IP and Industry Agreements towards Industry Commons

White Paper

This white paper proposes strategies for the management of Intellectual Property and Industry Agreements across industrial domains, particularly from the point of view of stimulating open innovation in a data-driven economy. The paper examines emerging use cases that have been identified to require novel IP strategies or that carry potential for innovative industrial agreement solutions. The resulting recommendations aim to contribute to the Open DEI strategy for Digitising European Industry.

Table of Contents

1. Context

1.1. Towards the industry commons

The aim of industry commons is to unite verticals including health, manufacturing, agrifood, mobility, construction and energy. It does so by providing several enabling layers supporting effective interaction, optimisation, sustainability and innovation for cross-domain data-driven market activities.

To stimulate effective exchange between domains, industry commons rely on a comprehensive interoperability strategy including several levels of functionality, from data reference models for cross-domain Interoperability to application protocols between cross-domain applications and, at a more granular level, interoperability between detailed functional components of cross-domain applications. From the perspective of enterprise integration, and by extension business ecosystem integration, the management and support of IP and Industry Agreements (IAs) is the key additional enabling layer for the creation of cross-domain open innovation and for the valorisation of data in the industry commons.

1.2. IP and Industry Agreements in the context of the EU Data Act

The proposal for EU Data Act adopted by the European Commission on 23 February 2022[1], includes several directives and recommendations that strongly support and advocate for open innovation approaches. The EU's ambition is to encourage as many actors as possible, regardless of their size, to participate in the data economy. It wishes to protect participants, especially SMEs, against unfair contractual terms imposed by parties enjoying significantly stronger market positions. It intends to create framework conditions where EU businesses, especially SMEs, have more possibilities to compete and innovate on the basis of data they generate thanks to data access and portability rights.

Open innovation approaches are also applied to proprietary data in specific scenarios. The Data Act introduces an obligation for private companies to unlock their data in exceptional situations of high public interest, such as floods or wildfires. It also intends to enable users of smart objects access to the data those objects generate so that they can share this data with third parties and spur the development of a broader range of services.

Impact studies which follow the Data Act proposal, ask for measures to ensure citizen empowerment in a human-centric data economy, development of rights strategies for co-generated data, and the establishment of metadata standards (both technical and legal) across or within sectors for data sharing. They ask for the introduction of a legislative framework for fairness controls in data sharing contracts, and a horizontal cross-domain legislative framework with access rights for data re-use.

The development of rights strategies for open innovation is thus seen to contribute to the ultimate goal, that is to unite all of the domain-specific data spaces into a single European data space and create a genuine single market for data.

1.3. The legal framework and associated challenges

The term "industry agreements" is not a term of art in law or in policy. A recent study commissioned by the EC focused on the concept of industry agreements and how they operate in multilateral value

[1] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1113

chains.[2] Industry agreements are a mechanism for reaching a common understanding of functionalities or architectures and specifications. They may include a variety of tools, such as, for example, federated digital infrastructures, common vocabulary standards, and also relational contractual agreements.

Industry agreements share some common features with codes of conduct and standards but they are distinct regulatory mechanisms. For example, standards influence data and technological specifications, but they do not offer governance guidance. Codes of conduct, on the other hand, typically encompass behavioural norms and some form of a governance mechanism. However, codes of conduct have limited influence on technological specifications and they are not typically considered in discussions of new specifications.

Industry agreements address the need for coordination among economic operators in different jurisdictions and across different value chains. Their open, cross-border nature serves as a natural counterbalance to the limitations imposed by the legal principle of territoriality. The principle of territoriality dictates that national rules govern the subject matter within a particular territory. Intellectual property rights are a case in point. They are exclusive rights that subsist in subject matter and can be exercised solely on territorial basis. With the exception of some limited harmonisation in certain aspects of IP law, questions of both ownership and licensing remain heavily dependent on national interpretation of legal rules. This is a challenge for industries and value chains that extend across multiple jurisdictions.

Typically, there are two stages in the lifecycle of an IP right. The first stage concerns how rights subsist in the subject matter, e.g. works when we talk about copyright or inventions in the case of patents. This happens either by operation of law, e.g. copyright, or through an application and registration regime, e.g. patents. The second stage concerns the licensing of rights relating to the exploitation of the work, invention or other subject matter.

A first problem is, therefore, identifying the rights that subsist in the subject matter. The modalities of a legal transaction depend on the type of subject matter and the applicable law. A second problem is to identify the proprietors and the allocation of rights, specifically considering scenarios of individual and shared rights in cases of data pooling. Finally, when transacting with these rights, it must be clear what transactional tools are most effective and efficient. Many actors, particularly SMEs and start-ups, find the existing practices in data licensing confusing and part of the reason is that many of these practices draw on licensing models initially created for open source software.

Subsistence of rights. It is essential to know what is owned, who owns it and how it is licensed. These questions require a fact-intensive inquiry which may prove particularly challenging if we do not know what rights might subsist in the subject matter.

Data are a problematic subject matter from the perspective of intellectual property law. The law covering data is in some ways extremely unpredictable and confusing. While compilations of data or other material which by reason of the selection or arrangement of their contents constitute intellectual creations is protected as such, this protection does not extend to the data or material itself, and it is without prejudice to any copyright subsisting in the data or material itself [TRIPS Agreement]. Thus, unlike software, for example, data is not categorically protected by copyright. In spite of this, various data licences have been developed in recent years and the majority have been modelled after open source software licences.

Open source software licensing models are supported by copyright law. They operate on the basis that computer programmes as subject matter are protected by copyright. Most of the existing open

[2] European Commission. Directorate General for Communications Networks, Content and Technology., CARSA, Consultores de Automatización y Robótica, S.A., ECORYS., KU Leuven, Katholieke Universiteit Leuven, & VDI/VDE Italy. (2021). Study on technological and economic analysis of industry agreements in current and future digital value chains: final study report. Publications Office. https://doi.org/10.2759/495071

data licensing models rely on the same assumption which, however, is erroneous. There is no legal certainty as to whether copyright subsists in data and, even if it does, how the different doctrines of copyright law apply to data. For instance, the law is unsettled on the status of machine learning models, e.g. as independent works or as adaptations of the training dataset. This means that data licensing models may rest on shaky ground. Even though they have some traits in common, the categories in data licensing and copyright licensing are conceptually distinct, e.g. the legal distinction between static and dynamic linking in software licensing which does not exist in data licensing. The law should clarify which different forms of rights might subsist in data and the threshold for subsistence of any such rights as they flow along the value chain. Overcoming this challenge would engender trust and make data transactions more predictable and reliable for stakeholders.

Tracking of rights. Another challenge is how to trace and track ownership in multilateral digital value chains. Tracking ownership is essential to improve transparency in the value chain. Transferring rights in data is much more dynamic and is likely to occur more often than, for example, the assignment of a patent application or patent. Furthermore, there are no registers of data transactions at the ecosystem level to facilitate transparency and engender trust.

As data travels across the value chain, it undergoes changes and transformations which may produce legal consequences. It is unclear, for example, whether collective contributions by different economic operators to the same data set give rise to any shared rights and whether the independent contributions merit protection by means of exclusive rights. Furthermore, if any independent contribution merits protection, a downstream user may find it impossible to get assurances that every contributor has granted a licence where the number of contributors may be in the order of thousands. These issues are well understood in the practice of open source software licensing where the doctrines of sole and joint ownership have provided some degree of clarity. While these doctrines are unlikely to apply to data transactions because of the uncertainty around the forms of exclusive rights that may subsist in data, the open source development and licensing models may inspire new solutions for collaborative data ecosystems.

Transacting with rights. Given the scale, dynamics and sheer amount of transactions taking place in the data economy, adequate technological infrastructure should be put in place to support economic operators. One possible solution is the automated licensing and clearance of rights based on distributed ledger technologies and smart contracts. This could enable transparency and improve legal certainty by increasing the predictability of data transactions. An economic operator interested in procuring a data set would not only know what rights might have subsisted in the data set but also with whom they may need to negotiate access and usage rights. Finally, automated negotiation mechanisms may facilitate the process and perhaps even relegate some low-risk transactions to entirely machine-to-machine interaction.

2. Opportunities

2.1. Open Innovation as driver of new data ecosystems

Open innovation environments present opportunities for a new strategic framework for intellectual property, based on use cases that result from collaborative and cross-domain development. The act of collaboration creates opportunities and new incentives, but also the risk of misunderstandings and disputes. Successful open innovation collaborative environments set out clear rules of engagement for a level playing field that stimulates trust among all participating stakeholders. The IP framework must therefore work together with open innovation codes of conduct and guidelines for best practice. It must particularly consider the impact of IP registration on sustainability strategies and focus on the need to track and trace the complete lifecycle of materials and products across digital value chains (DVCs) in order to achieve the ambitions of the Green Deal. It must encourage rather than stifle innovation that will bring sustainable solutions and incentivise behaviours that contribute to the Green Deal's grand vision. Solving the Green Deal challenges cannot rely on a "winner takes all" mentality, but on systems of incentivisation that encourage collaborative co-creation that generates greater value for all stakeholders. This includes systems that, on the one hand, stimulate the larger organisations to contribute their background IP in a way that becomes beneficial to them, and on the other, allow SMEs to build additional value with this background IP to amplify its potential, and add their contribution to the value network.

The framework must also consider the shift in power dynamics that results from an entirely data-driven economy. The value in data sets may not always be contained within the data themselves but in the knowledge of how to leverage and apply the information they contain. In the example of neural networks, systems are creating vast amounts of data that often cannot be parsed in real time, so may require visualisations that highlight salient moments according to use case-driven parameters. Value of these data may only become apparent at the level of application, and IP strategies may be applied at the point of valorisation. Novel incentives, behaviours, business practice and new business models emerge out of these paradigm shifts.

The following use cases illustrate some of the recent changes of business incentives and behaviours, and changes of technological power dynamics.

2.1.1. MTF Labs open innovation community use case

Incentivised by the potential of emerging data-driven market applications, large organisations contribute datasets, components and products into a tech transfer toolkit, to be used for novel applications by the MTF Labs[3] *community of innovators. The innovators solve several challenges related to products, technical aspects, market adoption, and emerging market scenarios. Background IP that is embedded into a new product is tracked and reveals a new market possibility. The breakthrough application idea is registered as innovation IP, so that the innovator or SME who created it has a vested interest in taking it to market. Several prototypes are ready after 4 months of incubation and tested on a community of early adopters. In month 5 a patent application is filed for the most marketable solution.*

[3] MTF labs emerged from a DG CNECT CSA and have been running for the past 10 years. 21 labs have been run across global locations over three continents, with over 8000 contributors to date. 74% of the CNECT Advisory Forum innovation recommendations for 2018-2020 were based directly on real use cases from MTF Labs. https://mtflabs.net/

2.1.2. Chemical industry use case

In 2019 SAP published the guideline booklet showing how they can manage the entire chemical industry production from start to finish through data driven systems[4]. Much discussion followed questioning the implications this had on power structures and on the ownership of the chemical industry's tools of production. If data-driven systems were the primary tools of production, the tangible assets of the chemical industry's production line could now be considered as content managed by the DVC. The resulting paradigm shift requires a review of IP and IA dynamics.

2.2. Boosting SME engagement and innovation with FAIR and JUST data

The essence of leveraging all intellectual outputs in open innovation environments is ensuring attribution and accountability. Aside from setting up basic codes of conduct and rules of engagement, DVCs offer the possibility of designing automatised and semi-automatised systems of attribution and accountability, including the tracking of IP in the DVC and annotations of data provenance.

Industry requires assurances about commercially available datasets[5]. "FAIRification" of data (certification that the dataset is FAIR), and JUST data annotation (a practice for the RRI researcher and data owner) have proven to be extremely useful for the valorisation of commercial datasets. This presents opportunities for small and large players alike. Aside from assurances, certifications offer additional knowledge and information about the potential quality and performance of the dataset, often assisted by innovation SME applications, that build further value for their assets with layers of additional IP.

This is one of the reasons why is it particularly interesting for industry to be involved in the spaces of the commons. Every single step that is taken with their data assets builds further knowledge and adds value to it. The IP valorisation grows and scales with its use. The interconnected system allows for notifications from every step of deployment and tracking of their IP through the value network. This allows IP owners to make informed decisions about further investments and market development.

The following use cases highlight the optimisation and valorisation of datasets brought by FAIR and ethical approaches to data management.

2.2.1. JUST data annotation use case

A computer scientist is using a FAIR dataset of energy usage patterns among city dwellers to optimise energy supply. When modelling several usage scenarios, the scientist realises that the dataset contributes to optimisation only under certain parameters. Wishing to understand better the data bias and provenance, the scientist requests from the data provider to annotate the dataset according to JUST data principles[6]. The data owner/provider contributes responsible data annotation that aims to be Judicious, Unbiased, Safe and Transparent, and provides information about the geographical location where data was collected, relevant environmental circumstances, the population demographic that was sampled, and highlights any data privacy or security issues.

[4] https://www.sap.com/documents/2019/04/66cf30b9-497d-0010-87a3-c30de2ffd8ff.html

[5] https://www.eoscsecretariat.eu/cocreating-eosc/expanding-eosc-engagement-wider-public-sector-and-private-sectors-eosc

[6] JUST data principles have been proposed to complement FAIR data by placing into focus the responsible researcher or data owner. The proposal was welcomed by the EOSC Secretariat and is part of its strategy for the expansion of EOSC to innovation and industry stakeholders (ibid) as well as the EOSC SRIA (https://eosc.eu/sria). It is also part of the recommendations for DG CNECT in a study of AI in the CCS (https://www.technopolis-group.com/report/study-on-opportunities-and-challenges-of-artificial-intelligence-ai-technologies-for-the-cultural-and-creative-sectors/).

The computer scientist can now make an informed decision on whether further data is required in order to optimise the energy supply, and can annotate the existing dataset further by noting both successful and unsuccessful application scenarios as reference for the next user of the dataset.

2.2.2. Whistle rights use case

A textiles multinational is developing a data-driven system for effective tracking of product supply networks. The organisation aims to embed ethical approaches to supply chain management by tracking the working conditions of workers and prevent labour violations. In doing so, the organisation must protect the workers' data, while collecting sufficient information to be able to make informed decisions and take appropriate corrective actions. The textiles multinational partners with an innovative SME that is building software in collaboration with the Whistle project at Cambridge University[7]. Whistle's tools allow for reports to be collected through smart phones and social media via a secure platform. All identities and associated data are verified, anonymised and aggregated into an ICT SME-designed dashboard that assists multinationals in decision-making processes. The anonymised information about the supply chain working conditions can instigate systemic change inside the multinational's organisational structure.

2.3. Managing IP in multilateral DVCs

The core question for IP management in multilateral DVCs is which IP will be generated and how should it be protected and shared among stakeholders.

The digitisation of all industries, where existing and new knowledge is turned into data, including representation of all tangible industry assets in digital twins, provides infinite scope for interoperability and innovation between sectors. IP assets that are part of the data commons thus generated, may include copyrights, patents, trademarks and designs that focus on different aspects of a creation, novelty or industrial applicability. Bringing them together requires alignment over a shared top-level *metadata framework*, that is FAIR and references the related open or protected documentation, smart contracts and industry agreements.

Clarity over types of innovation is essential for a successful IP strategy. *Incremental innovation* is the standard practice applied to most innovation within large organisations that optimises and improves existing technologies and business models. *Radical innovation* creates a new technology that serves the existing business model. *Disruptive innovation* creates a new business model that leverages the same technology. *Architectural innovation* changes both the technology and the business model simultaneously[8].

The value and potential economic leverage of these different categories of innovation IP vary significantly in scale across different global business ecosystems. For example, the United States tends to be more conducive to patenting new business models than the EU, where patents are mostly based on scientific breakthroughs. Innovation in the technological domain without corresponding innovation in the business model (and vice-versa) can often realise short term results but may become redundant over time.

Since process optimisation is high priority for data-driven business models, *accuracy and timeliness of the data* becomes the key driver of successful systemic solutions for enterprises. Obtaining and enforcing exclusive rights over the raw data is not a sustainable business model. Data are a highly time- and context-sensitive resources. Business models built on licensing exclusive rights over out-of-date, inaccurate or biased data sets are unlikely to remain profitable in the long run. It is not exclusive rights, but timely and convenient access that allow economic operators to tap into the value that lies

[7] http://thewhistle.soc.srcf.net/projects/

[8] Pisano, G. (2019), Creative Construction: The DNA of Sustained Innovation, Public Affairs.

in high-quality data, i.e. by focusing on providing 'exclusive rights-agnostic' access to accurate and contextually relevant data with guaranteed quality of service parameters.

The following use cases illustrate business challenges across different industrial domains, that affect the design of supporting IP and IAs.

2.3.1. Dynamic metadata in manufacturing use case

The digital twin of a tangible manufacturing asset performs localised cognitive processes. It tracks the asset performance as well as environmental conditions for its optimisation. In addition, the digital twin is linked to updates of enterprise integration data and can model quantitative or qualitative design values in response to business requirements. A change in production values triggers an update of IP values in the digital twin and the IP metadata is automatically updated to reflect the new valorisation state.

2.3.2. Otter.ai use case

An EU SME proposes to record and transcribe their confidential business meetings using Otter.ai software. The AI-assisted software analyses and trains on the speech patterns and accents of each of the contributing speakers. In order to evaluate potential risks and gaps, the SME investigates whether the data analytics generated by the software can be made available to them. They discuss levels of risk associated with their rights as providers of the data, particularly in respect of making their data available to Otter.ai's partners such as the video conferencing software Zoom. They attempt to evaluate the risk of their business confidentiality being exposed to Otter.ai's VC investors. The SME concludes that it requires advice and guidance from EU regulatory bodies.

2.3.3. Medical annotations use case

A clinician is evaluating data about specific medical treatments to assist in choosing the correct treatment for a patient. Aside from data from clinical trials, the clinician is able to access the annotations database that has compiled data about applied treatment scenarios. The clinician's peers have annotated the dataset based on their experience of applying a specific medical treatment on particular use cases assisted by tools developed by innovative SMEs such as labelstud.io[9] and prodi.gy[10]. The annotations are FAIR and searchable according to tags and keywords, allowing the clinician to find the closest use cases, and ascertain which treatment produced good results. The clinician finds the annotations save time in applying the correct treatment, increase success rates and reduce risk. The pool of knowledge created through the clinicians' annotations is incentivised through attribution of IP to each contributor which is then compensated when valorised by e.g. AI software that leverages patterns in those annotations. Annotations therefore create intellectual property that is valuable in its own right.

[9] https://labelstud.io/
[10] https://prodi.gy/

2.4. Incentivising rich data value networks

The transition from current data value chains into richer multilateral ones with the right incentives, requires the building of an industry commons *ecosystem of trust*[11]. Innovation is enabled by cross-domain interoperability supported by data reference models such the EU's OntoCommons EcoSystem (OCES[12]). However, interoperability requires the creation of a supporting system of systems that stimulate data exchanges in optimal, sustainable and ethical ways.

The industry commons model therefore anticipates a series of enabling systems connected and supporting the interoperability and innovation layers. *Systems of agreements* embed regulation, IAs, peer-to-peer contracts and IP registration and tracking. *Systems of resilience* include environmental sustainability and resilience strategies to mitigate against Black Swan events. *Systems of responsibility* introduce responsible AI, ethics, and Corporate Social Responsibility. At the foundational layer, *systems of beliefs* set parameters that reflect societal values, including making sure that inclusivity is foundational to the whole system.

Entering an open innovation ecosystem of trust is accompanied by multiple business and optimisation incentives[13]. Releasing industry background IP into the space of the industry commons is supported by feedback loops and notifications that highlight salient advancements in research, innovation, technology transfer, product development, marketing and HR recruitment. Participation provides additional value of FAIR data from academic research and TTOs. As innovators model new use case scenarios based on industry background IP, or build upon identified gaps across domains, they provide significant emerging market data, onboard early adopters, and identify themselves as potential partners for incubation and market acceleration.

In open innovation environments therefore, building on the shoulders of one's peers provides greater value for all, and therefore requires updates to IP strategies. As it is currently configured, patent registration actively ring-fences individual ideas. In open innovation environments, showing provenance and context reinforces, rather than detracts from an argument for novelty or patentability. It makes clear that which is new and how it advances the knowledge. Showcasing a value network of ideas can clearly distinguish one IP registration from a similar idea that has been arrived at through another DVC with different background IP. This incentivises greater participation and stimulates multiple opportunities for valorisation for involved stakeholders.

The following use cases illustrate how DVCs allow for agile integration of innovators and entrepreneurs in innovation processes.

2.4.1. Industry commons use case

An innovation SME is modelling a novel use case within the industry commons. The SME uses a range of proprietary data from materials companies to test material properties in combination with a novel use case scenario and related environmental data from public sources. All data is FAIR and reusable. The resulting dataset creates a layer of innovation IP that indicates optimal conditions for certain materials in the specific innovation use case. The proprietor of the best performing material dataset receives a notification of the material's optimal performance in the modelled innovation use

[11] Michela Magas & Dimitris Kiritsis, 2021. Industry Commons: an ecosystem approach to horizontal enablers for sustainable cross-domain industrial innovation (a positioning paper), International Journal of Production Research, DOI: 10.1080/00207543.2021.1989514 [https://www.tandfonline.com/doi/abs/10.1080/00207543.2021.1989514]

[12] https://ontocommons.eu/

[13] The EU project RE4DY explores the business potential of data by uniting multiple platform and software stakeholders into a multilateral DVC valorisation system. https://re4dy.eu/

case that reveals a potential new market application. Both the SME and the background IP holder can make an informed decision about a potential emerging market opportunity.

2.4.2. IP Stack use case

An innovation SME is an avid tester of breakthrough technologies and has good knowledge of emerging markets. It sources background IP from TTOs in the DVCs and designs technology transfer IP (hardware and software) that it combines with background IP to lower the entry barrier to emerging markets. It uses modelling software designed by a partner SME to model emerging market use cases and gather data about market deployment. The resulting dataset creates a layer of innovation IP, that combines with background IP and transfer IP to create an emerging market IP Stack. All partners in the value network are notified of the emerging market opportunity.

2.4.3. MARLs use case

An SME is producing a low-risk application that does not require a large investment upfront and long development times. They are faced with having to decide what to patent and how long to keep the development confidential. They assess patenting times as too long for timely release of the product to the market. They prefer to be the first in the market and benefit from a competitive advantage. For a timely release, the SME finds the Technology Readiness Levels alone inadequate for monitoring rapid development progress, and instead wishes to involve adopters at early TRL stages. The SME opts for Market Adoption Readiness Levels (MARLs)[14] to help finetune the application's usability and encourage early adoption. They consist of evaluating the level of risk of an application, incentivising early adoption and estimating the adoption potential, analysing the data from early adoption, and assessing technology readiness.

2.5. Industry Agreements for replicability and emerging business models

Fostering participation in multilateral DVCs relies on ensuring replicability and a business continuum, and therefore requires more than cross-domain interoperability and FAIRification of data. The multilateral DVC combination of technological and industry assets with business strategies and horizon scanning for market opportunities, goes beyond enterprise integration to a new dimension of cross-domain technological and business *ecosystem integration*, that brings novel business incentives, business optimisation, new business models and access to emerging markets.

Within the context of multilateral DVCs, SMEs are under pressure to build fast, but may not always be sufficiently agile or have sufficient knowledge of both technology and business to be able to identify correctly the innovation opportunity in the market.

The following use cases illustrate models for reducing risk and increasing business opportunities for innovation SMEs.

2.5.1. IP Screener use case

A startup SME website proposes to reduce CO2 and methane emissions by developing additives for cattle fodder. The summary of their business model is copied from their website and fed into the IP Screener AI-assisted software[15]. IP Screener analyses the text and maps out the global activity in this

[14] Market Adoption Readiness Levels (MARLs) were introduced by the CNECT Advisory Forum in 2014 in order to speed up market deployment of low-risk data-driven applications.

[15] IP Screener provides AI-assisted software for rapid scanning of the global patenting landscape, including the entire WIPO and EPO database: https://ipscreener.com/

domain, ranking research and innovation results by relevance and visualising them on a world map. Most economic activities in this domain appear in the US, followed by Canada. In Europe the dominant market activity is in the UK, followed by Belgium, Germany and Finland. Australia, Japan, and New Zealand show some relevant market activities, that could also be targeted by the SME's business plan. A notable presence in the European market is shown to be Royal DSM, known for nutrition technologies, though less known for fodder. As part of their business plan, the startup could consider partnering with such a big player or include them in their exit strategy. The software reveals that the topic is trending, and that the trend has been increasing steadily over the past 20 years. For the benefit of investors this demonstrates that the startup idea is not hype. The software reveals a particularly prolific researcher/inventor on the topic, whom the SME could consider hiring. A classification code reveals four further species of cattle who can benefit from the invention. In summary, the software has enabled the SME to perform a risk and business assessment in a very short time. They have been working on this product for two years, but in around 10 minutes they have found a new selling proposition, relevant companies on the market, relevant updates for their business plan and even technology which could be used to improve their product. The patenting heat map shows relevant patent registration in the US, but an available market in Europe.

2.5.2. Berkeley startuppers program use case

Berkeley offers an eight-week program with coaching and training of SME business "startuppers". This includes an obligation for SMEs to conduct 100 interviews. An AI-assisted software that scans the global research and innovation landscape, such as the one shown in 2.5.1, can help them to target the right stakeholders, investigate where to pivot, and correctly position their business proposition early in business development to reduce risk.

2.5.3. Cross-domain applications use case

An SME has identified a gap between two industry verticals, and created a hybrid solution, compatible with both data domains. The SME uses the MARLs model (see 2.4.3) to onboard early adopters from both domains and identify the uptake rate. Engagement with the breakthrough solution yields a great deal of data and results in useful business insights for product improvement. Despite a low technology readiness, data from early adoption is shown to background IP proprietors and to potential investors to illustrate market potential and help them make an informed decision on further investments.

2.6. DIH as key players in multilateral DVCs

The European Digital Innovation Hubs were created as ecosystems where various SME stakeholders could be integrated in larger value networks, contribute to knowledge transfer and to the building of innovative solutions. Much of DIH activities are already aligned with open innovation strategies and therefore well placed to capitalise on the new business and IP strategies coming from the DVCs.

Tracking IP in value networks, making SME IP FAIR through a standardised top-level metadata, ensuring registration of SME *innovation IP* built on top of background IP provided by large organisations, layers of attribution, accountability, as well as confidentiality and protection of SME trade secrets, are all models that can support SME participation in future multilateral DVCs.

The following use cases demonstrate the value that open innovation rules of engagement and multilateral DVC strategies can bring to DIH SMEs.

2.6.1. Open Source use case

In a connected DVC that tracks IP valorisation, an organisation uses open source code in a software product that is to be licenced under a proprietary licence. 95% of the final product is based on public domain or open source material and 5% is novel. Since the application of the open source code is trackable in the value network and attributed to the SME that originated it, the SME receives a notification of the code reuse and the system triggers a minimum level of compensation for the SME.

2.6.2. Patent for primary industry use case

At seed stage, an SME uses a microboard supplied by a large semiconductor supplier that offers novel affordances for embedded ware using data from proprietary sources. It creates a prototype that allows the use of bodily gesture to change menus hands-free while on the move. The system recognises the difference between regular movement (e.g. jogging) and deliberate gesture that gives instructions to a control centre. The SME registers the invention as an innovation IP layer in the DVC. The system is then tested in conjunction with operators of primary industry vehicles who ordinarily have to stop operations in order to answer phone calls or react to an emergency. Prior to testing the novel application, the potential partner from primary industry had been testing ways to improve the operator's controls using expensive screen and camera equipment. This was raising the price of the vehicle too much for the corporate buyer. The novel system designed by the SME proves to be very effective at optimising communications and adding security features while keeping the costs of implementation low. The SME receives an offer for deployment of the product in primary industry vehicles. The SME then negotiates a percentage profit with the semiconductor supplier that owns the proprietary IP embedded in the solution, and seeks competitive offers for similar embedded ware. With clarity over the registration of innovation IP in the DVC, the SME proceeds to file a patent in the domain of primary industry.

3. Analysis

Tetradic analysis of use cases

Use Case	ENHANCES	OBSOLESCES	RETRIEVES	REVERSES
3.1. Analysis of open Innovation use cases				
3.1.1 MTF open innovation community	Innovation IP Layer built on top of industry source IP by diverse, creative and interdisciplinary community of experts. Rapid knowledge exchange.	In-house innovation as the sole source of incremental IP development, focus groups and satisfaction surveys as guides or success indicators.	Creative discovery at the intersection of knowledge categories, testing with experts and early adopters to feed observations and discoveries back into the development cycle.	Loss of control of the planned trajectory of product development, target market focus or feature roll-out
3.1.2 Chemical Industry	Full process management through data driven systems	Requirement for arcane sector-specific knowledge and industrial gatekeepers of materials knowledge	The domain of business as a discipline in itself, understood as a system of processes and practices independent of the specific inputs or outputs of an individual organisation	Entire industrial sector reclassified as 'content provider' to software and data companies
3.2. Analysis of SME engagement and innovation use cases				
3.2.1 JUST data annotation	Decision-making and broader ethical context for application of data sets	Replication and reinforcement of inherent or unconscious bias	First-hand field experience for third party users of data sets	Scope creep: the expansion and dilution of primary data research into related but peripheral concerns

Use Case	ENHANCES	OBSOLESCES	RETRIEVES	REVERSES
3.2.2 Whistle rights	Convenient self-reporting and unobtrusive research to enhance staff wellbeing and productivity. Autonomy.	Dehumanised workforce following standardised and mechanised processes.	Creative and collaborative individual contribution to shared goals	Micromanagement and surveillance, mismatch of reporting and actual work performed in order to conform with perceived expectation.
3.3. Analysis of managing IP in mutilateral DVCs use cases				
3.3.1 Dynamic metadata in manufacturing	Mass customisation and adaptation. Complete lifecycle circular production. Context-sensitive alteration of IP production and generation.	One size fits all manufacturing. Excess production and waste. Inability to adjust according to environmental factors or changing conditions.	Bespoke customisation reintroduced in mass production contexts. Creation of subtlety in manufacturing iterations	Adaptive products as standard. Constant shifting of manufacturing output threatening consistency of brand identity
3.3.2 Otter.ai	Creates a text searchable record of internal intelligence for the organisation	Excessive reporting and administration that obstructs agile decision making	Organisational memory and the ability to return to closed-door meetings. Grouped information and internally-shared private intellectual property	Increased exposure to industrial espionage and foreign leverage of AI training through contribution to big data sets in convenience trade-offs that are difficult to calculate or mitigate.

Use Case	ENHANCES	OBSOLESCES	RETRIEVES	REVERSES
3.3.3 Medical annotations	Shared specialist knowledge and analysis amongst peer practitioners.	Compound errors from access only to one's own subjective analysis. Reliance on peer-review process for knowledge acquisition	Clinical practice conference networking to share observations and anonymised diagnosis metadata	Potential to over-rely on consensus diagnosis rather than trust one's own expertise.
3.4. Analysis of incentivising rich data value networks use cases				
3.4.1 Industry commons	Pool of shared knowledge from which new products and data applications can be generated	Lockdown of IP for fear of loss of control or that others may gain competitive edge	Collaboration across industrial sectors and between large and small platers to create mutually beneficial connections through layers of tracked and attributed IP	Outsourcing of innovation to independent or smaller organisations in order to leverage new IP created from unused assets
3.4.2 IP Stack	Ability to model new use case scenarios through digital twins and interoperability of data between TTOs, industry and innovation communities	High risk and costly experimentation within real-world manufacturing and production processes	Innovation process as a collaboration between trades	Disruptive and architectural challenges to organisations as a result of combinative IP innovation
3.4.3 MARLs	Usefulness of assessment of product readiness or market fit in an age of digital twins and rapid prototyping	Measures based on NASA safety protocols for high risk, high cost ventures	Experimentation and iterative product development	Ongoing releases of minimum viable product rather than fully realised and tested applications
3.5. Analysis of IAs for replicability and emerging business models use cases				
3.5.1 IP Screener	Patent search speed and ability to	Expense and limitation of	IP registration as frontier	Reverse engineering of

Use Case	ENHANCES	OBSOLESCES	RETRIEVES	REVERSES
	locate high quality work happening in the field that may connect with proposed developments	patent search focusing only on elimination of possible competing ideas	knowledge creation rather than territory claiming	patent application through elimination of searchable terms
3.5.2 Berkeley startuppers programme	Rapid AI feedback on market fit and early pivot recommendations for new SMEs and entrepreneurs.	Tenacity and luck as the key defining features of successful market innovations. Fixed 'grand visions' and missions	Flexible Intellectual property as the central valuable asset of an entrepreneurial team.	Market-led rather than market-driving or market-creating innovation. Regression to the mean rather than outliers.
3.5.3 Open Source	Talent pool of collaboration for the creation of useful services and applications. Creative forks and unforeseen innovation leaps.	In-house development teams working to a single coordinated plan. Proprietary software as the sole economic model.	Mission-driven innovation, moonshots and alignment of multitudes around a single vision	Corporate exploitation of community contribution.
3.6. Analysis of DIH as key players in multilateral DVCs use cases				
3.6.1 Cross-domain applications	Shared data formats and standardisation enable hybrid innovation. New market categories and novel solutions to societal challenges	Industrial silos and locking down of specialist IP within specific industry sectors	The company as organisation of collaborators with complementary skills and knowledge bases. Age of Discovery.	Shallow understanding and misapplication of complex and deep sector-specific knowledge
3.6.2 Patent for primary industry	Identification of innovation in one domain as useful, applicable or even essential in other, seemingly unrelated verticals	Expensive investment in large scale incremental innovation	Ideas and innovation as cross-boundary IP applicable across industry sectors. Potential to 'invent the wheel' with a simple concept applicable and revolutionary across a wide range of domains.	Inventors and innovators disincentivised by working in sectors other than those that inspired them to create the original IP.

4. Recommendations

4.1. Recommendations for open innovation as a driver of new data ecosystems

- Ensure all EU data-driven platforms operate on the same ”railway tracks”.
- Create rules of engagement for a level-playing field for IP & IAs where all stakeholders can benefit.
- Ensure alignment between multilateral DVCs and the Green Deal ambitions.
- Support industrial testbeds where industries can effectively experiment within open innovation systems to create sustainable solutions.
- Democratise access to know-how and knowledge hidden in patents.
- Highlight pros and cons of solutions for different stakeholder groups – it’s not a “one size fits all”.

4.2. Recommendations for boosting SME engagement and innovation with FAIR and JUST data

- Design automatised and semi-automatised systems of attribution and accountability, including the tracking of IP in the DVC and annotations of data provenance.
- Include FAIRification of commercial datasets for assurance and quality purposes.
- Introduce guidelines for JUST data annotation to ensure RRI data practices.
- Consider the intellectual property value of annotations of data for use in e.g. AI software training.
- Assist students, researchers, startups & SMEs to make use of and understand IP information to boost development, avoid reinventing known concepts, handle legal risks with competitors’ rights and support more efficient business strategies.
- Empower SMEs with effective business and IP management ICT tools.

4.3. Recommendations for managing IP in multilateral DVCs

- Create a top-level IP metadata structure that is FAIR and applicable across all IP categories.
- Clarify the legal status of data, data products and data annotations under IP law.
- Discuss the application of sole and joint ownership doctrines in multilateral digital value chains.
- Identify solutions for tracking IP ownership in multilateral digital value chains.

4.4. Recommendations for incentivising rich data value networks

- Build an industry commons ecosystem of trust.
- Ensure that IP & IAs are one layer of a necessary industry commons system of systems.
- Ensure that inclusivity is foundational to the DVCs.
- Ensure feedback loops and notifications for background IP owners that highlight salient advancements in research, innovation, technology transfer, product development, marketing and HR recruitment.
- Consider SMEs and innovators as providers of emerging market data, early adoption, and potential partners for incubation and market acceleration.
- Update IP registration strategies to incorporate background IP and incentivise greater participation in DVCs.

- Analyse data transactions from the perspective of exclusivity, on one hand, and the values of timeliness and accuracy, on the other.
- Develop an online ICT platform to facilitate streamlined innovation workflows, easier team collaboration and smarter follow-up on findings and learnings.
- Build upon existing open innovation frameworks that rely on derivative and appropriation mechanisms, to ongoing collaborative innovation practices that include background IP provided in DVCs.

4.5. Recommendations for Industry Agreements for replicability and emerging business models

- Move beyond enterprise integration to a multilateral DVC cross-domain technological and business ecosystem integration.
- Clarify the legal effect of automated data transactions from the perspective of IP law
- Identify key elements in data-driven business models that determine the choice of open, closed or mixed IP strategies.
- Raise IP awareness as a business tool and educate users to be able to have more mature and valuable discussions around it.
- Implement AI to support SMEs in reviewing and benefiting from the mapping of their innovation landscape, to make use of extracted business intelligence and other IP activities on the market.
- Identify where IAs are needed and where more informal agreements can yield timely results.

4.6. Recommendations for DIH as key players in multilateral DVCs

- Support SME participation and awareness of business and IP opportunities in multilateral DVCs in the next EU frameworks.
- Ensure that participation in DVCs is stimulated by valorisation strategies that are sufficiently affordable and sustainable for SMEs.
- Ensure DIH SMEs benefit from attribution, accountability, layers of confidentiality and protection, the tracking of IP in value networks, FAIR data strategies for a standardised top-level metadata, and registration of innovation IP built on top of background IP provided by large organisations.
- Create mechanisms for support of arbitration and dispute resolution to protect EU DIH SMEs IP.

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