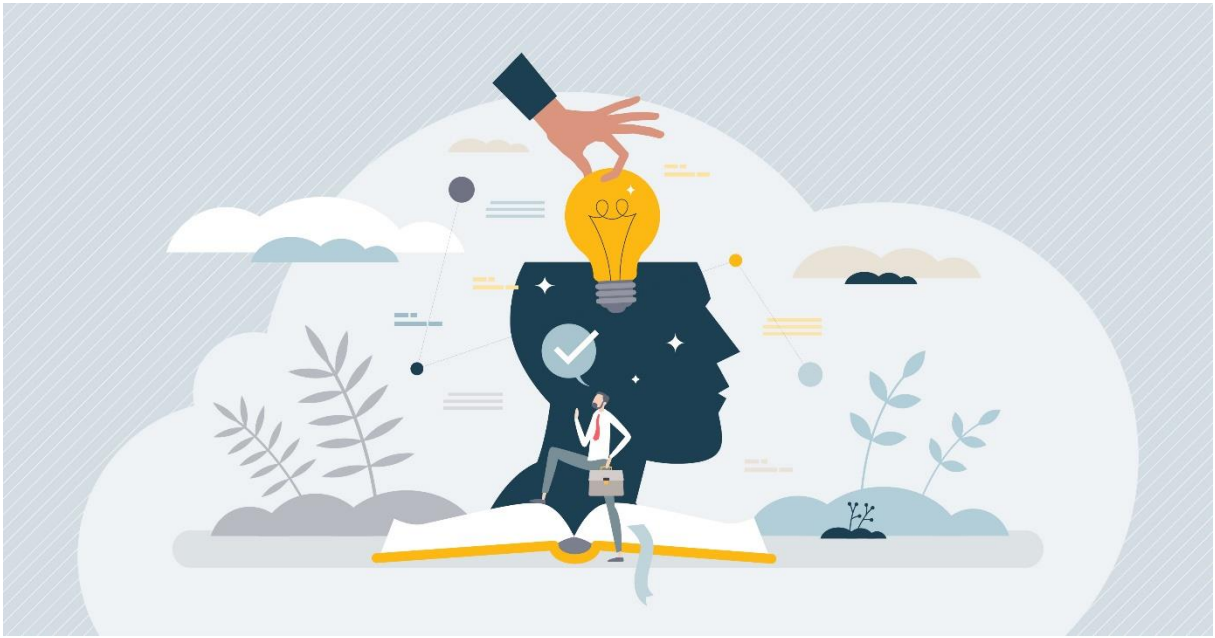

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# Futures of Innovation and IP Regulation in 2040: Scenarios and Policy Implications

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# Acronyms

| | |
|---|---|
| AI | Artificial Intelligence |
| API | Application Programming Interface |
| EC | European Commission |
| EU | European Union |
| EPO | European Patent Office |
| FRAND | Fair, Reasonable and Non-Discriminatory |
| ICT | Information and Communication Technology |
| IoT | Internet of Things |
| IP | Intellectual Property |
| IPR(s) | Intellectual Property Right(s) |
| KIPO | Korean Intellectual Property Office |
| NGO | Non-Governmental Organization |
| OECD | Organization for Economic Cooperation and Development |
| R&D | Research and Development |
| SDG | Sustainable Development Goals |
| SIPO | State Intellectual Property Office (China) |
| TRIPs | Trade-Related Aspects of Intellectual Property Rights |
| UPC | Unified Patent Court |
| US | United States |
| USPTO | United States Patent and Trademark Office |
| WIPO | World Intellectual Property Organization |
| WTO | World Trade Organization |

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In addition to the authors, several external experts contributed to the work by participating in the workshops and providing further feedback. While we are immensely grateful for their contributions, the views expressed in the brief are the authors' only.

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# Summary

Innovation is changing in several dimensions. First, initially closed innovation processes are complemented by various forms of open innovation. Second, innovation was never performed only by companies, but more and more other actors, like users via crowdsourcing or non-governmental organisations, get strategically involved. As a result, knowledge transfer, acquisitions and collaborations among startups, large firms, universities and research institutions are increasingly relevant. Third, markets of technology have emerged and further expanded, which require an appropriate definition of traded rights to become effective and to perform efficiently. Fourth, the dominance of innovation based on hardware components is not only complemented, but also partly substituted by digital components including software, and interoperability and complementarity of innovations increasingly require coordination and standard setting. Fifth, digitalisation and the rapid adoption of artificial intelligence are changing the nature of work and transforming innovation processes. Finally, the initially envisaged impact of innovation on firms' and countries' economic success has been significantly widened to consider not only economic returns but also ambivalent contributions to sustainable development. The existing IP regime, as one of the building blocks of science and innovation systems, is thus challenged in both its registration and examinations processes and its products, e.g. patents, and the appropriateness of Intellectual Property Rights (IPRs) in providing incentives to produce and exchange new knowledge is questioned.

This policy brief explores how these changes in several dimensions of innovation might influence IP regimes, and their impacts on society in the future. IP is a global phenomenon and we look toward IP regimes in 2040. However, our policy implications are developed especially from the point of view of the European research and innovation policy.

The following five scenario narratives from 2040 are the result of the work in the scenario workshops and the subsequent internal discussions of the expert team. The initial scenarios have been enriched by commenting on how different factors of change relate to them.

**Scenario 1:** The end of IP as we know it. By 2040, the digitalisation of the economy has been completed in all sectors. The private interests of platform companies drive the collection of lots of data, which is the main source of IP. Since they embed their IP into lines of code, they do not rely on formal IP rights, like patents, anymore, but de facto on trade secrets. The monitoring and enforcement of IP rights is possible via smart contracts. A few global big techs set the rules via their Application Programming Interfaces (APIs) and industry standards and replace them with the initial legal rules. In 2040, what remains is a world essentially dominated by trade secrets, and where IP protection is automated and 'contractualised'. The use of confidentiality-enhancing technologies powered by quantum cryptography has emerged as the most effective protection mechanism for IP.

**Scenario 2:** 'Creative destruction' of the IP regime. In 2040, the scenario is driven by the private interests of big companies in computing, ICT, medical devices, machinery and pharma which are located in the Global North and which are experienced players in the intellectual property system. Increasing technological complexity and interconnectivity accelerated by the Internet of Things provide the conditions for big companies that know how to use the IP system. Patenting features have changed, especially because disruptive technologies like AI determine the rules and techniques of how intellectual property titles are defined (e.g. inventions created by AI), filed (e.g. patent filings drafted by AI), and examined (e.g. patent offices using AI for search and examination services). The regulator and intellectual property offices have difficulties in following technological advances. Innovation is delivered by machines and there is less space for human creativity. This trend undermines the economic incentive and the purpose of the IP system.

**Scenario 3:** IP as a battlefield of geopolitics. In the context of rising geopolitical tensions, IP has become an instrument for different regions to protect their commercial interests, complementing their trade

strategies. In 2040, Europe focuses on granting high-quality patents, with a harmonized and efficient Unified Patent Court (UPC) system. China's pressure on national champions to deliver and protect new technologies has led to an overburdened patent system in China. Others, such as South Africa and India, have built new creative hubs in the world, the results of which are often kept secret, as they rely on first-mover advantage in their fast-evolving markets. Consequently, there are different strategies towards how IP is managed and administrated as well as the economic incentive system and social values in general. While innovation is still encouraged, areas where global solutions are needed and a harmonized treatment of IPRs is required, are negatively affected. Some examples where global solutions are needed are the interoperability and compatibility of devices, the implementation of massive Internet of Things (IoT) applications and the development and incorporation of worldwide applicable green tech solutions. Recognizing the benefits of global wireless communication, countries around the world meet to agree on how to develop global solutions, such as the next generation of cellular standards. To do so, they are building a new international standard development organisation, based on the lessons learned from 3GPP, a joint effort of seven standard development organizations that successfully developed 2G to 6G cellular standards.

**Scenario 4:** Global and balanced IP for open innovation. Following a series of extreme weather events, health crises and wars, the achievement and implementation of science-based innovative solutions to global challenges is a key policy priority. In 2040, IPRs serve their primary purpose by defining the boundaries of the inventions and creations of the human mind, and by recognising their ownership and priority date. Governments, competition authorities and courts favour commercialisation and access to knowledge for the public interest. Balanced and transparent IP regimes and procedures include IP laws and strongly coordinated and harmonised (substantively and procedurally) IP offices. Applicants can file and obtain IPRs with global protection following a single procedure, rather than multiple national paths as in the past. Digitalisation and AI are part of all processes now and help track the adoption of IPR-protected inventions and ensure transparency, thanks to coordination among authorities and incentive-compatible regulations that prioritise the common good. Science-based innovation is accelerating at an unprecedented rate to address health and environmental challenges. Inventors and creators apply for IPRs to become visible in globally connected IP and innovation systems, to obtain funding and find partners. IP rights support innovation by providing recognition to innovative talent, enabling commercialization and increasing the diffusion of knowledge. Changes in public governance of IP, changes in the behaviour of IP owners, and increasing relevance of demands from civil society are the three main forces behind the transformation of the IP system from an opaque, complex and multi-layered system to the current transparent, simple and harmonized IP system.

**Scenario 5:** Open source collaboration globalized innovation. By 2040, the IPR regimes for physical and information goods have diverged and are by and large disjunct. Open source collaboration dominates innovation of digital and other intangible goods, e.g. software source code, machine-readable specifications executable in additive manufacturing, AI training instructions, data models, etc. Private interests self-align based on voluntary participation in the innovation process. Public interests in knowledge transfer and digital sovereignty are supported by the licensing of technologies as digital public goods. The management of IPRs is reduced to the necessary minimum by applying non-negotiable, ex-ante agreements. Open source licensing enables global collaboration. Innovation is incremental and continuously disclosed. Operating principles and production processes of physical goods continue to be managed in the traditional way of acquiring and licensing patents. Significant breakthroughs in additive and automated manufacturing processes led to the emergence of an industry of on-demand custom manufacturing factories that execute production orders based on electronic specifications. The pervasive use of machine learning and computer-aided authoring and inventing removed human cognitive limitations and language barriers from being a factor in global innovation collaboration. Civil society and policy makers increasingly demand openness and transparency about societal impacts. Supra- and international regulation unifies and displaces national

rulemaking. Regulatory approaches that impose strict rules for market access shape competition and create a globally level playing field.

Finally, policy implications are elaborated - although to a different degree – from across all five scenarios. As a general-purpose technology, AI substantially impacts at least two scenarios, its regulation, e.g., via the AI Act, has been addressed, in particular, to consider the implications and interactions between different IPRs. Further technologies, like blockchain being the base for smart contracts, might impact contract law and indirectly affect IPR. Since IPRs are only an instrument to foster and direct innovation, implications for R&D and innovation policy need to be elaborated as much as the role of IPRs in achieving the SDGs, particularly in tackling climate change. We conclude with some general recommendations for regulating IP and related policy domains in the future.

# 1. Introduction

Innovation is changing in several dimensions. First, the investment into research and development as the base for innovation has been concentrating in fewer larger scale multinational enterprises.[1] Second, initially closed innovation processes are complemented by various forms of open innovation. Innovation was never performed only by companies, but more and more other actors, like users via crowdsourcing or non-governmental organisations, get strategically involved. Knowledge transfer, acquisitions and collaborations among startups, large firms, universities and research institutions are increasingly relevant. Third, as a consequence, markets of technology have emerged and further expanded, which require an appropriate definition of traded rights to become effective and to perform efficiently. Fourth , the dominance of innovation based on hardware components is not only complemented, but also partly substituted by digital components including software, and interoperability and complementarity of innovations increasingly require coordination and standard setting. Fifth, digitalisation and the rapid adoption of artificial intelligence are changing the nature of work and transforming innovation processes. Sixth, large scale radical innovations are more and more based on successful large scale platforms, which not only exploit economies of scale at the supply side, but also network effects at the consumer side. Finally, the initially sought impact of innovation on firms' and countries' economic success has been significantly widened to includee not only economic returns but also ambivalent contributions to sustainable development. The existing IP regime, as one of the building blocks of science and innovation systems, is thus challenged in both its processes and its products, and the role of Intellectual Property Rights (IPRs) in providing appropriate incentives to produce and exchange new knowledge is questioned.

This policy brief explores how these changes in several dimensions of innovation might influence IP regimes and their impacts on society in the future.

**Scope of the exercise**
Since IP is a global phenomenon, we have no specific geographical focus, but look toward IP regimes in 2040. However, our policy implications are developed especially from the point of view of the European research and innovation policy.

Our understanding of innovation is based on the definition in 4th edition of the Oslo Manual:
“a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)” (EC/OECD 2018).

Regulation as such has been defined by the OECD (2018):
“regulation includes all laws, formal and informal orders, subordinate rules, administrative formalities, and rules issued by non-governmental or self-regulatory bodies to whom governments have delegated regulatory power”

However, we focus on IPRs following a modified definition of WIPO (2020):
Intellectual property (IP) refers to creations of the mind, such as inventions; literary and artistic works; designs; and symbols, names and images used in commerce.
IP is protected in law by, for example, patents, copyright, designs, trade secrets and trademarks, which are IPRs and enable people to earn recognition or financial benefit from what they invent or create. By striking the right balance between the interests of innovators and the wider public interest, the IP system aims to foster an environment in which creativity and innovation can flourish.

[1] See Rammer, C. and Schubert, T. (2018): Concentration on the few: mechanisms behind a falling share of innovative firms in Germany, Research Policy, 47(2), 379-389.

## 2. Five scenarios on innovation and IP in 2040

**Scenarios**[2] are not predictions of the most likely futures, but they depict a range of possible futures. While scenarios often consist of a possible future state and the pathway from the present to that future, in this case, **we develop the narratives of the future (written in the present tense, as if we were already in the future).**

In total, five scenarios were constructed by the expert team based on the extensive discussion of the identified factors of change (Annex I). The following Table 1 reveals how some of the key factors of change on innovation are reflected in the five scenarios, thus providing the initial logic of the scenarios and also differentiating between them.

| | Scenario 1. The end of IP as we know it | Scenario 2. 'Creative destruction' of the IP regime | Scenario 3. IP as a battlefield of geopolitics | Scenario 4. Global and balanced IP for open innovation | Scenario 5. Open source collaboration of globalized innovation |
|---|---|---|---|---|---|
| Concentration of innovation among a fewer stakeholders | | X | X | | |
| Open innovation | | | | X | X |
| More diverse stakeholders | | | | X | X |
| Markets for technology | X | | X | X | X |
| Digitalisation | X | | | | X |
| Platformisation | X | | | | |
| SDGs | | | | X | |

**Table 1. Key factors of change on innovation and their relevance for the five scenarios.**

Source: Authors.

Thinking about the future of IP we consider the following dimensions: The way private interests are balanced against the public interest: First, IP has always a private dimension, because it incentivizes inventors and innovators to invest in research and development. IP serves the public interest by promoting innovation and by enabling knowledge exchange and dissemination. How any future IP arrangement balances the interests of individual inventors and innovators and the public interest relains open. Whether in the future control over IP will be concentrated only in a few organisations or countries or will be more broadly distributed among entities is another dimension that is important for the future of the IP system, . These two dimensions were used to identify dominant features to describe in the scenarios, but also to consider alternative practices in relation to those dominant features.

**Two vertical extremes on IP use**

[2] Exploring alternative scenarios helps to expand one's own span of observation further towards the future, and to possible risks and opportunities that otherwise might not be in the immediate attention span, or just being excluded for being regarded as unlikely.

a. **Private use of IP**: IP serves mainly private interests, in particular, of companies, e.g. to protect exclusively the results of their R&D activities for commercializing their innovative products and processes.

- **Public use of IP**: IP serves mainly public interests by making the generated R&D results fast and efficiently available for interested organisations, mainly companies, but also countries, to allow their use for commercialization, but also follow-up research.

**Two horizontal extremes on the concentration of IP control**

a. **Concentrated IP control:** A few companies and other organisations located in a small number of rather large economies dominate the control over IP.

b. **Distributed IP control**: Numerous companies and other organisations located all over the world control IP, or IP is made available for use by all for any purpose.

In Figure 2, one can see the five scenarios positioned along the axes as orientation for the development of scenario narratives. While the dimensions were used to identify dominant features, also alternative practices were considered in relation to the dominant features.

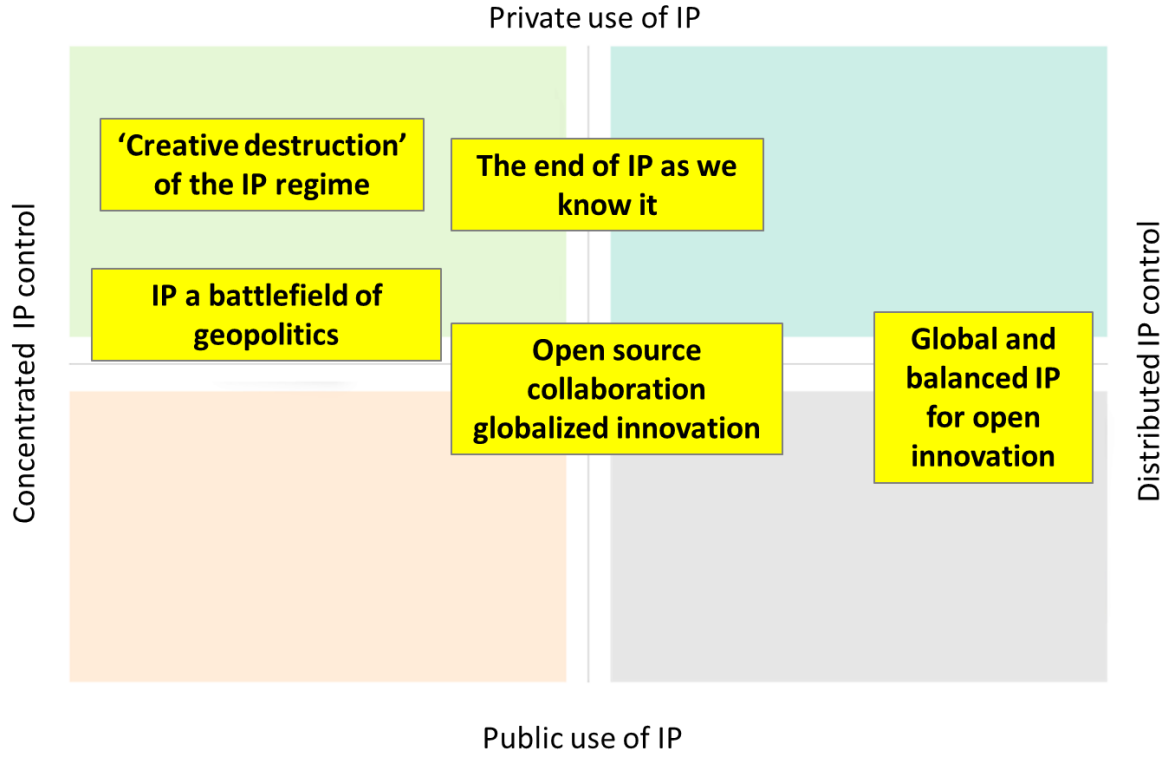


**Figure 2. The positioning of the scenarios.**

Source: Authors.

The following five scenario narratives are the result of the work in the scenario workshops and the subsequent internal discussions of the expert team. The initial scenarios have been enriched by commenting on how different factors of change (see Annex I) relate to them.

## Scenario 1: The end of IP as we know it[3]

*Key dimensions*

- Driven mainly by the use private of IP
- IP generation and control driven by both a few global big techs and many small organisations

*In brief*

By 2040, the digitalisation of the economy has been completed in all sectors. The private interests of platform companies drive the collection of lots of data, which is the main source of IP. Since they embed their IP into lines of code, they do not rely on formal IP rights, like patents, anymore, but de facto on trade secrets. The monitoring and enforcement of IP rights is possible via smart contracts. Finally, a few global big techs set the rules via their Application Programming Interfaces (APIs) and industry standards and replace them with the initial legal rules. In 2040, what remains is a world essentially dominated by trade secrets, and where IP protection is automated and 'contractualised'. The use of confidentiality-enhancing technologies powered by quantum cryptography has emerged as the most effective protection mechanism for IP.

*Key Drivers*

- Societal: private governance of innovation
- Technological: complete platformisation of real economy sectors, the emergence of pervasive smart contracts governed by advanced AI systems (large language models)
- Environmental: the pursuit of environmental goals through innovation is entrusted to large-scale digital platforms, which orchestrate the application layer
- Economic: upstream market concentration, vibrant platform-based innovation at the application layer, mediated by privately governed large-scale platforms
- Political: institutions such as patent offices lose relevance, 'technopolar world' emerges.

The world is dominated by a few digital platforms, which run their systems through algorithms and accumulate enormous data and computing resources. Given their mastery of AI, these firms dominate many of the top innovations in the world, and thanks to cryptography and AI they manage to embed their IP into lines of code, de facto protecting themselves much more effectively than any formal IP system would be able to do. Thanks to this, they also dominate incremental innovation based on code. IP rights, and in particular patents, have become redundant since 'code as law' has come to protect trade secrets.

This scenario is primarily caused by the continuation and amplification of five trends visible already in 2020s, namely:

(1) the platformisation of the digital economy accompanied by the collection of big volumes of data, the concentration of around a fistful of cloud-based players that dominate data flows and orchestrate innovation on their platforms/stores, capturing most of the value generated therein;
(2) the transformation of legal provisions such as those aimed at protecting IPRs into 'code', a trend that started many years ago with the Digital Rights Management in the field of copyright, and continued with smart contracts and the tokenization of IPRs;
(3) the continuous affirmation of trade secrets as the prevalent form of IP protection for algorithms deployed by large-scale giants.

[3] Andrea Renda is the main author of this scenario.

(4) the rise of private governance, or as some define it, a 'technopolar world'[4], in which private tech giants de facto become the new global rulers[5], and the rules they set through APIs and industry standards supersede traditional legal rules;
(5) the gradual digital transformation and platformisation of the real economy, from manufacturing to finance, energy, agriculture, etc.

*Key actors and their strategies/activities*

U.S.-based firms continue to dominate the North-Western tech world, whereas Chinese firms dominate the South-East, and Indian ones catch up. This has led not only their countries but the whole globe under the business model adopted by large-scale multi-sided platforms (be they American or Chinese). From the Chinese Digital Silk Road to the U.S.-dominated supply chains, everything happens through smart contracts governed by cloud- (and edge-) based companies, that have created a dense stack for the Internet of Things. AI-enabled high-frequency transactions govern the remuneration of innovation, and are managed by highly compute-intensive systems controlled by big tech.
The gradual decision to abandon traditional IP protection was determined by several factors over the last two decades:

- In copyright, the massive use of copyrighted information and content by generative AI systems has become impossible to control solely by legal means, and required the use of watermarking solutions that were then embedded into content that flows on the web. As content itself was subject to high-frequency transactions, attribution and right to remuneration were managed through software and standards defined by the producers of leading generative AI systems, including Microsoft/Open AI, Amazon/Anthropic, Google etc. This further entrenched these companies' positions in the technology stack, and this in turn made them unavoidable partners for any content creator. Traditional rights owners associations were dismantled and replaced by a pure 'celestial juke-box' model.[6]
- The softwarisation, datafication and virtualisation of all industry sectors created tensions in the patent system, as many inventors preferred to rely on trade secrets to avoid having to navigate through an expensive and dense patent thicket. Geo-political tensions called for limits to knowledge-sharing with rivals, and mounting cybersecurity risks also led companies to gradually abandon open architectures. Technology fell into a dense web of secrecy. Private governance dominates the scene now, and the large gatekeepers compete on reputation by keeping data and AI specifications secure. As cloud-based architectures dominate most of the economy, incremental innovation is rewarded through contractual means.
- Trademarks became watermarks. Considering their typical function of signals in a market dominated by incomplete information, trademarks were completely replaced by tamper-proof credentials associated with proof-of-origin of content flowing on the Web. As the metaverse overlapped with the real economy, a broadly distributed ledger technology emerged, with tech giants as supernodes validating transactions.

In 2040, what remains is a world essentially dominated by trade secrets, and where IP protection is automated and 'contractualised'. The use of confidentiality-enhancing technologies powered by quantum cryptography has emerged as the most effective protection mechanism for IP.

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[4] See Ian Bremmer https://www.gzeromedia.com/ai/what-is-a-technopolar-world

[5] Büthe, T., Mattli, W. (2011): The New Global Rulers: The Privatization of Regulation in the World Economy. Princeton University Press, 2011. JSTOR, http://www.jstor.org/stable/j.ctt7t7sn. Accessed 21 Nov. 2023.

[6] Goldstein, P. (1994): Copyright's Highway: The Law and Lore of Copyright from Gutenberg to the Celestial Jukebox, Hill & Wang, New York, NY.

*European perspective*

Antitrust law has become 'behaviouralist', not 'structuralist', i.e. antitrust authorities prosecute undertakings only when there is clear evidence of consumer harm, and otherwise do not take action to remedy cases of highly concentrated market structures. The claim that consumer harm is not visible prevails essentially and enables tech giants to continue operating as a de facto oligopoly. In addition, tech giants claim that competition is vibrant on their platform ecosystems, and as such avoid competitive scrutiny based on (attempted) monopolisation.

IP is protected through smart contracts. In the case of complex system goods, smart contracts govern so-called liability rules, i.e. remuneration of complementor producers at seemingly fair conditions, such as FRAND.[7] The conditions, however, are often dynamically and algorithmically determined, which means participating entities do not know, if they are being discriminated compared to their peers.

For patents, the determination of novelty and the 'inventive step' is entrusted to certified experts. These could be experts working in patent offices, or certified experts with sufficient reputation on digital platforms (vetted experts). In 2040, generative AI systems can quickly determine IPR violations and settle outstanding claims through smart contracts (Google Patents is already the n. 1 source of information for GPT, even ahead of Wikipedia: in other words, GPT 4 could already work to identify prior knowledge in existing patent claims).

'Voting with the feet' is practically impossible. A company that decided to use alternative ways to protect its IP would immediately lose market share, as the tech giants dominate 90% of the market. That said, attempts to unlock this situation are likely, and may eventually succeed, creating a space in which IP is freely shared.

Idle patents have disappeared. Non-practicing entities have been excluded by tech giants, who can leverage their AI resources to assess potential obstacles to innovation originating from idle patent claims. In this respect, transaction costs associated with the patent thicket and the 'tragedy of the anticommons' are reduced or eliminated.

*Policy implications for Europe today*

Three implications for policy stand out in this scenario:

- Due to the strong market power of the platform companies, mostly located outside Europe, the **EU has to promote antitrust and ex-ante regulation**, e.g. Digital Market Act or Data Act, to avoid obscure, oligopolised private governance of IP. Antitrust should therefore also look at market concentration, or the position of specific players as key intermediaries, or gatekeepers (in the jargon of the DMA). Policy interventions could look both at the fairness of intra-platform conditions (not to alter the level playing field between innovators relying on a given platform); on interoperability between platforms (to enable a single innovation space); and on the contestability of platforms that act as gatekeepers.

- Furthermore, the **EU should seek leadership in RegTech solutions or 'Law as code',** to be able to scrutinise large corporations' algorithms. In particular, the regulation of smart contracts governing innovations requires the use of IT tools going forward, powered by AI.

[7] The acronym FRAND - which stands for fair, reasonable, and non-discriminatory - is often used in relation to technical standards developed through an open, consensus-based, and industry-led standardisation process.

- Finally, a **data space for IPRs offered and governed by the EU** could avoid the privatisation of intellectual property governance dominated by players located outside Europe. The creation of a publicly-backed data intermediary, possibly in cooperation with the EPO, may create a public layer of control and validation of existing innovation, even when this takes the form of trade secrets. Patent offices may start operating based on cryptography and confidentiality-enhancing technologies.

## Scenario 2: 'Creative destruction' of the IP regime[8]

*Key dimensions*

- Driven by private interests
- IP generation and control dominated by a few companies

*In brief*

In 2040, the scenario is driven by the private interests of big companies in computing, ICT, medical devices, machinery and pharma which are located in the Global North and which are experienced players in the intellectual property system. Increasing technological complexity and interconnectivity accelerated by the Internet of Things provide the conditions for big companies that know how to use the IP system. Patenting features have changed, especially because disruptive technologies like AI determine the rules and techniques of how intellectual property titles are defined (e.g. inventions created by AI), filed (e.g. patent filings drafted by AI), and examined (e.g. patent offices using AI for search and examination services). The regulator and intellectual property offices have difficulties in following technological advances. Innovation is delivered by machines and there is less space for human creativity. This trend undermines the economic incentive and the purpose of the IP system.

*Key drivers*

Key drivers in this scenario are the following:

- Societal: Belief in technological progress as a solution stronger than ethical concerns, the concept of inventorship reversal by AI.
- Technological: Increasing technological complexity, e.g. internet of things and the interconnectivity of technologies; dynamic technological progress challenges existing regulatory framework for IP; in particular, AI as disruptive technology challenges basic principles of the current patent system.
- Environmental: Belief in technology and progress: technology will provide solutions to environmental problems.
- Economic: Business interest clashes with the inertia of IP administration.
- Political: Geopolitical pressure and regulatory competition to maintain IP ownership and filings in the country/region.

In 2040, IPR applications continue to drive the system and have led to new records of filing numbers. IP offices and in particular those who are self-financed, have a natural interest in supporting this trend. Increasing global competition animates also IP offices to participate in this race for IPR filings. At the same

[8] Nikolaus Thumm is the main author of this scenario.

time, the resources of IP offices are limited and examination time per file is going to decrease with increasing filing numbers. Despite some efficiency compensation by technical instruments such as AI search and examination tools, this has led to a decrease in the quality of IPR. Lower-quality IPRs have not only led to less innovation but have also increased litigation due to fuzzy boundaries of IPR and unclear IP claims. Granting too many IPRs of low quality has become detrimental to innovation and the economy. Ultimately, the overuse of the IP system may lead to its destruction.

This trend has evolved along with an increase in the complexity of the system. Innovation and IPR tend to be based on small-step-inventions. For smaller players such as micro-and small enterprises obtaining and maintaining IPR is expensive and the processes often are excessively complex. Small inventors and startups are deterred from using the IP system due to these costs, potentially limiting their ability to protect their inventions.

Technical remedies by technological advances such as artificial intelligence provide possible technical solutions for handling higher numbers of IP filings by facilitating higher scrutiny in the process of IP examination. This is used as a guarantee for the quality of IPRs. In this sense, technology, e.g. the use of AI, is providing a solution to cope with technological complexity. At the same time, AI becomes part of the problem and helps to accelerate the decline of the IP system. AI disrupts the concepts of creativity and inventorship which are the bases for rewards and incentives included in all IP systems. IP filings are carried out with the help of AI tools and IP offices use AI tools for examination. The IP systems try to incorporate these new tools in a way that would not undermine human creativity and to avoid that the system itself would become irrelevant.

In conclusion, the overuse and strategic use of the patent system has led to negative consequences for innovation and economic growth. However, the destruction of the intellectual property system is not yet inevitable. It depends on how well the system is managed, reformed, and adapted to the changing needs of society and technology. Striking a balance between rewarding inventors and promoting innovation while preventing abuses is a complex challenge that requires ongoing attention and adjustment.

*Key actors and their strategies/activities*

The trend of AI-driven intellectual property creation and filing is easier to cope with by players who have the resources to follow technological advances. Increasing intellectual property filings make it more difficult for individuals and SMEs to keep an overview of the IP system itself, to understand the underlying intellectual property information, and to use the system effectively for their purposes. The huge amounts of information embedded in the IP system will be underused at least by those users who do not have the financial resources to participate in it (‘tragedy of the anti-commons’). Contractual solutions with smart contracts and predetermined conditions are one way out of this dilemma. But also, contractual solutions require skills and resources and are not always accessible for smaller entities.

AI challenges traditional IP models in some industries. For example, in the pharmaceutical industry, AI-driven drug discovery has led to a re-evaluation of the patent system as drug development has become more data-driven and less reliant on individual inventions.

There is sufficient existing evidence that IPRs of lower quality are creating less innovation and economic growth and might even be counterproductive for innovation (cf. the well-known concept of patent thickets). IP offices are not recognizing this pitfall, partly because of administrative inertia, and partly because of a vested interest in higher income creation from increasing IP filings.

At the same time, IP offices use AI tools for search and examination services. Boundaries of human creativity and the inventive step are shifted beyond the existing levels. This technology-driven process initiates a race

to the bottom between IP offices and big IP-driven companies where human creativity is marginalized. The use of AI in the field of intellectual property jeopardizes the system of invention and incentives to invent. The role of IP offices is reduced to the roles of participating in this process and administrating legal titles. The proactive role of IP offices serving the economy by strengthening the benefits of IP for innovation and creativity is undermined. Smaller entities are not able to participate in this race to the bottom. Altogether, this may lead to a collapse of human innovation and a disruption of creation and inventorship.

Mainly large sophisticated firms, multinationals mostly, are the ones able to navigate the increasingly complex system, where freedom to operate is more and more difficult to achieve. Innovation stalls and a new economic crisis arises. Small firms are increasingly threatened by legal action for infringement by non-EU non-practicing entities.

One side effect of increasing IP filings is that IP offices that are not following quickly technological advances may suffer backlogs of intellectual property applications, leading to delays in processing and granting patents. This backlog can result in uncertainty for inventors and companies. Additionally, concerns about the quality of granted patents are raising, with some patents being overly broad or lacking in novelty.

*European perspective*

While the unitary patent system aims to reduce costs compared to traditional European patents, concerns are raised about the fees associated with obtaining and maintaining unitary patents. The new system is a tool in the hands of big companies and is of less importance to SMEs. Its effect is also considerably limited by the opt-out option.

There are multiple regulatory challenges, e.g. AI regulation, SEP regulation etc., and the international competition at the regulatory level has become an accelerator of the race to the bottom of the IP system as described above. The outcome of this regulatory race depends on the capacity of regulatory authorities at the EU level to follow technological and global challenges. EU-specific solutions, e.g. the unitary patent package, the new regulation on standard essential patents etc., may become good practice models or may become an accelerator of ongoing trends towards more IP rights, lower IP quality and more litigation.

*Policy implications for Europe today*

In view of a future represented by this scenario, there is a need to take or prepare policy action in the following regards:

- The pressure on IP regulation and administration to follow the dynamic technological advances in new and emerging technological fields will further increase. To cope with major technological and societal challenges, there is thus a **constant need for the EU to adopt amendments to the existing intellectual property legislation** to make it relevant and responsive to current and emerging IP issues.
- **National IP offices need to better understand the changing IP marketplace, and redefine their roles**. Innovation and IP rely on data, therefore, IP offices are becoming data-driven organizations. The whole marketplace around licensing, trading, monetizing, and enforcing IP is digitized and depends more and more on available data. Full disclosure of IP data and its appropriate use are essential. The use of the technological information contained in patents and other IP documents as a source of information for effective innovation has been discovered as an important policy tool. The regulator and IP authorities should operate in the public interest and strive for the highest level of transparency possible.

- **Policy-makers have to rethink the role of 'traditional IP'** in conjunction with the ongoing trends of digitization and openness, the increased use of secrecy, e.g. via using trade secrets, and with

respect to the general role of AI in the IP system. IP offices themselves have to redefine their role in this new environment and dissolve themselves from established ways of thinking and operating. This does include their way of financing, which is influenced by the path dependency by generating revenues from IP fees, staff recruiting and way of international collaboration. IP offices should serve the public interest and become detached from the financial pressure to thrive for higher IP filing numbers.

- The **use of AI in the IP system challenges the role of human creativity in the IP system and requires rethinking the economic incentive function of IP for innovation**. The speed of technological change forces regulators into a race against technological change while trying to maintain high standards of IP quality and ethics. There should be specific policy measures addressing IP quality and continued efforts to facilitate SMEs' access to the IP system. Specific policy measures will have to mitigate increasing IP litigation. One way of doing this is by enforcing the role of out-of-court dispute settlements, e.g. via arbitration services, at European and international levels.

- The **EU has to take an active part in a regulatory competition on how to cope with the new IP environment.** Models to follow may be created by ongoing and future regulations at EU-level such as the Unitary Patent/Unified patent court and the proposal for the regulation of Standard Essential Patents (COM(2023) 0232). Moving first carries an inherent risk of failure, but gives the EU a first-mover advantage in the global competition of IP regulations. However, not doing anything shouldn't be a policy option in this competition.

## Scenario 3: IP as a battlefield of geopolitics[9]

*Key dimensions*

- Driven by both private and public use of IP
- A few companies located in the Global North control IP generation

*In brief*

In the context of rising geopolitical tensions, IP has become a strategic trade-policy instrument and different regions have developed different patent systems. In the past IP offices collaborated by exchanging best practices and meeting regularly. Political pressure and contradictory objectives have put an end to this. Europe focuses on granting high-quality patents, with a harmonized and efficient Unified Patent Court (UPC) system. China's pressure on national champions to deliver and protect new technologies has led to an overburdened patent system with low quality outputs. Others, such as South Africa and India, have built new creative hubs in the world, the results of which are often kept secret, as they rely on first-mover advantage in their fast-evolving markets. There are different strategies towards how IP is managed and administrated as well as the economic incentive system and social values in general. For implementation patents, European courts hear fewer cases and reach decisions more quickly. US courts are granting injunctions. Chinese courts are slowing down decisions as the large number of patents has led to increased patent litigation. In other jurisdictions, IP is rarely enforced.
While innovation is still encouraged despite different treatment of patents, areas where global solutions are needed suffer from a lack of harmonized treatment of IPR. For instance, in fields where interoperability and compatibility of devices are needed, such as the implementation of massive Internet of Things (IoT) applications and the development and incorporation of worldwide applicable green tech solutions,

[9] Claudia Tapia is the main author of this scenario.

innovation and rapid deployment are hamperred. Recognizing the benefits of global wireless communication, countries around the world meet to agree on how to develop global solutions, such as the next generation of cellular standards. To do so, they are building a set of new international consortia based on the lessons learned from 3rd Generation Partnership Project (3GPP).

*Key drivers*

Factors of change driving this scenario include the following:

- Societal: Consumer behaviour is characterized by buying environmentally friendly products and collectively demanding politicians to collaborate to develop global solutions. The media are a key player in reporting the disadvantages of national protectionism; security concerns lead to the veto of national solutions.
- Technological: Technology investments are mainly focused on R&D that can be protected by implementation patents.
- Environmental: Alarming global warming, increased energy prices, and limited natural resources are influential environmental framework conditions.
- Economic: Economic growth is significantly reduced due to nationalism in the telecommunication field; trade strategies are being complemented by IP to protect national interests.
- Political: Trade barriers in place protect national interests; antitrust is misused to protect national interests, e.g. by harming foreign companies.

*Key actors and their strategies/activities*

Europe has lost its leadership in standardisation. The 2024 Standard Essential Patent (SEP) regulation backfired by undermining the competitive position of leading technology companies of the EU, which at that time were major contributors of cellular technologies. Following this regulation which discriminated EU companies, non-European actors took the lead in the global standardisation ecosystem. EU companies progressively stopped contributing to 3GPP, the consortia of seven standard development organisations in charge of developing successful mobile communication standards such as 4G and 5G. As a result, 6G and in particularly 7G were development by Chinese companies. Being considered “made by China”, 7G is not being implemented on all continents, arguing security concerns. De facto standards developed by US big tech companies have also not succeeded to high licensing fees and fear of being locked-in.

The gradual decoupling of global standards from European technology had an important negative effect on Europe’s digital transformation, influencing European systems and values on global standards. Highly innovative European technology companies have being taken over by their Chinese and US competitors. Others have shifted their R&D activities into non-standardised technologies. Investment in standardization in the EU has drastically fallen. The US government is increasingly favouring national big tech companies, which are developing de facto standards and are becoming more powerful IPR owners. No commitment to license on fair, reasonable and non-discriminatory (FRAND) terms is given by these US companies. Thus, big tech companies are in the position to offer expensive licenses for their de facto standards for communications. Some companies claim these licenses discriminate those outside the US in favor of those companies producing in the US. Following Europe’s example, China created its own SEP regulation in 2024. Chinese courts are currently determining global FRAND royalties for SEPs. Critics argue that in this process Chinese courts are favouring their national champtions.

As it became more challenging to agree on global standards, companies around the globe struggle to deliver globally interoperable products. Many companies are calling on governments to work together to create a new global standardisation system. This is heavily supported by society, which suffer from the interoperability problems. Communications has slowed down, logistics have become uncertain and processes of convergence have ceased, while trade blocks have pursued their individual paths, some more

successful than others. Products and services have become more expensive, and quality has been compromised. While not particularly well organized, consumers begin to actively campaign for global standards, especially in cellular communication – and area where the deterioration of interoperability touches individuals across the world.

Faced with a demanding public, governments show willingness to compromise and collaborate in some areas where global solutions are required. Understanding that global solutions require heavy R&D investments and a harmonized and efficient IP system, Europe and China agree to repeal their respective SEP Regulations. US is also keen to access to global solutions. A platform with experts from all over the world is created to develop an IPR policy and a new global standard development organisation based on the lessons learned in 3GPP. These experts include engineers, lawyers, economists, and philosophers. Research institutions and government representatives are also heavily involved.

*European perspective*

Europe is being presented with a new opportunity to once again become a leading player in standardisation. However, having lost its former global champions, massive investment is needed to develop technical solutions to contribute to the development of the new standard.

Caught in the middle of the battle between China and the US, Europe is looking for an IP system that fairly rewards innovative and secure solutions.

Ultimately, European companies need a well-functioning and affordable IP and standardisation system that works globally. This is in particular relevant for SMEs, as they can once again get access to technologies, which are ready to use (full blueprint), upon which they can build their products or services, increasing the leadership of Europe.

A new international standard development organisation would also allow SMEs to get access to worldwide markets. It is therefore important to increase the participation of innovative SMEs in the new international standardisation organisation, to help them build strong networks, and to become more influential and innovative.

*Policy implications for Europe today*

From this scenario, the following implications for current policy can be derived:

- There is a need to collaborate on a global scale to develop global solutions to global problems, such as climate change disasters, future pandemics or insufficient international communication infrastructure. Taking the 3GPP process as a model, Europe needs to take the opportunity to create a new international standard development process, and to increase the participation of European SMEs in that process.

- The most important area for global standards is the next generation of cellular standards. To achieve this, these are some measures, the EU should initiate:

    - The EU **is considering the creation of a system of mandatory mediation,** which can be requested by SMEs approached for licensing. The mediator should have access to agreements signed between the SEP owner and other potential similarly situated licensees. This way the mediator can address whether the offer is or not FRAND and communicate this to the SME. While the decision is not mandatory it could address the main concern of SMEs, i.e., Am I paying (much) more than my competitor?

- The **new standard development process must include SME-friendly principles in its IPR policy**: SMEs must be informed about the existence of the European IP Helpdesk and its role as support for SMEs in the notification of infringement.

- The **funding for the European IP Helpdesk should be significantly increased**, so that i) they can hire more IP experts (permanent highly qualified employees), and ii) they can extend the tasks of the European IP Helpdesk to explain the rights and obligations in SEP licensing; inform about case-law, reports, declarations of companies on royalty rates, etc

- In the new international standard development organisation, a **database of claim charted patents based on the agreed definition and process has to be established**. Moreover, a definition of what constitutes a claim chart and the process of creating a claim chart to guide stakeholders has to be agreed upon within the EU and published, so that claim charts present consistent documents to determine essentiality.

- **Patent pooling should be further encouraged by the EC** to complement bilateral licensing negotiations.

## Scenario 4: Global and balanced IP for open innovation[10]

*Key dimensions*

- Between private and public use of IP
- Distributed control of IP

*In brief*

Following a series of extreme weather events, health crises and wars, the achievement and implementation of science-based innovative solutions to global challenges is a key policy priority. IPR serve their primary purpose by defining the boundaries of the inventions and other creations, and by recognising their ownership and priority date. Governments, competition authorities and courts favour commercialisation and access to knowledge for the public interest. Balanced and transparent IP regimes and procedures include IP laws and strongly coordinated and harmonised (substantively and procedurally) IP offices. Applicants can file and obtain IPR with global protection following a single procedure, rather than multiple national paths as in the past. Digitalisation and AI are part of all processes now and help track the adoption of IPR-protected inventions and ensure transparency, thanks to coordination among authorities and incentive-compatible regulations that prioritise the common good. Science-based innovation is accelerating at an unprecedented rate to address health and environmental challenges. Inventors and creators apply for IPR to become visible in globally connected IP and innovation systems, to obtain funding and find partners. IP rights support innovation by providing recognition to innovative talent, enabling commercialization and increasing the diffusion of knowledge. Changes in public governance of IP, changes in the behaviour of IP owners, and increasing relevance of demands from civil society are the three main forces behind the transformation of the IP system from an opaque, complex and multilayered system to the current transparent, simple and harmonized IP system.

[10] Catalina Martínez Martinez is the main author of this scenario.

*Key drivers*

Factors of change driving this scenario include the following:

- Societal: Civil society perceives science, research and innovation positively because it promises to address global challenges and widespread IP education and IP awareness campaigns have changed the perception of IP from a blocking to a sharing tool. From a demographic point of view, younger generations place more importance on the common good and saving the planet, which also has a significant influence.
- Technological: The further development of digitalisation in general and AI tools, in particular, create a high demand for transparency and also push the relevance of business ethics.
- Environmental: Extreme weather events, health crises, and wars have strong implications on the environmental framework conditions.
- Economic: International technology markets are developed based on global IP but also driven by open science and open innovation. Solid and sound IP regimes are needed to support global IP and technology markets.
- Political: International coordination and multilevel governance substitutes nationally driven public interests to promote global public goods.

Twenty years after the COVID-19 pandemic, we now live in a world where the effects of climate change are increasingly damaging and threatening life on this planet. At the same time, solutions are coming at a faster pace than ever, thanks to the widespread and responsible use of generative AI, quantum computing and further emerging technologies, in which risks have been identified and controlled. Science-based innovation is accelerating at an unprecedented rate to address health and environmental challenges. Inventors and creators apply for IPRs to become visible in globally connected IP and innovation systems, to obtain funding and find partners. IP rights support innovation by providing recognition to innovative talent, enabling commercialization and increasing the diffusion of knowledge.

AI tools have simplified IP filing and enforcement procedures substantially, enabled the tracing of public funding for inventions and imposed public interest conditions (favouring commercialisation and access). AI has also transformed the way IP offices examine and grant IPRs. For patents, the use of generative AI helps examiners filter out the most obvious, predictable and less novel inventions and rapidly identify the most valuable contributions, which are still those where human intelligence has a decisive role. The IP system is now more inclusive than in the early years of the 21st century, and it privileges transparency and access to protected knowledge. IP courts, funding agencies and competition authorities work closely together, also in cooperation with independent experts and evaluators, and they have access to a vast amount of information as well as the capabilities and capacities to analyse it. This enables them to ensure incentive-compatible regulations that prioritise the common good aspects of IP. Changes in public governance of IP, changes in the behaviour of IP owners, and increasing relevance of demands from civil society are the three main forces behind the transformation of the IP system from an opaque, complex and multilayered system to the current transparent, simple and harmonized IP system.

*Key actors and their strategies/activities*

. IP commercialization is common in a world dominated by open innovation and collaboration, where the division of innovative labor and resources is essential to achieve meaningful progress. Technology markets and knowledge transfer work efficiently, supported by AI tools, where the matching of supply and demand is no longer a barrier. Corporate social responsibility and business ethics are important parts of a firm's reputation, which consumers and investors study/scrutinise closely when deciding what to buy or where to

invest. Voluntary IP pledges are very common (committing to license to all or a specific target group under specific conditions or for free)[11], and have become a popular way for firms to: i) reduce barriers to entry for the adoption of their technologies; ii) to achieve collective goals in their benefit; iii) to address antitrust remedies; iv) to contribute to the public good, and as a result obtaining social recognition.[12] Firms in Information and Communication Technology (ICT) sectors were initially those using pledges more often, as they have decades of experience in licensing SEPs and patent pools to guarantee interoperability, but other sectors have followed their example.

Research institutions are important players. Universities and public research centres were pioneers in ensuring open access to research results, following legal requirements of publicly funded research, for the benefit of society and common public goods, and have designed, together with funding agencies and governments, innovative solutions to ensure broad access to their knowledge without diminishing private partners' incentives to collaborate and invest to commercialise innovations deriving from that knowledge.

Civil society has an important role via social networks pressure and representation in high level meetings, and their demands for a more balanced, transparent and open IP system are heard. Their current relevance can be understood partly thanks to demographics in developed countries and the increasing influence of social networks and civil society movements in shaping policy making. The members of the so-called Generation Alpha (born in 2010-2024) are now in prominent positions (a permanently connected, IT-skilled, internationally mobile, climate-conscious and well-educated generation) and the so-called Generation X (their parents) are now starting to retire in good health and with sufficient resources, and increasingly conscious about global challenges too. The most influential Non-Governmental Organizations (NGOs) are satisfied with the possibility of using compulsory licensing (although it continues to be very rarely used by governments) and temporary IP waivers (combined with ex-post compensation) in cases of global emergencies, like pandemics as COVID-19. However, more importantly, they praise the high level of transparency and simplicity that characterizes the IP system today, which makes possible for them, as well as for IP offices and governments, to closely monitor (supported by AI) the enforcement of IP rights and tilt the balance towards facilitating access and follow-on innovation, with competition policy and market regulation when needed.

Governments have prioritized access to global public goods. Legislators, regulators, courts, competition authorities, public institutions and other bodies, such as standard-setting organisations, ensure compliance. Transparency and commercialization are the rule. IP rights resulting from publicly funded research are closely monitored to facilitate transfer and collaboration with industry to bring research results and technologies to the market and society. Public support for entrepreneurship and science-based innovation is on the agenda of most if not all governments. The policy facilitates and incentivises IP sharing and commercialization takes different forms, such as subsidies to science-industry collaboration, tax incentives, supply-demand matching platforms, support to the professionalization of intermediaries and knowledge transfer offices, etc.

Multilateral cooperation contributes significantly to the correct functioning of the system. After many years of negotiation, most UN member countries signed a series of international treaties to guarantee strong integration and coordination procedures and the total harmonization of IP laws, so that there is now a unified global system of international IP rights administered by WIPO. The EU-wide IP treaties signed in the past are now part of them, and WIPO has become a sort of front office for IP examination and enforcement procedures for all IP offices worldwide, serving as a one-stop-shop and information hub for IP applicants,

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[11] Ehrnsperger J.F.; Tietze, F. (2019): Patent pledges, open IP, or patent pools? Developing taxonomies in the thicket of terminologies. PLoS ONE 14(8): e0221411. https://doi.org/10.1371/journal.pone.0221411

[12] Contreras, J. (2015), Patent Pledges, Arizona State Law Journal, 47:3, 543

owners and opponents. WIPO does so by serving as a hub, without replacing patent offices, especially the largest ones (EPO, USPTO, SIPO, KIPO), but its role does not end with the 'national phase entries' as it was the case years ago. Now applicants can follow their national procedures at WIPO as well beyond national or regional phase entries because IP offices share global dossiers and thanks to AI and digitalisation it is easier to coordinate.

IP offices play an important role as custodians of compliance with registration and examination requirements for different types of IP rights, but AI has completely changed the way IP procedures are applied. IP examiners, who have less work than before, help in technology markets, supporting with their knowledge of the functioning of match-making platforms and knowledge transfer tools. Since national IP laws are fully harmonized, an examination is undertaken in a coordinated way among the IP offices designated for each IP right application following the agile process model. International protection is the rule for patents, designs and copyrights, and only a minority of applicants seek national protection only, but for other rights, mostly for utility models (which are now available in all jurisdictions) and trademarks, national protection is still very relevant. Digitalisation, AI tools and the predominant use of online markets have enabled the shift from applicants seeking primarily national protection to international protection, and IP offices have signed important agreements to reduce duplication of efforts and simplify procedures for applicants (with the support of governments and international organisations for the public interest).

National and international IP courts call for greater integration to avoid 'forum shopping', as well as for simpler and more transparent procedures. For their part, the growing use of generative AI makes it clear that their work would only make sense within a 'single global IP' system, rather than independently, unnecessarily duplicating efforts in increasingly connected and global technology markets.

*European perspective*

The single EU technology market, supported by unitary IPR, is well integrated into a global technology market relying on global IP rights. The current global IP institutions are well-balanced and solid, and they are key for the good functioning of technology markets, and the EU has played an important role in their design (e.g. priority of public interest, transparency, incentive-compatible mechanisms). Not to forget, international coordination and multi-level governance within the EU has been key in getting here.

Almost twenty years of Unified Patent Court (UPC) rulings, supporting a balanced view of IP rights, prove that the EU market is a good destination for foreign direct investment. EU startups as well as EU large firms are increasingly going global with a significant presence in countries of both the Global North and Global South.

The view of IP as a policy tool to ensure access to knowledge and incentive to innovate has been included in a number of EU Directives, regulations and guidelines in the past decades. Moreover, EU funding for R&D and innovation in line with these regulations has been a significant factor of change, as public funding is increasingly conditional on knowledge transfer and societal impact. Monitoring and evaluation of the impact of public funding programs, and of the compliance of such conditions, is increasingly frequent and rigorous, supported by experts and AI tools.

*Policy implications for Europe today*

The scenario suggests the following policy implications:

- The view of **IP as a policy tool to ensure access to knowledge, valorisation and incentives to innovate has to be included in EU regulations and guidelines**. EU funding to support R&D and innovation investments can be a significant factor of change, where compliance with conditions on access to results and socioeconomic impact can be facilitated by monitoring and evaluation supported by experts and AI tools.

- The traditional EU view on the need to have **regulations to deter certain behaviours could be moderated in the next few years** by the increasing transparency, availability of information and connected databases at the firm level (from patent offices, tax authorities, registers, funding agencies, trade, employment, etc) as well as AI tools that will enable to better identify positive and negative effects of specific actions and act on a case-by-case basis.

- **EU should play an important role in the international policy making scene** by showing the added value of integrated markets and harmonised legislations at the international level, as well as an increasing reliance on independent evaluations at all levels of the policy cycle and the diffusion of best practices to design incentive-compatible mechanisms for future IP and innovation systems.

- EU should take a lead in the **design of balanced, global, transparent, solid and inclusive IP institutions for open innovation** drawing from consultations with experts, civil society and stakeholders, relying on thoughtful interdisciplinary analyses.[13]

## Scenario 5: Open source collaboration globalized innovation[14]

*Key dimensions*

- Driven by a mix of private and public use of IP
- As well as a combination of concentrated and distributed control over IP

*In brief*

The IPR regimes for physical and information goods have diverged and are by and large disjunct. Open source collaboration dominates innovation of digital and other intangible goods, e.g. software source code, machine-readable specifications executable in additive manufacturing, AI training instructions, data models, etc. Private interests self-align based on voluntary participation in the innovation process. Public interests in knowledge transfer and digital sovereignty are supported by the licensing of technologies as digital public goods. The management of IPRs is reduced to the necessary minimum by applying non-negotiable, ex-ante agreements. Open source licensing enables global collaboration. Innovation is incremental and continuously disclosed. Operating principles and production processes of physical goods continue to be managed in the traditional way of acquiring and licensing patents. Significant breakthroughs in additive and automated manufacturing processes led to the emergence of an industry of on-demand custom manufacturing factories that execute production orders based on electronic specifications. The pervasive use of machine learning and computer-aided authoring and inventing removed human cognitive limitations and language barriers from being a factor in global innovation collaboration.[15] Civil society and policy makers increasingly demand openness and transparency about societal impacts. Supra- and international regulation unifies and displaces national rulemaking. Regulatory approaches that impose strict rules for market access shape competition and create a globally level playing field.

*Key drivers*

[13] See e.g. Cockburn, I., Lanjouw, J., Schankerman, M. (2016): Patents and the global diffusion of new drugs, American Economic Review 106: 136-64, or Van Overwalle, G. (2015): Inventing inclusive patents. From old to new open innovation, Kritika: Essays on Intellectual Property, vol. 1, P. Drahos, G. Ghidini, H. Ulrich (eds), Edward Elgar, 206-277.

[14] Mirko Böhm is the main author of this scenario.

- Societal: String demand by society for free access to knowledge and technologies in the context of a global public goods movement. Sensitivity to diversity, equity and inclusion has risen globally.
- Technological: The technological development is dominated by digitalisation in general and AI tools. Due to higher openness, the gap between innovation leaders and laggards is decreasing.
- Economic: Economic growth is driven by increasing trade, but also by more open business models. We observe a shift from innovation concentrated in a few big tech companies to the collaboration of a multitude of innovative SMEs from all regions.
- Environmental: Climate change, but also energy poverty and increasing environmental pollution are dominating framework conditions.
- Political: Keeping laws and administrative processes up to date, i.e. adoptive capacity, with technological progress is a major challenge. However, we observe a substantive harmonisation of IPR regimes and more collaboration in procedures towards a single IPR system worldwide. Public and private investments in research and technology are still high accompanied by intensive technology transfer and standardization activities.

The IPR regimes for physical and information goods have diverged and are by and large disjunct. Open source collaboration dominates innovation of digital and other intangible goods, e.g. software source code, machine-readable specifications executable in additive manufacturing, AI training instructions, data models, etc. Private interests self-align based on voluntary participation in the innovation process. Public interests in knowledge transfer and digital sovereignty are supported by the licensing of technologies as digital public goods. The management of IPRs is reduced to the necessary minimum by applying non-negotiable, ex-ante agreements. Open source licensing enables global collaboration. Innovation is incremental and continuously disclosed.

Operating principles and production processes of physical goods continue to be managed in the traditional way of acquiring and licensing patents. However, all aspects of the innovation process that can be represented in the digital, computer-processable form are invented in openly governed, collaborative methodologies derived from the open source development models pioneered by software development communities.

Significant breakthroughs in additive and automated manufacturing processes led to the emergence of an industry of on-demand custom manufacturing factories that execute production orders based on electronic specifications. The physical attributes of the automatically produced components depend primarily on the capabilities of the automated factories, which can produce metal, plastic or glass pieces to specification, as well as circuit boards and physical-chemical compounds like battery layers. Commodity consumer goods are assembled from such components, shifting the innovation focus to two key aspects: 1) the ever-increasing capabilities of the automated manufacturing processes, representing patentable technical inventions, and 2) the development of new source code, knowledge and component production specifications, to which copyright is applied.

The pervasive use of machine learning and computer-aided authoring and inventing removed human cognitive limitations and language barriers from being a factor in global innovation collaboration. At the same time, highly impactful sea changes continued to affect the innovation landscape:[16] Methods of online collaboration and incremental knowledge sharing evolved to cover the new applications of open source innovation. Civil society and policy makers increasingly demand openness and transparency about societal impacts. Supra- and international regulation unifies and displaces national rulemaking. Regulatory approaches that impose strict rules for market access shape competition and create a globally level playing field.

[16] Boehm, M., & Eisape, D. (2021): Standard setting organizations and open source communities: Partners or competitors?. First Monday, 26(7). https://doi.org/10.5210/fm.v26i7.10806

*Key actors and their strategies/activities*

For a brief period, the innovation system was swamped with shallow AI-generated content, overwhelming reviewers in patent offices and resulting in an impenetrable thicket of conflicting IPRs. This effect was exacerbated by national IPR offices applying diverging granting policies, significantly delaying the rollout of key innovations in the EU.

Once this was recognized as an incumbrance of the efficiency of the EU internal market, the EU replaced all member-state patent offices with a single EU patent office. By way of the EU exporting its regulatory regimes, other regions followed suit and IPR authorities consolidated into three major blocks (the United States, China and the EU) and two emerging regions (South America and Asia, in particular India, but except China). While Africa continues a period of dramatic economic growth, it has not yet become an emerging innovation region. However, due to a continuing closer- association of African countries with the EU, there are indications that this gap will be closed by 2060, finally connecting all regions of the world into a global network of innovation on equal footing. The new environment is more inclusive to developing countries and less western dominated.

Reflecting that IPRs are intended to nurture creations of the mind, the major regional blocks adopted policies that grant patents only to humans who can present their creative work in front of an expert panel. Information generated by AI systems as such, including software source code or large knowledge models, is not considered worthy of protection. Instead, a human is required to form machine-generated content into a creative expression to gain copyright, or an applicable invention to gain a patent. Since then, application filings have dropped dramatically in numbers due to a shortage of creative inventors, and the quality of granted IPRs is increasing. However, the closer international collaboration and larger investments required to gain demonstrable inventive steps make the patent races to gain IPRs a highly risky investment, viable only in highly concentrated markets with few large competitors. Emerging technologies are characterized by thousands of globally competing startups, where the chance for a patent grant is so low that venture capitalists need to rely on alternative forms of collateral. All, but a small number of highly concentrated economic sectors have converged on collaborative, open source-based innovation.

Collaborative, incremental and open innovation is by far the most common approach to diffusing technical innovations globally by a number of transactions and supply chain relationships. The openness of systems to introspection, the public good character of open sourced innovation with the rights to use, study, modify and redistribute and, most importantly, non-discriminatory access by any user for any purpose became pillars of civil society demands especially in regions where human rights are less respected by governments. Automatic translations and language-agnostic AI models of the global innovation landscape reduce cultural and regional barriers. Improved methods of collaboration enable the incremental, public development of a global body of knowledge licensed so that any interested party can understand, use, improve and redistribute the artefacts. At the United Nations, a debate is ongoing if IPR grants should be awarded also for contributions to the advancement of the Sustainable Development Goals complementary to considering inventive steps.

Firms implement a differentiate-or-collaborate strategy, creating an environment of mixed concentrated as well as distributed control of IP. They invest in IPRs only for market-differentiating functionality, while they prefer open source methodologies and shared R&D funding for non-differentiating or foundational technology due to efficiency concerns. Product design and manufacturing are further disconnected, with the innovative value being added primarily by code, specification and the manufacturing processes, while the manufactured units have a commodity character. Proprietary research and development has become more risky due to closer international competition. Digital products are predominantly built upon open source technologies, which increases reuse and sustainability while reducing costs. As patents lost their

function to protect manufactured units as opposed to manufacturing processes and specifications being openly licensed, standard essential patents have disappeared.

Academia and research institutions are part of the open innovation ecosystem. Research findings are substantiated and reproduced based on open source licensed data models. Publicly funded research is required to yield openly licensed results.[17] Automatic translation has reduced the barriers to the global dissemination of research findings. Commercialization of research findings is driven by entrepreneurship, i.e. start-ups and less by IPRs.

Civil society closely monitors digital public infrastructure development and provision for human rights and sustainable development goals. Sensitivity to diversity, equity and inclusion has risen globally and led to scrutiny of international agreements and corporate influence.

National governments (except the US and China) exert less influence over technology and innovation policy, which is taken over by the major economic blocks. National governments play a significant role in enforcing regulatory and IPR compliance and directing research and development investments.

Small and medium-sized enterprises find themselves in an environment of global competition, where the ability to differentiate is highly contested. Their opportunity to acquire patents of meaningful market value is greatly reduced.

Multinational corporations compete for manufacturing capabilities and the ability to satisfy consumer demand. Technology ownership is diminishing as a differentiator as the stock of openly licensed technologies grows, forcing companies to become more technology-takers as opposed to -makers. Access to IPR portfolios continues to be required for technology areas where they traditionally played a strong role. However, in newly developed technology areas the emergence of controlling IPR portfolios is pre-empted by applying open source licensing. International trade rules enforce mutual access to the internal markets of the major blocks.

Open source foundations were developed to have global relevance by building bridges of collaboration between regions and economic blocks. They act as pro-competitive collaboration platforms for the provision of open source licensed foundational technologies as public goods.

IP offices have been centralized to match the scope of the internal markets to the major economic blocks. The centralization also helped with pooling the workforce of experts and examiners, easing their workload and raising their decision quality. The rejection of AI-generated filings helps the IP offices focus on human-centred inventive activity.

Courts play a stronger role based on the generally tougher regulation of internal market access. The international alignment of IPR regulation and the closer global innovation collaboration increases the importance of international arbitration and a rule-based world order.

*European perspective*

Europe's role in the innovation ecosystem is characterized by strong inventiveness driven by collaborative communities and start-ups, while not being home to very large ICT businesses.

[17] Open source licensing requires permission to any interested party to use, study, modify and redistribute content, for any purpose.

Europe was forced to act primarily as a regulator of market access, first for the EU internal market but then increasingly also gaining global influence. Horizontal EU regulations commonly shape markets and supply chains globally by regulating access to the EU single market, but also because the EU is seen as a principled regulator that sets stringent standards. Governments especially in emerging markets benefit from adopting those or similar standards by gaining access to the EU market and by requiring less regulatory capacity to regulate their markets. Based on that, the EU continues to be a global regulator and has a significant impact on the convergence of global IPR regimes.

Since the EU considers IPRs a key influence on internal market efficiency, it centralized IPR regulation across the EU and leaves compliance oversight and legal enforcement to the Member States.

*Policy implications for Europe today*

The emergence of open source collaboration as an alternative approach to the development and diffusion of primarily copyright-based IPR triggered impactful policy implications for the EU:

- In the context of achieving digital sovereignty, understood as freedom to operate when deploying public and private digital infrastructure, a path decision has to be made. Digital sovereignty is either established by ownership of a regionally developed tech stack (which implies control over participation in the development process and the outcomes) or by the regional deployment of digital infrastructure developed globally in an open source model (which implies open governance of the development process and openly licensed outcomes). The **choice between control of the development process versus control over deployment** directs the build-up of EU-based skills and expertise, which makes it partially an either-or decision.

- The EU's ability to further consolidate the single market in Europe is hampered by not managing its own IPR regime. Establishing an effective IPR regime as one of the three major global economic blocks requires the **alignment of the IPR regime with the EU legislative mandate**.

- As the open source development model increases its relevance in the context of IPR, safeguarding the open source ecosystem is becoming crucial to the ability of the EU to transfer and diffuse technologies and to participate in their development. To achieve this, the **EU will need to provide guidance, recognition and protection to open source foundations** similar to that granted to standards development organisations. The EU will also need to minimize barriers to sharing technology under open source licenses in EU regulation.

# 3. Overall policy implications

In the end of each scenario, we detailed specific recommendations for policymakers on how to address depicted future developments. In this section, we derive cross-cutting implications from the scenarios – although to a different degree – into the context of ongoing IP initiatives at the EU level. Across the scenarios, the coordination between national, particularly EU, and international IPR initiatives emerges as a relevant policy challenge. Complementary to this the changing interfaces between various types of IPR, including trade secrets, have also to be considered. IPR must be aligned with further domains of public law, like competition and contract law.

IPR are crucial institutions to create incentives for investments in research and innovation and to disclose information about new technologies. Whereas in the past, until the beginning of internationalization and globalization, research and innovation processes have taken place within regional and national boundaries, nowadays they are performed on a supranational level involving numerous actors from different types of organizations. Consequently, there is an important need to harmonize IPRs on a supranational level, in particular, to create adequate incentives to invest in research and innovation and - although to a lesser degree - to disseminate technological knowledge. One step towards the required harmonization has been the launch of the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) in 1995, as the most comprehensive multilateral agreement on IP supported by the Patent Cooperation Treaty, and the Unitary Patent at the EU level complemented by hundreds of bilateral IP-relevant Bilateral Treaties.[18] Complementary to TRIPS, the more than one hundred years older Berne convention[19] should be revised to ensure a harmonized framework for copyright at the global level. However, current geopolitical tensions put pressure on existing agreements and treaties. IDiscrimination against foreign rights'-applicants and rights'-holders contributes to a re-fragmentation of the global IPR landscape.[20]

*Coordinate regulatory initiatives between IP and competition and develop horizontal guidance.*

In addition to coordinating the regulatory initiatives related to different types of IPRs, their interface to competition regulation needs further attention. In particular, the further datafication and platformisation of markets increase the likelihood of dominant and incontestable market positions, as we have seen with social media platforms. However, a more comprehensive approach is recommended for the horizontal guidelines on IPR, particularly patents related to standards, related to cooperation and anti-trust.

*Complement IPR regimes with public investment and develop open science, open source and standardization.*

An effective IPR regime is not a substitute for R&I policy, but a complement that can increase the effectiveness of R&I policy. Social innovation is less likely to be incentivized with the current portfolio of IPRs which tend to favour dominant players, particularly those located outside the EU, also call for public policy initiatives that go beyond enforcing effective competition regulation. R&D activities contributing to open science, open source[21], but also standardisation have to be promoted.

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18 https://www.wipo.int/wipolex/en/treaties/bilateral

19 https://www.wipo.int/treaties/en/ip/berne/

20 See, e.g., de Rassenfosse, G., Hosseini, R. (2020): Discrimination against foreigners in the US patent system. Journal of International Business Policy, 3, 349–366. https://doi.org/10.1057/s42214-020-00058-6

21 See already Blind et al. (2021).

Public and, in particular, pre-commercial procurement can be shaped to keep technologies open, e.g., by referencing standards not covered by IPRs or open source in the specification of tenders.[22] Possible developments in updating the EU public procurement directives or the public procurement strategy, mainly related to green technologies, play an essential role in Scenario 4 (Global and balanced IP for open innovation).

*Consider Integrating IPRs in SME policies*

Already in the 2020 published EU SME strategy[23], it has been highlighted that SMEs have difficulties developing IP strategies to protect their R&D investments and attract investors. Currently, less than 10% of SMEs protect their IP by registering formal rights because of unawareness and fear of the complexity and cost of acquiring and enforcing them. Therefore, future Intellectual Property Action Plans[24] have to consider the developments threatening SMEs' IP strategies and, eventually, innovation, e.g by reducing the costs and risks for SMEs using IPRs.

*Align IPR initiatives with the objectives of European Green Deal and SDGs.*

IP can be mobilized to accelerate the Green Transition. Possible measures could include harmonization of fast track procedures for green technologies in patent offices[25]; more transparency about IP ownership and legal status to foster markets of IP-protected green technologies; and incentives for IP owners to enter into broad licensing schemes for green inventions and increase diffusion and adoption, including patent pools and IP pledges to license technologies at zero or low royalties.[26] Current proposals to develop a predictable and simplified regulatory environment rarely consider intellectual property regulation. The Net Zero Industry Act[27] could have addressed the topic because it tries to support innovation, but, here, the focus is on regulatory sandboxes.

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[22] See already Blind, K., Böhm, M. (2019): The Relationship Between Open Source Software and Standard Setting; https://ec.europa.eu/jrc/en/science-update/relationship-between- open- source

[23] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0103.

[24] https://single-market-economy.ec.europa.eu/industry/strategy/intellectual-property/intellectual-property-action-plan-implementation_en

[25] The first empirical analysis of fast-tracking green patent applications, carried out by Dechezlepretre (2013), showed that "applicants require accelerated examination for patents of relatively higher value and that fast-tracking programmes seem to be particularly appealing to start-up companies in the green technology sector that are currently raising capital but still generate small revenue." https://cep.lse.ac.uk/_new/publications/abstract.asp?index=4196

[26] Learning from previous experiences, such as the Eco-Patent Commons" (EcoPC) on the diffusion of patented environmentally friendly technologies, which suffered from structural and organizational issues, as shown by Contreras, Hall and Helmers (2018) in https://www.nber.org/papers/w25271

[27] European Commission (2023): Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on establishing a framework of measures for strengthening Europe's net-zero technology products manufacturing ecosystem (Net Zero Industry Act).

# Annex: Factors of change

While the main scenario dimensions provide the structure for the scenario work, the factors of change provide ideas on possible future developments and issues to be taken into account in the scenarios. In the workshops, participants **related and adapted the factors** to the dimensions of each scenario and **proposed new factors and issues** to be addressed. For the workshops, we prepared a very initial non-exhaustive collection of factors of change:

- Societal (including behavioural)
- Technological (including science and knowledge bases)
- Economic (like macro, finance, sectors)
- Environmental (namely ecological)
- Political factors (including geopolitical, governance).

## Societal (including behavioural)

| Title |
|---|
| **Demand for free access to knowledge/technologies** |
| **Inventorship reversal** |
| **Public interest** |
| **Ethical issues (e.g. biotech, AI patentability)** |
| **Information gap about IP, education, awareness building** |
| **Bad IP press (based on lack of knowledge)** |
| **Education/public awareness incl. IP** |
| **Gender equality incl. enhanced female participation** |
| **Positive perception of science** |
| **Migration** |
| **Massification** |
| **Consumer behaviour towards sustainable consumption** |
| **Demographic changes, incl. ageing society** |
| **Work from home** |
| **Mental health** |
| **Environmental conscious society** |
| **Media** |
| **Security** |
| **Family** |
| **Lifestyles** |
| **Social and cultural values** |
| **Individualism – end of social fabric** |
| **Global public goods movement** |
| **Diversity, equity and inclusion** |

## Technological (including science and knowledge bases)

| Title |
|---|
| Communication |
| Transportation |
| Energy saving technologies |
| Green technologies |
| IoT, interconnectivity |
| AI |
| Blockchain, DAOs and quantum cryptography |
| Geo-engineering |
| Synthetic biology/gene editing |
| Disruptive technologies |
| Speed of technological change vs continuous adaptation |
| Digitization |
| Datafication |
| Interdisciplinarity |
| Medical breakthroughs |
| Openness vs control tradeoffs |
| Division of S&T labour |
| Internationalisation |
| Excellence science hotspots |
| Publish or perish to the extreme |
| Precariousness of scientific careers |
| Hybrid scientific careers (academic-private-government-other) |
| Excellence hotspots |
| Publish or perish to the extreme |
| Innovation champions and winner takes it all |
| Innovation hotspots and spillovers |
| Increasing role and value of intermediaries for collaboration, valuation and knowledge transfer |
| Gap between leaders and laggards (decreasing/increasing) |
| Public and private investments in research and technology |
| Technology transfer |
| Standardisation |

## Economic (like macro, finance, sectors)

| Title |
|---|
| Economic growth |
| Unemployment, redistribution of jobs, inequality |
| Shortage of skilled labour |
| World trade |
| Business ethics |
| Demand for transparency |
| Economies of scale |
| Change of business models (demand for open models) |
| Antitrust efforts due to increasing power of corporations |

| |
|---|
| Pool solutions and arbitration |
| Shift from invention from big corporate entities to SMEs |
| Taxation and customs duties |
| Global value chains vs local production |
| BRICS |
| Single enlarged EU market |
| Transformation of traditional energy producing countries (oil and natural gas) |
| Renewable energies |
| Digital economy |
| Circular economy |
| Business ethics |
| Platformisation of business models |
| Market concentration/dominance in key technologies |
| Re- and friend-shoring of production |
| Place-based innovation |

## Environmental (namely ecological)

| Title |
|---|
| Climate change |
| New and emerging technological fields |
| Dynamic technological progress |
| Administrative pace |
| Pandemic situations |
| Biodiversity |
| Energy poverty |
| Pollution |
| Desertification |
| Preserved areas |
| Energy-saving initiatives |
| Waste management and disposal |
| Geo-engineering |

## Political factors (including geopolitical, governance).

| Title |
|---|
| Keeping laws and administration up to date (adoptive capacity) with technological progress |
| International best practices |
| Geopolitical shifts (east/west, north/south) |
| Regionalisation |
| Global justice |
| Crisis of the multilateral order (e.g. WIPO) |
| Polarisation |
| Economic security narrative |
| Weaponisation of technology and resource dependencies |
| Nationalisms |
| Civil society |

| |
|---|
| **Private sector lobbies** |
| **Multilevel governance** |
| **Environmental regulations** |
| **Market regulations incl. anti-trust** |
| **Health** |
| **Trade barriers** |
| **Infrastructure** |
| **Unitary patent and unitary patent court in the European Union** |
| **Interactions and overlap between different IPRs** |
| **Substantive harmonisation of IPR regimes** |
| **Collaboration in procedures towards a single IPR system worldwide** |

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