IMPAC³T

WP3: Technology Trends

D3.1 Analysis of technology trends

AUTHORS:

N. Rodríguez, R. Heitzmann,

A. Guillén, E. Maughfling,

J. Fernández, A. De León,

N. Zhuravleva, G. Somawarpet,

L. Cowey

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List of Acronyms

AHSS	Arts, Humanities and Social Sciences
AI	Artificial Intelligence
AI TRiSM	AI Trust, Risk and Security Management
AR	Augmented Reality
BI	Business Intelligence
CDSMD	Copyright in the Digital Single Market Directive
CLM	Contract Lifecycle Management
COA	Clinical Outcomes Assessment
CRM	Customer Relationship Management
CRTY	Cancer Research Technology
DMA	Digital Markets Act
DRM	Digital Rights Management
DSA	Digital Services Act
DSS	Decision Support Systems
EC	European Commission
ESG	Environmental, Social and Governance
EU	European Union
FML	Federated Machine Learning
GAI	Generative Artificial Intelligence
GDPR	General Data Protection Regulation
GenAI	Generative Artificial Intelligence
Git	Global Information Tracker
HIPAA	Health Insurance Portability and Accountability Act
IP	Intellectual Property
IPM	IP Management
KT	Knowledge Transfer
LAION	Large-scale Artificial Intelligence Open Network
LMIC	low- and middle-income countries
ML	Machine Learning
NGO	Non Governmental Organisations
PC	Preventable Crisis
PRO	Patient Reported Outcomes
PRO	Public Research Organization
RegTech	Regulatory Technologies
RL	Reinforcement Learning
SIG	Special Interest Group
TT	Technology Transfer

UC	Unforeseen Crisis
UCL	University College London
VR	Virtual Reality
WP	Work Package

Keywords list

- Intellectual Property
- IPR management
- Licensing
- Tool-box
- Patent
- Classical+ licensing
- Crisis licensing
- Co-creation licensing

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Table of Contents

Executive Summary

This report provides a comprehensive analysis of emerging technologies and platforms used in intellectual property (IP) licensing, focusing on how they enhance and transform licensing activities. It is an output of the HORIZON EUROPE Funded IMPAC3T-IP project. It represents Deliverable 3.1 Analysis to Technology Trends, of Work Package 3: Technology trends. More information about the IMPAC3T-IP project and the aims and objectives of Work Package 3 is offered in Chapter 1.

As noted in Chapter 2, traditionally, many technology licensing activities have been largely manual and time-consuming, with associated tools being primarily paper-based, such as guides, templates, and decision trees. As organisations including academic institutions and businesses increasingly seek to optimise their licensing practices, a diverse array of technologies has emerged. These technologies, while also broadening the scope of technology being licensed also offer great potential to support or accelerate different forms IP licensing activities in their own right, not only enhancing efficiency and accuracy but also facilitating the broader dissemination of IP assets. The integration of new platforms further complements these technological advancements, offering tools for the listing of IP assets, expediting transactions, and promoting active engagement with stakeholders.

Alongside technological advances, Chapter 2 also considers the evolving legislative framework in which new technology and in particularly Artificial Intelligence (AI) is regulated including the implication of the Digital Services Act (DSA)[1], Digital Markets Act (DMA)[2] and the AI act.

Chapter 3 introduces and analyses a number of technologies that are having impact on licensing activity including:

- Federated Machine Learning (FML)
- AI-Augmented Software Engineering
- Generative AI
- Blockchain and Smart Contracts
- Digital Twin of a Customer
- Reinforcement Learning
- Homomorphic Encryption
- AI TRiSM (Trust, Risk, and Security Management)
- Internal Developer Portals and GitOps
- Disinformation Security

A key component of the analysis in chapter 3 is the identification of seven technology clusters that are influencing IP licensing.

These are:

- Cluster 1: Digital Contracting and Transaction Technologies
- Cluster 2: Data Privacy and Security Technologies
- Cluster 3: Artificial Intelligence and Machine Learning Applications
- Cluster 4: Collaboration and Development Technologies
- Cluster 5: Compliance, Risk Management, and Ethical Technologies

[1] Regulation (EU) 2022/2065 of the European Parliament, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R2065 , last accessed, 27 Oct, 2024.
[2] Regulation (EU) 2022/1925 of the European Parliament, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R1925 , last accessed, 27 Oct,2024.

- Cluster 6: Communication and Engagement Technologies
- Cluster 7: Analytical and Decision Support Technologies

The report explores the impact of these clusters on IP licensing, examining both the opportunities they present and the potential limitations or challenges associated with their adoption.

Chapter 4 addresses the emergence of new platforms and delivery methods that facilitate licensing activities, offering insights into how organisations can integrate these solutions effectively. These platforms exist in six distinct types:

Listing and aggregation of technologies and IP assets

1. Listing of Technology / IP assets
2. Listing and active promotion of IP portfolios

Expediting IP licence transactions

3. Platforms owned by IP management (IPM) software solutions
4. Feature Rich Licensing Platforms
5. ‘In-house’ licensing websites
6. Licensing Platforms for specific product categories

Chapter 5 analyses the technologies and platforms in relation to the three main scenarios of the IMPAC3T-IP project: Classical Plus licensing, Co-creation, and Crisis situations, illustrating how these technologies and platforms streamline operations, improve efficiency, and facilitate wider societal impact.

Chapter 6 offers conclusions and emphasises the need for the licensing community to embrace technological advancements thoughtfully. The findings highlight the importance of assessing the characteristics and requirements of specific solutions, such as technology-driven tools or platforms, and select them based on the individual needs or the organisation’s strategic objectives.

1. Introduction to the report

This document is Deliverable 3.1 of the IMPAC3T-IP project.

IMPAC3T-IP is an ambitious Coordination and Support Action that aims to develop, pilot and support the sustainable adoption of a scenario based licensing ToolBox through a certified user and trainer programme, for efficient IP licensing for market uptake and societal value creation. IMPAC3T-IP explores three main licensing scenarios:

- Classical Plus – licensing that encompasses newer types of IP assets e.g. assets that are not patent based and are therefore different to the assets that have formed the main part of the traditional for-profit licensing approach.
- Crisis – licensing that takes place in repose to or to prevent crisis situations such as emerging or preventable medical emergencies.
- Co-creation – licensing that takes place as a result of interactions involving multiple different stakeholders and that goes beyond classical collaborations and contract research.

This document is an output of Work Package 3: Technology trends

Aims and objectives of WP3

Work Package 3 (WP3) had two main tasks:

Task 3.1 Technology scanning

Examples of integration of new technology into licensing activity as well as technology use to present opportunities and digitally execute deals online were identified. The work was based on desk-based research, including interaction with the IMPAC3T-IP special interest groups (SIGs) and wider licensing groups.

Task 3.2 Case study development

Examples of novel use of technology to facilitate licensing activity have been captured in form of case studies and analysed for good practice and viable transfer paths.

This document presents the results of Task 3.1 namely the report on technology trends. The report analyses the technologies and platforms in regard to their impact, their implications for the licensing community and addresses potential limitations and reservations in the adoption of these technologies.

2. IP Licensing

2.1. Introduction to IP Licensing

Intellectual Property (IP) licensing is a legal mechanism whereby the owner of IP rights grants permission to another party to use, develop, or commercialise those rights under defined conditions and for a specified period. The spectrum of IP rights that can be licensed includes patents for inventions, copyrights for literary and artistic works, trademarks for brand identification as well as trade secrets encompassing confidential business information that are covered by relevant law. Increasingly software, data and artificial intelligence (AI) powered algorithms are being licensed particularly from academia, as research is adopting and producing many of those techniques.

The importance of IP licensing is multifaceted and pivotal for fostering innovation and economic growth. It serves as a bridge connecting companies, academic research institutions and other organisations, enabling discoveries to be transformed into products and services that address real-world challenges. Effective IP licensing facilitates collaboration, promoting the transfer of knowledge and technology that can lead to the development of new industries and enhancement of existing ones.

The adoption rate of IP licensing varies notably among different industries. High-tech sectors such as information technology, biotechnology, and pharmaceuticals exhibit high adoption rates due to the intrinsic value of their IP assets and the rapid pace of innovation. In contrast, traditional manufacturing industries may have lower adoption rates of IP licensing, focusing more on trade secrets and process know-how rather than formal licensing agreements. Finally, the rate of adoption of tools when carrying out work is of course heavily dependent on the organisational culture. No comprehensive statistics can be provided at this point, but individual observations made during discussions with IP professionals supports this observation. While some organisations have been using advanced software for many years, it became clear that even large research institutions and internationally renowned law firms usually work with conventional software such as Excel.

Traditional IP licensing, particularly from public to private sectors, involves several critical stages that require careful consideration. Initially, the IP must be accurately identified and legally protected, which may involve filing for patents, registering trademarks, or securing copyrights. This protection is essential to establish ownership rights and prevent unauthorised use by third parties. Whether the licence agreement arises from a prior cooperation or is discussed independently, negotiations frequently play a crucial role in traditional IP licensing, as they establish the terms of the agreement. Once consensus is achieved, the agreement is formalised in a legal contract, addressing additional and more detailed considerations.

2.2. The evolving role of Technology in IP Licensing

Technology has historically played a pivotal role in shaping the landscape of IP licensing. As technological advancements have progressed, they have significantly influenced the **creation of new forms of IP**, transformed **IP management** practices, and introduced novel challenges and solutions in **IP enforcement**. Understanding these influences is essential for comprehending the current dynamics of IP licensing. The emergence of **advanced**

technologies such as AI, blockchain, machine learning (ML) and big data analytics is now having a profound impact on the practical business of licensing itself.

Technological innovation has impacted the **creation of IP** by expanding the domains in which IP rights can be established. The emergence of computer software in the late 20th century challenged traditional notions of patentability, as software was initially not considered eligible for patents, leading to uncertainties in protection. Over time, legal frameworks evolved to recognise that software-related inventions could be patented if they produced tangible results, prompting jurisdictions to develop nuanced legal protections and licensing models for software innovations. Similarly, advancements in biotechnology led to the harmonisation of legal protections for biotechnological inventions in Europe and the world, acknowledging that genetic sequences and bioengineered organisms could be patented. Current technological advancements, such as AI, are generating new forms of IP, raising complex issues regarding authorship and ownership since traditional IP laws did not anticipate non-human creators. Patent offices are beginning to address these challenges, but legal frameworks are still evolving, and experts are looking to emerging cases for guidance.

Technology has also revolutionised **IP management** by introducing tools that enhance the administration and monitoring of IP assets. The transition from paper-based records to digital databases has significantly improved efficiency. Furthermore, IP management software has streamlined portfolio management to such a degree, that going back to non-assisted processes seems unthinkable to institutions handling IP portfolios today. Software solutions offer platforms that automate tasks such as renewal fee payments, deadline tracking, and document management. This automation reduces the risk of administrative errors that could lead to the loss of IP rights.

The digital age has introduced both challenges and advancements in **IP enforcement**. The widespread availability of high-speed internet and digital technologies has made the unauthorised copying and distribution of protected works easier than ever. A significant historical example is the music industry's experience with digital piracy in the early 2000s, leading to substantial revenue losses and prompting the industry to seek new enforcement strategies and business models. In response to the challenges of digital piracy, digital rights management (DRM) technologies were developed to protect digital content. AI and data analytics have become very important in monitoring and enforcing IP rights. Image recognition software, for instance, can scan the internet to detect unauthorised use of protected images or trademarks.

The interplay between technology and IP licensing is dynamic and continually evolving. Technological advancements not only create new opportunities for innovation but also necessitate adaptive approaches to IP protection, management, and enforcement. Historical examples demonstrate how technology has been shaping change in legal frameworks, management practices, and enforcement mechanisms for the past decades.

The emergence of **advanced technologies** like AI, blockchain, machine learning and big data analytics lead to a new generation of software tools, that allow licensors and licensees to automate and streamline various stages of the licensing process. AI can be used to analyse large datasets to identify organisations with strategic interests aligned with technologies or as generative AI[3] (often referred to as GenAI or GAI) for content of all kinds. Smart contracts, built on blockchain technology, offer a way to streamline the agreement phase. Big data analytics further enhances the ability to monitor and manage ongoing licensing agreements. These tools

[3] Generative artificial intelligence (generative AI, GenAI, or GAI) is a subset of artificial intelligence that uses generative models to produce text, images, videos, or other forms of data.

can track usage, performance metrics, and other key indicators of licensing effectiveness in real-time. With emerging autonomous agents and agentic workflows, the level of automation in many of these tasks is only likely to increase. Autonomous agents are software systems designed to perform tasks or make decisions independently, often using machine learning to adapt and improve over time. As their capabilities evolve, agents are becoming integral to streamlining workflows and enhancing the precision of tasks that were once heavily reliant on manual effort.

In summary, the role of technology in the business of licensing has expanded significantly. Recent technologies such as AI, blockchain, and big data analytics are already reshaping the way licensing is conducted, offering improved methods for identifying partners, negotiating agreements, and managing contracts. As technology continues to evolve, the business of licensing will adapt, becoming more efficient, transparent, and responsive to market needs.

2.3. Legal and regulatory considerations

As the technological landscape evolves, the European Union has embraced a digital strategy[4] aimed at creating a human-centred, sustainable, and prosperous digital Europe. To accomplish this goal, the EC (European Commission) has introduced a series of regulations designed to shape the Union's digital future.

2.3.1. Digital Services Act Package

The Digital Services Act (DSA)[5], and Digital Markets Act (DMA)[6] are two complementary legislations aimed at creating a 'secure, vibrant and competitive online environment both for all EU users and online service providers'. The DSA regulates the liability of digital intermediary services such as marketplaces, social networks, and content-sharing platforms, to prevent illegal and harmful activities online, as well as curbing the spread of disinformation, commonly referred to as "fake news." Meanwhile, the DMA lays down harmonised rules for ensuring fairness and contestability on platforms acting as 'gatekeepers who provide core platform services'. The EC has designated a number of named gatekeeps including Alphabet, Amazon, Apple, ByteDance, Meta and Microsoft as gatekeepers. These entities have been designated based on their provision of around 22 core platform services such as, Alphabet provides core platform services such as YouTube, Google maps, Google search, Google Android, Google shopping, Google Chrome; Amazon provides platform services through Amazon marketplace, Amazon Ads. Under DMA, designated gatekeepers must allow third party interoperability, provide data access, competing app stores, allow independent verifications of advertisements hosted by the gatekeeper. The DMA introduces a radical change in competition policy by ex-ante regulation of digital gatekeepers.

Although DSA and DMA list extensive obligations on digital intermediaries and platforms thus strengthening and safeguarding consumers, they further assist and facilitate the takedown of IP-infringing content on their platforms. Under DSA, hosting services and platforms must provide user-friendly means for users to notify the platforms about illegal content hosted.

[4] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age_en

[5] Regulation (EU) 2022/2065 of the European Parliament, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R2065 , last accessed, 27 Oct, 2024.

[6] Regulation (EU) 2022/1925 of the European Parliament, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32022R1925 , last accessed, 27 Oct,2024.

Additionally, to reduce counterfeit goods and to trace counterfeiters, DSA mandates that online marketplaces must ensure the traceability of the traders by obtaining their name, address, trade registration number, electronic identification, account payment details etc, before offering their products on the platform.

2.3.2. AI Act

The AI Act (Regulation 2024/1689)[7] is the first AI legal framework laying down specific requirements and obligations on AI developers and deployers to develop trustworthy AI. The AI Act is a regulatory legislation that primarily prescribes transparency measures, risk management and mitigation obligations on deployment and usage of generative AIs within the Union, it briefly outlines guiding principles on copyright policy, adherence and reporting on the training data used by AI developers.

The AI Act has adopted a risk-based legislative approach wherein, AI technologies used in critical infrastructure, life and health of citizens, credit scoring, law enforcement etc. are deemed to be high-risk AI systems. In contrast, AI systems used in video games or spam filters are considered to be low risks AI system. Further, the AI Act explicitly prohibits usage of AI systems - for subliminal manipulation or employing deceptive techniques to distort behaviour of an individual or a group of people, classification and social scoring mechanisms of persons based on their personal characteristics.

Copyright-related questions can arise across different phases of the AI value chain, that is, from the input used to train the AI model to the ownership issues related to output generated by generative AI models. To address any copyright usage reservations set out by the copyright holders, the AI act in Art.53 (3) mandates providers of General-purpose AI models to have a compliance policy to adhere to any reservations set out by copyright holders set out in Article 4(3) of Directive (EU) 2019/790 (CDSMD (Copyright in the Digital Single Market) Directive).

Apart from the specific article, recital 104 specifically provides mandated transparency obligations for open-sourced general purposes AI models, as their parameters and weights are made publicly available.

Additionally, Recital 105 of the AI Act, reiterates Art. 3 of the CDSMD that text and data mining to train AI models can be carried out for purposes of scientific research. However, according to Art. 4 of the act, wherein right-holders have opted out from usage of their copyrighted works, explicit permissions have to be obtained for reproduction and extractions. This has strong implications for universities as well as other ‘research organisations’ developing intellectual property based on existing external data sources, particularly if the final output has commercial potential.

Case law in this area is still developing but In a recent landmark judgment the Hamburg Regional Court in Kneschke v. LAION[8] held that the ‘scrapping’/use of images by Large-scale Artificial Intelligence Open Network (LAION) to develop image datasets (LAION 5B) containing copyrighted images of Kneschke did not constitute a copyright violation based on Section 60d of Urheberrechtsgesetz (Section 60d UrhG implements Article 3 of the CDSMD).

[7] Regulation (EU) 2024/1689 Of The European Parliament And Of The Council, Of 13 June 2024, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:L_202401689, last accessed, 27 Oct, 2024

[8] https://copyrightblog.kluweriplaw.com/2024/07/22/machine-readable-or-not-notes-on-the-hearing-in-laion-e-v-vs-kneschke/

First, the court determined that artificial intelligence training is an automated analytical technique that generates correlations, and as such, it falls under the definition of text and data mining outlined in Article 2(2) of the CDSMD.

Second, Section 60d of the UrhG allows text and data mining for research purposes by universities, research institutions, and other organizations, provided that reproductions are made for:

- For non-commercial purposes.
- Reinvest all their profits for scientific research
- Act of public interest based on a state-approved mandate. (These exceptions do not extend to research organisations cooperating with private enterprises)

The court concluded that since the image dataset was made freely available to the public, LAION's reproduction of copyrighted works can be justified for the purposes of scientific research. Furthermore, the court dismissed the plaintiff's claims that LAION received funding from Stability AI and that members of LAION were employed by Stability AI. The court reasoned that Stability AI did not exert a decisive influence on LAION's work.

The ruling clarified that, even if individual members of LAION collaborate with commercial enterprises, this does not affect LAION's status as a research organization. It highlighted that the data utilized by commercial firms does not alter the organization's fundamental non-commercial and research-oriented goals.

That being said, the LAION judgment is rather narrow and does not clarify many issues that universities and research institutes may face while curating, developing, and deploying AI models.

1. The court ruled that the commercial use of a dataset does not change LAION's stated non-commercial purpose. However, some experts argue that this view overlooks the potential ways the dataset could be used in profit-driven environments, which might challenge its protection under the research exception. While the decision focuses on the creating and curating the dataset for non-commercial scientific purposes, it remains unclear how the joint development of AI training models and their deployment by public research organizations in collaboration with private companies will be handled.
2. The court does not consider the author's rights to reserve usage of a publicly accessible work. Although works may be publicly available, their use can still be restricted. Therefore, a distinction should be made between public accessibility and lawful access, which the court appears to have overlooked.[9]

In the United States, there is no specific positive law regarding text and data mining; however, it has traditionally been considered under the fair use doctrine, which is evaluated on a case-by-case basis. However, numerous AI copyright cases are being brought against Open AI raising key questions about the legality of using copyrighted content without permission in training generative artificial intelligence models[10].

[9] Elenora Rosati, The German LAION decision: A problematic understanding of the scope of the TDM copyright exceptions and the transition from TDA to AI training, Oct 07, 2024.
[10] https://www.bakerlaw.com/services/artificial-intelligence-ai/case-tracker-artificial-intelligence-copyrights-and-class-actions/

Apart, from the Digital Services Act and AI Act, the European Commission has introduced a host of complementary legislations such as the European Chips Act[11] (with the main theme of collaborative R&D to boost chip research, design, and testing facilities in the European Union); Data Governance Act[12] and Data Act[13] which aim at facilitating data sharing and use to enable fair distribution of data generated from usage of connected devices.

To summarize, numerous regulations have been implemented in the EU to address the rapidly evolving technological landscape. The primary concerns of these legislative frameworks include privacy, transparency, trustworthiness, security, ethics, and contestability. Additionally, issues such as the use of copyrighted content for general-purpose AI training and copyright questions related to generative AI outputs, as well as the opaque nature of AI models, have raised new intellectual property questions that remain unresolved.

[11] Regulation (EU) 2023/1781 of the European Parliament and of the Council of 13 September 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32023R1781 , last accessed, 27th Oct, 2024

[12] Regulation (Eu) 2022/868 Of The European Parliament And Of The Council, Of 30 May 2022, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022R0868, last accessed, 27 Oct 2024.

[13] Regulation (EU) 2023/2854 of the European Parliament and of the Council of 13 December 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ:L_202302854&qid=1730330498767, last accessed 27th Oct, 2024.

3. Emerging Technology in licensing activity

This chapter takes a closer look at the role of emerging technology in licensing activity. In the following sections the integration of new technology into licensing activity is analysed. A subsequent technology analysis describes the impact on IP licensing and the implications for the licensing community.

3.1. Integration of new technology into licensing activity

The rapid evolution of technology continues to reshape the landscape of IP licensing. Several innovations outlined in the latest Gartner Hype Cycle[14] are particularly relevant to how research and innovations are transferred from licensors to licensees. These technologies are poised to enhance both the value and efficiency of technology licensing, offering new opportunities for organizations to capitalise on their intellectual property.

Below is an elaboration of the most relevant technologies from the latest Gartner Hype Cycle that have direct implications for licensing, along with insights on how they may contribute in the near future. Each of these technologies presents unique opportunities for licensors to license their innovations, either through traditional intellectual property agreements or novel, technology-enabled contract mechanisms like smart contracts. As these technologies mature, the licensing landscape will continue to evolve, favouring organisations that remain at the forefront of innovation.

Federated Machine Learning (FML)

Federated Machine Learning (FML) represents a new approach in collaborative data-driven technology development, particularly in the context of data privacy preservation. Traditional machine learning approaches often require the aggregation of data from multiple sources into a central repository for model training, which raises significant privacy and security concerns. FML addresses this issue by enabling the training of machine learning models across multiple devices or servers holding local data samples, without exchanging the actual data.

In licensing negotiations involving sensitive data – such as medical research involving patient records, genomic information, or proprietary financial algorithms – FML allows multiple parties to collaboratively develop and improve ML models without the need to share or expose their underlying datasets. This capability is especially valuable when dealing with cross-border licensing agreements, where differing data protection regulations such as the General Data Protection Regulation (GDPR) in Europe or the Health Insurance Portability and Accountability Act (HIPAA) in the United States present substantial legal and logistical challenges.

By employing FML, academic institutions or commercial entities can engage in collaborative research and development while ensuring compliance with stringent data privacy regulations. This approach not only streamlines the negotiation process by reducing legal complexities, but also potentially improves the time to agreement closure. Furthermore, the use of FML can increase trust between licensors and licensees, as both parties can benefit from the shared development of advanced models without compromising their respective data assets.

[14] https://www.gartner.com/en/newsroom/press-releases/2024-08-21-gartner-2024-hype-cycle-for-emerging-technologies-highlights-developer-productivity-total-experience-ai-and-security

In the future, as concerns over data privacy continue to escalate and regulatory frameworks become increasingly stringent, the use of FML in licensing agreements is likely to become more widespread. Organisations that integrate FML into their collaborative projects will be better positioned to expand their research partnerships and licensing opportunities on a global scale, unimpeded by data privacy concerns.

AI-Augmented Software Engineering

AI-Augmented Software Engineering is poised to transform the software development landscape by incorporating AI to automate and enhance various aspects of the software engineering process. This technology is only indirectly influencing IP licensing, but is a relevant trend as it will be reshaping the way software tools are made. As AI-Augmented Software Engineering continues to evolve, its integration into the licensing process will become increasingly sophisticated.

Generative AI

Generative AI, a subset of AI focused on creating new content from existing data, offers powerful tools for analysing, drafting, and negotiating licensing agreements. By utilising advanced natural language processing and machine learning algorithms, Generative AI systems can simulate negotiation scenarios, generate draft agreements, and provide strategic insights to licensors and licensees. One of the key applications of Generative AI in licensing is the rapid generation of contract drafts. Traditional contract drafting and review are labour-intensive processes that require attention to detail to avoid ambiguities and inconsistencies. AI tools equipped with natural language processing capabilities can automate portions of these tasks. For instance, Generative AI can assist in identifying potential risks and inconsistencies within contracts by comparing them against a database of legal precedents and regulations. This proactive risk management enhances the quality of licensing agreements and reduces the likelihood of future disputes. Generative AI can improve the accuracy of contracts and also reduce the time and resources required for legal review. Moreover, AI-driven tools can facilitate the automatic generation of licensing agreements tailored to the specific requirements of both licensors and licensees. By inputting predefined parameters and preferences, these systems can produce draft contracts that align with the strategic objectives of the parties involved. This level of automation allows licensing managers to focus on higher-level strategic decisions and relationship management rather than on the details of contract drafting. In terms of enforcement, AI systems will monitor compliance with licensing terms by tracking usage metrics and identifying deviations from agreed-upon conditions. This proactive approach to compliance management reduces the likelihood of disputes and enhances the overall integrity of the licensing process.

Additionally, Generative AI has the capability to analyse vast amounts of historical contract data to identify patterns and outcomes associated with different negotiation strategies. This analytical capability enables licensors to evaluate the potential impact of various terms and conditions, informing their negotiation approach. AI can also analyse large data sets such as patent databases and can therefore be used for patent analyses such as novelty searches and freedom-to-operate analyses.

Organizations that adopt these tools will benefit from increased efficiency, reduced legal costs, and improved accuracy in their licensing agreements, thereby enhancing their ability to

capitalise on intellectual property assets. The capability of Generative AI significantly reduces the time required to prepare initial drafts, allows licensing managers to focus on higher-level strategic decisions and relationship management rather than on the details of contract drafting and allows legal teams to focus on reviewing and refining the agreements rather than creating them from scratch.

Blockchain and Smart Contracts

Blockchain technology, and specifically smart contracts, are expected to heavily influence the enforcement and execution phases of licensing agreements. A blockchain is a decentralised ledger that securely records transactions across multiple computers, ensuring that the data is transparent and tamper-proof. Smart contracts are self-executing contracts with the terms of the agreement directly written into code, which automatically enforce licensing terms once predefined conditions are met. In the context of technology licensing, smart contracts can automate the execution of royalty payments, access rights, and compliance monitoring. For example, when a licensee uses a licensed technology, the smart contract can automatically calculate and transfer the appropriate royalty payment to the licensor without the need for manual invoicing or auditing. This level of automation reduces administrative overhead and minimises the potential for human error or deliberate non-compliance.

Furthermore, the transparency inherent in blockchain technology enhances trust between licensors and licensees. All transactions and contract executions are recorded on the blockchain, providing an immutable audit trail that can be accessed by authorised parties. This transparency mitigates disputes over compliance and ensures that all parties have a clear understanding of the licensing activities. The adoption of blockchain and smart contracts in licensing is particularly advantageous for high-volume agreements where efficiency and accuracy are crucial. Academic institutions can leverage these technologies to securely track the use of their intellectual property, streamline royalty collections, and reduce reliance on intermediaries such as legal teams and auditors. So far, the adoption of these technologies has been sluggish, however, as blockchain technology matures and becomes more widely adopted, it is expected that smart contract platforms will become standard tools for licensing practice. Academic institutions that integrate blockchain solutions into their licensing operations will be better equipped to manage their intellectual property assets effectively in an increasingly digital and decentralised marketplace.

Digital Twin of a Customer

Digital Twin technology involves the creation of a virtual replica of a physical entity, system, or process, allowing for simulation, analysis, and optimisation in a digital environment. When applied to customers, a Digital Twin provides a detailed digital representation of customer behaviours, interactions, and preferences. This technology could significantly enhance the way licensing managers understand and forecast the value of licensing agreements. By developing a Digital Twin of a customer, licensors may model how products and services licensed to a company will perform in real markets. This predictive capability allows licensors to assess the potential market adoption, performance, and impact of their technologies before committing to a licensing agreement. Such insights enable licensors to negotiate better terms based on data-driven projections of revenue, market penetration, and customer satisfaction.

Moreover, Digital Twins can facilitate continuous improvement post-licensing by providing ongoing data on how the licensed technology is performing in the market. This feedback loop

allows licensors to make decisions about future enhancements, support services, and potential upselling opportunities.

In negotiating licensing deals, the utilisation of Digital Twins may strengthen the licensor's position by providing empirical evidence to support the proposed terms and conditions. It also allows for more strategic alignment between the licensor and licensee, as both parties can collaborate on optimising the technology for market success. Digital Twins can also support in simulating potential negotiations enabling the formulation of specific licensing strategies to gain a competitive advantage and get the maximum return out of the technology assets.

Reinforcement Learning

Reinforcement Learning (RL) is a type of machine learning where an agent learns to make decisions by performing certain actions and receiving rewards or penalties. In the context of licensing, RL could improve decision-making by optimising negotiation strategies over time based on historical data and outcomes. By analysing past negotiations and the resulting contract performances, RL systems can identify patterns and strategies that have led to successful outcomes. These systems can recommend optimal approaches for future negotiations, considering factors such as financial terms, legal provisions, and partnership potential. This data-driven decision-making enhances the effectiveness of licensing professionals by providing actionable insights that are grounded in empirical evidence. Additionally, RL can adapt to changing market conditions and negotiation dynamics in real time. As new data becomes available, the RL system updates its recommendations, allowing licensing managers to adjust their strategies accordingly. This agility is particularly valuable in fast-paced industries where market conditions can shift rapidly.

Homomorphic Encryption

Homomorphic Encryption is an advanced cryptographic technique that allows computations to be performed on encrypted data without the need to decrypt it first. This capability is significant in licensing negotiations involving sensitive or proprietary information. In scenarios where technologies are licensed that involve proprietary algorithms, datasets, or other confidential information, Homomorphic Encryption enables potential licensees to evaluate the functionality and performance of the technology without exposing the underlying sensitive data. For example, a licensee could test the efficiency of a proprietary algorithm on its own data while the algorithm remains encrypted, ensuring that the licensor’s intellectual property is not disclosed.

This approach enhances security and trust during the negotiation process, as it alleviates concerns about data leakage or misuse. It also facilitates compliance with data protection regulations, as sensitive data is not exposed or transferred between parties. The use of Homomorphic Encryption can streamline negotiations by reducing the need for extensive legal safeguards or non-disclosure agreements related to data sharing. It can also expand the potential pool of licensees, as organisations that were previously hesitant to engage due to data privacy concerns may be more willing to consider licensing agreements under these secure conditions.

AI TRiSM (Trust, Risk, and Security Management)

AI Trust, Risk, and Security Management (AI TRiSM) refers to frameworks and tools designed to manage risks and ensure compliance in the deployment of AI technologies. As AI-based innovations are increasingly licensed, the importance of addressing issues related to bias, transparency, and security becomes paramount. AI TRiSM frameworks help in assessing the trustworthiness of AI systems by evaluating factors such as algorithmic fairness, explainability, and robustness against adversarial attacks. In the context of licensing, incorporating AI TRiSM into agreements ensures that both licensors and licensees are aligned on standards for ethical AI deployment.

By defining clear metrics and guidelines for AI transparency and risk management within the licensing agreement, potential disputes over ethical AI use can be minimised. This proactive approach protects the licensor from liabilities associated with the misuse or unintended consequences of their AI technologies.

Furthermore, adherence to AI TRiSM frameworks can enhance the marketability of the licensed technology. Organisations are increasingly conscious of the ethical implications of AI and may prefer technologies that come with built-in assurances of trustworthiness and compliance.

Internal Developer Portals and GitOps

Internal Developer Portals and GitOps[15] represent modern approaches to software development and deployment within organisations. Internal Developer Portals serve as centralised platforms that provide developers with access to tools, documentation, and resources necessary for efficient software development. GitOps is a methodology that uses Git repositories as the single source of truth for declarative infrastructure and applications, enabling automated and continuous deployment.

The rise of these technologies influences how the development tools are managed and licensed software is distributed. By leveraging Internal Developer Portals, licensees can more easily integrate licensed software into their existing development workflows. This integration reduces barriers to adoption and accelerates the deployment of innovations within commercial environments. GitOps further enhances this process by automating deployment pipelines, ensuring that licensed software is consistently and reliably deployed across various environments. This automation reduces the potential for human error and increases the scalability of the licensed technology within the licensee's infrastructure.

From a licensing perspective, agreements may evolve to place greater emphasis on the efficiency and effectiveness of technology integration and deployment. Licensors may need to provide support and resources to facilitate this process, thereby enhancing the value proposition of their licensed technologies.

Disinformation Security

Disinformation Security involves technologies and strategies designed to detect, prevent, and mitigate the spread of false or misleading information. In sectors where content integrity is

[15] GitOps is a framework that uses Git (Global Information Tracker) as a source control system to manage infrastructure and application code deployments. It's a DevOps best practice that applies DevSecOps practices to infrastructure automation and management.

critical, such as media, government, and public health, Disinformation Security becomes an essential component of licensing agreements. Licensors that develop innovations aimed at combating disinformation can license these technologies to entities that require robust solutions to protect the integrity of information disseminated to the public. Licensing agreements in this domain must address specific considerations related to security measures, implementation strategies, and liability provisions.

For instance, licensors need to ensure that their technologies are deployed effectively and responsibly, with clear guidelines on performance metrics and compliance requirements. This may involve collaborative efforts to tailor the technology to the specific needs of the licensee and to monitor its effectiveness in real-world scenarios.

Additionally, agreements may need to include clauses that address the ethical implications of using such technologies, ensuring that they are not misused for censorship or suppression of legitimate information.

3.2. Technology Analysis

3.2.1. Impact on IP Licensing

This chapter provides an overview of how technologies can shape different domains of IP licensing. Beyond the cutting-edge innovations previously discussed, there exists a spectrum of technologies that have been and will continue to be instrumental in changing the manner in which licensing and contracts for technologies are executed. To understand these influences systematically and in order to structure the large number of technologies identified during the research, they were categorised into seven distinct clusters:

- Cluster 1: Digital Contracting and Transaction Technologies
- Cluster 2: Data Privacy and Security Technologies
- Cluster 3: Artificial Intelligence and Machine Learning Applications
- Cluster 4: Collaboration and Development Technologies
- Cluster 5: Compliance, Risk Management, and Ethical Technologies
- Cluster 6: Communication and Engagement Technologies
- Cluster 7: Analytical and Decision Support Technologies

This segmentation is designed to be mutually exclusive and collectively exhaustive, ensuring clarity and avoiding redundancies. Each cluster represents a distinct domain that contributes to the evolution of licensing practices, from the automation of contracts and secure data sharing to the enhancement of collaboration and compliance management. By recognising and integrating these technologies into their licensing strategies, licensors can navigate the complexities of modern licensing environments more effectively. This comprehensive approach enables them to capitalise on their intellectual property assets fully, foster robust partnerships, and maintain a competitive edge in the global market. The following sub-chapters describe and develop these clusters and how they can be used to bring value to the three main scenarios dealt with by IMPAC3T-IP.

Cluster 1: Digital Contracting and Transaction Technologies

This cluster encompasses advanced digital solutions that fundamentally transform the processes of contract creation, management, execution, and enforcement in the field of technology licensing. These technologies digitise and automate contractual transactions between licensors and licensees, aiming to enhance efficiency, accuracy, transparency, and security.

Characterised by their ability to streamline traditional contractual workflows, these technologies leverage innovations in automation, digital authentication, and secure transaction processing. They facilitate the drafting, negotiation, and execution of contracts through digital platforms, reducing reliance on manual processes and physical documentation. By automating various stages of the contract lifecycle – from initial drafting and negotiation to execution and renewal – they minimise time-consuming manual tasks, reduce errors, and accelerate the overall contracting process.

These technologies employ advanced encryption and digital authentication methods to ensure the security and integrity of contractual agreements. This includes verifying the identities of parties involved and safeguarding documents against tampering or unauthorised access. Digital contracting platforms maintain transparent records of all contractual transactions, and the immutability of digital records ensures that once a contract is executed, its terms cannot be altered without proper authorisation. This transparency and immutability enhance trust between parties.

Automated enforcement mechanisms ensure that contractual obligations are executed promptly and accurately. Actions such as royalty payments or granting access rights are automatically triggered when predefined conditions are met, reducing administrative burdens and streamlining processes. This enables faster negotiation and execution of licensing agreements, allowing licensors to manage more agreements simultaneously without compromising on quality or compliance.

Furthermore, the automated tracking and enforcement of contract terms reduce the risk of non-compliance and associated disputes. Institutions can more effectively monitor adherence to licensing agreements, ensuring that intellectual property rights are respected. Digital platforms also break down geographical barriers, enabling licensors to engage with licensees worldwide seamlessly. This global accessibility expands the potential market for licensed technologies.

Minimising manual intervention lowers operational costs associated with contract management, and savings can be redirected towards research and development or other strategic initiatives. Additionally, digital contracting tools often come with analytics capabilities, providing valuable insights into contract performance, negotiation patterns, and market trends. This data-driven approach supports informed decision-making and strategic planning.

By integrating digital contracting and transaction technologies, licensors and licensees position themselves at the forefront of modern licensing practices. These technologies not only optimise current operations but also provide a scalable foundation to adapt to future advancements in the digital economy. Embracing this cluster enables organisations to protect their intellectual property effectively, engage in more dynamic partnerships, and maximise the commercial potential of their innovations.

While these technologies offer several advancements, it is important to acknowledge potential limitations and concerns. For instance, these technologies may face legal challenges due to varying recognition of digital signatures and smart contracts across different jurisdictions. Not all countries have legal frameworks that fully support or validate digital contracts, potentially

leading to enforceability issues. Additionally, the adoption of blockchain technologies can involve upfront costs and may require specialised technical expertise, which might be a barrier for smaller institutions or those with limited resources in adopting these technologies. Furthermore, there may be security vulnerabilities associated with digital contracting platforms, such as the possibility of cyberattacks that could compromise sensitive contractual information. Authentication mechanisms like digital signatures and digital certificates may also be at risk if not properly secured, potentially leading to fraud or unauthorised access to contractual agreements. These security concerns could make adoption more difficult for some organisations.

Specific Technologies:

Blockchain and Smart Contracts are central to this cluster. Blockchain technology provides a decentralised ledger system that ensures transparency and immutability of transaction records. Smart contracts, built upon blockchain platforms, are self-executing agreements with terms directly embedded in code. They automate the enforcement of licensing terms, such as royalty payments and access rights, once predefined conditions are met. This automation reduces administrative overhead and minimises the potential for disputes by ensuring that all parties adhere to the agreed-upon terms without the need for intermediaries. However, the lack of opportunity for specific negotiations may be too restrictive for the needs of some organisations due to the predetermined conditions.

While transparency is often seen as a key advantage of blockchain, extreme transparency can also present challenges. For example, the visibility of transaction prices can be a concern, as it reveals sensitive information such as the amount paid for a license or asset. This can complicate business strategies where price confidentiality is desired or when market competitiveness relies on discretion. One example of this is in the art world, where artists might prefer to keep sales prices private to maintain a certain market perception or exclusivity for their work. Similarly, in licensing for digital assets, revealing prices and transaction details may impact negotiations in subsequent deals, especially when different clients or territories are involved. To address these challenges, some blockchain systems are beginning to explore privacy-preserving mechanisms or hybrid models that allow selective data concealment while still retaining core blockchain benefits, such as traceability and immutability.

AI-Augmented Contract Drafting involves the use of artificial intelligence to automate and enhance the process of creating legal documents. Advanced AI algorithms analyse vast repositories of legal texts to generate draft contracts that comply with legal standards and reflect the specific needs of the parties involved. This technology reduces the time and resources required for contract preparation, allowing legal professionals to focus on negotiation and strategic considerations.

Contract Lifecycle Management (CLM) Software provides a comprehensive platform for managing all stages of a contract's life, from initiation and negotiation to execution and renewal. CLM systems offer features such as version control, compliance tracking, and performance analytics. By digitising the contract management process, licensors and licensees can improve efficiency, ensure compliance with contractual obligations, and gain insights into their licensing activities. Digital negotiation features facilitate drafting, negotiation, and execution of contracts such as collaboration agreements or licensing agreements. They reduce manual processes, email-based interaction and physical documentation by automating various stages of the contract lifecycle and thereby accelerate the overall contracting process.

Electronic Signatures and Digital Authentication technologies facilitate the secure and legally recognised signing of contracts in a digital environment. These tools ensure the authenticity of

signatories and the integrity of the documents, enabling faster execution of agreements without the delays associated with traditional paper-based processes.

Cluster 2: Data Privacy and Security Technologies

This cluster encompasses a range of advanced technologies designed to address the paramount concerns of data protection, privacy, and secure information sharing in the digital age. In the context of licensing, these technologies are critical enablers that allow licensors and licensees to collaborate effectively while safeguarding sensitive information and adhering to regulatory requirements. The increasing reliance on data-driven innovations has amplified the importance of robust privacy and security measures, making this cluster integral to modern licensing practices.

Characterised by their focus on encryption, secure data processing, and privacy-preserving methodologies, the technologies within this cluster facilitate the exchange and processing of data without exposing it to unauthorised access or breaches. They employ sophisticated cryptographic techniques and decentralised frameworks to ensure that data remains confidential and secure throughout its lifecycle, from transmission and storage to processing and analysis.

One of the key aspects of this cluster is the implementation of advanced encryption methods such as homomorphic encryption. This technique allows computations to be performed on encrypted data without the need to decrypt it first, enabling licensees to evaluate and utilise proprietary algorithms or datasets without accessing the underlying sensitive information. This capability is particularly crucial when dealing with confidential research data, intellectual property, or personal information subject to strict data protection regulations.

Another significant component is federated learning, a decentralised approach to machine learning where models are trained across multiple devices or servers holding local data samples, without exchanging the data itself. This methodology allows licensors and licensees to collaboratively develop and improve machine learning models while maintaining data privacy. It addresses regulatory challenges by ensuring that sensitive data does not leave its original location, thus complying with data protection laws.).

Secure multi-party computation and differential privacy are additional technologies within this cluster that enable parties to jointly compute functions over their inputs while keeping those inputs private. These techniques allow for the aggregation and analysis of data from multiple sources without revealing individual data points, thereby preserving privacy and enabling compliance with ethical standards and legal obligations.

The impact of data privacy and security technologies on licensing moving forward is substantial. By providing mechanisms for secure collaboration, these technologies expand the opportunities for licensors to engage with a broader range of licensees, including those in heavily regulated industries such as healthcare, finance, and defence. They mitigate the risks associated with data breaches and unauthorised access, which can lead to significant legal liabilities and reputational damage.

Moreover, these technologies facilitate compliance with an increasingly complex landscape of data protection regulations. As governments worldwide implement stricter data privacy laws, the ability to ensure compliance becomes a competitive advantage. Licensors that adopt these technologies demonstrate a commitment to ethical standards and legal obligations, enhancing their credibility and attractiveness to potential licensees.

The integration of data privacy and security technologies also fosters trust between licensors and licensees. When sensitive information is handled with the highest levels of security, both parties can engage in open collaboration without fear of compromising intellectual property or violating data protection laws. This trust is essential for long-term partnerships and the successful commercialisation of academic innovations.

Furthermore, these technologies enable new business models and licensing arrangements that were previously unattainable due to privacy concerns. For example, they allow for the licensing of data-driven services and analytics without transferring the underlying data, opening up new revenue streams and opportunities for innovation.

However, there are certain limitations and potential reservations associated with these technologies that have to be taken into account. Implementing advanced privacy and security measures can be complex and resource-intensive. There may be reservations about the computational overhead associated with techniques like homomorphic encryption, which can impact system performance. Users might also be concerned about compliance with diverse international data protection regulations, as navigating the legal landscape across different regions can be challenging and may hinder global collaboration efforts.

Specific Technologies:

Homomorphic Encryption allows computations to be performed on encrypted data without the need to decrypt it first. This capability is crucial when licensing technologies that involve proprietary algorithms or sensitive datasets. Licensees can evaluate the functionality of the technology while the underlying data remains secure, thereby preserving confidentiality and complying with data protection laws.

Federated Machine Learning enables the collaborative training of machine learning models across multiple devices or servers holding local data samples, without exchanging the actual data. This approach is particularly valuable in scenarios where data privacy regulations prohibit the sharing of sensitive information. By utilising federated learning, organisations can engage in collaborative projects while ensuring that private data remains protected.

Secure Data Sharing Platforms provide controlled environments for the exchange of information between parties. These platforms utilise encryption, access controls, and audit trails to ensure that only authorised users can access specific data. They are essential for facilitating research collaborations and licensing agreements that require the sharing of confidential information.

Privacy-Preserving Computation techniques, such as differential privacy and secure multi-party computation, enable data analysis while safeguarding individual privacy. These methods allow aggregate data insights to be derived without exposing personal or sensitive information, thus supporting compliance with privacy regulations and ethical standards.

Cluster 3: Artificial Intelligence and Machine Learning Applications

This cluster encompasses technologies that leverage AI and ML to enhance various facets of the licensing process. By applying AI and ML, these technologies transform traditional licensing activities, introducing efficiency, strategic insight, and improved engagement with stakeholders. The integration of AI and ML into licensing practices reflects a broader trend of digitisation and automation in the management of intellectual property.

Characterised by their ability to process vast amounts of data, learn from historical patterns, and make predictive analyses, the technologies in this cluster significantly augment human

decision-making capabilities. They enable licensing professionals to navigate complex negotiations, optimise strategies, and make informed decisions based on data-driven insights.

One key aspect of this cluster is the utilisation of AI-powered analytics to enhance negotiation strategies. By analysing historical licensing agreements, market trends, and competitor activities, AI algorithms can identify patterns and suggest optimal negotiation approaches. This strategic assistance allows licensors to tailor their proposals more effectively, anticipate counteroffers, and ultimately reach more favourable terms.

Another critical component is the application of ML in contract drafting and review (see specific technology 'AI augmented contract drafting' in Cluster 1). Advanced natural language processing algorithms can analyse legal documents to identify potential risks, inconsistencies, or ambiguities. By automating the review process, these technologies reduce the likelihood of errors and expedite the preparation of licensing agreements. This efficiency not only saves time but also ensures a higher degree of accuracy and compliance with legal standards.

AI also plays a significant role in performance analysis and monitoring of licensing agreements. ML models could track and predict licensee compliance, revenue streams, and market performance of licensed technologies. By providing real-time insights into how a licensing agreement is performing, licensors can make timely adjustments, address issues proactively, and optimise the value derived from their intellectual property.

Furthermore, AI and ML technologies enhance customer engagement by personalising interactions and tailoring communications to the specific needs and preferences of potential licensees. Predictive analytics can identify promising leads, assess their likelihood of conversion, and recommend targeted outreach strategies. This personalised approach strengthens relationships with stakeholders and increases the efficiency of marketing efforts.

In addition, these technologies facilitate the creation of digital twins and simulations to model potential outcomes of licensing decisions. By simulating various scenarios, licensors can evaluate the potential impact of different strategies, terms, or market conditions. This foresight enables more informed decision-making and reduces the risks associated with uncertainty.

The impact of AI and ML applications on licensing is transformative. By automating routine tasks, providing strategic insights, and enhancing engagement with stakeholders, these technologies allow licensing professionals to focus on high-value activities that require human judgement and expertise. They improve efficiency, reduce costs, and increase the potential for successful licensing outcomes.

Moreover, the adoption of AI and ML in licensing aligns with the broader digital transformation. It positions licensors as innovative and forward-thinking partners, enhancing their reputation in the marketplace. As these technologies continue to advance, their integration into licensing practices is likely to become increasingly essential for organisations seeking to remain competitive and maximise the value of their intellectual property assets.

Despite their potential, these technologies introduce some limitations and challenges. Reliance on AI and ML introduces concerns about transparency and accountability, as the decision-making processes of complex algorithms can be opaque. There is a risk of inherent biases in AI systems if the training data is not adequately representative, potentially leading to unfair or unintended outcomes. Users may also be cautious about dependence on automated systems, fearing that it could diminish human oversight and result in errors with significant repercussions. Furthermore, there is the potential that users become overly reliant on these systems and working on "autopilot", which may lead to a lack of critical thinking or the oversight of errors of the AI created results.

For instance, the approach of using AI in regards to drafting contract templates or agreements may be limited by several respects. In transnational scenarios, contract drafting tools powered by AI have to take into account possible pitfalls and advantages of selecting a specific country's law, otherwise a lawyer's advice would be needed, reducing the tools advantages. The same applies for drafting templates, where a tool might lack the insights of an experiences TT or licensing professional regarding the appropriateness of certain provisions, clauses, terms and conditions.

Specific Technologies:

Generative AI utilises advanced algorithms to create new content or data based on existing information. In licensing, generative AI can produce draft agreements, but can also be used to generate marketing material, personalised letters for messages to potential partners or licensees based on the technology and target person, simulate negotiation scenarios, and generate strategic insights. By analysing patterns in historical data, these systems assist licensors in optimising their negotiation strategies and expediting the contract drafting process. The ability of AI to process large volumes of documents also benefits applications such as the analysis of patent databases and the generation of insights and analyses, for example for the purpose of novelty searches.

However, there could be general reservations about AI that affect the quality and credibility of the results and have an impact on trust in these tools. There may also be a need for training in order to be able to use the tools effectively and accurately. In the IP context, it must also be ensured that entries in novelty search systems are handled confidentially so as not to compromise the novelty of inventions.

Reinforcement Learning involves algorithms that learn optimal actions through trial-and-error interactions with an environment. Applied to licensing, reinforcement learning systems can analyse past negotiations to identify successful strategies and recommend optimal approaches for future agreements. This continuous learning process enhances decision-making and improves the outcomes of licensing negotiations.

AI-Augmented Software Engineering refers to the use of AI to automate and improve software development processes. In the context of licensing, this technology can streamline the integration of licensed software into the licensee's systems. AI tools can assist in code adaptation, compatibility testing, and performance optimisation, facilitating a smoother technology transfer.

AI for Negotiation Support involves AI systems that provide real-time assistance during negotiations. These tools can analyse conversation dynamics, suggest responses, and predict the potential impact of proposed terms. By offering data-driven insights, they enhance the licensor's ability to negotiate favourable agreements.

Digital Twins of Customers create virtual models of customers' behaviours, preferences, and interactions. In licensing, digital twins enable licensors to simulate how their technologies will perform in the licensee's environment. This predictive capability informs strategic decisions, allowing licensors to tailor their offerings and negotiate terms that reflect the anticipated value and impact.

Cluster 4: Collaboration and Development Technologies

This cluster encompasses a range of advanced technologies designed to enhance collaboration between organisations, as well as to streamline the development and deployment of licensed innovations. These technologies facilitate seamless interaction, efficient knowledge transfer and thereby optimising the overall licensing process.

Characterised by their ability to connect geographically dispersed teams, these technologies leverage digital platforms and methodologies to enable real-time communication, collaborative development, and effective project management. They support co-creation and joint problem-solving, allowing organisations to work closely throughout the development lifecycle of a technology.

A key aspect of this cluster is the utilisation of cloud computing platforms, which provide scalable and flexible resources for developing and deploying licensed technologies. Cloud services enable licensees to access, test, and implement innovations without the need for significant upfront investment in infrastructure. This accessibility accelerates the adoption of new technologies and reduces barriers to entry.

Another significant component is the use of internal developer portals and collaborative development environments. These platforms centralise access to development tools, documentation, and resources, making it easier for licensees to integrate licensed technologies into their existing systems. By providing a unified workspace, these technologies enhance productivity, reduce integration challenges, and ensure consistency in development practices.

The implementation of methodologies like GitOps streamlines the deployment process by using version control systems to manage infrastructure and application configurations. This approach automates deployment pipelines, ensuring that licensed technologies are deployed reliably and efficiently across various environments. It reduces human error, enhances scalability, and supports continuous integration and delivery practices.

Virtual collaboration tools, such as video conferencing, real-time messaging, and shared digital workspaces, facilitate effective communication between project partners or even licensors and licensees. These tools enable teams to collaborate synchronously or asynchronously, regardless of geographical location. They support ongoing dialogue, knowledge sharing, and the development of strong working relationships, which are essential for the success of licensing partnerships.

The impact of collaboration and development technologies on licensing moving forward is substantial. By enhancing communication and cooperation, these technologies enable licensors and licensees to align their objectives more closely, tailor innovations to market needs, and accelerate the time-to-market for new products and services. They reduce delays and misunderstandings that can arise from traditional communication methods, thereby improving efficiency and effectiveness.

Moreover, these technologies support iterative development and feedback loops, allowing for continuous improvement of licensed technologies. Licensees can provide real-time feedback on performance and integration challenges, enabling licensors to make timely adjustments and enhancements. This collaborative approach increases the value of the licensed technology and strengthens the partnership between the parties.

The adoption of these technologies also expands the reach of innovations. By lowering technical barriers and simplifying integration processes, they make it feasible for a broader range of licensees, including small and medium-sized enterprises, to adopt cutting-edge technologies. This democratisation of access enhances the potential impact and commercial success of academic research.

In addition, the use of collaboration and development technologies aligns with the increasing trend towards remote and distributed work environments. By embracing these tools,

organisations can engage with global partners more effectively, tap into diverse markets, and foster international collaborations.

By integrating collaboration and development technologies, they position themselves to maximise the commercial potential of their innovations. These technologies not only facilitate the practical application of innovations but also enhance the overall experience for licensees, making partnerships more attractive and productive. Embracing this cluster is essential for licensors and licensees aiming to modernise their licensing practices and remain competitive in an increasingly connected and technology-driven global market.

While these technologies facilitate collaboration, they may also introduce limitations and risks, such as security vulnerabilities, particularly when sensitive information is shared across platforms. Issues related to intellectual property ownership can arise when co-developing technologies with multiple partners, potentially leading to disputes. Additionally, dependence on cloud-based services raises concerns about data sovereignty, control, and the potential impact of service outages on critical activities.

Specific Technologies:

Internal Developer Portals are platforms that centralise access to development tools, resources, and documentation within an organisation. For licensees, these portals simplify the integration of licensed technologies by providing developers with the necessary information and tools in a single location. This centralisation enhances productivity and accelerates the adoption of academic innovations.

GitOps is a methodology that uses Git repositories as the source of truth for infrastructure and application configurations. By automating deployment processes through version-controlled code, GitOps ensures consistency and reliability in software deployment. In licensing, GitOps facilitates the seamless deployment of licensed software, reducing integration challenges and improving scalability.

Cloud Computing Platforms provide on-demand access to computing resources over the internet. The utilisation of cloud services enables licensees to deploy and scale licensed technologies without the need for significant upfront infrastructure investment. For licensors, offering cloud-compatible technologies increases their appeal to potential licensees seeking flexible and scalable solutions.

Virtual Collaboration Tools include video conferencing, shared workspaces, and real-time communication platforms. These tools enable effective collaboration between project partners as well as licensors and licensees, regardless of geographical location. They support joint development efforts, problem-solving, and facilitate the building of strong relationships by enabling frequent and meaningful interactions.

Cluster 5: Compliance, Risk Management, and Ethical Technologies

This cluster encompasses a suite of advanced technologies designed to assist licensors and licensees in navigating the complex landscape of legal compliance, risk assessment, and ethical considerations inherent in the licensing of technologies. These technologies play a crucial role in ensuring that licensing agreements and the deployment of licensed innovations adhere to regulatory requirements, manage potential risks effectively, and uphold ethical standards.

Characterised by their ability to analyse, monitor, and enforce compliance with laws, regulations, and ethical guidelines, the technologies in this cluster leverage automation, AI, and data analytics to enhance the governance of licensing activities. They provide tools and frameworks that enable institutions to proactively identify and mitigate legal and ethical risks, ensuring that both licensors and licensees operate within the bounds of applicable laws and societal expectations.

A key aspect of this cluster is the utilisation of regulatory compliance management systems. These platforms automate the tracking of relevant laws and regulations, analyse their implications for licensing agreements, and provide alerts or recommendations to ensure adherence. By keeping abreast of changes in legislation across different jurisdictions, these systems help organisations avoid legal pitfalls and ensure that their licensing practices remain compliant over time.

Another significant component is risk management technologies that employ advanced analytics and ML to assess potential risks associated with licensing agreements. These systems evaluate factors such as financial exposure, intellectual property infringement, and contractual obligations. By quantifying risks and forecasting potential issues, they enable licensors and licensees to make informed decisions and implement strategies to mitigate adverse outcomes.

Ethical technologies, including frameworks for responsible AI and data usage, are also integral to this cluster. They guide the ethical deployment of licensed technologies, particularly those involving AI and data analytics. These technologies help organisations identify and address concerns related to bias, privacy, and the societal impact of their innovations. By integrating ethical considerations into licensing agreements, they demonstrate a commitment to responsible innovation and build trust with stakeholders.

Additionally, technologies focused on transparency and accountability, such as audit trails and compliance reporting tools, enhance the ability to monitor and document compliance efforts. They facilitate internal and external audits, support regulatory reporting requirements, and provide evidence of due diligence in managing legal and ethical obligations.

The impact of compliance, risk management, and ethical technologies on licensing moving forward is significant. In an era of increasing regulatory scrutiny and public awareness of ethical issues, these technologies enable licensors and licensees to navigate complex legal environments confidently. They reduce the likelihood of legal disputes, financial penalties, and reputational damage resulting from non-compliance or unethical practices.

By proactively managing risks and integrating ethical considerations, organisations enhance the value and appeal of their licensed technologies. Licensees are more likely to engage with licensors who demonstrate robust compliance and ethical standards, as this reduces their own risk exposure and aligns with their corporate responsibilities.

Furthermore, the adoption of these technologies supports sustainable and socially responsible innovation. By ensuring that technologies are developed and deployed ethically, institutions contribute positively to society and foster public trust in scientific advancements.

In the global marketplace, where regulations and ethical norms vary across regions, compliance and risk management technologies provide the tools necessary to adapt licensing practices to different legal contexts. This flexibility expands the potential reach of innovations and facilitates international collaborations.

By integrating compliance, risk management, and ethical technologies into their licensing practices, academic institutions position themselves to protect their intellectual property effectively, manage potential risks, and uphold the highest ethical standards. These technologies not only safeguard the institution's interests but also enhance the overall integrity and success of licensing agreements, contributing to long-term partnerships and the positive impact of academic innovations on society.

Although these technologies enhance stakeholder engagement, there can be limitations and concerns that have to be taken into account: Implementing compliance and ethical technologies requires ongoing effort to keep pace with evolving regulations and ethical standards, which can be resource-intensive. Users might be apprehensive about the accuracy and completeness of automated compliance tools, as exclusively relying on them could lead to overlooked legal or ethical considerations. There is also the challenge of integrating these technologies into existing systems without disrupting established processes.

Specific Technologies:

AI Trust, Risk, and Security Management (AI TRiSM) frameworks provide tools for evaluating and mitigating risks associated with AI technologies. They assess factors such as algorithmic bias, transparency, and security vulnerabilities. Incorporating AI TRiSM into licensing agreements ensures that both parties are aligned on standards for ethical AI deployment, reducing the likelihood of disputes and enhancing trust.

Disinformation Security Technologies are designed to detect and counteract the spread of false or misleading information. In licensing, these technologies are crucial when tools intended to combat disinformation are licensed. Agreements must address the ethical use of such technologies, implementation strategies, and performance metrics to ensure effectiveness and responsible deployment.

Compliance Management Tools assist organisations in adhering to legal and regulatory requirements. These tools monitor activities, generate compliance reports, and provide alerts for potential violations. In the context of licensing, compliance management ensures that both licensors and licensees fulfil their contractual obligations and operate within the bounds of applicable laws.

Regulatory Technologies (RegTech) utilise advanced analytics and automation to simplify compliance processes. RegTech solutions can analyse regulatory texts, monitor changes in legislation, and assess the impact on licensing activities. By staying informed about regulatory developments, licensors can adapt their licensing strategies accordingly and avoid legal pitfalls.

Cluster 6: Communication and Engagement Technologies

This cluster encompasses a range of advanced technologies designed to enhance communication and engagement between stakeholders, including licensees, partners, and the wider community. In the context of licensing, effective communication is crucial for successful negotiations, relationship management, and the dissemination of information about innovations. These technologies facilitate transparent, efficient, and interactive exchanges, thereby strengthening partnerships and fostering collaborative environments essential for the commercialisation of academic research and industrial innovations.

Characterised by their ability to connect individuals and organisations across geographical and cultural boundaries, the technologies within this cluster leverage digital platforms, social media, and interactive tools to improve the flow of information and engagement. They enable organisations to present their innovations compellingly, engage in meaningful dialogues with potential licensees, and maintain ongoing relationships with existing partners.

One significant aspect of this cluster is the utilisation of customer relationship management (CRM) systems tailored to the needs of technology transfer and licensing offices. These systems centralise information about interactions with licensees and partners, allowing institutions to track communication history, preferences, and engagement levels. By providing insights into stakeholder relationships, CRM technologies enable more personalised and effective communication strategies, enhancing trust and fostering long-term partnerships.

Another key component is the use of digital marketing and outreach platforms. Through social media channels, webinars, virtual conferences, and interactive websites, innovations can be showcased to a global audience. These platforms facilitate the dissemination of information about new technologies, licensing opportunities, and research developments. By reaching a broader and more diverse audience, the visibility of intellectual property assets can be increased to attract potential licensees and collaborators.

Advanced communication tools such as virtual reality (VR) and augmented reality (AR) technologies offer immersive experiences that can enhance presentations and demonstrations of innovations. By providing interactive and engaging demonstrations, licensors can effectively convey the value and potential applications of their technologies to prospective licensees, making complex concepts more accessible and understandable.

The impact of communication and engagement technologies on licensing moving forward is significant. By enhancing the effectiveness of communication, these technologies improve the efficiency of licensing negotiations, reducing misunderstandings and delays. They make it possible to respond promptly to enquiries, provide timely updates, and maintain open channels of dialogue with stakeholders.

Furthermore, by leveraging data analytics and feedback mechanisms embedded in these technologies, licensors can gain insights into stakeholder engagement patterns and preferences. This information allows for the refinement of communication strategies, ensuring that messaging resonates with the intended audience and achieves the desired outcomes.

These technologies also play a crucial role in relationship management. By maintaining consistent and personalised communication, organisations can nurture relationships with existing licensees, leading to higher levels of satisfaction, repeat engagements, and the potential for expanded collaborations. Strong relationships are essential for the successful commercialisation of technologies and for sustaining long-term partnerships.

Moreover, effective communication and engagement are critical for building reputation and brand in the marketplace. By presenting a professional and innovative image, institutions

enhance their credibility and attractiveness to potential licensees and partners. This positive perception can lead to increased interest in their technologies and a competitive advantage in the licensing landscape.

In an increasingly globalised and digital world, the adoption of communication and engagement technologies is essential for licensors seeking to maximise the impact of their innovations. By embracing these tools, institutions can overcome geographical barriers, engage with a diverse range of stakeholders, and ensure that their messaging is effective and compelling. This cluster of technologies not only enhances the operational aspects of licensing but also contributes to the broader mission of disseminating knowledge and advancing technological progress.

Although these technologies enhance stakeholder engagement, they may lead to information overload, making it difficult to manage and prioritise communications effectively. Privacy concerns may arise regarding the collection and handling of personal data within customer relationship management systems. Furthermore, an emphasis on digital communication platforms might inadvertently exclude stakeholders who have limited access to technology or who prefer traditional modes of interaction.

Specific Technologies:

Customer Relationship Management (CRM) Systems are integral to managing interactions with potential and existing licensees. CRM systems allow licensors to maintain detailed records of communication history, preferences, and engagement levels. By utilising CRM technologies, interactions organisations can personalise their interactions, tailor their communication strategies, and strengthen relationships with licensees. This personalised approach enhances trust and can lead to more successful licensing agreements.

Social Media and Digital Outreach Platforms play a significant role in raising awareness of innovations and engaging with a broader audience. By leveraging social media analytics, institutions can gain insights into market trends, stakeholder opinions, and public perception of their technologies. This information can inform licensing strategies, identify potential licensees, and highlight areas of interest within the market.

Virtual and Augmented Reality Communication Tools offer immersive experiences that can enhance presentations and demonstrations of technologies during licensing discussions. By providing interactive and engaging demonstrations, licensors can better convey the value and potential applications of their innovations to prospective licensees.

By integrating these communication and engagement technologies, licensors can improve the effectiveness of their licensing negotiations, foster stronger relationships with licensees, and enhance the overall success of their technology transfer activities.

Cluster 7: Analytical and Decision Support Technologies

This cluster encompasses a range of advanced technologies designed to provide data-driven insights and support strategic decision-making within the licensing process. By utilising sophisticated analytical tools, these technologies enable organisations to make more informed decisions regarding their licensing strategies, optimise negotiations, and maximise the value of their intellectual property assets.

Characterised by their ability to process vast amounts of data, identify patterns, and generate predictive models, the technologies within this cluster leverage AI, ML, and advanced statistical methods. They assist in interpreting complex datasets related to market trends, intellectual property portfolios, licensing agreements, and competitor activities. This analytical capability

transforms raw data into actionable intelligence, empowering decision-makers to develop strategies grounded in empirical evidence rather than intuition.

One significant aspect of this cluster is the use of predictive analytics to forecast market demand, revenue potential, and the success probability of licensing agreements. By analysing historical data and current market conditions, these tools can estimate the commercial viability of different technologies, identify promising market segments, and assess risks associated with various licensing opportunities. This foresight allows an organisation to prioritise resources effectively, focusing on initiatives with the highest potential return on investment and social impact.

Another critical component is business intelligence (BI) platforms that aggregate and visualise data from multiple sources. These platforms provide real-time dashboards and reports that offer insights into key performance indicators, such as licensing revenue, patent lifecycles, and compliance metrics. By maintaining a comprehensive overview of their intellectual property portfolios, institutions can monitor performance, identify trends, and make timely adjustments to their licensing strategies. This continuous monitoring enhances agility and responsiveness in a dynamic market environment.

Decision support systems (DSS) within this cluster integrate data analysis, modelling, and simulation to assist in complex decision-making scenarios. For example, during licensing negotiations, DSS can evaluate different contract terms, financial models, and partnership structures to determine the most favourable outcomes. By simulating various scenarios and assessing their potential impact, these systems enable decision-makers to weigh alternatives objectively and choose strategies that align with the goals and risk tolerance of their organizations.

Competitive intelligence tools also play a vital role in this cluster by analysing information about other organisations' activities, technological advancements, and market positioning. Understanding the competitive landscape makes it possible to position their technologies more effectively, identify unique value propositions, and anticipate potential challenges in the licensing process. This strategic insight is crucial for differentiating their offerings and negotiating from a position of strength.

Risk assessment and management technologies are integral to supporting informed decision-making. By evaluating factors such as market volatility, regulatory changes, and financial exposure, these tools help organisations to identify potential risks associated with licensing agreements. They provide quantitative assessments that inform risk mitigation strategies, ensuring that decision-makers are aware of potential pitfalls and can plan accordingly.

The impact of analytical and decision support technologies on licensing moving forward is substantial. By enabling data-driven decision-making, these technologies enhance the strategic capabilities of licensors and licensees. They reduce reliance on intuition or fragmented information, thereby increasing the likelihood of successful licensing outcomes. The ability to analyse large datasets quickly and accurately allows an organisation to respond swiftly to market changes, seize emerging opportunities, and avoid potential threats.

Furthermore, these technologies contribute to greater efficiency in the licensing process. Automating data collection and analysis reduces the time and resources required for research and evaluation. Licensing professionals can focus on high-value activities such as strategy development and relationship building, rather than being encumbered by manual data processing tasks. This efficiency not only accelerates decision-making but also improves the overall effectiveness of licensing operations.

The adoption of analytical and decision support technologies also fosters a culture of continuous improvement. By regularly reviewing performance metrics and outcomes, licensing offices can learn from past experiences, refine their strategies, and enhance their approaches to managing intellectual property. This iterative process leads to better alignment with market needs and increased success in commercialising innovations.

In an increasingly competitive and data-driven global market, integrating analytical and decision support technologies is essential for licensors aiming to maximise the commercial or social potential of their innovations. By harnessing advanced analytics, institutions can make informed strategic decisions that enhance their ability to license technologies effectively, generate revenue, and contribute to technological advancement. Embracing this cluster places organisations in a position to navigate the complexities of the modern licensing landscape with confidence and foresight.

Despite their benefits, some potential limitations of these technologies should be considered: Dependence on analytical tools may result in overconfidence in data-driven insights, potentially neglecting qualitative factors that are crucial for informed decision-making. Users might question the reliability of predictive models, especially if based on incomplete or biased data. The cost and complexity of deploying and maintaining advanced analytical systems could also be prohibitive for some institutions, limiting their accessibility and benefits.

In addition, depending on the tool selected, the relevance of the data may not align with the needs of an organisation or may be too limited in terms of thematic focus.

Specific Technologies:

Predictive Analytics utilises statistical algorithms and ML techniques to forecast future outcomes based on historical data. In the context of licensing, predictive analytics can estimate market demand, revenue potential, and the likelihood of successful licensing agreements. By providing quantitative projections, these tools assist licensors in prioritising technologies for licensing, setting appropriate terms, and identifying the most promising market segments.

Business Intelligence (BI) Tools aggregate and analyse data from various sources to provide actionable insights. BI platforms enable licensors to monitor performance metrics, track licensing activities, and identify trends within their portfolio of intellectual property. This comprehensive overview supports strategic planning, resource allocation, and the optimisation of licensing operations.

Market Intelligence and Competitive Analysis Tools gather and analyse information about market conditions, competitor activities, and industry trends. By understanding the competitive landscape, licensors can position their technologies more effectively, identify unique value propositions, and anticipate potential challenges in the licensing process.

Decision Support Systems (DSS) integrate data analysis, modelling, and simulation to assist in complex decision-making scenarios. In licensing, DSS can evaluate different negotiation strategies, assess the impact of various contractual terms, and simulate potential outcomes. This systematic approach enables licensors to make informed decisions that align with their strategic objectives and risk tolerance.

By adopting analytical and decision support technologies, organisations can enhance their strategic capabilities in licensing. These tools provide the insights necessary to make data-driven decisions, improve negotiation outcomes, and maximise the commercial and social potential of their innovations.

3.2.2. Implications for the licensing community

Technological advancements are reshaping the landscape of IP licensing, with significant economic and strategic implications for the licensing community. The integration of advanced digital tools enhances efficiency in licensing processes, automating routine tasks and reducing administrative burdens. This increased efficiency translates into cost savings and allows licensors and licensees to focus on high-value activities such as strategy development and relationship building. However, it is important to note that these technologies also have potential limitations and challenges, such as legal uncertainties, security vulnerabilities, or the need for specialised expertise. With regard to the specific software tools or platforms that actually implement the technologies outlined above, there are further specific adoption barriers. These include the points just mentioned, but also aspects such as the ability to integrate into existing systems, language restrictions or the cost of a specific solution.

Enhanced data privacy and security measures can build greater trust between licensors and licensees, facilitating more open and collaborative partnerships. Access to sophisticated analytics empowers better decision-making, helping to maximise the value of intellectual property assets and identify new opportunities. Enhanced communication tools strengthen stakeholder relationships, leading to more successful agreements and long-term collaborations. Effective compliance and risk management reduce legal disputes and ensure responsible, sustainable licensing practices.

AI and ML provide powerful analytics and decision-making support, enabling more informed strategic choices and optimising negotiations, identify lucrative opportunities, and better assess risks. This strategic advantage enhances the ability to maximise the value of intellectual property assets.

Overall, the adoption of these technologies enables the licensing community to operate more effectively in a global, digital economy. They support new licensing models that prioritise wider societal impact alongside economic gain, reflecting a shift towards more inclusive and collaborative innovation processes. In times of crisis, the ability to rapidly deploy technologies and adapt licensing practices is critical. Collectively, these technological advancements contribute to a more dynamic, responsive, and impactful licensing community, capable of meeting the challenges and opportunities of the modern era.

4. Emerging Platforms and delivery methods

In this chapter the focus lies on identifying new, non-traditional platforms and delivery methods.

4.1. Integration of new platforms into licensing activity

Licensing workflows have two major bottlenecks. Firstly, connecting licensor and licensee and secondly licence negotiation. Accordingly, online technology platforms can be broadly categorised as either **listing / aggregation sites** (where the 'value add' is exposure to the marketplace and in some cases pro-active promotional / partnering activity) or where the focus is the **expediting the licence transaction** (negotiation, approval, payment).

Technology and IP listing platforms are well established with the main differentiation being how licensor and licensee become connected. The following section segments technologies in six distinct types of platforms:

1. Listing and aggregation of technologies and IP assets
    a. Listing of Technology / IP assets
    b. Listing and active promotion of IP portfolios
2. Expediting IP licence transactions
    a. Platforms owned by IP management (IPM) software solutions
    b. Feature Rich Licensing Platforms
    c. 'In-house' licensing websites
    d. Licensing Platforms for specific product categories

Platforms **listing and aggregating technologies and IP assets** are described in the following sections.

Listing of Technology / IP assets

Because of the high cost of marketing broad technology portfolios, online listing sites or platforms are commonly used by Universities and other research institutions to give visibility to their IP assets. However, they rely heavily on the licensor to 'find' the IP assets. Also, as a result of the historical focus of research commercialisation on the STEM disciplines, such portfolios usually have a heavy focus on patentable technologies.

Many institutions set up listings pages on their own website and/or use the listings functionality provided by their IP management (IPM) software solution (e.g. **Flintbox**[16] (Wellspring) and **Techpublisher**[17] (Inteum)).

Flintbox (a spin out from the **University of British Columbia**[18]) was launched in 2001 to reduce the cost of marketing and licensing of early stage research results - especially non-patentable technologies i.e. copyright materials and research reagents. The platform was acquired by Wellspring in 2009 and integrates with their IP management (IPM) solution 'Sophia'. Each organisation can selectively 'push' technologies and IP assets managed within Sophia to a specific Flintbox listing site.

Techpublisher is another listing platform integrated with an IPM solution – in this case Inteum's **Minuet**[19]. Technologies and IP assets managed in Minuet can be 'pushed' to an institution-specific subdomain of Techpublisher and to an aggregated platform (**Canberra**[20]).

In addition, there are a number of technology listings platforms available for research organisations at a national (e.g. **TransferAllianz**[21] **(De), KnowledgeShare**[22] **(It), Knowledge Transfer Ireland**[23] **(Ire)**) or regional (**Réseau Lieu**[24] **(Be)**) level or for pre-existing research consortia such as **Réseau SATT**[25] **(Fr**) and **National Labs**[26] **(USA**). Most listings platforms are designed for and used by the public research sector, which tend to have large and diverse IP portfolios that cannot be targeted at a single market. There are also a small number of tech listings platforms that are used by organisations of all types – for example (**LeadingEdgeOnly**[27]) and **Flanders Research Information Space**[28] **(Be)**.

Listing and active promotion of IP portfolios

Listing IP assets online does not guarantee that a customer will find them. To resolve this problem, some platforms employ a proactive approach to direct potential licensees to the technologies.

InPart's Connect platform[29] matches biotech assets from its University / Academic institute customers to biopharma companies based on pre-defined needs and requirements and using "Natural Language Processing, smart-matching algorithms and supervised machine-learning". This allows research organisations to market their whole tech / patent portfolio's, including

[16] https://www.wellspring.com/products/flintbox
[17] https://www.inteum.com/category/technology-publisher-showcase/
[18] https://www.ubc.ca/
[19] https://www.inteum.com/minuet/
[20] https://www.canberra-ip.com/
[21] https://www.transferallianz.de/inventionstore/
[22] https://www.knowledge-share.eu/en
[23] https://www.knowledgetransferireland.com/Benefits_to_Business/Licensing-Opportunities/
[24] https://reseaulieu.be/en/our-technology-offers/
[25] https://www.satt.fr/en/technology-offers/
[26] https://labpartnering.org/
[27] https://www.leadingedgeonly.com/
[28] https://www.researchportal.be/en/search?f%5B0%5D=fris_content_type%3Apatent&sort=fris_publication_date&order=desc
[29] https://www.inpart.io/products/connect

those assets for which the market may be too small / uncertain to justify dedicated marketing resource.

Wellspring offers **Scout**[30], an AI powered tool, which facilitates connections between innovators and corporates – whether they be development partners or licensees.

Similarly, **Tradespace**[31] enables Universities and government organisations to manage and assess the value of IP assets and then uses AI tools to identify and connect with potential licensing partners.

Leading Edge Only is a global innovation marketplace that allows innovators (either individuals or organisations including universities) to display technologies on the portal for corporates to see. Commercial organisations can search for technologies and also run challenges where they are seeking a solution for market need.

As well as generalist solutions such as **Docusign**[32] and **Adobe Sign**[33] that allow contract management with digital or e-signatures and the collection of fees there are range of specialist platforms available, that are **expediting IP licence transactions**, as described in the following sections:

Platforms owned by IP management (IPM) software solutions

Although most technologies listed on the platforms are patentable, (as would be anticipated given their full integration with IP management solutions), both **Flintbox** and **Techpublisher** allow licensees to access suitable IP assets through **click-licensing** on **standard terms** (often referred to as 'Express Licensing'). Flintbox also allows the **online** collection of **licence fees** and the **download of digital assets**.

Inteum also offer **MTAShare**[34] (co-developed with Vanderbilt University) to automate the transfer of research reagents between academic institutions with click Material Transfer Agreements (MTAs) and simple approval workflows.

Feature Rich Licensing Platforms

e-lucid[35] was developed at **UCL Business**[36] (the technology transfer office of University College London (UCL)) to meet the challenges posed by the management of contracts for low-cost, high-volume IP assets. Now made available to any organisation, e-lucid is a cloud-based, white-labelled solution that can be integrated with 3rd party IPMs (whilst being agnostic to them). As with other platforms, e-lucid makes use of **standard terms** and **click licences** to expedite licence transactions. Uniquely, it has added sophisticated approval workflows and pricing configurations so that organisations can replicate their existing licensing processes online. Licence approval workflows ensure that the necessary legal checks and balances are included in a largely automated process. Flexible licence fee structures means that complex

[30] https://www.wellspring.com/products/scout
[31] https://www.tradespace.io/
[32] https://www.docusign.com/en-gb
[33] https://www.adobe.com/uk/sign.html
[34] https://www.mtashare.com/
[35] https://e-lucid.com/
[36] https://www.uclb.com/

deals (for example licences for healthcare questionnaires often include set-up fees and costs optional translations) that were previously difficult to automate can now be managed with ease.

The design of this particular solution means that most assets on the 25+ storefronts are available with express licensing options although some organizations do also list patent portfolios.

'In-house' licensing websites

A number of research organisations have developed their own, bespoke digital delivery systems – for example Cornell University (**Cornell Express Licensing**[37]), MIT (**MIT Available Technologies**[38]), NASA (**Software Catalogue**[39]) US Departments of Defence and Veteran Affairs (**TechLink**[40]) and Oxford University Innovation (**PROcess**[41]) for licensing their IP asset portfolios online.

Terms and Conditions are usually non-negotiable and presented to the licensee either as a printable / fillable pdf document (e.g. MIT or NASA) to be signed / completed and returned to the licensor electronically or, more often, through click licensing.

The development of PROcess was inspired by the large number of licences for a specific product category (Patient Reported Outcomes (PROs) also known as Clinical Outcomes Assessments (COAs)) that Oxford University Innovation were routinely managing. Designed to meet the specific requirements of licensing PROs, the platform now also supports software licensing.

Licensing Platforms for specific product categories

A number of other licensing platforms, with a focus on specific product types, have also been developed to allow research organisations to market and licence their IP on an aggregated site. As well as supporting the marketing and licensing of the IP asset type there is also a strong focus on asset delivery.

Healthcare tools: Mapi Research Trust[42] is the official licensor and distributor of more than 700 COAs, facilitating access to COAs by centralizing the licensing process and all existing material, while ensuring that the copyright holders' rights are respected and that the integrity of the COAs are protected. The website manages licences, payment of fees and digital downloads for uses, from routine clinical purposes to research.

Research tools: CancerTools.org[43], is a cancer-focused **biorepository**[44] of research tools managed Cancer Research Technology Limited (CRT), a part of **Cancer Research UK**[45]. The platform manages access to a wide range research tools (antibodies, cell lines, small

[37] https://ctl.cornell.edu/industry/
[38] https://tlo.mit.edu/industry-entrepreneurs/available-technologies
[39] https://software.nasa.gov/
[40] https://techlinkcenter.org/
[41] https://process.innovation.ox.ac.uk/
[42] https://www.mapi-trust.org/
[43] https://cancertools.org/
[44] https://cancertools.org/tools/
[45] https://www.cancerresearchuk.org/

molecules, mouse models, etc) under licence from providers or with Terms and Conditions of supply from CRT. **AddGene**[46] is a global, nonprofit repository that enables scientists share plasmids, viral vectors & recombinant antibodies. When scientists publish research papers, they deposit their associated plasmids at Addgene which takes care of the quality control, MTA compliance, shipping, and record-keeping.

Software / algorithms: Shaipup[47] is an algorithm hosting platform and marketplace provided by Terracipher that enables researchers to grant access to commercial partners and collaborators quickly and cheaply without handing over source code. The platform currently holds approximately 20 algorithms from Australian research organisations.

Patents: Medicines Patent Pool (MPP)[48] supports access to life-saving medicines for low- and middle-income countries. MPP partners with civil society, governments, international organisations, industry, patient groups, and other stakeholders to prioritise and license needed medicines and pool intellectual property to encourage generic manufacture and the development of new formulations.

Media: In the arts and humanities, there are a number of specialist platforms such as **Getty Images**[49] and **Bridgeman Images**[50] that enable the online licensing of images, video and audio files for personal, research, educational or commercial purposes.

4.2. Technology Analysis

This section describes the impact of the platforms described on IP licensing and implications for the licensing community. The potential impact of such platforms on the licensing community – increased efficiency of transactions, increased impact & revenues, enabling staff to focus on higher value & more complex deals – is widely understood. However concerns regarding adoption of such tools and how they might integrate with existing tools and processes persist.

Platforms for listing of Technology / IP assets are mainly used by public research organisations and their TT (Technology Transfer)/ KE (Knowledge Exchange) / valorisation office as well as those commercial organisations with portfolios of IP assets. Such platforms are either free add-ons to existing IPM services (Flintbox, Techpublisher) or provided as part of regional / national / consortium membership. Listings platforms showcase technology portfolios and need to be accompanied by targeted marketing activity as is appropriate for the size of each commercial opportunity. Listings platforms can be considered to be established practice and should be the minimum activity to help connect licensor and licensee.

Platforms that employ a more proactive approach by **listing and active promotion of IP portfolios** are used by universities, research organisations and their TT / KE / valorisation offices as well as commercial organisations with portfolios of IP assets.

[46] https://www.addgene.org/
[47] https://products.terracipher.com/shaipup/#/marketplace
[48] https://medicinespatentpool.org/
[49] https://www.gettyimages.co.uk/
[50] https://www.bridgemanimages.com/en/

Platforms owned by IP management (IPM) software solutions are mainly used by universities, research organisations and their TT / KE / valorisation offices that are already customers of the IPM solution providers and thus represent a low barrier to adoption. These solutions allow users to efficiently market and, in some cases, license IP assets with no additional cost. Online licensing represents a new way of generating revenue and/or saving admin costs for universities and other research organisations.

Feature Rich Licensing Platforms are used by University and research organisations and usually managed by TT offices / KT offices / companies. Barriers to adoption are lowered by users not being restricted by which (if any) IPM solution they may use. The platform introduces costs savings thanks to reduced time spent negotiating and concluding licences. In addition, the faster rate of transaction allows offices to scale non-exclusive licensing activity to generate both commercial and social impact. The cost-effectiveness of the solution allows for the impactful dissemination of previously hard to commercialise assets, e.g. from the Arts, Humanities and Social Sciences (AHSS).

'In-house' licensing websites are used by Universities, research organisations and their TT / KE / valorisation offices that are not tied to IPM solution providers. The cost impact of developing a solution is significant but you do get a bespoke solution that you can align to any pre-existing tools and processes. In most cases it will represent a new business model for an institution that can support long-term efficiency and deliver significant impact and commercial success.

Licensing Platforms for specific product categories are used by licensors that do not necessarily have a large portfolio of IP assets but who wish to commercialise or disseminate lower value assets. These platforms represent a cost-effective way to create impact / generate revenues with minimal cost or administrative burden. Barriers to adoption are low, since most of these product-specific platforms manage all aspects of the licensing process.

5. Considerations for use in the tool-box

This chapter focuses on the analysis of the technologies and platforms identified in the previous chapter. After a summary of the main findings of WP2 and the description of the three scenarios of the IMPAC3T-IP project, these technologies and platforms are analysed for their use in the IMPAC3T-IP toolbox by evaluating their relevance to these scenarios.

5.1. Practical considerations: lessons learned from the wider project

The following sections provide an overview of the results of WP 2 of the IMPAC3T-IP project (scenario definition and analysis) and conclusions from interactions with the SIGs (Special Interest Groups) and wider licensing groups relating to technology adoption. These sections demonstrate the extent to which technology-driven tools are important for stakeholders of the IP licensing process and thus their relevance for the IMPAC3T-IP toolbox.

5.1.1. Results of Work Package 2

Work Package 2 (WP2) of the IMPAC3T-IP project focused on defining three licensing scenarios: Classical Plus, Crisis, and Co-Creation, and identifying intervention points for each one where a new tool might improve the efficiency and effectiveness of licensing.

Classical Plus Scenario

The Classical Plus scenario focused on licensing IP assets that go wider than traditional high-value patent-based rights. These include copyrights, databases, and digital content and include the situation where the individual asset is of low financial value or it is hard to identify a viable business model where the end user will pay to access the asset. IP assets emerging from the AHSS in particular fall under the Classical Plus scenario.

In this scenario tools such as IP assessment guidelines and legal guidelines can be useful early in the process to make sure that the final results can be licensed without unforeseen issues. Towards the end of the process negotiation templates are useful to support licensing negotiations and streamline the agreement process for assets with diverse value metrics. Online licensing automation tools can also be helpful for assets with low value but high volume sales as these reduce the associated licensing costs and make the transfer process more attractive to a TTO. Post-licensing guidelines are also helpful for ongoing assessment, monitoring, and gathering of feedback may take place to support further research and further asset development.

Co-Creation Scenario

The Co-Creation scenario examined the processes that arise from collaborative efforts to addressed challenges involving multiple stakeholders, including universities and industry partners, as well as individuals, non-profits, and communities. In this situation the final assets are co-created by different entities who may have varying motivations and expectations that would influence a licensing action. The main challenges identified in this scenario included managing the expectations of the co-creators and ownership of IP, ensuring fair distribution of rights, and aligning stakeholder objectives.

The first intervention point in this scenario is commonly at the outset of the collaboration when trust needs to be established and clear agreements on interaction and IP ownership agreed. An understanding of intended usage of the co-created results, and usage of the project results, can help all participants in the process to identify common goals and trust each other. Errors and shortcomings in interaction or document flow at the initial stage can ruin the entire process of Co-creation, which makes this point of influence critical.

Despite the special importance of the initial point of cocreation, the point of influence immediately before licensing remains very important in the cocreation scenario due to the frequently impossibility of determining the values and composition of the intellectual asset package for licensing at the initial stage of Co-Creation. In addition to the initial and pre-licensing stage interventions the Co-Creation process often benefits from strong management of contributions throughout the entire intellectual asset development process. The main reason for this is the number and diversity of stakeholders involved in the process. During the Co-Creation process, changes may occur and need to be addressed.

New tools such as IP ownership management frameworks, contribution tracking systems, and post-licensing evaluation methods would be useful to support the Co-Creation process. Such tools would aim to foster transparency, fairness, and collaboration among stakeholders, ensuring that the outcomes of co-creation efforts could be effectively licensed and utilized.

Crisis Scenario

Crisis scenarios involving licensing can be separated into 2 main classes: unforeseen (UC) and requiring immediate action such as the COVID-19 crisis and foreseen and preventable (PC) through advanced planned action such as absence or low access to basic medicines in low- and middle-income countries (LMIC). Awareness of the steps to be taken to support the preventable crisis is lower in Europe amongst policymakers, researchers, and civil society.

Intervention points and tools in the UC scenario aim to ensure that licensing activities during crises can be both efficient and equitable, addressing the needs of vulnerable populations while supporting IP holders.

For UC, the need for rapid access to critical technologies often requires expedited licensing processes to address crisis situations effectively. The emphasis needs to be on ensuring that the licensing of IP assets can be performed quickly, transparently, and with broad access to essential technologies. Support for voluntary, non-exclusive licensing has taken several forms including establishing technology pools, developing pledges, and issuing guidelines on licensing conditions. Direct supporting tools may include rapid online non-exclusive licensing and such instruments have been used during the COVID-19 crisis.

PC is starting to receive more attention by Higher Income Countries (HIC) in an effort to ensure more Equitable Access or Ethical and Affordable Access to technology and in particular medical technologies. However, these have only recently been focused on early-stage technologies through the interventions of organizations such as the Welcome Trust and Medicines Patent Pool

Analysis suggests that there are two main intervention points in a Crisis where tools would be useful: at the research stage where funding is being sought, secured, and used under specific terms and conditions designed to create more equitable access, and at the license planning and execution stage when equitable access can be reflected in licensing clauses. In addition, overarching national and institutional level policies to EA at can support both other stages,

To address this situation series of guidelines for policy makers, funding agencies PROs and enterprises is needed. These would be strengthened by example clauses and templates, as well as a library of case studies.

For a more in-depth look at the results of WP2, please refer to the three deliverables namely

- D2.1 Results of scenario definitions, mapping, and intervention points,
- D2.2 Analysis of licensing drivers for enterprises, and
- D2.3 Extended case studies and good transfer paths.

Relevance of technology driven tools

The intervention points identified in WP2 coincide in many cases with the capabilities of the emerging technologies that have been identified in the previous analysis. In this respect, it can be concluded that technology-driven software tools and platforms, that implement emerging technologies are highly relevant for addressing the needs stakeholders, experienced in many of the specific intervention points.

5.1.2. Up-take of technology-based tools and platforms – indications from user groups'

In order to identify examples of integration of new technologies or delivery platforms into licensing activity a survey among the IMPAC3T-IP SIG-members of both Classical+ and CoCreation-scenarios was conducted. SIG members were asked about existing innovative tools or platforms that their organizations had recently used or observed. The survey revealed that only a small share of the members used advanced software tools at all to support their work. The most relevant tools mentioned in the survey have been analysed in more detail in the Deliverable 3.2 in the form of case studies. In order to identify further technologies and to widen this research to other experts, a short online survey was then carried out among the members of ASTP and LESI. However, due to very low response rates the exiting findings were only slightly supplemented.

To summarise, our previous assumption that the adoption rate of advanced software tools seems not to be so advanced yet, at least in many organisations, was confirmed.

5.2. Scenario-based considerations

In the following sections the technology clusters and platforms are analysed in more detail in respect to the scenarios of IMPAC3T-IP. This should help to assess the relevance of emerging technologies and thus also the correlating specific tools and platforms for the IMPAC3T-IP toolbox.

5.2.1. Technologies

As we consider the complexities inherent in modern licensing scenarios, particularly those that extend beyond traditional frameworks, it is essential to examine how emerging technologies can address specific action points within IMPAC3T-IPs three core use cases: Classical Plus, Co-Creation and Crisis. These are described in more detail in the previous section 5.1.1. (Results of Work Package 2). The integration of advanced technological clusters can significantly enhance the practice of licensing in general, ensuring that it remains effective, ethical, and responsive to contemporary challenges. Here is an overview of what practical considerations the new technologies within the seven clusters can have to improve activities for the three scenarios for IMPAC3T-IP.

Classical Plus

The 'Classical Plus' scenario emphasizes not just economic value but societal impact, which requires navigating complex layers of intellectual property (IP), including non-patent IP like copyrights, trademarks, and trade secrets. This broader focus necessitates tools that can manage and transfer a diverse set of IP rights efficiently, while ensuring that licensing agreements align with ethical and sustainable business practices.

In addressing this use case, **digital contracting and transaction technologies** may play an important role in enabling the seamless transfer of a broader base of IP assets. By utilising blockchain and smart contracts, licensors can create transparent and immutable records of licensing agreements. The use of smart contracts and blockchain technologies, for instance, can automate the execution of complex licensing terms, ensuring transparency and minimizing the risk of disputes. These tools can handle multiple IP types in a single transaction, reducing the friction involved in managing a wide array of assets. For example, blockchain-based digital ledgers can track the lifecycle of IP assets across different jurisdictions, providing verifiable records that enhance the trustworthiness of these transactions.

Compliance, **risk management, and ethical technologies** can be used to ensure that the licensing process aligns with legal obligations and ethical standards. By employing regulatory compliance management systems and ethical AI frameworks, institutions can navigate the complexities of transferring a broader base of assets responsibly. These technologies help in assessing potential risks associated with non-traditional licensing arrangements and in implementing safeguards to mitigate them. With a heightened focus on ethical and sustainable practices, there is a need to monitor the use of IP to ensure it aligns with environmental, social, and governance (ESG) criteria. Tools from this cluster can assess the ethical implications of technology use and ensure compliance with increasingly stringent global regulations. For instance, AI-driven risk management platforms can evaluate the long-term impact of licensing decisions on different stakeholder groups, ensuring that IP use does not lead to harmful societal outcomes.

Data privacy and security technologies are vital in safeguarding the expanded range of intellectual property assets involved in Classical Plus licensing. As this scenario deals with a broad range of IP assets, which may include sensitive data, privacy and security concerns are heightened. Technologies in this cluster could ensure that proprietary information, trade secrets, and licensing terms are securely handled, protecting the confidentiality of sensitive data shared between institutions and partners.

AL and ML applications provide sophisticated tools for identifying new "opportunities for action" and viable business models. By analysing vast datasets, AI algorithms can uncover patterns and opportunities that align with societal needs. For example, predictive analytics can forecast the potential impact of a technology on specific communities, aiding in the prioritisation of licensing efforts towards areas where they can achieve the greatest good. Also, with regard to creating IP licensing agreements easily from templates or past agreements, this reduces the effort for each individual licence case and can enable licensing of lower value IP as this can be done faster and easier. AI-Creation of marketing content can be used to attract new licensees with less effort.

Collaboration and development technologies facilitate effective engagement between creators and external stakeholders. Tools in this cluster could help organisations communicate the broader societal value of their IP, engage with non-traditional stakeholders like NGOs (Non-Governmental Organisations) or public sector bodies, and foster partnerships aligned with ethical and social goals. Through virtual collaboration platforms and cloud computing resources, institutions can co-develop solutions with partners who are committed to driving wider impact. These technologies break down geographical barriers, allowing for inclusive participation and the pooling of diverse expertise.

Communication and engagement technologies enhance the ability of institutions to reach and interact with a diverse range of stakeholders. Through advanced CRM systems and digital outreach platforms, organisations can effectively disseminate information about their technologies, fostering relationships with partners who share a commitment to societal impact. This engagement is crucial for building networks that support sustainable licensing activities.

Analytical and decision support technologies provide the necessary insights to make informed strategic decisions. By leveraging business intelligence tools and decision support systems, organisations can evaluate the potential outcomes of different licensing strategies focused on wider impact. These technologies enable the assessment of social return on investment, helping to identify the most effective pathways to achieve the desired societal benefits.

By integrating technologies from all relevant clusters, organisations can effectively address the action points within the **Classical Plus** licensing model. These technologies enable a shift from purely economic objectives toward a broader societal impact, facilitating the secure, ethical transfer of diverse IP assets, and supporting the development of sustainable business models. This approach ensures that licensing activities are aligned with societal needs and aimed at creating greater public good.

In this scenario, **Digital Contracting and Transaction Technologies** (Cluster 1) and **Compliance, Risk Management, and Ethical Technologies** (Cluster 5) play particularly significant roles. They enable the efficient transfer of a variety of intellectual property rights, from patents to copyrights and trade secrets, while ensuring that transactions are transparent, secure, and compliant with ethical standards. Together, these clusters streamline complex IP agreements and provide tools to monitor and assess the societal impact of the licensed innovations, making them vital for a sustainability-driven approach to IP management.

Co-Creation

Co-creation represents a transformative approach to innovation, characterised by collaborative engagement between businesses and a wide array of stakeholders, including customers, employees, partners, academic institutions and communities. This participatory model blurs the traditional distinctions between producers and consumers, fostering a shared process of value creation.

In this context, **collaboration and development technologies** are fundamental. Thus, collaborative approaches that simplify the way collaboration is mediated, measured and considered for future licensing purposes will be highly relevant to improve the use case. Virtual collaboration tools, cloud-based development platforms, and shared digital workspaces enable real-time interaction and joint development efforts. These technologies provide the infrastructure necessary for diverse stakeholders to contribute to the innovation process effectively, regardless of their physical location and at the same time to simplify the tracking of individual contributions to the resulting work.

AI and ML applications enhance co-creation by facilitating idea generation and refining concepts through data-driven insights. AI-powered tools can analyse input from various participants, identify emerging trends, and synthesise suggestions into actionable strategies. ML models can adapt to evolving stakeholder inputs, ensuring that the co-creation process remains dynamic and responsive. AI-powered prior-art search or patent drafting tools can be used to perform freedom-to-operate analyses or to protect commonly created inventions.

Communication and engagement technologies are essential because co-creation hinges on the ability to engage and communicate with a broad set of participants. Advanced CRM systems and social media platforms enable institutions to reach out to a broad audience, invite collaboration, and maintain ongoing dialogues. This creates an inclusive space where diverse ideas are nurtured, contributing directly to the value creation process. These technologies ensure that all voices are heard, and that feedback is integrated into the development process, enhancing the quality and relevance of the innovations produced.

Digital contracting and transaction technologies support the co-creation model by facilitating flexible and transparent agreements among multiple parties. Smart contracts can define the terms of collaboration, intellectual property rights, and revenue sharing in a manner that is clear and enforceable. This transparency builds trust among participants and ensures that contributions are recognised and rewarded appropriately.

Data privacy and security technologies safeguard the sensitive information exchanged during co-creation. Secure data sharing platforms and privacy-preserving computation techniques protect the proprietary data and personal information of all participants. This protection is crucial for encouraging open collaboration without exposing stakeholders to undue risks.

Compliance, risk management, and ethical technologies provide frameworks to navigate the legal and ethical complexities of co-creation. With multiple parties involved, ensuring compliance with regulations and ethical standards becomes more challenging. These technologies assist in monitoring adherence to agreements, managing intellectual property rights, and addressing potential conflicts of interest.

Analytical and decision support technologies enable institutions to assess the progress and effectiveness of co-creation efforts. By analysing participation metrics, feedback quality, and innovation outcomes, decision-makers can identify areas for improvement and adjust

strategies accordingly. Predictive analytics can forecast the potential success of co-created innovations, guiding resource allocation and further development efforts.

In the co-creation model, integrating all seven technological clusters can be important for addressing the necessary action points for successful collaborative innovation. These technologies facilitate inclusive participation, ensure secure and transparent collaboration, support effective communication, and equip stakeholders with the tools needed to navigate the complex dynamics of co-creation.

Collaboration and Development Technologies (Cluster 4) and **Communication and Engagement Technologies** (Cluster 6) are particularly vital in this context. They empower businesses and stakeholders to collaborate in real-time, sharing knowledge, feedback, and ideas that drive innovation. By providing platforms for seamless collaboration and fostering ongoing engagement, these technologies blur the lines between producers and consumers, enabling a shared value creation process that defines co-creation.

Crisis

Crisis scenarios necessitate swift and effective responses to unforeseen (UC) events that demand immediate action or preventable crisis (PC), which can be faced through advanced planned action. In the context of licensing, UC situations require rapid dissemination of technologies to address urgent needs, as exemplified by the global COVID-19 pandemic. For UC, all development and technologies that speed up the process from drafting to negotiation and signing are highly valuable to support this use case. In the case of PC scenarios, emerging technologies may be less relevant. They may aid in advanced planning and risk assessment, but once the assets are developed, the licensing activities often align with classical models or with the Classical Plus model.

Digital contracting and transaction technologies are instrumental in expediting licensing agreements during crises. Smart contracts enable the rapid formulation and execution of agreements, with predefined conditions that trigger automatic actions. Also, technologies like automated contract generation and electronic signatures become indispensable, allowing agreements to be finalized quickly without the need for lengthy negotiations or sending paper-based documents for signature. This automation reduces delays associated with traditional contract negotiations and ensures that essential technologies are made available promptly.

AI and ML applications can dramatically reduce the time needed to identify suitable partners and technologies for licensing. AI-powered platforms can rapidly analyse global patent databases, clinical trial data, and market needs to identify the most relevant technologies for a given crisis. AI can also automate the drafting of contracts based on past agreements, ensuring that legal documents are tailored to meet urgent needs without sacrificing accuracy. For instance, during a health crisis, AI could quickly match pharmaceutical companies with universities that hold critical IP for vaccine development, speeding up collaboration. AI and ML applications can also accelerate the development and deployment of solutions in crisis situations. Machine learning algorithms can rapidly analyse data to inform decision-making, enabling institutions to respond effectively to evolving circumstances.

Data privacy and security technologies are critical when sensitive information must be shared quickly during a crisis. This is particularly important during health crisis, where health data – which require specific safeguards due to its recognition as sensitive data under the GDPR – could be exchanged. Homomorphic encryption and secure multi-party computation allow for the secure exchange of data necessary for developing and deploying crisis-response

technologies without exposing confidential information. This security is essential when collaborating with multiple parties under time constraints.

Collaboration and development technologies facilitate coordination among diverse teams working under urgent timelines. Cloud computing platforms and virtual collaboration tools allow researchers, developers, and licensees to work together seamlessly, sharing information and resources in real-time. This coordination is vital for pooling expertise and accelerating the innovation process.

Compliance, risk management, and ethical technologies ensure that rapid actions taken during crises remain within legal and ethical boundaries. Regulatory compliance management systems help navigate emergency provisions and temporary waivers of intellectual property rights. Ethical frameworks guide decision-making to balance urgency with responsibility, ensuring that actions taken do not have unintended negative consequences. Such guidelines could potentially also be helpful for PC scenarios, as they could influence licensing conditions in favour of low- and middle-income countries.

Communication and engagement technologies are essential for disseminating information and coordinating efforts during a crisis. Advanced communication platforms enable institutions to broadcast updates, share critical developments, and engage with stakeholders and the public. Effective communication builds trust and facilitates collaboration on a broader scale.

Analytical and decision support technologies provide real-time data analysis and forecasting crucial for crisis management as well as decisions regarding IP licensing strategies, e.g. predictive analytics can estimate the market situation and revenue opportunities.

In the context of unforeseen crises, all seven technology clusters can provide valuable tools to expedite the licensing process, significantly enhancing the effectiveness of crisis response efforts. These technologies facilitate the rapid, secure, and compliant dissemination of critical innovations, support collaboration under pressure, and improve decision-making through timely data and insights. By adopting and integrating these technologies, institutions can respond effectively to urgent needs, fulfilling their societal responsibility during times of crisis.

Particularly, **Digital Contracting and Transaction Technologies** (Cluster 1) and **Artificial Intelligence and Machine Learning Applications** (Cluster 3) play pivotal roles in this scenario. They streamline the swift execution of licensing agreements and enhance the identification of key technologies or partners. The synergy of automated contract tools and AI-driven data analysis ensures that life-saving innovations can quickly reach the market, making these clusters essential for effective crisis response.

5.2.2. Platforms and delivery methods

In the following section the focus lies on platforms and delivery methods and how they can address specific action points within the three scenarios of IMPAC3T-IP:

Listing of Technology / IP assets

These platforms can be highlighted to stakeholders as solutions for technology / IP showcasing. The decision as to which platform a stakeholder should deploy will, in most cases, be defined by pre-existing use of IPMs, territory and consortium membership.

Listing and active promotion of IP portfolios

These standalone, paid platforms can facilitate marketing at scale but are better suited to facilitating collaboration or targeting higher value IP assets for exclusive licensing and are perhaps less applicable for use in classical plus, crisis, Co-creation scenarios.

However the use of Natural Language Processing, smart-matching algorithms and supervised machine-learning to connect licensor and licensee is encouraging.

Licensors should consider utilising AI tools in their marketing practice or as a nice-to-have or must-have when searching for marketing software solutions.

Platforms owned by IP management (IPM) software solutions

Platforms that provide a marketing / transaction platform for organisations that already use the IPM solution. Whilst IPM solutions are usually designed for the management of patentable IP, the seamless transition between IP management, marketing and licensing represents an effective way of supporting Classical+ scenarios.

Feature Rich Licensing Platforms

Offers the user a full range of functionality that allows users to replicate all aspects of licensing on an online platform. Any type of IP asset or technology can be click-licensed through these platforms, expediting transactions of commercial value and, thanks to the efficiency of the licensing processes, support societal impact in a cost-effective manner. As well as being a useful tool for such Classical+ scenarios, the ability of these platforms to handle high volumes of licence transactions, 24 hours a day, to licensees anywhere in the world means that they can meet the demands in times of global crisis.

In-house' licensing websites

These licensing sites can (i) inform staff of the specific institutions what support is available 'in-house' to disseminate / commercialise IP assets or (ii) act as example of what can be developed by an organisation to expedite their licensing activity. Whilst developing an in-house solution is time- and resource-intensive, it does give an organisation the potential to meet its own licensing needs in Classical+ and Crisis scenarios.

Licensing Platforms for specific product categories

Platforms that are particularly useful to institutions with a strong portfolio of specific assets – e.g. research reagents, COAs. Platforms can become the 'go-to' site for licensing certain IP assets and support licensing in Classical+ scenarios for a narrower range of IP assets – for example copyright (e.g. for Clinical Outcomes Assessments).

6. Conclusions

The analysis of emerging technologies has highlighted significant potential in utilising software tools and platforms to support the IP licensing process in several aspects. These advancements, reflected in the previously discussed technological clusters, offer transformative capabilities that can streamline licensing activities, improve efficiency, and facilitate more effective collaboration among stakeholders involved in IP licensing. An emerging trend among these tools is the integration of AI assistants, which enhance user interaction by providing intuitive interfaces, automating complex tasks, offering real-time support, and streamlining workflows. The identification of various platform solutions shows the versatility and applicability of these tools across different contexts. These platforms, ranging from those that list and aggregate technologies and IP assets to those that expedite IP licence transactions, demonstrate that tailored technological solutions can address specific needs within the licensing process. The adoption of such platforms can significantly enhance the visibility of IP assets, making it easier for potential licensees to discover and engage with available innovations.

Advanced technologies and specialised platforms present a substantial opportunity for the licensing community. Embracing these tools and platforms allows for the modernisation of licensing practices, unlocking new avenues for innovation transfer and commercialisation.

The strategic use of software tools and platforms will play a pivotal role in the future of IP licensing, offering benefits in quality of work results, time saving and in may even reduce the level of expert knowledge required for specific activities. As these tools unfold and expand their capabilities adopting newer technologies, it will be increasingly difficult for any potential user to navigate and differentiate to find suitable solutions to their own use cases and needs.

Recognizing that the development of such technology-intensive software tools from scratch is challenging, and acknowledging that developing such complex tools within the IMPAC3T-IP Toolbox may be out of scope in most cases, efforts should focus on informing the licensing community about these technologies. By providing comprehensive information and guidance, stakeholders can be better equipped to identify and adopt existing solutions that meet their needs.

However, developing a new tool through the IMPAC3T-IP toolbox that helps stakeholders to find specific software solutions and platforms suitable to their needs, highlighting features, cost implications and other relevant properties may address a market need. This additional tool would enable users to navigate the diverse landscape of available tools and technologies more effectively. Integrating an AI assistant into this tool could further enhance user experience by providing personalized recommendations. The AI assistant could interact with users to understand their specific requirements and guide them toward the most suitable solutions, streamlining the selection process and making it more efficient.

info@impac3tip.eu

www.impac3tip.eu

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