
Research question (max. 400 words)

Introduce the research question and explain clearly how it is embedded in the literature

'3D Printing' is a relatively new technology that enables the user to print three-dimensional objects from a digital file. It has developed to a stage in which firms like Shapeways and Thingiverse have already entered the market with new business models to provide a new kind of service to the customer at home (Weinberg, 2010). Kim (2012) notes that the firm Makerbot has already sold over 13,000 printers for home usage. And the first small communities consisting of pioneers and Do-it-yourselfers have already surfaced (Makerbot, 2014). Consumers that are in need of spare parts for a device could produce it themselves at home instead of ordering it (often for considerable money) at a supplier. At a later stage, they might even produce full products at home, from small to larger.

This new technology is not only likely to be disruptive and have an impact on society as such; many academics also worry about effect of this technology on our *Intellectual Property Rights (IPR) Systems*. The technology will enable consumers to generate their own products or part of products -in the form of useful designs. It seems not clear whether the current IPR systems 'cover' such new ways of production, and even if they do, patent holders might not even be able to determine that their patents (or design rights) are infringed and cannot take effective action against large numbers of individual users. And on the other hand, creators at home might not even know whether they are infringing a property right (Doherty, 2012). Desai & Magliocca (2013) note that these developments are similar to what digitalization did to the music and film industry. Here, incumbents tried to restrict usage, failed and eventually seized their aggressive strategies. Like Doherty (2012), they suggest that 3D printing should be regulated mildly because it is important to keep stimulating new creation and progress of useful designs and science for which the intellectual property rights was originally intended. Dictating use would limit the technology's potential.

Following these academics, it seems reasonable to assume that a *technological change* is at hand that might endanger the intellectual property rights system. However, next to some empirical evidence that Do-it-yourselfers have access to the technology, a scientific ground for understanding the evolution of the technology and its impact is yet to be found. This research aims to provide a scientific foundation for the technological progress of 3D printing technology. This will help providing a deeper understanding of what this technology means for intellectual property systems, management and policy. The implications for society will become clearer, as innovation is important for economic growth (Schumpeter, 1934). Intellectual property systems are there to stimulate the flow of innovations into society (Granstrand, 2000).

Formulate the research question as adequately as you can, possibly together with sub questions and hypotheses

The central research question of this study is: 'What is the impact of 3D printing technology on our current intellectual property rights systems?'

Sub-question 1: 'What is the underlying technological evolution of 3D printing and to what degree does it have potential for large scale consumer applicability?'

To address the main research question, it is useful to map the direction in which the technology is developing. This will provide deeper understanding of the technology's history and shows the direction in which it is developing.

Sub-question 2: 'What is the nature of this technological change?'

The second sub-question lays a foundation for the kind of technological change at hand. Answering this question will show the impact on society separate from the impact of the technology itself and helps understand its disruptive potential.

Sub-question 3: 'What are the implications of this technology if it is diffused widely on large scale by consumers?'

Answering this question will show the technological capabilities of 3D printing technology and enables a comparison with the current situation.

Sub-question 4: 'How does this development challenge existing systems of Intellectual property rights?'

Answering the last question will highlight the implications and challenges for intellectual property right systems, which are widely used across countries.

Scientific and TIW relevance (max. 150 words)

Explain why your project fits the Innovation Sciences/ Human Technology Interaction domain (dealing with technology AND people) and how it connects or contributes to IS/HTI science.

Research about intellectual property rights in relation to consumers has always revolved around *Copyrights* as a main point of interest. Few have looked at *patents*. The main difference being the usefulness of the invention. The subject of analysis is different and only little is known about the implications for the patent system. This research will provide new insights inside this relatively new dimension of IPRs.

The patent system ensures a trade-off between private actors and society: knowledge in exchange for monopoly. A balance has been established between creation and diffusion. Many firms and actors use business models that include IPRs and distribution methods to compete. 3D printing technology might disturb this balance. The short term effects seem to boost creativity. However, long-term effects on society are not yet known. This research aims to better understand these effects and thus has societal relevance.

Method (max. 200 words)

Indicate HOW you are going to answer your research question. Describe for example what the (in)dependent variables are, what methodology you will use or develop. How are you going to collect your data? For example interviews, and if so, who are you going to interview and what for? How will you analyze your data?

RQ1: A citation analysis as proposed by Verspagen (2007), Bekkers & Martinelli (2012) and Fontana (2009) will produce a *Technological trajectory*. Because relevant 3D printing patents may be difficult to identify on the basis of keywords or IPC categories, I aim to use Castle Island Co.'s 'Rapid Prototyping US Patent Database' with 4937 US patents concerning 3D Printing technology. I aim to create citation pairs by cross-referencing the Derwent Innovation Index (DII) with information from the Castle Island dataset after which I will create a relation matrix in Microsoft Office Access. *Cited Patent* information will show a *dominant technology* and important actors. *Citing patent* information will reveal patents that build upon the knowledge of 3D printing technology. Here, I aim to perform an IPC/ Keyword query to reveal the scope of industries that 3D printing technology affects, as developments in 3D printing will affect possibilities in these industries. This will show which markets are affected by the technology and thus tells us where the change occurs. The citation networks are analysed with Pajek.

RQ2: This part of the study will draw heavily on literature on *evolutionary* models of technology development, *such as those of* Anderson & Tushman (1990) and *Disruptive* change models, as described by Christenson & Bower (1996). Using this literature, I will determine the nature of the *technological change* of 3D printing technology.

RQ3: On the basis of the work in RQ1, a subset of important international firms concerned with 3D printing will be established. I will list these firms according to number of patents and select interviewees based on list rank and business model. I aim to approach project leaders within the marketing divisions of these firms as daily work of these actors involves creating value (Anderson, 2008) for diffusion of their 3D printing product and knowledge about technology diffusion. 10 Semi-structured interviews serve as a basis to predict *use cases* as proposed by Cockburn (2001) for *Entrants*, *Incumbents* and *End users*. These actors are the most likely to change their business models (Pierce, 2010). A Compare & Contrast analysis between current business models as described by authors like Anderson (2008) and the interviewees will point out the impact on society through changes in *Distribution networks & Actor relations*.

RQ4: Because not much is known about 3D printing technology challenges to IPRs, I aim to search the internet for statements from academics, Patent offices and news articles. The search will encompass keywords like 'IPR' and '3D printing'. After finding a thread, I will perform in-depth research and approach the writer or specialist behind the statement. An actor is qualified when his/her work revolves around the borders of IPR in society in relation to 3D printing. 10 interviewees will engage in semi-structures interviews and provide information about 3D printing technology in context of law. *Direct- & indirect infringement*, *induced & contributory infringement* as described by Doherty (2012) and results from the interviews on *designs and patents* are compared with the current situation on *copyrights* caused by *digitalization* described by Desai & Magliocca (2013) & Engstrom (2013).

References

Provide three references of scientific articles and/or books that underlie the research proposal. Make complete references (refer to: *Publication Manual of the American Psychological Association*, 6th ed. (Washington, DC: American Psychological Association, 2001).

- 1 Doherty, D. (2012). Downloading Infringement: Patent Law as a Roadblock to the 3D Printing Revolution, *Harvard Journal of Law & Technology*, vol. 26. Number 1. Fall 2012.
 - 2 Verspagen, B. (2007). Mapping Technological Trajectories as Patent Citation Networks: A Study on the History of Fuel Cell Research, *Advances in Complex Systems*, 10 (1), 93-115.
 - 3 Christensen, C. M., & Bower, J. L. (1996). Customer Power, Strategic Investment and the Failure of Leading Firms. *Strategic Management Journal*, 17, 197-218.
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