D6.2 REPORT ON ETHICAL IMPACT FOR REGULATION

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Executive summary

Deliverable D6.2, “Report on ethical impact for regulation”, reports on our work on the ethical evaluation of DiDIY activities in the present and near-future, in particular on our recommendation whether these activities need to be guided by new policy regulations of some kind. The deliverable draws on the analysis developed in several other deliverables (esp. D6.1, D3.3, D4.6, D8.11, D5.6) and presents a step toward D7.4, “DiDIY-related policy recommendations”. To allow this evaluation we need to explain what the relevant activities are, which issues ethical issues arise and what kind of policy may be recommendable. We present an overview of the DiDIY techniques and an analysis of what makes Digital DIY special, which also shows what special ethical issues may arise. The concerns we found are grouped in broadly two areas: challenges to rights (in particular intellectual property rights and consumer rights) and physical risk (in particular product safety and legally limited artefacts like weapons). At this stage, we tentatively conclude not to recommend new governmental policy or laws, but a) self-regulation in the DiDIY community, b) attention whether IP rights needs a cautious application in order not to stifle creative DiDIY, and c) a continued close look at the technological developments because the potential for highly disruptive changes that demand regulatory intervention is significant.

Revision history			
Version	**Date**	**Created / modified by**	**Comments**
0.1	10/7/2016	AC	First, incomplete draft.
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1.0	29/12/2016	LIUC	Approved version, submitted to the EC Participant Portal.

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1. Introduction

This deliverable, D6.2, "Report on ethical impact for regulation" was developed in WP6, Laws, Rights, Responsibilities, Task 6.4: Ethical impact of DiDIY on rights and responsibilities (M15-M30) (Leader: AC). "The task will carry out a critical investigation of the ethical impacts and threats of DiDIY and their relevance for legal rights and responsibilities. Ethical considerations will be considered here as input for possible regulations and laws in the area." (GA 112f).

Partner AC runs the Transversal Task TT2 on 'ethics', which cuts across the content Work Packages because "DiDIY will have significant ethically relevant impact (that will occur) and it poses significant threats (that might occur). Impacts and threats directly affect the well-being of humans and society, but DiDIY also indirectly has an impact on (and perhaps constitutes a threat to) the ethical norms that currently exist in European societies." (GA 152). Consequently, this deliverable summarises the work on *possible* impacts and evaluates the *actual* impacts and risks.

Since this deliverable serves as input for regulation, it must indicate in which areas regulation may be advisable, and indicate what direction such regulation may take. Where no adverse effects are expected, no restriction of freedom through regulation is required. Also, even when adverse effects are expected, it may be that the restriction itself would be disproportionately negative, and in such cases we recommend refraining from regulation. Given the aim to serve as basis for regulation, this deliverable must focus on the 'bad news', on the areas where DiDIY has negative impact or poses some risk of such negative impact (thus it is not on 'nudging' towards behaviour that's considered positive). Given that the largest part of DiDIY turns out to be fairly innocuous, most areas of DiDIY will be mentioned here only in passing. Further to regulation, it may be advisable to positively support some areas of DiDIY via positive *policy*, but this question is beyond the scope of the current document.

In this deliverable, we look into the need of new regulatory policy; we do not specifically look at the need to revise or remove current regulation or law. This is an important issue, however, since current regulation and law are typically not suitable to deal with a 'collaborative/sharing economy' and generate hurdles for socially desirable changes. For example, patent law is designed for the industrial exploitation of inventions, and is unsuitable for the protection of individuals and communities in DiDIY. We also do not look at the issue of whether in DiDIY there are ethical obligations beyond the legal ones that people have to observe, as one author put it "Yes We Can. But Should We?" (Arieff, 2014). Finally, there are many social and economic developments that are influenced by DiDIY – such as job markets, product distribution, customisation, the design process, education etc. etc. –, and these developments may be considered positive or negative in the long run; we will only consider these if they are dramatic enough to warrant considering regulatory policy.

The ethics of DiDIY is almost totally undiscovered in the academic discussion. So, the progress beyond the state of the art consists in structuring the problems, identifying the major issues and the possible approaches, including links to extant research in related areas, such as intellectual property rights, product safety, medium-term risk, etc. More details on activity in Annex 1.

The areas of DiDIY where we have identified issues that may require policy are challenges to rights (in particular intellectual property rights and consumer rights) and physical risk (in particular product safety and legally limited artefacts like weapons). From the standpoint of ethics, *rights* are

closer to the core of ethical concerns, since *rights* are elementary guidance for human action: if some agent has rights, this implies that other agents have *obligations*, e.g., if you have the right not be deceived then I have the obligation not to lie to you. The considerations of *risk* are of a different nature since they concern the *consequences* of actions, which is central to "consequentialist" approaches to ethics, esp. utilitarianism. For the evaluation of consequences, the main questions are a) evaluation of particular outcomes, usually in terms of utility (pain and pleasure) for sentient beings, and b) the probability of particular outcomes.

We see challenges to rights (in particular intellectual property rights and consumer rights) and physical risk (in particular product safety and legally limited artefacts like weapons). Given that consumer rights and product safety are just two sides of the same coin, in our case, our findings just boil down to three issues. Each of these forms the core of one deliverable in TT2 (Transversal Task 2, "ethics"):

1. risk through "dangerous" artefacts (D4.6, "Ethical issues in education and research");
2. intellectual property rights (D3.3, "Ethical issues and work");
3. liability and safety (D5.6, "Institutions and creative DiDIY").

We should note that some uses of DiDIY also pose a threat to the right to privacy, esp. the making of DiDIY drones and Internet-of-Things (IoT) devices. This important issue was discussed in an earlier deliverable in WP 6, not from TT2 (D6.1, "Dominant legal challenges and solutions practised", p. 31-37) and is now discussed in more depth, esp. on technology, in the parallel deliverable:

4. privacy (D8.11, "Risks, synergies and education").

The present deliverable tries to draw together these strands from the 4 other deliverables and express the consequences for regulation, if any.

On 1, the discussion is complicated since we need to predict the future of what will be made. From what can be seen right now, DiDIY will remove the distinction between threats in the digital realm ("cyberspace") and the physical realm – so, cybersecurity and physical security will really be a single problem: 3D printed guns, killer-robots and biohacking are cyberthreats, just like the hacking of digital systems of some opponent. This is what we call 'atoms-bits-convergence, or ABC, in other documents of this project. Whatever moves into the digital realm moves into a "state of nature": we may well get the worst of both worlds, with the uncontrollability of the digital but the impacts of the physical. We tend to think that current laws, e.g., on gun control, are sufficient to deal with these developments, but we foresee massive problems in enforcement of these laws.

On 2, there is a substantial amount of discussion about the impact of the digital revolution on intellectual property (IP) rights and the need to revise extant legal systems, including a restriction on IP rights or the inability to apply these to a collaborative economy. There are also known fundamental socio-economic changes for entire industries that are traditionally based on intellectual property, especially the music and video industry, advertising and publishing – largely due to the inability to control violation of IP rights because digital files allow multiple realisation and perfect replication, as well as enabling anonymity. The digital realm also has a strong cultural preference for a "state of nature" and "free information", being opposed to "control". It is thus assumed that these changes affect "the media" – but not design and production of artefacts. We argue that this assumption is false because the digital revolution is now supplemented by a revolution in digital systems that automatically transform bits to atoms (prominent examples are 3D printers and

industrial robots) and atoms to bits (as in 3D scanning). Even though there are practical limits to these technologies, digital making will undermine IP rights on 3-dimensional design, just as digital media technologies did for 2D design and arts. Is that a good thing? Does it require regulation?

On 3, the rise of DiDIY poses significant challenges for current European laws on product liability but given the few solutions that have been proposed in the existing academic literature, we suggest that while these challenges do need to be taken seriously, an aggressive response at the legal level is not called for. For example, there are strong links between the practice of DiDIY and the free, open-source movement (whether at the level of the software, hardware, and digital blueprints used to make a DiDIY product). Introducing measures that would increase the liability of the creators of such open-source products would almost certainly stifle innovation in this field and might well, if sufficiently stringent, spell the end of the movement and of the various benefits it provides to society. As a result, we suggest that less radical solutions – sometimes generated by the participants themselves – are more likely to strike the right balance between the value of promoting such innovation and respecting everyone's autonomy, on the one hand, and on the other hand the need to protect consumers from defective products and to ensure that they know the level of risk they might be taking when deciding to use an open-source tool to make a DiDIY product.

On 4, the problem of *privacy* is mainly that DiDIY gives access to electronic means of data collection to more people and in more ways. Electronic DiDIY such as work based on Arduino boards and bits-to-atoms technologies enter the ubiquitous digital realm, often connected to the Internet of Things (IoT). Spy cameras and such are now easy to build, even where they are hard to buy, a simple key (e.g., the TSA key) is easy to 3D print. Again, this is a gradual change, but with more means for more people, it will change what is actually done and what can actually be controlled. And that will have an effect on what will be enforced – for example in many European jurisdictions it is illegal to make video recordings of people (except under special circumstances: e.g. they have consented, or are persons of public interest or part of a larger scene such as a city square), but practically this is not enforced any more in many places. These and other privacy problems are discussed in more detail in D8.11, section 2.1.2, "Privacy and Identity Theft".

1.1 Technical terms and acronyms

Term	**Meaning**
ABC	Atoms-Bits Convergence
CAD	Computer-Aided Design
CNC	Computer Numerical Control
DIY	Do-It-Yourself
DIYer	individual or organisation (formal or informal) that engages in DIY
DiDIY	Digital Do-It-Yourself
DiDIYer	DIYer that engage in DiDIY
DiDIY design	(1) process of designing an object by a DiDIYer, usually by means of CAD software (2) digital blueprint resulting from a process of designing an object by a DiDIYer

DiDIY manufacturing	manufacturing of a product by a DiDIYer using DiDIY tools
DiDIY product	product created by a DiDIYer using one or more DiDIY tools
DiDIY tool	DiDIY resource as physical or virtual tool or machine directly used in physical or design work for the purpose of engaging in DiDIY
fab lab	small-scale non-profit workshop that makes its equipment, including digital fabrication devices, available to the public
GA	Grant Agreement
IoT	Internet of Things
IPR	Intellectual Property Right
KF	Knowledge Framework
prosumer	person who combines the roles of producer and consumer with regard to one and the same product
STEM	Science, Technology, Engineering, and Mathematics
SV	Shared Vocabulary

2. Some basic conceptual clarifications

2.1 How to understand DiDIY: reminders from the Knowledge Framework

Before we start discussing the ethical issues that DiDIY raises in the context of work, it is crucial to clarify how we will understand the concept of DiDIY in this deliverable. On this issue, we will rely on the explanation of the concept presented in three foundational documents: the Grant Agreement (GA) for this Project; the DiDIY-related shared vocabulary (SV); the revised version of the Knowledge Framework (KF; deliverable D2.4). The GA gives the following characterization of DIY, or Do-It-Yourself: "What is customarily called '*do it yourself' (DIY)* is more a (long standing) *social phenomenon* than a (brand new) technology, and as such its scope is not well delimited: *it customarily denotes activities performed by individuals, outside companies and without the support of professionals,* in such diverse fields as mechanics and electronics but also gardening, pottery, sewing, etc." (GA, p. 4; emphasis in original).

These characterizations of DIY in turn suggest a few key features of DiDIY: it refers to a certain type of activity or *practice*, but also to a *social phenomenon*. The type of activity in question is typically performed by individuals who are not thereby engaged in a professional endeavour and are unassisted by professionals – at least, this applies to DiDIY narrowly understood; we will see shortly that there can also be broader understandings of the concept that do not rule out the presence of professionalism. The novelty brought by DiDIY as compared to DIY in general (which, as the KF reminds us, is a phenomenon that goes way back in history) is clearly the "digital" element: the DIY activities it enables are now performed with the help of new digital tools, from 3D printers to Arduino boards.

Let us also note that the KF defines DiDIY as being both an *objective* and a *subjective* phenomenon. To quote the formulation of the KF, DiDIY is simultaneously something that someone:

- *does*: an activity for the creation, modification or maintenance of objects or services; in this sense DIY and DiDIY are *objective* phenomena, that can be studied from the analysis of tools, products, structure of collaborations, etc.; and
- *has*: a mind-set, and then a producing and consuming culture; in this sense DIY and DiDIY are *subjective* phenomena, that can be studied from the analysis of motivations, competences, social contexts, etc (KF, p. 8).

In this deliverable, our focus will mostly be on the objective facet of DiDIY, even though we will also take the subjective component into account. Understood as an activity, DiDIY involves, among other things, the use of technologies like 3D printing, CNC milling, laser cutters, and other digital manufacturing devices, by hobbyists rather than professionals, as illustrated by the rise of the contemporary "maker" movement. As the definition just quoted from the KF indicates, however, DiDIY goes beyond this to also incorporate, for instance, the modification of existing objects (which can for instance be made "smart" with the help of devices such as Arduino boards).

There is a distinction between *narrow* and *broader* conceptions of DiDIY:

- in a narrow conception, DiDIY, as we have seen, is only practised by non-professionals and without the assistance of professionals. Furthermore, it also involves what the KF calls

"atoms-bits convergence" (ABC), that is, the integration of physical and informational components, resulting in the production of a physical artefact (KF, p. 18);

- in a broader view, by contrast, DiDIY "is also for professionals who maintain their DIY mind-set" (p. 25), and "is also aimed at creating intangibles and performing services" (p. 18).

In this deliverable, we will overall adopt the latter understanding of DiDIY, although we will mostly be focusing on cases where people do not engage in the relevant activities as professionals. We will, however, confine our analysis to cases where a person (the "DiDIYer") can clearly be said to have *made* or created something herself in more than a minimal sense, even if the thing she made is not a physical artefact. One example would be a case in which a person (a non-professional) obtains the digital blueprint for some printable artefact and uses it to print the item on her home 3D printer. We take the view that this person is engaging in DiDIY, insofar as (s)he is manufacturing the item herself using her own tools and basic materials.

A crucial related notion for our purposes is that of *DiDIY product.* As referred to in the SV, we will understand a DiDIY product to be "a product created by a DiDIYer using one or more DiDIY tools", which could be designing tools (CAD software) or manufacturing tools (e.g., 3D printing). A paradigm case of such a product would be one (say, a coffee mug) that gets designed by a DiDIYer on her computer and then manufactured by that same person on her home 3D printer. However, the definition just given allows that an item designed by a DiDIYer that then gets printed by a professional 3D printing service like shapeways.com, or conversely, one designed by professional designers that a DiDIYer then prints on her own 3D printer, also count as DiDIY products. In both of these scenarios, the DiDIYer in question could either be the end user of the product, or a third party (such as a hobbyist making her 3D printer available for use by others, whether for free or against a small fee). The former type of case is arguably a "purer" case of DiDIY than the latter. Items that were both designed by professionals and then printed at a 3D printing bureau would, on the other hand, fall outside the category of DiDIY products.

3. DiDIY – ‘anyone can make anything?’

3.1 Digital-Analogue

For our purposes, we need a deeper understanding what is particular to DiDIY and thus what particular issues it involves. What is the difference between “digital” and other DIY? The example of games shows this difference rather well (Haugeland, 1985): chess is a digital game because each position is a *discrete* state, a pawn can be on A2 or A3, but not somewhere in between. In between does not count as a ‘position’ in chess. In billiards, on the other hand, the positions of the balls are *continuous*; any position counts. Furthermore, positions on a chessboard are tokens out of a (finite) set of types (A1 to H8) with a (finite) set of pieces – this point was expressed as the digital being *coded* through a convention in D2.2 (section 3). In billiards, on the other hand, the positions of the balls are *continuous*; any position counts. There is a certain disagreement within the consortium on the detail whether *discreteness+tokens* or rather *encoding* should be the crucial criterion for being digital. This difference matters in a few cases that have the one feature but not the other, e.g., a clock with analogue hands that move in discrete steps – this has discreteness+tokens but not digital encoding. However, all cases of igital DIY are digital in both accounts and a feature that remains on both accounts is ‘multiple realisation’, and that feature is crucial for the risks of DiDIY.

Our present computers are digital devices, which means that the same digital state or sequence of such states can be realised on different computers, even if they are build differently. So a file with a programme or a digital description of a text or image can be replicated perfectly (not just nearly perfectly) many times, without limits. Furthermore, this replication has almost no cost, can be transported near-instantly, and anonymously. So if something is digital, it’s impact is potentially far higher than if it isn’t. When “Mississippi Fred McDowell” plays the blues, only people who are present there and then can hear it, when an analogue recording is made it can be duplicated and transported physically at some cost, but now his music is recorded digitally on YouTube for anyone to hear at any time – provided they have the necessary technical equipment. The digital has much *higher impact*.

So far, this situation applied to media that can be reproduced on a computer with a screen and a loudspeaker, i.e. text, music, images, video – but not to 3D physical objects. This is one major change that we see with DiDIY, though of course it deals with purely digital DIY as well.

3.2 The uncontrollable digital realm

The digital realm has its own rules, and that makes it a particularly challenging place for regulation. It is harder to actually control who does what and where and but it is also culturally and politically opposed to control (Barry, 2015; Depoorter, 2014; Lessig, 2008). The rally cry of the Internet is “Freedom of Information!” Of course owners of IP rights have tried to restrict the distribution of material they have legal rights to (whether or not they should have these rights), especially text, music and video … but these “file sharing wars” were lost by IP rights owners. Pirate Bay, Silk Road, etc are alive (perhaps in new forms), even YouTube, a Google company, now plays any amount of rights-protected video and music you want. Trying to prevent the spread of a digital piece of information typically has the *opposite* effect: it become more popular and more easily available (this is known as the ‘Streisand Effect’).

The ‘freedom of information’ advocates won *technically* and *culturally*. The latter is important since it shapes what people do in the digital realm: copying music on tapes was considered a somewhat dubious activity, but to the digital natives copying music, or listening to a stream has no ethical concern whatsoever – and for that reason it is done on a huge scale.

The digital realm is largely in Hobbes’ or Rousseau’s “state of nature”: there are no rules, no state to enforce rules (anarchy) and the result is either “true freedom” (Rousseau) or “war of all against all” (Hobbes) – depending on ones’ ideology of human nature. So what moves into the digital realm moves into the state of nature. Of course this is not quite true, as we will see soon. States try to enforce rules in the digital realm, but their success is very modest indeed (which is often unfair when only very few violations are punished by the ‘old’ rules).

3.3 Technologies (ABC)

The crucial technologies in DiDIY show ABC (atoms-to-bits-convergence), i.e., they rely on the conversion of atoms to bits or bits to atoms by automated digital means, which leads to a “convergence” of the two. There are many such technologies, and they are in swift development, but the primary ones are 3D printing (additive manufacturing in a variety of materials), CNC milling (subtractive), laser cutting, weaving, and DNA hacking. These are also used for the self-reproduction of the converters themselves, so parts for 3D printers are printed (RepRap) and parts for CNC mills are CNC milled. The main driver of these technologies at the moment is the DIY Culture, especially the “makers” culture of bricolage with sharing of information and technologies – the ‘free software’ movement has generated the ‘open hardware’ movement.

For our purposes, the crucial feature of this “anyone can make anything” socio-technical phenomenon is the automation of conversion. The atoms-to-bits and bits-to-atoms conversion itself takes place with digital technology. So we have the characteristics of the digital realm (duplication and communication at near-instant speed, unlimited copying, etc) with the DIY realm (no organisational or professional organisation, no legal representation, etc) – these two together mean that DiDIY is practically very difficult to regulate, should this be desired.

3.4 Lacunae & 3D hype

Having said that, it is currently far from the case that “anything” can be made with automated bits-to-atoms processes that require no particular expertise. Some hurdles are:

- Where does the “making” start? What kinds of components or “raw materials” are assumed and how are these acquired? (metal piece, magnet, electrical motor, ...?)
- Components that cannot be made due to lack of precision, complexity, etc (think mobile phone or watch (Branwyn, 2016): microchip, precise metal parts, cables, textiles, organic material, living material, …).
- Some “making” requires a particular process, rather than just an outcome (cooking, curing, cutting, welding, screwing, bending, pressing, baking [cement, ceramics, cake], twisting [springs, coils in electric motor] sewing, casting metal, pulling metal, painting, drilling, gluing, knitting, weaving, braiding, heating, cooling, drying, soaking, other chemical processes [see chemical engineering], agriculture & animal rearing, biological growth, …).
- Assembly or application of components may be a highly complex work for experts (think of assembling a car or of implanting an artificial organ (Wolf & Fresco, 2016)).

- Some technologies may be available but practically not suitable for DIY (too expensive, too large, require special conditions, e.g., sterile environment, etc).

3.5 Ethics and affordances – in DiDIY

So, is a technology or a socio-technical phenomenon like DiDIY even susceptible to ethical analysis? We think so. Taking the usual division of ethical theory – which looks at consequences of an action, rules for action and motivations for action – as our framework, we see that technologies have direct ethical impact in several ways:

- consequentialist perspective (unleaded petrol) – leads to better *outcomes*;
- rule following perspective (TurnitIn, surveillance, nudging) – leads to better *actions*;
- virtue perspective for "moral sensitivity", second order desires, phronesis, habit-formation … (moral enhancement?) – leads to better *humans*.

Introducing a technology introduces "affordances": it makes certain actions easier and thus more likely than others, it forms habits and desires (virtue), it makes following or violating rules easier (rules) and makes certain consequences more or less probable (consequentialist). Think of introducing handguns into a society: this will form virtues, make it easier to violate certain rules and will make certain consequences more likely. DiDIY will do the same, and we need to think whether the virtues, rules and consequences it supports are positive. Perhaps the technology needs some kind of control, just like guns need gun control (Müller, 2015)?

4. Main areas of concern

4.1 Physical risk with digital power

So, what are the ethically relevant impacts of DiDIY? It appears that the automated ABC and BAC produce a new quality because we now get the physical risks and the digital risks – in one. We get physical impact like that of a bullet, but in the digital 'state of nature' with its perfect reproduction under anonymity, and the difficulty for control – both technically and culturally.

If fully featured banknotes could be DiDIY made automatically, then we would have to take drastic measures – of giving up on banknotes (perhaps in favour of electronic means) or of restricting certain DiDIY technologies. Fortunately, that does not seem to be on the cards, just yet.

DiDIY guns, however, are real. The "Liberator" is a 3D printed single-use handgun and it's description file saw 100,000 downloads in 2 days, in 2013. This means that this file is now 'in the wild' and there is no known way to get the genie back into the bottle. The "Solid Concepts" file for the Browning 1911 pistol is on the Internet since (2013). Unlike the "Liberator" it is not in plastic, so printing it requires a specialised and fairly expensive metal 3D printer (All3DP, 2016)… but the result is a real gun that can fire many times (it was used by military in WWI and II). The "Ghost Gunner" is a concept of making the 'lower receiver' of a particular military grade semi-automatic rifle on a CNC mill. The mill + file has been for sale since 2014 at 1500$ under the slogan "Legally manufacture unserialized AR-15's in the comfort and privacy of your home." (Greenberg, 2015b) Here the "ghost" refers to the fact that these guns do not have a serial number, i.e. they cannot be traced. US government is trying to restrict sales, but the situation is pending since the people selling this set have started a "right to free speech" lawsuit – we are not selling a gun, we distribute information, thus "free speech" (Greenberg, 2015a). The development now includes 3D printed ammunition (Mitchell, 2013), rockets and explosives. The government in the Australian state of New South Wales has outlawed the mere possession of files that describe a 3D printed gun (Daly, 2014; Oswald, 2015). Most countries currently only regulate the use, carrying, possession and making of guns and other weapons, but not the possession of means to make them. A list of 'notable 3D printed weapons and parts' is maintained on Wikipedia: https://en.wikipedia.org/wiki/List_of_3D_printed_weapons_and_parts.

In the area of synthetic biology, there are developments in this direction (Dvorsky, 2014). "Biohacking" is now a popular branch of the Makers scene. For example, Ellen Jorgensen in her talk "Biohacking – you can do it, too" (TED June 2012), she just says if someone is into pathogens they are not part of the biohacking community. Famous biologist Craig Venter works on a notion of "Biological Teleportation" (MacKenzie, 2012) for transporting vaccines and other DNA digitally to devices that would 'print' the results – currently DNA … then proteins, viruses, cells (Sandberg, 2014). Some people have proposed uses for this, e.g. releasing a "Pink Army" of computer designed viruses to fight cancer (A. Hessel) or transporting life to Mars via this teleportation. – It is fairly obvious that this technology would lend itself to careless or intentionally harmful uses with large negative potential (a new influenza virus would kill millions), but also to widespread problems of other sorts, e.g. if cosmetic surgery or treatment becomes a DIY procedure.

3D printing of tissue is now feasible on a simple scale (we were invited to a relevant workshop earlier this year) and is about to be used for drug-testing on these tissues – rather than on live

animals (Kamen, 2015). These techniques can be used for treatment but also for enhancement of humans and perhaps for prolonging life through replacing 'spare parts'. Whether this distinction between 'treatment' and 'enhancement' can be maintained will be a crucial question for regulation in this area of the "The human body in the age of its technical reproducibility" (with reverence & reference to (Benjamin, 1955)). The potential for these technologies is large and they are discussed in detail in our deliverable 4.6 on 'education and research' (M24).

4.2 IP rights

Intellectual property rights fall into 4 main categories with different function:

a) Trademark. "A trade mark is a sign aimed at distinguishing the goods and services of a party from those of its competitors (the party may refer to its trade mark as its "brand")" (DiDIY D6.1, p. 17). The famous "swoosh" under the Nike symbol, or the superimposed L and V letters forming the Louis Vuitton logo are paradigm examples of trademarks. The purpose of trademarks, as Elif Sonmez puts it, is two-fold: "to prevent consumer confusion when searching for goods in the marketplace, and to protect and encourage property ownership and quality control by the maker of the goods to which the trademark is attached" (Sonmez, 2014, p. 757).

b) *Design rights*. Such rights protect "the outside appearance of a product. The design may consist of three-dimensional features, such as the shape or surface of a product, or of two-dimensional features, such as patterns, lines or colour" (OECD/EUIPO, 2016, p. 19). To deserve such protection, a design normally has to be novel, in the sense that no identical or very similar design is known to have existed before. Furthermore, design rights do not protect technical functions of the relevant products (*ibid.*). Design rights are limited in time, e.g. 25 years in the EU. Rights are subject to a fee. The practice of 'counterfeit' products (the classic fake Rolex watch) violates both trademark and design rights (Ahuvia, Gistri, Romani, & Pace, 2013; Grunewald, 2016).

c) *Patent rights*. "A patent enables the patent holder to exclude unauthorised parties from making, using, offering for sale, selling or importing the protected inventive subject matter" (OECD/EUIPO, 2016, p. 18). Patents protect inventions, whether products or processes, that provide a new solution to specific problems in the field of technology, broadly understood. The protection conferred by the patent is usually for a period of 20 years from the date when the application is filed (*ibid*., pp. 18-19; DiDIY D6.1, p. 16). Rights are subject to a fee.

d) *Copyright*. Copyright is a set of rights related to the original creative works of authors. It grants authors exclusive control over, among other things, the reproduction, distribution, translation and adaptation of their work. The rights in question, however, are subject to limitations, such as Fair Use. Works protected by copyright include literary works, musical works, films, or works of visual art (and in some countries, as we have mentioned, fashion designs). In most legislations, copyright is granted automatically, with no need for registration, from the moment a work is created. It is also limited in time: with some exceptions such as films and photographic works, the international minimum standard for copyright protection is the life of the author plus 50 years (OECD/EUIPO, 2016, pp.17-18; DiDIY D6.1, p. 16).

These rights are under significant pressure in recent decades due to digital developments, esp. on copyright and, to a lesser extent, trademarks. So far, design rights and patents have been fairly "safe" (Desai & Magliocca, 2014) since they apply mainly to 3D objects – this is where DiDIY changes the game. These issues are discussed at some length in our deliverable D3.3 (M24).

4.3 Liability and safety

A ‘legal person’ that can be either a ‘natural person’ (like you and me) or a juridical person (like a company or a state) has legal liability (criminal and civil) and moral responsibility for actions (e.g. Eshleman, 2014). In a general sense to say that someone is legally liable for the harm incurred through the use of some object is equivalent to saying that she is legally responsible or accountable for it. This liability can be criminal (for natural persons only) or civil, which means that financial compensation may be paid – even for damages that are not in themselves financial, such as bodily injury.

There is a complicated and well-developed legal framework for liability law that covers in particular the framework of consumers, manufacturers and sellers of products (Engstrom, 2013). This framework is largely designed to deal with commercial, for-profit, interactions. So, as far as DiDIY enters this area, liability law will apply – and that is presumably desirable, since the consumer should not have a disadvantage from the manufacturer using a particular manufacturing technology.

Having said that, if individuals interact with each other as private individuals (not as professionals and not with commercial aims), then commercial law does not apply, not even if one individual pays another. In these cases, liability is typically limited to the sold item ‘as is’ and to avoiding deception. If no commercial activity takes place, e.g. if one person gives something to another as a gift, then there is no civil liability. So, if a maker downloads a file and makes an item that then breaks down and injures someone (the lamp falls off the ceiling), the maker is as liable, as if they had made the item by hand.

Some have proposed that this risk could be reduced by “a clearinghouse for the distribution and sale of authorized 3D printer CAD files” (Harris, 2015) and that seems like an option, but, again, the liability would remain with the user – unless the ‘clearinghouse’ explicitly sells ‘safe’ designs. Websites like Thingiverse, through their terms of use, place pretty much all of the responsibility on the consumer. We see little additional risk being generated by DiDIY in this field. If there is a risk, that is of stifling DiDIY through the existing regulation, but change in this area seems unlikely since ‘consumer protection’ is high on the political agenda.

These issues will be discussed at length in deliverable D5.6.

5. Proposals for policy & self-regulation

As we explained above, the digital realm is a particularly difficult place for enforcing a regulation. And the ability to enforce is critical for the consideration whether a regulation is fair – some regulations have already lost that property and are thus not actually enforced any more. The results depend on how high the stakes are, how efficient regulation can be, and how negative the effects of the regulation itself are. The fight against doping in sports is an instructive example where some people think the stakes are high and the regulation broadly efficient and conclude that we should continue, while others (Savulescu, Foddy, & Clayton, 2004) think the stakes are not so high, regulation fails badly and enforcement would unduly restrict the participants. The first group think doping must remain illegal, the second think that doping should be permitted. Is it time for regulation (Kellogg, 2012)?

5.1 Legally controlled artefacts and cybersecurity

Our discussion on these issues (http://www.didiy.eu/blogs/some-more-thoughts-controlling-spread-dangerous-information-online) has shown that measures to suppress some behaviour (e.g. acquiring guns or viewing child pornography) can be useful even if they are only partially successful, while accepting that they can become useless if they are largely unsuccessful – because then they become unfair to the "few" that are caught. It remains to be seen hat technical means there may be in the future to exercise such control, e.g. of a file 'containing' the design of a gun, and whether the use of these means is a good idea – given that it may violate other rights, esp. that of privacy. Note that when there is a significant movement in favour of the "freedom" of some kind of information (e.g., spreading the view that "the Holocaust is a lie", which is illegal in Germany), then control becomes nearly impossible, except with the means of dictatorial regimes – and using these would defeat the purpose. How easily something is accessible *does* matter, for practice and regulation, this is an important lesson from DiDIY.

5.2 IP rights

IP rights such as copyright, trademarks, design rights are a frequent bone of contention in the DiDIY scene since they are felt as restrictions of freedom, imposed by powerful agents like the state and corporations (see the discussion in D3.3). The tradition of valuing 'freedom' highly can lead to the conclusion that we should abandon these rights and move away from rights and licensing – or we should use our IP rights for 'free and open' licensing models. This is supported by the fact that IP rights have been expanded significantly over the years, e.g. copyright now often runs to 70 years after the death of the author, or 100 years after creation – which means it covers the whole lifespan of typical grandchildren of the author, and some of great-great-grandchildren. Some rights, like trademarks, run forever (the name and the design of Mickey Mouse are trademarks, as well as copyrighted). It seem doubtful that these provisions still serve the interests of society at large or of creative agents, rather than of big business. Having said that, IP rights are largely still in force (though copyright has been limited in the digital realm), they have significant clout, and in principle they do serve a societal need – so maintaining them in the commercial arena will likely be possible and is thus likely to happen. We do not see immediate need for new policy in this area, but the current discussion should serve as an occasion to re-think what IP rights are for, and whether some

of them have gone “over the top” and need reform such as to serve societies needs. In particular non-commercial uses like 3D printing spare parts (see D6.1) may need to be de-criminalised.

5.3 Liability and safety

This is the area where we see the least need for direct regulation beyond the large body that already exists. Furthermore, the stakes are high (safety) and the chances for enforcement at reasonable societal cost are also high, so there is little motivation to change the current regime. Having said that, liability should not stifle creative new societal developments, so it is probably advisable to watch this area for measured response – it is hardly demanded to come down hard on a person selling privately printed devices (say drinking cups) because they violate regulation (food safety, (Federal Ministry of Food and Agriculture, 2014)). There is also a question whether a form of ‘collective insurance’ is needed to cover some of these risks where they threaten to stifle creative and playful DiDIY movements.

5.4 Self-Regulation

It is characteristic that the Maker movement is not just a technical development but primarily a social movement with its ethical values. This can be exploited. From our Knowledge Framework:

“LW11. DiDIY and ethical values practised

In a narrower view DiDIY simply refers to a new approach to making things, while in a broader view it also involves a set of ethical values and convictions that tend to prevail among practitioners of DiDIY and to govern their activities.

When observing the core values behind the characteristics of DiDIY we can extract the following: (i) the value of sharing and helping others (solidarity); (ii) the reputation economy (trust, transparency, demonstration of skills); (iii) equal rights of access and participation (equity); (iv) participants do not need to obtain permission (free-as-in-freedom, autonomy). These values may not be necessarily shared by all, but they can be seen as present in most if not all of the DiDIY communities.” (D.4.2, p. 21).

Given these values, we can assume that there will be significant dynamics towards self-regulation in the DiDIY movement and this can be encouraged by official “threat” that regulation may be in the offing. This structure may be relevant for safety considerations, in particular, but also for weapons and biological DIY.

6. Conclusion

As we said above, the question whether regulation is advisable depends on whether the stakes are high (i.e., the probability and the negative impact are high), whether regulation is practically feasible, and whether regulation would have itself negative impact (e.g., the need for surveillance).

As a society, we can tolerate a certain violation of standard rights, esp. IP rights of large corporations, if we decide that it would be highly damaging to fight these violations through means that may be able to root them out, since such means would imply massive surveillance and criminalisation of a large part of well-intended DiDIY makers. It was for these reasons that we primarily recommend only self-regulation at this point. However, we also recommend that extant legal provisions, e.g., on product safety, weapons and dangerous substances are enforced with DiDIY (as far as this is suitable, given that many DiDIY exchanges are not commercial). The stakes in these cases are high, and the costs low.

If severely disruptive technologies were to find their way into the hands of DIYers, this balance will change. If there is significant risk that DIY results in the availability of serious weapons, pathogens or the like without massive hurdles and serious risk to be caught, then the society would be called upon to erect such hurdles and increase the risk to be caught. For example, in Europe, we have outlawed most weapons and put severe licensing restrictions on small firearms and even knives even though these laws have restricted the freedom of citizens significantly.

The issue of IP rights is probably the most contentious and the one where a balance is most difficult to strike – mainly because it is doubtful that current law is fully in the interest of society and whether enforcement itself would not result in significant negative results. However, even here we would not recommend throwing the baby out with the bathwater by removing these rights, which is in any case politically very unlikely.

Annex 1: Deliverable-related academic activities

We have discussed this work with people in applied ethics and related fields on a couple of occasions, typically as a result of invitations to academic events this year (thus at no cost to the Project). Collaborators at AC have presented papers at:

- University of Sheffield, Department of Robotics, 15.02.16;
- University of Leeds, Centre for Applied Ethics, 22.02.16;
- Conference "Towards an Ethics of Copying", Centre for Interdisciplinary Research, University of Bielefeld, 09.03.16;
- European Institute for Theoretical Neuroscience in Paris, HBP Foresight Lab: "Dual use, Future Computing, Neurorobotics and the Human Brain Project", 11.03.2016;
- University of Copenhagen workshop "Digital Representations: Cultural, Social and Legal Critiques", 18.04.16;
- Fondation Brocher, conference "3D Bioprinting – a New Medical and Ethical Frontier?", Geneva, 25.05.16;
- 13th World Congress on Bioethics, University of Edinburgh, 17.06.2016;
- University of Zurich, conference "Designing Moral Technologies – Theoretical, Practical and Ethical Issues", Ascona, 13.07.16.

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