fashion designers are even starting to prepare entirely virtual collections with their corresponding virtual presentations.

000128 Use of avatars

In addition, AR may allow the user to create avatars (virtual representations of a person) to embody himself or herself in a social or work environment, which could result to abandoning the need for a physical presence at social or work events, and subsequently lead to some individuals feeling isolated though this will not apply to all individuals. It was commented by some experts that this shift in lifestyle towards seclusion could affect employment, causing the disappearance of some jobs but also the need for specific profiles, such as programmers and IT experts.

000129 Threat of mass surveillance

Some experts were of the view that one of the more evident threats of AR is permanent mass surveillance. In a situation where practically every person possesses a mobile phone and, in the future, also a device capable of registering and rendering the surrounding environment, the collection of data becomes more valuable than ever. This represents a number of risks in terms of the use given to the information collected, which could be sold to third parties, and also in terms of the protection of personal data and privacy. Some AR games that also rely on geolocation systems have been used to identify new paths and improve mapping tools, which could entail legal issues considering that the games could also be used by children. AR is already used to provide user information on daily actions (e.g. in relation to transportation and goods for sale in shops).

000130 Positive societal impact of augmented reality (AR)

However, it was the view of a number of experts that AR will have a mainly positive impact on society, creating new opportunities for businesses, education and the health sector. Even the environment will benefit from a more customised user experience that will reduce the physical return of goods and its consequent footprint on the planet. Some experts emphasised that an economy around digital assets could evolve in the years to come, changing the perspective of ownership. A wide range of original products will be created, introducing new shopping habits and also innovative services and forms of marketing that will expand the virtual industry and resonate all over the world.

Picture 20: Person Interacting with Augmented Reality Interface at Home

8.2.4 *IP protection use cases*

000131 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

000132 Augmented reality (AR) to enhance IP protection

Some experts mentioned that AR applications will have an effect on the protection of patents, trade marks, designs, copyright, etc. AR can be used as an effective visualisation tool to reproduce items in 3D form, thus helping rights holders and also rights examiners to appreciate the nuances of the marks, designs and innovations and make better decisions during the registration, verification and examination processes. Some experts believed that the amount of applications for registering holograms, 3D shapes and new forms of trade marks and designs may increase with the rise of pioneering AR applications, although it was noted that the recent reform of the trade mark law has not yet been accompanied by the expected registration response rate by applicants.

000133 Proof of trade mark use

Some experts mentioned that AR might give new opportunities of providing proof of use of trade marks. The use of a trade mark in an AR environment will be highly detailed, traceable and be based on mathematical certainty, therefore making dependable proof easier for rights holders to provide.

8.2.5 *Threats and challenges for IP*

000134 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale online and offline infringement;
- augmented infringement;
- automation.

000135 Crime between reality and virtuality

Currently there is a considerable and growing amount of global crime online, even though human beings exist offline. AR has the ability to merge both worlds and provides an opportunity for criminals to generate a whole new criminal system at 'the back end' of the technology. The sense of morality and respect of legal rules could, according to some experts, become more fluid. Thus, AR has great potential to shape the way we interact with the world, but such potential could also be used in unexpected, unlawful ways. However, a number of the experts were of the view that the currently known different possible uses of the technology does not pose any major issues that as of now require new legislation on criminal liability.

000136 Augmented IP Infringements

The virtual space is growing and continuously has to be explored as it opens the door to new applications that can pose threats to IP. An example of this are 'augmented' products, which enhance lower-quality physical products. For instance, a low-quality product in a living room can appear to be a high-quality expensive product via AR. Some experts suggested that the untrue improvement of a product by AR could

be unfair and misleading to the consumer but not directly an IP infringement (it is a deception of an original product against the consumer by its own owner). Because so much of what makes AR compelling is its ability to display creative text and images in new ways, the potential for copyright issues is obvious. Before AR technology is able to add digital content to our view of the world, the devices must first be able to know what we are looking at – hence the video cameras that come as standard on all such devices that have been announced. Most of the public discourse around these cameras has centred on their privacy implications. But making audiovisual recordings of our everyday surroundings creates an obvious potential for reproducing copyrighted visual art, text and music. Once AR software begins to make this captured footage 'greater' by adding digital content to it, there is a potential for creating derivative works. We can think of it as taking pictures or video of our surroundings with static digital imagery overlaid on top. After all, just as desktop computer users have long customised the appearance of their screen's wallpaper, so too will AR users eventually be able to customise the look and feel of the 'clickable world' around them. In other cases, the evolution from the original to the final creation will have to be assessed, and the decision about whether there has been an IP violation may depend on the level of augmentation or improvement experimented. Perhaps even the algorithms would need protection in the future.

000137 Challenges with transformation of objects protected by patent or copyright

On the other hand, for example in the field of patents, any improvement that needs to be made using a previously patented product or procedure must have the authorisation of the previous owner, so if it does not exist it would be an infringement regardless of the level of improvement. Something similar happens with copyrights, since the author is the only one who can transform (or improve) the work, and therefore it does not matter the degree of improvement, because if you do not have his or her authorisation it will be an infringement. Therefore, the risk or threat for IP is to develop digital tools for detecting this kind of infringement, sometimes quasi-undetected by the human eye. Finally, today the algorithms (code) find protection via copyright against literal copies (plagiarism), but the protection obtained is not enough to fight against AR enhanced copies. The threat is the misuse of the algorithms to infringe, without the possibility of control for the previous owner.

000138 Pirated applications

To date, AR/VR applications are quite expensive to develop, especially the ones made for entertainment purposes. Just as applications or games made for smartphones, AR applications may be pirated and distributed illegally for free (including on alternative AR/VR app stores), which could harm the developers and makers of such programmes. The AR/VR market is still experimental and has not yet adopted or implemented specific DRM systems or anti-piracy protections (unlike video games, for instance). This lack of anticipation could be a problem, as it is always more difficult to fight against piracy afterwards (compared with taking protective measures before piracy spreads, which is preferable).

000139 IP infringements in virtual marketplaces

As pointed out by some experts, virtual marketplaces are already a reality. While AR can be introduced as a tool to facilitate legitimate sales, AR can also complicate the task of protecting IP, as copyright protected works, trade marks and designs can easily be manipulated in AR enhanced environments. Some experts emphasised the potential threat from temporary pop-up marketplaces applying AR. Such marketplaces could lead to difficulties for effective enforcement and pose evidential challenges. The use of AR in virtual markets can encourage infringement, as it is very simple to copy a product or offer it through AR for use in other markets, such as gaming or sports. Everything can be manipulated by AR, even a patented product, but some experts pointed out that trade marks, designs and copyrights will be most affected by possible copies using AR. Another risk is that AR is used to make the consumer believe he or she is buying something online, but then turns out to be a fraud. The speed at which digital platforms or purchase profiles can be opened and closed makes this risk even greater.

000140 Deep fakes

Some experts mentioned the rise of 'deep fakes' and emphasised that AR could be used to recreate an artist's behaviour, moves and voice. This could be misused for copyright infringement but also in discrediting the artist thereby leading to lower popularity and economic loss. The creation of a certification stamp for legitimate content may become a necessity in such scenarios and digital deposit systems could also prove useful.

000141 'Augmented' deceptive marketing

Another threat already existing in the digital world is the replacement of legitimate content for infringing content. For instance, cases have already been registered where the advertising in a film has been modified or changed. Moreover, when scanning a code, the device could be redirected to an infringing web page, since this link can be easily hacked. With AR, the possibilities of infringers making use of personal data is exponential. In the future, personalised (and maybe infringing) advertisements may be embedded into the entertainment products we watch. Due to the lack of control and checks in the virtual world, it is quite likely that IP will be violated. In the artistic sphere, the value of an artwork lies in its uniqueness, in the privilege of owning an original piece. Nevertheless, the democratisation of art made it possible for the average viewer to acquire a copy and enjoy it as decoration in the scope of private use. Will AR improve enough so as to enable the creation of perfect 3D copies of original artworks? Over time, some experts noted, it is probable that the development of the technology will not allow it to distinguish between a fake hologram and an original piece, and this would open the door to the sale of illegal reproductions, with the consequent loss of copyright income for the artist. In the future, the client may purchase holograms instead of actual decoration items, and some mechanisms may be necessary to detect unauthorised copies of products that are protected in reality. Some experts mentioned that the private nature of the relation of the user and the device adds to the problem of overseeing personalised communication.

8.2.6 Investigative and enforcement opportunities

000142 Prompts for workshop discussion

The experts were asked to identify some potential opportunities for the use of the technology for investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- OSINT;
- faster judicial cooperation and procedures;
- more or less dependable and transparent evidence;
- product individualisation;
- better or worse notice and takedown procedures;
- automation.

000143 Visualisation tools

According to some experts, AR would allow for an original and a suspected fake product or part of a product to be compared or even merged, facilitating the task of spotting differences and detecting unfair competition. Besides that, AR could serve as a prediagnostic tool for brands and companies before launching a product, and it could also have evident applications for law enforcement authorities (LEAs), especially for customs. Conversely, AR could also be valuable in the event of a dispute. It could be used as a visualisation tool for legal assessment in a court room, an instrument that would allow it to specify an accurate percentage of similarity, considering that the current procedure consists of comparing the design registered with the infringing product. This technology would increase the probability of establishing

whether there is an infringement by providing the chance to escalate the objects, since the scope of protection is not related to size, but to the general view of the product. Imagine a lorry in the court room: with AR this would be possible. Space would not be a barrier anymore to present bulky objects as evidence during a trial: the prosecutor could show any object, no matter its size, shape or weight, before the court. This means that AR could also serve to display big sculptures and buildings.

000144 Crime scene documentation

Imagine documenting a crime scene during an investigation that could be later presented in a court room via AR. It would be possible to even feel how the location was. The technology would recreate a space to leave notes, tag objects or mark areas of interest, actions that could be visible only to the selected person or audience, allowing for undercover information. Furthermore, the enhanced reality representation could be sent to an investigator who cannot get to the original scene of crime and enable him or her to study it from a distance. This system is already being developed by Google in the Museums View project, which allows it to take virtual tours in some of the world's greatest museums and heritage sites. However, it is important to bear in mind that the creation process of augmented and VR worlds is highly costly and labour-intensive, factors that may delay the development of these technologies and that in some cases are already decisive for the quality of the outcome. In addition, it becomes essential to protect that content, as it is also subject to piracy.

000145 Police training

Another field where AR could have a relevant role in the protection of IP would be as a training tool to be used in police academies. The students could practice in an enhanced reality crime scene and move around it searching for clues. Not to forget the already-mentioned applications of AR for training of enforcement authorities. AR, which is characterised for enhancing the visual sense, could be complemented by haptic interfaces, which allows the human to interact with the computer by creating experiences related to the tactile sense and simulating differences in touch.

000146 Customs application of augmented reality (AR)

AR could be used for the performance of functions by customs. For instance, the 3D image display of the products could be available via databases used by customs and with the adequate equipment, customs authorities could use AR for evaluation of goods and for seizures. Having clear and updated lists would help enormously too. However, for this system to be effective, rights holders should be responsible for creating the images, uploading them to the databases and maintaining them, a challenge in itself. Besides, facial recognition and car registration data could be used by LEAs as an overlay to obtain instant information, always respecting data privacy regulations.

000147 E-enforcement

The idea of e-enforcement may be materialised in the future to respond to infringing applications of new technologies. IP infringement, such as IPTV piracy, could be fought more easily with the establishment of an online system where experts would not have to be on location to act. Considering that real experts in these matters are rather scarce, the elimination of the need to travel would make them more accessible. This is especially relevant in the case of infringement operations that locate the network, server, streaming service, etc. in different geographical points, and which according to some experts could be subject to more efficient notice and takedown procedures. Further to this, AR can enhance the visualisation of content where there is a physical lack of means, for instance, by projecting images onto a large number of 'screens' when there is not enough equipment or space to contain it, allowing for investigations to be better monitored or suspected links to be displayed.

8.3 Blockchain and Distributed Ledger Technology (DLT)

000148 Quote from the Bitcoin White Paper

What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party. Transactions that are computationally impractical to reverse would protect sellers from fraud, and routine escrow mechanisms could easily be implemented to protect buyers.

Nakamoto, Satoshi, *Bitcoin: A Peer-to-Peer Electronic Cash System*, 31 October 2008, https://bitcoin.org/bitcoin.pdf, last accessed 6 May 2020.

8.3.1 The technology in a nutshell

000149 Examples of the technology to begin the workshop discussion

A few examples of the technology were given to the experts to start the discussion:

- cryptocurrencies and assets;
- smart contracts;
- autonomous organisations.

000150 Blockchain definition

Some experts proposed to adopt the commonly accepted definition of a blockchain as a method for the decentralised recording of data in an immutable encrypted ledger maintained in a peer-to-peer (P2P) network. Transactions in a blockchain network can be conducted without the authentication of a central authority while still being trustworthy. A blockchain is considered to be a type of DLT. Strictly speaking, DLTs do not need to be cryptographic in nature, but the most popular instantiations of DLTs are delivered as blockchain technologies due to the particular characteristics the latter offer, as presented below.

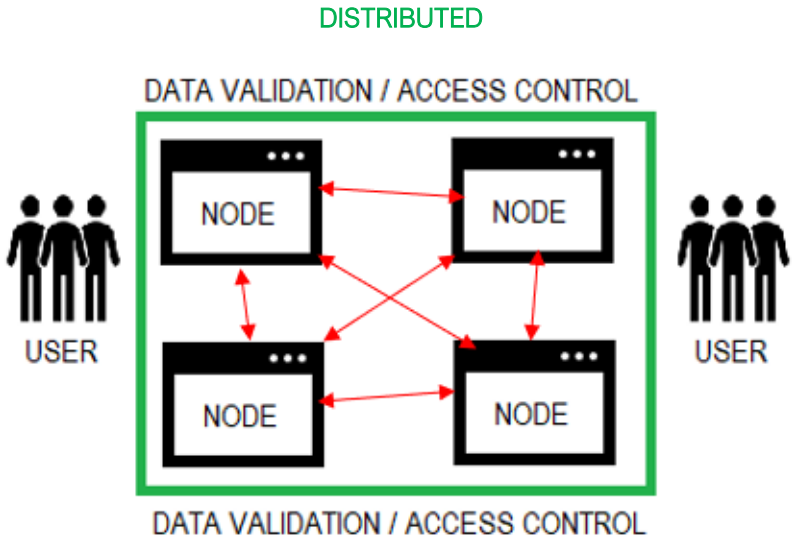
000151 Blockchain key characteristics

According to some experts, blockchain technology has the following key characteristics.

- Decentralisation. In conventional centralised transaction systems, each transaction needs to be validated through the central trusted agency (e.g. the central bank). In contrast, a transaction in the blockchain network can be conducted between any two peers (P2P) without authentication by a central agency.
- Immutability. Since transactions are stored in different nodes in the distributed network and validated through distributed consensus, it is nearly impossible to tamper with the blockchain. Each broadcasted block and its transaction are validated by all the nodes before being recorded. Any falsification can be detected easily. On the other hand, this presents a challenge when repairing an error or changing the data.
- Efficiency. It takes time to propagate transactions and blocks on a global public blockchain network. As a result, transaction throughput is limited and latency can be high. With fewer validators, consortium and private blockchains can be more efficient.
- Anonymity. Each user can interact with the blockchain network with a generated address. Users can have many addresses to avoid identity exposure. No central party keeps a user's private information. This mechanism preserves a certain amount of privacy on the transactions included in the blockchain. Note that blockchains cannot guarantee perfect privacy preservation.
- Auditability. Since each of the transactions on the blockchain is validated and recorded with a timestamp, users can verify and trace the previous records by accessing any node in the distributed network. In bitcoin blockchain, each transaction could be traced to previous transactions iteratively. It improves the traceability and the transparency of the data stored in the blockchain.

Figure XIX. Distributed v Decentralised Ledgers

- **Distributed**: running on multiple nodes owned by a single entity where there is one single trust boundary assuring data validation and access control for potential users.
- **Decentralised**: running on multiple nodes (owned by different entities) where each entity establishes its own trust boundary in relation to the data validation access control for any potential user.



000152 Different types of Blockchain

Current blockchain systems can be roughly categorised into three types: public blockchain, private blockchain and consortium blockchain. This has an impact on how consensus is determined, who can read and/or write the blockchains, whether there are permissions required, the transaction speed and who maintains the ownership. A good comparison of these types is shown below.

Figure XX. Differences Between Blockchain Types

BLOCKCHAIN VARIATIONS	CHARACTERISTICS
Public	No permission is needed to enter the blockchain as a user and no access control is administered for reading and adding data. Public blockchains are not supervised and provide anonymity features for users. However, the speed of public blockchains can be rather slow.
Private	Permission is needed to enter the blockchain as a user and access control to read or add data is administered on an invitation only basis. Private blockchains are supervised by a single entity and anonymity is usually not provided for users. However, the speed of private blockchains are often fast.
Consortium	Permission is needed to enter the blockchain as a user and access control to read or add data is administered on a case-by-case basis. Consortium blockchains are supervised by several entities and anonymity is usually not provided for users. However, the speed of consortium blockchains are often fast.

8.3.2 Information resources

000153 Suggested reading

The experts suggested the following general sources of more information:

- https://en.wikipedia.org/wiki/Blockchain;
- Melanie Swan, Blockchain: Blueprint for a New Economy, 2015, O'Reilly;
- Don Tapscott and Alex Tapscott, Blockchain Revolution, 2016, Penguin USA;
- Primavera de Filippi and Aaron Wright, Blockchain and the Law, 2018, Harvard University Press;
- bitcoin presentations by Khan Academy, https://www.khanacademy.org/economics-finance-domain/core-finance/money-and-banking/bitcoin/v/bitcoin-overview.

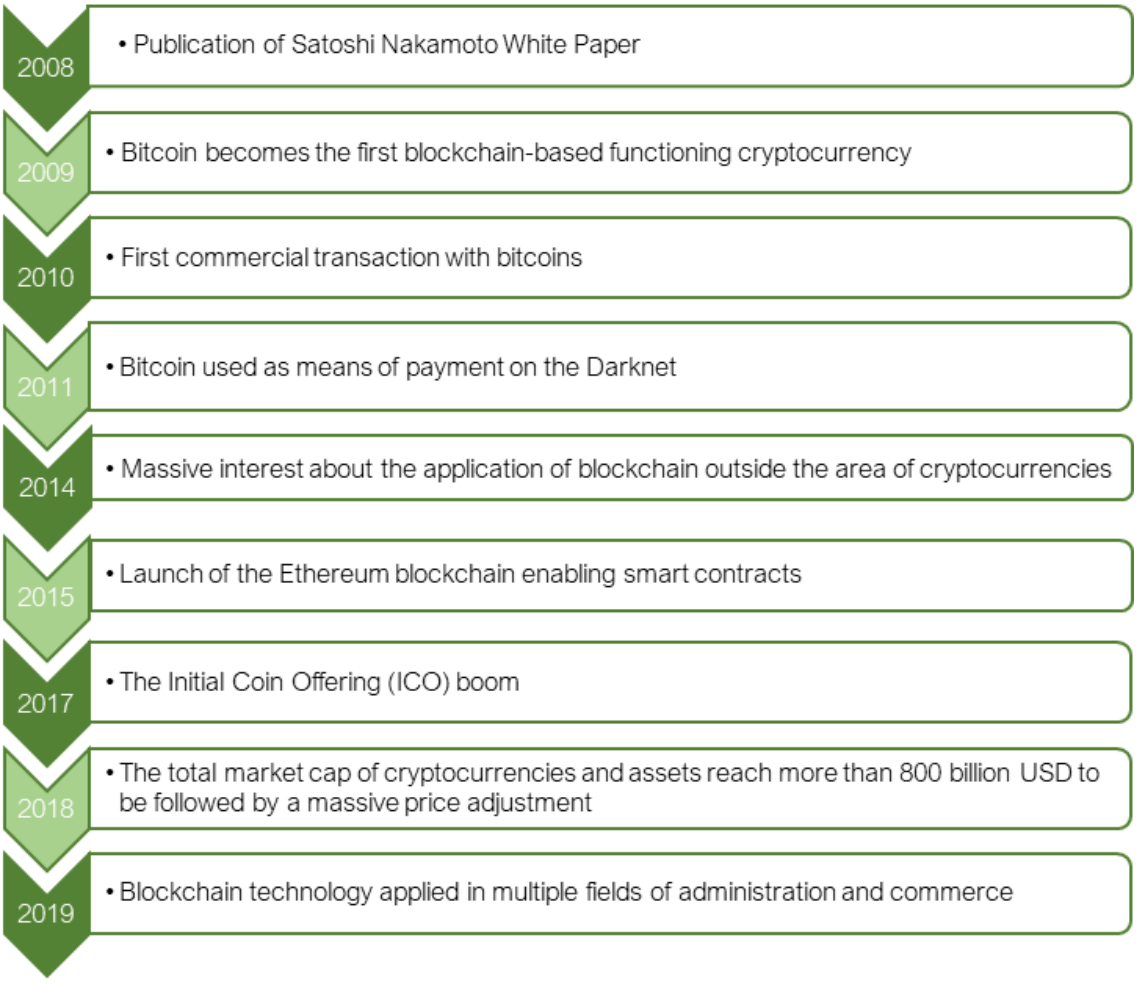
8.3.3 *Impact on Society, the economy and World Trade*

000154 Prompts for workshop discussion

The experts were asked to identify some important potential societal and economic impacts of the technology and to consider especially these issues:

- sharing economy;
- mass unemployment;
- economic inequality;
- process effectiveness;
- mass surveillance;
- quality of goods and services;
- new ways of producing and distributing goods;
- automation.

Figure XXI. The History of Blockchain



000155 Cryptocurrencies and other applications

During the workshop discussion, one of the main impacts of blockchain on the global economy was considered to be that of the cryptocurrencies payment systems, which are not controlled by the central banks. This system is used, for instance, to send money to emerging countries where the population has no access to credit cards or bank accounts. In that case, instead of sending and receiving money via traditional payment options, cryptocurrencies are used, creating a parallel payment system. However, it was noted that blockchain technology can have several other applications in fields such as social media, administration of assets, health care, insurance and law enforcement.

Picture 21: Bitcoin ATM

000156 Challenges and concerns

It was noted that blockchain technology can potentially make transactions and the recording of data cheaper and more dependable as the information entered in the blockchain is traceable, transactions are passed directly without the need for intermediaries, and the system provides reliable evidence of data logged. The technology, however, also involves risk as regards the quality of entered data due to the removal of a central trusted authority. Of course, as mentioned by some experts, there are a series of concerns and challenges when using the technology. The main concerns identified by some experts were:

- the need to verify the authenticity of the data entered in terms of legitimacy and ownership. What are the rules for ensuring that information is 100% legitimate and accurate, and how can the participant introducing the information prove authorship and legal ownership? Considering that data cannot be deleted once entered and that the system is not governed by an authority, it remains unalterable;
- the pseudo-anonymity of the blockchain and the removal of intermediaries enables illegitimate businesses to use it for criminal purposes and money laundering, but its traceability, on the other hand, opens up opportunities for these crimes to be unravelled;
- however, new types of intermediaries have emerged, namely the crypto-exchanges that are susceptible to the risk of penetration or fraud with risk of loss to the owner of the deposit;
- another issue is the verification of the legality of physical products linked to tokenised representations in the blockchain and how incorrectly registered product information will be rectified, since there is no way to delete existing data and other nodes must be notified;

- the major concern would be the limitation in terms of capacity and scalability. The more information and data is added by more and more participants, the more storage space and processing power is needed. However, this challenge is already being addressed and it was the view that it will soon be resolved;
- an important threat to consider is quantum computing with its potential to break encryption. Based on this input, it has been decided to dedicate parts of the next workshop on quantum computing;
- blockchain technology is developing into multiple formats and generations. From ripple to Ethereum, from tree ledger to singular line – the technology is evolving too fast to adapt into a multiple scale ecosystem. The technology is only relevant if used in its own context and environment and is currently not suited to interacting between technologies and to interconnected domains. Hence, some solutions need to be proposed to fix this problem;
- it has also been shown that blockchain is still prone to privacy leakage even when using public and private keys. Users' IP addresses have been tracked;
- current consensus algorithms like proof of work (PoW) or proof of stake (PoS) are facing some serious problems. For example, PoW uses excessive electricity while the phenomenon that the rich get richer could be a weakness of PoS consensus. These concerns need to be addressed in the blockchain technology challenges and opportunities;
- also, as regard blockchains involving a validation of the blocks by a majority of peers, there is a significant risk of 'blocking' if one actor (a State, for instance) manages to control a majority of peers. By doing so, this majority actor becomes able to refuse the validation of the incoming transactions, which will block the whole system. IP protection use cases

000157 Prompts for workshop discussion

The experts were asked to identify some potential use cases for the protection of IP by way of the technology and to consider especially these issues:

- new IPRs to be developed;
- application and examination procedures;
- documentation of IP;
- automation.

000158 Protection and registration of IP

Some experts suggested that almost all types of IP can be managed through blockchain, such as the exploitation of TV rights, the registration and distribution of copyrighted contents, 3D objects, etc. In some countries, smart trade marks are already being explored to stamp websites by means of digital signatures created and stored in the blockchain to help prove authenticity. Blockchain technology is a legitimate candidate mechanism for protecting and registering property rights, including IP (e.g. trade marks) or documenting unregistered rights (e.g. copyright). A number of commercial solutions to protect and administer IP using blockchain already exist. Important applications of blockchain for protection of IP are: registration, use management, evidence of use, confirming priorities and making IP registrations available.

000159 Trade mark and design registration system

Some experts pointed out that it is a direct consequence of the IP protection capabilities of blockchain technologies that they can be used for distributed trade mark and design registration systems. Blockchain-based registration systems for trade marks and designs will make it possible to connect various IP offices in a network so that each office has copies and updates of all registrations. Through a secure network, the key characteristics of blockchain technology can provide high-quality, uncorruptible, instantaneous and easily accessible rights. Everyone can be given access to the registrations with authorities retaining the role of verification.

000160 Management of music and performing arts

Examples were given of how blockchain is used in the music and performing arts industries. Smart contracts have been created using digital signatures of involved parties. One example is how musicians can license music rights to consumers with transparent and immutable terms tailored to each contract's needs. Payments can be automatically triggered according to those terms. Currently, there are different initiatives using blockchain technology to facilitate the direct management of musical works by the rights holders. These initiatives seek to encode the economics of creative works administration into smart contracts to facilitate real-time royalty distribution and transparent reporting and accountability.

8.3.4 Threats and challenges for IP

000161 Prompts for workshop discussion

The experts were asked to identify some potential threats and challenges to IP by way of the technology and to consider especially these issues:

- mass scale (online and offline infringement);
- crime committed by robots, algorithms and decentralised autonomous organisations (DAOs);
- open decentralised marketplaces and other services without notice and takedown;
- automation.

000162 Copyright infringements

Due to the immutable, decentralised, accurate and transparent nature of the blockchain, there is potential for copyright infringement cases by way of application of the technology. Especially in decentralised networks without a central point of control, copyright infringement could exist with very few realistic means of enforcement response. Moreover, the possibility of anonymisation will make an enforcement response more challenging. Some experts pointed to an existing example of a cryptocurrency-based content-sharing platform. Users can share files on the platform and set a price. Other users who want to access the content will pay in tokens. Then, if they share the file, they will themselves get paid. The users can also watch advertising to obtain more tokens or they can buy tokens. The platform is based on a sound economic idea as long as the system is controlled but the concept can also be used in an infringing system without control because removal of illegal material will be difficult. It was noted that currently there is very little copyright infringement carried out by way of blockchain technology since it is overly difficult for criminals to use the technology for such purposes. One of the reasons for this could be the fee structure of some of the more popular blockchain solutions as well as the complexity for ordinary users of pirated content to use the technology at this time.

000163 Theft of musical recordings

Some experts considered a hypothetical example where a party steals an idea from a musician and records it on the blockchain first. This person would acquire legal rights over the work, therefore, how could the musician prove ownership?

000164 Misuse in registration of IP

However, if used correctly, blockchain technology is indeed a great tool to protect and register IP. There have not been obvious cases of blockchain violations yet, but there is the potential for danger due to the lack of rules and central authorities to oversee the correct use of the network, especially when the adoption of blockchain is streamlined and the technology widely adopted.

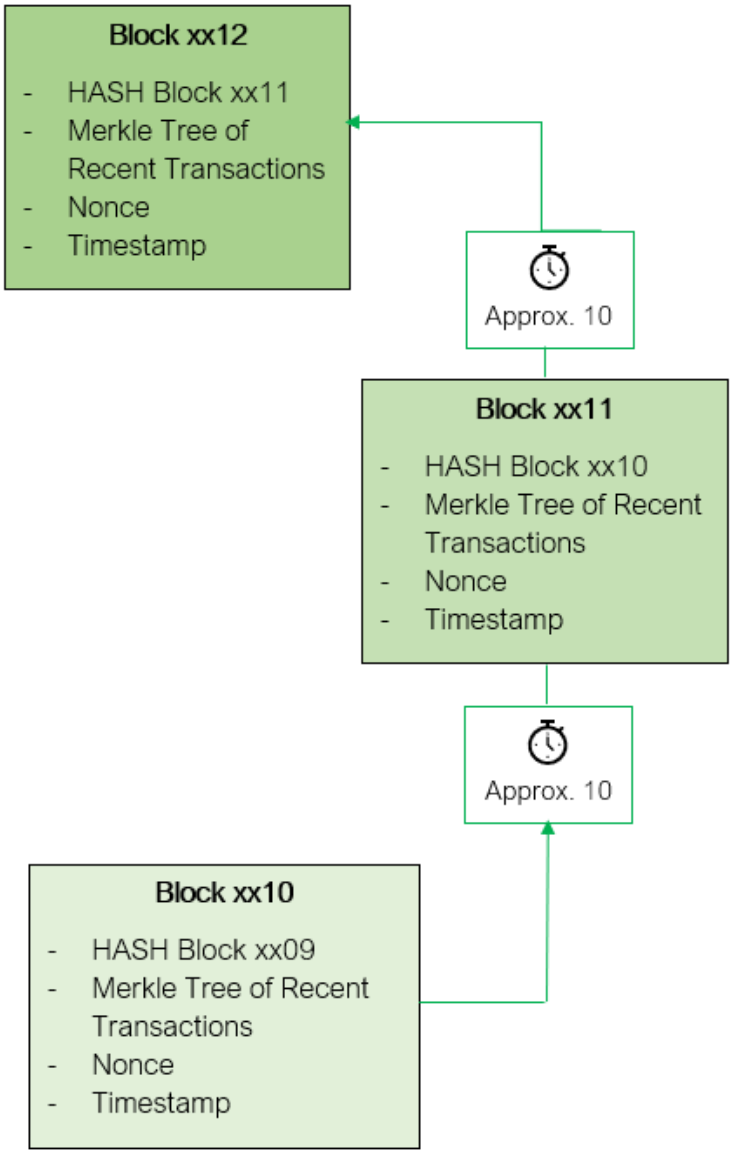
000165 Threat from decentralised marketplaces

In terms of buying and selling illicit products, decentralised blockchain-based marketplaces could be highly effective. It would be very difficult – especially for individual rights holders – to identify and remove illegal product postings in the marketplace.

000166 Alternative domain name system

Some experts presented different blockchain-based domain name systems that are fully decentralised, in contrast to the centralised traditional domain name system, the so-called blockchain DNS (BDNS). Such blockchains may not offer any means of preventing cybersquatting and may not provide dispute resolution mechanisms in the event of trade mark infringing domain name registrations.

Figure XXII. Functioning of the Bitcoin Blockchain



000167 Cybercriminality

Another threat to take into consideration is the different types of computer hacking, fraud, identity theft and other types of cybercriminal activity. For example, if a cybercriminal registers third-party information in the blockchain, who would the legal owner be in such a case? The lack of a central governing body makes it difficult to prove real ownership and without a central entity to contact for removing or correcting the information it is difficult to attribute liability for the actions. Another example would be blackmail or extortion of company secrets or IP where a criminal would post the trade secrets on a blockchain rather than a third party hosting such as paste-in. In this sense, additional mechanisms to ensure the authenticity of the content and holder are needed.

000168 Misuse of cryptocurrencies

It was noted by some experts that cryptocurrencies are to some extent used as means of payment in IP violations and tools, to money launder the proceeds from IP crime.

000169 Overall threat level

All this aside, it was noted by some experts that the potential overall impact of blockchain technology on IP is positive.

8.3.5 Investigative and enforcement opportunities

000170 Prompts for workshop discussion

The experts were asked to identify some potential opportunities for the use of the technology for investigation and enforcement in relation to IP and to consider especially these issues:

- even if the concept is great, it might not work in practice;
- better equipment for customs, market surveillance and police authorities;
- OSINT;
- faster judicial cooperation and procedures;
- more or less dependable and transparent evidence;
- product individualisation;
- better or worse notice and takedown procedures;
- automation.

000171 OSINT: cryptocurrency payments

Some cryptocurrency ledgers may be investigated, but at this point certainly not all of them. The current OSINT tools to investigate cryptocurrency payments does not facilitate investigation of all cryptocurrencies. Most of the tools focus on bitcoin forensics, but some also support other platforms and it is expected that in the future and increasing number of currencies will be covered. Based on this it was decided to look further into this issue in the next workshop.

000172 Other OSINT

As the use of blockchain technology will increase, it might make OSINT investigations easier in regard to, for example:

- land registries;
- company registries;
- IP rights registries.

000173 Securing supply chains

Use of blockchain technology has a potential in securing supply chains and making the identification of goods as genuine and counterfeit easier for enforcement authorities. Considering that large corporations produce thousands, millions or even billions of articles per year, this however also raises numerous obstacles that will need to be overcome. Supply chain and logistics systems use very diverse solutions nowadays so tying systems safely together through interledger communication and use of AI will have to be explored. There is also the interest of consumers that want easy-to-use smart systems. Solutions on how to create and track digital twins (tokens) of physical products are already under development so primary and secondary marketed products can be connected using a digital signature.

000174 Last mile problem

The issue here is not how to register the trade mark, but how to link it to the mass production of goods. When there are billions of goods, the ledger is heavy, encryption must be unique and the complexity of the ledger to compile and enter all the different goods and place them into a container for shipping is extremely complicated. Trade mark enforcement and patent linking is a problem within the ledger. The blockchain is excellent for trade marks and designs, but enforcement of a single product in the mass production of goods regarding what is genuine and what is counterfeit is very poor. The capacity of the server is a problem here; depending on which new generation blockchain is used, there is a higher cost. In addition, the physical capability of the server and the infrastructure to house the reporting system is costly.

000175 Evidential issues

How can we make sure this is a dependable, reliable tool? Some experts pointed out that although the use of hashcodes is accepted in court as a tool to prove veracity, the evidence must be corroborated and never based on one piece of information. It takes investigation to rely on the information recorded in the blockchain. It has to come from a reliable source and we cannot allow people to be truly anonymous on the internet.

9. CONCLUSIONS

This discussion paper is based on a unique methodology to assess the impact of new and emerging technologies on the infringement and enforcement landscape related to IP. The methodology has been developed by the Impact of Technology expert group of the European Observatory on Infringement of Intellectual Property Rights that was established in early 2019.

The methodology is named 'The Intellectual Property Tech Chain' and divides the application of new technologies into four phases:

- exploration: exploring the technology to ascertain whether it could be applied to protect, infringe or enforce IP;
- conversion: converting the technology to enable it to achieve the identified goal;
- weaponisation: finalising the development of the application;
- utilisation: using the application to protect, infringe or enforce IP.

Additionally, the methodology distinguishes (applying a double-edged sword metaphor) between each phase as regards:

- IP infringing application of the technology;
- use beneficial to IP.

It has, in the development of the methodology, been the ambition of the expert group to take a broad societal and economic view of the issues.

In the first Tech Watch workshop aimed at applying the methodology held in January 2020, the expert group discussed different technologies (robotics, 3D printing, nanotech, AI, AR and blockchain) in relation to six specific topics relevant to the scope of the expert group:

- key features of the technologies;
- identification of essential information resources;
- impact of the technologies on society, the economy and world trade;
- IP protection use cases;
- threats and challenges for IP;
- investigative and enforcement opportunities.

This discussion paper is a compilation of contributions from the expert group and guest experts from academia, the EUIPO DTD and the Observatory. Members of the expert group that did not attend the first workshop have also been invited to contribute.

From the discussions in the workshop, 10 significant horizontal points presented by one or more of the experts can be deduced.

(1) The six technologies are all rapidly evolving and have not yet reached their full potential.
(2) All the technologies will, in varying degrees and forms, have significant impact on labour, the economy and world trade.
(3) Predictions about the application of the technologies often range from potential significant improvement of the living conditions of humanity (e.g. better quality products and services) to major threats and dystopian visions (e.g. in relation to unemployment or mass surveillance).
(4) A key characteristic of each of the technologies is the potential for the automation of processes, including as regards the production of goods and setting up and administering of governmental and commercial activity.

(5) All of the technologies raise questions about the protectability of innovation and creativity related to the technologies themselves, e.g. protectability of innovation and creativity made by AI systems or the protectability of files used as a basis for 3D printing.

(6) Some technologies (most notably AI and blockchain technology) can make the protection of IP more effective and provide higher-quality registration and documentation systems.

(7) All of the technologies can be applied by IP infringers to either make production, marketing and distribution of counterfeits more effective (e.g. cheaper production with use of robots, use of local 3D printing facilities for production purposes and more appealing presentation of products using AR) or be used in other IP infringing ways (e.g. blockchain-based alternative DNS without the possibility for trade mark owners to enforce their rights or copyright infringement in AR applications).

(8) Most of the technologies (maybe with 3D printing as an exception) can be used as tools for IP enforcement (e.g. protection of supply chain integrity, easier product individualisation and identification of counterfeits, improve investigations by law enforcement, make customs risk analysis more effective or enhance effectiveness of notice and takedown procedures).

(9) For all the technologies it is characteristic that they represent new evidential opportunities and challenges for legal systems, due to the complexity of the technologies, the enormous amount of generated data but also due to the high level of reliability of the information.

(10) OVERALL OBSERVATION: all of the technologies have already shown themselves to be important emerging and disruptive technologies impacting businesses, the economy, government administration and the daily lives of many human beings and have proved to pose potential challenges and/or opportunities for IP.

This discussion paper will be updated after each subsequent workshop of the Impact of Technology expert group. In future workshops additional emerging technologies will be analysed and, occasionally, those analysed previously will be revisited to ensure the paper remains relevant.

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