Rigorous empirical research on intellectual property

An interview with Dr. Bowman Heiden on economic value

Center for Intellectual Property - Chalmers University of Technology, University of Gothenburg, and Norwegian University of Science and Technology; The Hoover Institution at Stanford University.

In December 2019, Dr. Bowman Heiden published – The Value of Connectivity in the Automotive Sector – A First Look. A webinar organised by 4iP Council will be dedicated to this topic on June 11th. Registration to the webinar is already open.

On this occasion, 4iP Council decided to sit down with Dr. Heiden to further explore the value of connectivity and how economic valuation methods could contribute to a sound understanding of the matter.

A lot happened since the publication of your research paper: everybody understands the importance of connectivity to keep individuals and businesses connected. The value of connectivity in our daily lives is huge.
Your research was focused on the value of connectivity in the automotive sector. You wrote "The vehicle is emerging as the next digital platform which may be analogous to the evolution of the smartphone and the opportunities that connectivity provides has incentivised automakers to increasingly install embedded connectivity to capture the value from this new ecosystem".

Question 1- Do you see any new developments that you would like to highlight?

Certainly, the biggest news since the publication of my report is the COVID-19 pandemic, which has impacted everyone's lives in many ways and has had a significant impact on our personal transportation and broadly on the automotive market. The pandemic has both highlighted our need to be connected as well as challenged us to find new ways to stay connected.

Even with increased telecommuting in the future, people will still spend a great deal of time in vehicles. This creates four increasingly important roles for connectivity in vehicles:

1. For consumers as a communication platform for value added services in competition with mobile phone ecosystems (e.g. advanced navigation, eCall/bCall, in-vehicle hotspot, etc).
2. For producers as a source of data to improve vehicle performance and provide specific automotive applications (e.g. remote diagnostics and maintenance, remote vehicle control, etc.).
3. For commercial actors to provide better vehicle management and remote services (e.g. fleet management, usage-based insurance, etc.) in competition with 3rd party interfaces.
4. Redefining vehicular travel through the development of V2X capabilities and AD/ADAS.

The last role for connectivity will redefine safety and the nature of travel. V2X, for example, will link the connected vehicle with smart infrastructure and smart cities, in addition to communicating with pedestrians and other vehicles. Ford, for example, announced earlier this year that all 2022 models in the U.S. will be equipped with an advanced V2X system. Cadillac is working to enable its cars with V2X capabilities by 2023. And most of Volkswagen's 2020 European models will be equipped with V2X. This brings us one step closer to autonomous vehicles, where connectivity not only provides added value services, but becomes a core technology that defines the function of a vehicle.

One of the results you highlighted in your research paper is that "market revenues do not provide the whole picture, especially when multi-sided business models are deployed. Therefore, the total economic value, including consumer surplus and relevant externalities, is important to bear in mind when determining the value of connectivity in the automotive sector or regulation of the sector."
Mobility has been strongly impacted since the beginning of the COVID-19 outbreak. Connectivity has allowed for families and friends to stay in touch and for industries to keep a lot of their workforce working from home.

Question 2- Understanding the relevance of a high-performance connectivity, do you think governments should more heavily invest or incentivise investments in cellular standardisation?
Do you think that connectivity will play an even greater role in smart mobility in the coming months/years?

As we move towards a world where everything is connected – what is often termed the Internet-of-Things (IoT), the ICT infrastructure that enables this connectivity becomes an issue of both national competitiveness and security. Certainly, it is impossible to separate the role of connectivity from modern "smart" devices from their ability to communicate as smartness often requires information and feedback from other sources.

If we are to benefit from connectivity in automotive, healthcare, energy, agriculture, manufacturing, etc., ICT infrastructure (including cybersecurity) will need to be further prioritised by governments. We can see that this is already becoming a geopolitical issue in relation to the US and China regarding Huawei. While the consumer-facing big tech companies have the largest market valuations, the actors that are developing standards and producing the components and infrastructure are often underappreciated. This creates a dangerous situation for the US and EU if they fail to understand the strategic significance of the firms that develop the technology for standards as well as the importance of the maintaining control over the standard development organisations. China has certainly understood their strategic value and is actively looking to gain control of these arenas.

Let's talk about the "product" at the heart of this question: cellular connectivity enables the car to send and receive data on the vehicle's status, condition and user preferences, communicate with itself as well as with various off-board devices, networks and services.

Question 3- What does it take to invent such technology and how does that technology get included in a technology standard (e.g., 5G)? Is R&D at the heart of a licensing transaction? What are we talking about?

The functionality of connected vehicles requires contributions by many actors in the value chain. In this value chain, the connectivity standard is the key enabling technology upon which all other developments are built. If we take cellular technology standards as an example, the investment in developing the standard is massive. First, each

standard takes approximately ten years to develop, requiring tens of billions of R&D investments per year by technology firms and over one million person hours dedicated to the SDO process from hundreds of participating companies. Technology contributions to the standard are adopted through an open, consensus process by the SDO participants. Those of us who have worked on collaboration projects with only a few actors can appreciate what it must take to build a highly complex, performance standard with hundreds of actors.

Many of the complex technologies required for the implementation of cellular standards are protected by patents – commonly referred to as standard essential patents ("SEPs"). SEPs represent core, pioneering innovations that entire industries, such as automotive, have started relying on.

Question 4- What do you think about the role of patent rights on firms' incentives to engage in R&D activities and participate in the development of these foundational technologies?

One important aspect that is often overlooked is that technology standardisation is technology transfer. While we speak of standard essential patents (SEPs), these are just proxies for the enormous investments in R&D and standard development. The fact that the standard is open and transferred as a specification to implementing firms prior to licensing negotiations can obscure the reality that an SEP license is a technology license, not a simple patent license. Thus, open standardisation is fundamentally a large open innovation ecosystem for technology development and transfer. Technology contributions and technology licensing are two sides of the same coin and represent the core of the open innovation model in cellular standards. Thus, patents are essential (excuse the pun) to the success of cellular standards as they govern the incentives of technology providers to participate and contribute their proprietary technology. Patents also facilitate an increased division of innovative labour by supporting R&D specialisation. Without patents all participating firms that contribute technology would need to be vertically integrated, which would reduce economic efficiency, in particular, dynamic efficiency.

Next, let's turn our attention to valuation of cellular SEPs whose valuation is more critical than ever before due to the growing ecosystem they support. 5G is the game-changing generation of wireless technology, creating a universal fabric of connectivity – by bringing together very high data rates, ultra-low latency and ultra-high reliability. Assessing which companies are the key-players in the development of these technologies is of immense interest.

Question 5- What are the key general principles for a proper valuation method? Exactly what is being valued? Is it important to make sure that experts rely on methods which do not depart from mainstream economics? If so, why?

In price theory, the value of goods is observed in the market through the consumer's willingness-to-pay (WTP) and the actual buying choices that they make, known as the principle of revealed preferences. The total value of goods in a market is defined by consumer demand and market price, including consumer surplus, producer surplus, and producer costs. Thus, the consumer is the final arbitrator of the value of goods in a market that, in turn, is distributed to all actors in the value chain based on their contribution. This is the same for a technology input, such as a technology standard, where the value should be determined based on the technology's contribution to the total economic value on the market. This is especially true for enabling technologies, such as standards, that underpin the value creation of all products and services in the market. Thus, valuation methods should be based on market transactions, either of the technology itself or in relation to the product or service that employs the technology.

It has been recognised by courts around the globe that comparable licenses should be central to any SEP valuation methodology whenever possible. Specifically, it is argued that licensing agreements reveal information about different parameters, including market value, patent validity, and the extent of the infringement.

Question 6- What are your thoughts on comparable licenses as a valuation method? Do prior agreements provide reliable evidence on the value of SEPs?

The key principle in mainstream economics is that markets define value through actual market transactions. Therefore, technology market transactions are the best indicator of technology value when available, as they provide information on agreed prices by actual buyers and sellers. Other valuation methods require the creation of hypothetical markets that don't exist, and the creation of assumptions for which there may be little evidence in practice. It's not a coincidence that Georgia-Pacific factors 1 & 2 in US case law refer to market comparables.

For SEPs, this implies the use of comparable licenses as the most appropriate valuation method when available. The main difficulty that can arise out of the use of comparable licenses is that they can have complex terms that can take some effort to unpack, though this is not insurmountable. Cellular standards with a long history of license agreements should be able to provide reliable evidence of the appropriate market of SEPs. SEP value in new market contexts, for example, in different IoT applications, will in turn depend on the value generated in the specific use cases. Value is dependent on use.

It has been suggested that, besides comparable licensing agreements, other indicators could be potentially considered for assessing the value of SEPs. For example, consumer demand, measurable benefits of the patented standardised technology, and the price difference between substantially identical products with and without the standardised technology.

Question 7- What is your view on the use of these indicators? Do you see any difficulties with the implementation of valuation methods that rely on these metrics?

If specific comparable licenses are not available then all of the indicators mentioned above are helpful in understanding the value of the technology based on its use by the consumer. For example, analysis of consumer demand through surveys of willingness-to-pay (WTP) are helpful in understanding consumer surplus (i.e. the added value to consumers). Price differences for products that are identical except for the inclusion of the technology standard, such as cellular connectivity in an iPad, provides a good market indicator of the value as it can be easily isolated from other product features. It is also a rather clear indication of the expected value by the producer as they are the ones who have set the price.

Some implementers of cellular technology have advocated the use of top-down as a method for valuation of SEPs. The typical version of top-down involves first determining the aggregate royalty payment for all SEPs. The aggregate payment is then apportioned to individual SEP portfolios based on some algorithm (e.g., patent counts). Well-known innovation economics scholars, such as Stephen Haber, Alexander Galetovic, Daniel Spulber, have expressed serious concerns about this method, arguing that placing a cap on the price of an input (cellular technology in this case) is not consistent with economic principles[1].

Question 8- Do you consider the top-down as a reliable method for determining the value of the patented standardised technology to users of the licensed product or services? Who decides what the aggregate royalty should be, and how will the idea of a cap impact the notion that 'FRAND is a range' (i.e. a cap seems to be in sharp contrast with that notion)?

The top-down model has a simplistic appeal but is not compatible with price theory as it requires the creation of a hypothetical market that never existed. In this hypothetical world, licensors and licensees would need to have agreed on an aggregate royalty cap as well as the relative value of all SEPs. This is a daunting exercise without actual market data, which is why courts typically only apply this model if comparable licenses are not available or as a secondary method to check the validity of the results of a primary valuation using comparable licenses.

It is the market that decides the aggregate royalty through either bilateral or multi-lateral negotiations. The flexibility of FRAND is that it allows for customised solutions among market actors that, while not identical, are still FRAND. This is why the more you specify exactly what FRAND "is" in detail, the less valuable the FRAND mechanism becomes as a governance mechanism for complex, multi-stakeholder open innovation platforms. I like to say that FRAND is "wonderfully vague" for its purpose. FRAND needs to be a range to facilitate negotiations between different actors in the market. While market actors are free to negotiate a cap (e.g. through participation in a patent pool), this is completely different than a non-market, imposed cap based on a hypothetical market that never existed. Again, a range would seem to fulfil the concerns of all parties while supporting flexible bilateral agreements to be negotiated among market actors.

Although patent valuation is a complex task and requires a sophisticated analysis, there is a tendency by some to use simplistic methods such as counts of SEPs or technical contributions to determine the relative strength of individual patent portfolios. However, many economists have noted that patents and technical contributions are highly heterogeneous, and thus, the informative value of counts is little[2].

Question 9- How can counts capture relative strengths and values when they ignore the uniqueness of each essential patent claim? Do you believe that the use of counts can help experts at addressing questions about portfolio value and reaching conclusions about the technological prowess of companies?

[1] Alexander Galetovic and Stephen Haber, "SEP Royalties: What Theory of Value and Distribution Should Courts Apply?," *Hoover IP2* (2019);
Daniel F. Spulber, "Licensing Standard Essential Patents: Preparing for 5G Mobile Communications", *SSRN* (2019).

[2] Griliches, Zvi. "Patent statistics as economic indicators: a survey." R&D and productivity: the econometric evidence. *University of Chicago Press* (1998)
Schankerman, Mark. "How valuable is patent protection? Estimates by technology field. "*The RAND Journal of Economics* (1998)
Justus Baron, "Counting Standard Contributions to Measure the Value of Patent Portfolios - A Tale of Apples and Oranges", *Telecommunications Policy* (2019).

It has been widely accepted by both academics and practitioners that patent counts are a bad indicator of portfolio strength or value. Numerous studies have supported the skew nature of patents where some patents have considerable value but most are of little value. When applied to standards, there is some evidence that SEPs are more valuable than a general set of related patents, but still skew in nature. Simply put, all patents are not equal. A recent study of technical contributions showed similar results. These two findings should not be surprising.

Furthermore, patents and contributions can be strategically managed to show increased counts. Thus, by both nature and nurture, counts of patents and technical contributions are poor indicators of overall portfolio strength and value.

Studies have shown that the total SEP royalties for the smartphone industry are approximately $12-13 billion[3] in a mobile economy that has been estimated to be over $4 trillion.[4] Despite these facts, SEPs are often portrayed as causing significant market problems that need policy intervention.

Question 10 – What am I missing? Haven't markets employing cellular standards been highly successful?

While $12-13 billion is a miniscule percentage of the global $4 trillion mobile economy, it is still a large amount of money to actors involved on both sides of the negotiation.

The irony is that the reason we are still discussing SEP value and licensing as a market problem is due to the historical success of markets that have been built on SEP-enabled connectivity standards and the anticipated success of new IoT markets. For example, in mobile communications, the current estimate in 2019 is 8 billion SIM connections and 5.2 billion unique mobile subscribers worldwide, contributing $4.1 trillion to GDP, and employing 30 million people directly indirectly in the mobile ecosystem. Mobile Internet has grown to 3.8 billion users, roughly half of the world population with access rates as low as $0.26 per GB in India. For the US market, smartphone mobile internet penetration is slightly over 80% and growing. In the automotive industry, nearly all automakers have pledged to install embedded solutions in all of their new vehicles in the near future. IDC (2019) estimates that by 2023 nearly 90% of new vehicles in the United States and 70% of worldwide vehicles will be shipped with embedded connectivity. In total, the current number of IoT connections is approximately 12 billion and forecasted to double to over 24 billion by 2024. Thus, one could argue that the current policy narrative would be better focused on improving a market success instead of solving a market failure. Maybe we should be asking why are SEP values so low given the economic impact of the markets they enable.

Conclusion

Professor Heiden, 4iP Council would like to thank you for your precious time and your continuous willingness to guide us through the complexity of economic concepts such as valuation methods that are so important in intellectual property.

More on this topic

Would you like to learn more or address a question directly to Dr. Heiden? Register here for the webinar that 4iP Council is hosting with him at 16.00 CET on 11 June 2020.

[3] Galetovic, A., Haber, S., & Zaretzki, L. (2018). An estimate of the average cumulative royalty yield in the world mobile phone industry: Theory, measurement and results. *Telecommunications Policy*, *42*(3), 263-276.

[4] See GSMA (2020) The Mobile Economy, retrieved at https://www.gsma.com/mobileeconomy/.

The views expressed in this feature are those of the interviewee and may not reflect the views of 4iP Council or its members. The purpose of this feature area is to reflect thinking on the topic of intellectual property and enable open discussion.