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Protecting the Values of Consumer Law in the Digital Economy: The case of 3D-printing

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I. Introduction

1. Core Questions and Answers

One of the most significant challenges for modern legal scholarship is to consider how disruptive new (especially digital) technologies¹ are for existing legal regimes. In order to tackle this challenge, one particular new technology, 3D-printing has been chosen as a case study here. 3D-printing brings potentially radical changes to the consumer goods market: new forms of production, new types of producer and a greater role for digital content. This paper considers what these changes should mean for the underpinning values of consumer law, and what this in turn should mean for consumer private law doctrine: as will be explained further below, there has been very limited work so far on these issues, and the work that has been done is grounded in a very limited understanding of consumer law values. We argue that the values currently underpinning our consumer protection regime in relation to consumer goods should guide our response to the challenges of new technology.

The law on consumer goods is currently underpinned to a significant degree by the need ethic (prioritising protection of consumers as vulnerable parties, over business self-interest and consumer self-reliance²). This is manifest in strict and quasi-strict liability standards. Notwithstanding 3D-printing innovations, there is a good case for adherence to the need ethic: The risks (of poor quality and unsafe goods) are as high as before (or higher); consumers are as vulnerable (or more so) than before; and there is insufficient evidence that the need ethic undermines innovation.

What are the implications of this at doctrinal level? We will argue in this paper that, despite the innovative aspects of 3D-printing, the law can often continue to reflect the need ethic via existing legal principles (current strict and quasi strict liability standards), subject to some extensions (e.g. as to supplier and producer liability for digital content), and through clarifications of existing legal rules and principles (e.g. as to who counts as a professional business supplier). However, to ensure that the need ethic is respected fully in all aspects of this technology, the law may need to go beyond these clarifications and modest extensions. For example, the increasing difficulty of locating the source of a quality or safety problem and

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¹ "Disruptive" in the sense that it disrupts/changes pre-existing patterns of production and supply: see Christensen, *The Innovator's Dilemma* (Harvard Business Review Press, 1997)

² See Willett, "Re-Theorising Consumer Law" (2018) 77 *Cambridge Law Journal* 179-210.

the impact this has on a consumer's ability to discharge the burden of proof, increase the need to impose some 'network' liability, involving re-allocation of responsibilities to traders (e.g. internet platforms) who would not be responsible under traditional legal regimes.

This analysis is significant in providing specific doctrinal solutions for an important and emerging sector of the consumer economy. More generally, it provides a new theoretical framework for analysing how consumer law should deal with the challenges of innovation. According to this framework, legal rules should of course be developed at least partly by reference to the underpinning values that are appropriate for new technological and market conditions. However, in deciding on what these values should be, we should not underestimate perennial traditional risks and consumer vulnerabilities and the scope for these risks and vulnerabilities to be exacerbated by the new conditions. Equally, we should not overestimate the threats to innovation of a strongly protective ethic.

2. Jurisdictional focus and significance

The article uses UK law to make the above arguments: as to current values, why these should continue to underpin legal doctrine, and what this means in terms of doctrinal responses to 3D-printing. However, the significance of the analysis goes well beyond UK law: many aspects of UK law on consumer goods are based on EU law (and this approach to regulating consumer goods is typical in many non-EU jurisdictions, too),³ so the arguments made here as to values and legal doctrine are of much wider international application and significance (and of course 3D-printing plays an increasingly important role across the world⁴). In the development of consumer law, a comparative approach has always played an important role, and our analysis with a primary focus on UK law will be relevant to the development of legal systems elsewhere as they seek to adapt their laws to the challenges of balancing consumer protection demands with the growth of the digital economy.

3. Structure

The remainder of this Introduction explains further the changes brought by 3D-printing; the questions such changes generate; and how the article will address these questions by creating a new theoretical framework-based around underpinning values. Part II explores these values (the need ethic) and discusses why they remain important in an era of digital innovation. Part III identifies the distinctive ways in which production and supply in the 3D printing market might cause safety and quality problems and how these problems can be dealt with by rules that continue to reflect the need ethic. In many instances, this is possible under existing laws, subject to clarifications and extensions; but it may also require more radical disruption to doctrinal tradition e.g. some form of network liability. Part IV summarises the arguments and

³ For example, provisions based on Directive 99/44/EC (Consumer Sales Directive) are found in Part 1 of the Consumer Rights Act 2015, for example; while similar strict liability standards exist for example in Australia (Australian Consumer Law 2010, Part 3-2, Div. 1), Canada (e.g. Nova Scotia Consumer Protection Act 1989, s. 26 and New Zealand (Consumer Guarantees Act 1993, Pt. 1).

⁴ Cf. United Nations Conference on Trade and Development (UNCTAD), *Information Economy Report 2017 – Digitalization, Trade and Development*, UNCTAD/IER/2017, at p.7.

considers how the framework developed here can be used to address the challenges posed for consumer law by digital innovation more generally.

4. Digital disruption and 3D-printing

The rapid rise of the digital economy is readily apparent, with many new business models having displaced long-established ones, and new forms of production rapidly being adopted. Invariably, this makes it necessary to ensure that the law does not fall behind these developments—that it continues to provide solutions that reflect how business is done, who does it and what (goods, services, digital content or whatever else) is the subject of this business. First there was on-line selling, initially just another way for large businesses to sell goods; followed by the development of on-line platforms like *eBay* which opened the market more for small business and individual sellers. These developments raised questions about whether there was an appropriate legal framework in place to ensure adequate consumer protection. In many jurisdictions, legal reforms were made to address the potential pitfalls of the on-line environment, e.g. ensuring that electronic contracts were legally enforceable,⁵ and that consumers were protected through information duties and cancellation rights (cooling-off periods).⁶ Platforms such as *eBay* in particular prompted discussion as to the effectiveness of the rules for determining when private individuals are treated as business sellers and therefore responsible for the quality of goods they supply.⁷

3D-printing further disrupts pre-existing business models, bringing with it potentially quite radical changes to production and distribution of goods and the role played by digital content. The term “3D-printing” is a popular short-hand for a manufacturing process known as “additive manufacturing” or “additive layer manufacturing”.⁸ It has been compared to the familiar idea of printing a document, because some additive manufacturing processes utilise technology which is very similar to traditional document printing. However, there are several different technological processes grouped together under this heading, with the common feature being that any item to be made is created by being built-up in very thin layers, with one layer added to layers already “printed”. In order to make an item using an additive manufacturing process, its design is therefore divided into very thin layers so it can be created using a “3D-printer”.⁹

There are common features to all of these processes.¹⁰ First, the item to be printed is designed on a computer and all its specifications and instructions for 3D-printing it are contained in a data file created using computer-aided-design software. This “CAD-file”, or “visual modelling

⁵ E.g., Art.9(1) of the E-Commerce Directive (2000/31/EC) (not expressly transposed into UK Law).

⁶ E.g., the Consumer Protection (Distance Selling) Regulations 2002, S.I. 2000/2334 (since replaced by the Consumer Contracts (Information, Cancellation and Additional Charges) Regulations 2013, S.I. 2013/3134).

⁷ Morgan-Taylor/Willett, “The Quality Obligation and Online Marketplaces” (2005) *Journal of Contract Law* 155.

⁸ Twigg-Flesner, “Conformity of 3D prints – Can current Sales Law cope?” in: Schulze/Staudenmeyer (eds), *Digital Revolution – Challenges for Contract Law* (Nomos, 2016).

⁹ For an explanation of various methods and applications (types of material and end-product), see Barnatt, *3D Printing* (Explaining the Future.Com, 2nd edn. 2014), ch.2.

¹⁰ Cf. Berkowitz, “Strict Liability for Individuals? The impact of 3-D printing on Products Liability Law” (2014) 92 *Washington University Law Review* 1019, 1023-1027.

file”¹¹ holds all the information about the item to be printed so a 3D-printer can produce a tangible item. Secondly, a 3D-printer interprets the CAD-file to make the physical item. 3D-printing technologies have thus far been primarily used in an industrial or commercial setting, although basic 3D-printers are already available on the consumer market.¹² Finally, there is the material (or materials) in which the item is to be printed. Various materials can be utilised, particularly plastic and certain metals. Some advanced 3D-printers can make items using more than one type of material.

This technology is already well-established in an industrial setting, e.g. for prototyping or for manufacturing customised components.¹³ It is rapidly entering the manufacturing mainstream for mass production of consumer goods because of its economical use of raw materials. UNCTAD recently suggested that 3D-printing would have a significant impact on production and trade patterns.¹⁴ It could reduce the need for international carriage of goods from the country of manufacture by establishing regional or local 3D-printing centres. It has been argued this could see the repatriation of manufacturing jobs to former industrial centres, like Manchester, that had lost out to developing economies.¹⁵ This would bring environmental benefits in that it would reduce the need for air and sea transport (although the full environmental implications of widespread 3D-printing have yet to be explored¹⁶).

5. Key questions

The impact of 3D-printing on the consumer market is most likely to be felt in how goods are produced and distributed and by whom; and also by the increasing role played by digital content in production and distribution: The issue is partly that many more goods produced by traditional manufacturers may be produced using 3D-printing. However, it is also likely to become common that instead of buying a product made by a traditional manufacturer, a consumer might simply buy a design (CAD) file (i.e. code) and produce a physical item on a home 3D-printer¹⁷ or via a commercial 3D-printing service.¹⁸ Ornaments and jewellery are among the early home-based 3D-printed products. As the technology develops, becomes more refined and commercially viable, more sophisticated home-based 3D-printers will enter the consumer market, allowing consumers to design and print more sophisticated products. So we have a transfer of the production process from traditional manufacturers both to individual consumers (especially ‘tech savvy’ ‘hobbyists’) and to 3D-printing services (a

¹¹ The term used in the European Commission’s *proposal for a directive on certain aspects concerning the supply of digital content* (COM (2015) 634 final) – see Recital 16.

¹² One of the consumer discount retailers has offered a 3D-printer as a “special buy” in 2018, for example.

¹³ Sculpteo, *The State of 3D Printing* (Sculpteo, 2017), p.19, *fn*s strong growth in the market

¹⁴ United Nations Conference on Trade and Development (UNCTAD), *Information Economy Report 2017 – Digitalization, Trade and Development*, UNCTAD/IER/2017, at p.7.

¹⁵ Anderson, *Makers: The New Industrial Revolution* (Random House, 2013).

¹⁶ Cf. Lin, “Herding Cats: Governing Distributed Information” (2018) 96 *North Carolina Law Review* 945.

¹⁷ On 3D-printing as a modern version of cottage industries, see Anderson, *Makers – The new Industrial Revolution* (Random House, 2013).

¹⁸ These have started to spring up in many towns already.

'democratisation' of production¹⁹). Indeed, individual consumers (especially 'tech savvy' 'hobbyists') may not only become producers of final products, they may also increasingly become producers (designers) of digital content-the CAD files. There are already online platforms where individuals can offer their designs for sale, and these platforms also offer the possibility of having more complex designs printed on an industrial 3D-printer.²⁰

It is clear that 3D-printing may bring radical changes to the consumer market: new modes of production, new consumer ('prosumer') (and other) producers, and a more significant role for digital content. The transition of the traditional roles of consumer and trader, which the consumer's role confined to that of a recipient of goods and services, has for some time been less clear-cut as individuals have increasingly been involved in making and/or supplying goods and services.²¹ The possibilities created by 3D-printing will further blur the boundaries. This raises the question whether this will require a fundamental shift in the legal regime. For example, should the goods produced be subject to the same or different standards as traditionally produced goods? What responsibility should there be for the quality and safety of digital content? Will the proliferation of hobby producers and sellers lead to liability gaps (with such parties not meeting traditional 'business' activity criteria to be held responsible under strict liability standards)? If so, should liability be transferred elsewhere in the production and supply network-to businesses that would not be liable under traditional contract or tort rules?

One way to address these questions is to focus on staying as faithful as possible to existing laws. This might involve clarifying the scope of such existing laws (e.g. clarifying when hobbyists become business suppliers and thereby undertake responsibilities under existing strict liability rules²²). It might also involve extending existing rules. However, under an approach prioritising faithfulness to doctrinal tradition, responsibilities should only be extended to the sorts of parties that would be responsible for something analogous under traditional legal principles, e.g. making contractual suppliers strictly liable not only (as currently) for poor quality goods, but also (by analogy) for poor quality digital content.²³ However if a party would not be responsible even for something analogous under traditional laws, they should not be made liable under an extension. For example, if an internet platform does not produce goods or digital content, they are not currently liable in tort for safety problems; and if they do not contractually supply them they are not liable in contract for quality problems.²⁴ Faithfulness to

¹⁹ Howells/Willett, "3D Printing: The Limits of Contract and Challenges for tort" in R. Schulze and D. Staudenmayer (eds) *Digital Revolution: Challenges for Contract Law in Practice* (Nomos, 2016)

²⁰ Designers may also share their CAD-files and allow others to modify these, this raising legal issues beyond the scope of this paper: see e.g., A Daly, *Socio Legal Aspects of the 3D Printing Revolution* (Palgrave-Macmillan, London, 2016).

²¹ For an overview, see Ritzer/Dean/Jurgenson, "The Coming of Age of the Prosumer" (2012) 56 *American Behavioral Scientist* 379; also, Jacobs, "The Energy Prosumer" (2016) 43 *Ecology Law Quarterly* 519.

²² See *infra* at Part II on these strict liability rules.

²³ CRA, Part I, ch. 3; Willett, "Re-Theorising Consumer Law", *supra*, fn 00, 191-4; and *infra*, Part III.

²⁴ *Infra*, Part III.

doctrinal tradition therefore dictates that the law should not be changed to make them liable for such problems.²⁵

Rather than placing such emphasis on staying true to existing law, one might focus on *values*: What should the technological changes mean for the underpinning values of consumer law and what, in turn, should this mean for legal rules and principles? The key difference from the doctrinally centred approach is that under the values driven approach, we are prepared to deviate from doctrinal tradition if it is necessary to reflect the underpinning values considered to be appropriate.

The term “values” here connotes ideas about the contextual motivations behind the level of consumer protection: in particular, how concerned (or not) one should be as to the risks facing consumers; how much or little one should focus on consumer vulnerabilities (in information processing, bargaining strength, loss bearing abilities, etc.). To put it slightly differently, “values” reflect the extent to which the law should prioritise consumer need, business self-interest, consumer self-reliance etc.²⁶ A values-driven approach recognises that legal rules do not exist in a vacuum. They are at least partly shaped by underpinning values, which exist for good reasons. For example, the need ethic (explained in full at Part II below) is based on a view as to consumer vulnerability to economic and social detriment;²⁷ so not insisting on legal rules that reflect this need ethic may increase such detriment. Of course, even if continuing to adhere to important underpinning values in times of technological change may suggest a possible need for doctrinal changes, but this is not to say that there cannot still be a pause for reflection in order to balance the importance of the underpinning values with the advantages (e.g. as to certainty and continuity) that may come with sticking to doctrinal tradition. The point however is that, having examined issues from a values-driven perspective (rather than focusing purely on doctrinal tradition), we are at least aware of the policy choices that need to be made.

For these reasons, this paper follows a values-driven approach. The argument made below is that the law on consumer goods²⁸ is currently based on the need ethic. Despite the suggestions that consumers are significantly empowered to cope with the risks of new technology it is then shown that there is a strong case for adherence to the values of the need

²⁵ Adherence to doctrinal tradition could be seen as congruent with ‘coherentism’, which seeks to preserve doctrinal coherence and its application to new circumstances (e.g., Brownsword, “After Brexit: Regulatory-instrumentalism, Coherentism and the English Law of Contract” (2017) 34 *Journal of Contract Law* 139-164, esp. pp.142-3, developing the work of Rubin, “From Coherence to Effectiveness” in van Gestel/Micklitz/Rubin (eds.) *Rethinking Legal Scholarship* (Cambridge University Press, 2017)). But in the present paper the approach being described is one where emphasis is on (i) *consistency* with existing doctrine (whether that doctrine is ‘coherent’ or not), and (ii) *doctrine* (coherentism might also be understood to cover coherence in *values* and in this way overlap with the values driven approach which the present paper actually offers as an *alternative* to an approach that prioritises the maintenance of consistency with traditional doctrine).

²⁶ Willett “Re-Theorising Consumer Law”, *supra*, fn 00. This approach could be associated with so-called ‘regulatory-instrumentalism’ which prioritises the implementation of policy goals (Brownsword, “After Brexit”, *supra*, fn 00). However, the present paper focuses on deeper values which are not always made explicit by States/Regulators in setting out their policy objectives.

²⁷ Willett “Re-Theorising Consumer Law”, *supra*, fn 00.

²⁸ I.e. contract, tort and product safety rules applicable to the goods, services or digital content that may play a role in the 3D-printing market.

ethic. It is wrong to underestimate perennial risks and consumer vulnerabilities and to ignore the possibility that these risks and vulnerabilities will be exacerbated by the new conditions. The risks are at least as high as before, consumer vulnerabilities are at least as significant, and the threats to innovation of a strongly protective ethic should not be overstated.

It is then shown that, despite the innovations brought by 3D-printing, the law can often continue to reflect the need ethic through clarifications and modest extensions; but on occasion it will need to deviate from doctrinal tradition e.g. by imposing liability for quality or safety problems on supply network members who would not be liable for this, or anything analogous to this, under traditional laws.

6. Filling key research gaps-a new way of responding to innovation

Previous legal literature has barely begun to address these questions. Much of the work on 3D-printing has concentrated on the intellectual property implications,²⁹ concerns about workplace protection, environmental risks, and safety,³⁰ and there has been US and Australian work on the use of 3D-printing to make inherently dangerous or prohibited items, especially guns.³¹ There has been *some* work on *some* of the rules we focus on here: tentative discussions of the product liability implications if 3D-printed goods cause harm,³² and of some specific questions that arise in contract and tort law in relation to 3D-printing.³³ However, this prior work does not adopt a methodical approach like ours that considers the relationship between 3D-printing, legal rules and principles, and underpinning consumer protection values.

The general scholarship on law and technology certainly includes important work on the relationship between new technologies and values such as liberty, equality and democracy.³⁴ Even in consumer law more specifically, in debates about artificial intelligence and reliance on recommendations made by digital assistants, there have been attempts to determine the role of underlying values such as autonomy and freedom of choice.³⁵ However, as will be explained further below (Part II), recent work has shown that labels such as autonomy and freedom are of limited help in understanding consumer law values. Essentially they are too indeterminate. Rather than focusing on the traditional framework that contrasts freedom/autonomy with

²⁹ See, e.g., Desai/Magliocca, "Patents, Meet Napster: 3D Printing and the Digitisation of Things" (2014) 102 *Georgetown Law Journal*, 1691.

³⁰ Kennedy/Giampetro-Meyer, "Gearing Up for the Next Industrial Revolution: 3D Printing, Home-Based Factories, and Modes of Social Control" (2014) 45 *Loyola University Chicago Law Journal* 955.

³¹ See e.g., Curtis, "A Wiki Weapon Solution: Firearm Regulation for the Management of 3D Printing in the American Household" (2015) 41 *Rutgers Computer and Technology Law Journal* 74.

³² Berkowitz, "Strict Liability for Individuals? The impact of 3-D printing on Products Liability Law" (2014) 92 *Washington University Law Review* 1019 (U.S.) and Nielsen/Griggs, "Allocating Risks and Liability for 3D printed products: product safety, negligence, or something new?" (2016) 42 *Monash L.R.* 712 (Australia).

³³ Osborn, 'Regulating Three-Dimensional Printing: The Converging World of Bits and Atoms' (2014) 51 *San Diego Law Review* 553; Twigg-Flesner, "Conformity of 3D prints – Can current Sales Law cope?" and Howells/Willett, "3D Printing: The Limits of Contract and Challenges for Tort", both in: Schulze/Staudenmeyer (eds), *Digital Revolution – Challenges for Contract Law* (Nomos, 2016).

³⁴ See generally Brownsword/Scotford/Yeung (eds.), *The Oxford Handbook of Law, Regulation and Technology* (Oxford University Press, 2017).

³⁵ Helbing/Frey/Gigerenzer/Hafen/Hagner/Hofstetter/van den Hoven/Zicari/Zwitter, "Will Democracy Survive Big Data and Artificial Intelligence?", *Scientific American*, February 25, 2017.

'fairness', it is more instructive to contrast competing ethics of 'need' and 'business self-interest/consumer self-reliance'.³⁶ However, even this prior work on need versus self-interest/reliance was focussed simply on how consumer law can and should be explained in terms of underpinning values; rather than with using such underpinning values to look forward-to help determine how law should react to innovation. This current paper is the first to take this step: to use the need ethic (as a key underpinning value in consumer law) as part of an approach to charting how legal doctrine should respond to digital innovation. This is core to the paper's broader purpose, to create a new theoretical framework for dealing with the challenges of digital innovation. This is a framework that emphasises the importance of underpinning values in shaping the development of doctrinal responses to innovations. However, this framework also stresses that in deciding whether these values should change in response to innovations, it is wrong to underestimate either traditional risks and consumer vulnerabilities or the potential for these risks and vulnerabilities to be exacerbated by the innovations. It is also wrong to overestimate the extent to which a strong protective ethic may stymie innovation.

Not only is the paper the first to develop this general framework for how consumer law should respond to innovation, it also applies this approach in such a way as to provides a set of original doctrinal solutions to the distinctive quality and safety issues that arise in the 3D-printing market.

II. Consumer Law Values and Digital Innovation

This Part considers the values which underpin the area of consumer law affected by 3D-printing and why these values remain important in an era of digital innovation.

1. The need ethic

Ultimately 3D-printing produces goods, so, to identify the relevant underlying values, we must consider the existing legal rules applicable to goods. These rules can be said to be rooted at least to a significant degree in a 'need-oriented' ethic,³⁷ which recognises consumer vulnerabilities. To explain what is meant by this, it is first necessary to deal with two contrasting ethics which are often evident in legal regimes. Thus, Consumer law can be explained in terms of a tension between rules based on a need ethic (emphasising protecting consumers from their vulnerabilities); and rules based on an ethic that emphasises both business self-interest (e.g. to maximise their profits, minimise their responsibilities) and consumer self-reliance (e.g. to protect their interests by informing themselves of risks and negotiating better deals with the business).³⁸

³⁶ Willett "Re-Theorising Consumer Law", *supra*, fn 00.

³⁷ Willett, "Re-Theorising Consumer Law", *supra*, fn 00; Wilhemsson, *Critical Studies in Private Law - A Treatise on Need-Rational Principles in Modern Law* (Kluwer, 1992).

³⁸ Willett, "Re-Theorising Consumer Law", *supra*, fn 00.

This 'need versus self-interest/self-reliance' framework is a more nuanced way to understand consumer law than the traditional 'fairness versus freedom' framework: The need ethic axiomatically makes it very clear that the priority is consumer 'need', i.e. to protect consumers from the consequences of their vulnerabilities. In contrast although 'fairness' may often be taken to equate with the need ethic, it is sufficiently vague that it is sometimes said to be 'fair' to favour business self-interest and consumer self-reliance. 'Freedom' can often be equated with business self-interest/consumer self-reliance. Again, however, 'freedom' is vague: e.g. one might plausibly claim that need based protections are required to replicate what consumers would agree to if they were 'really' free i.e. if they did not suffer from vulnerabilities preventing them from effectively negotiating to protect their interests. 'Self-interest/reliance' is clearer, the focus being specifically on trader freedom to pursue self-interest, and consumer freedom to exercise self-reliance.

In relation to consumer private law rules on goods, the need ethic manifests itself typically in strict (or at least quasi-strict) tort liability on producers for 'defective' products causing injury or property damage,³⁹ and strict contractual law liability on front-line suppliers as regards quality, fitness for purpose and compliance with description, model or sample⁴⁰.

Strict liability means that businesses are responsible for defective *outcomes* (unsafe, defective, poor quality, etc goods), even if they exercised reasonable care in their procedures. All that matters is whether the goods are in a defective condition. It does not matter whether the business was in any way at fault in bringing about this outcome. The alternative is to have fault/negligence based standards, where producers and suppliers of goods *would* escape responsibility based on their procedures, i.e. based on having exercised reasonable care (following standard business practice) in the production, selection or supply (as the case may be) of the goods.⁴¹ This generally makes it harder for consumers to establish their claim: e.g. producers may be able to show that the defective outcome was a fluke, that their procedures are generally sound and had been followed in the case in question.

It is true that the strict liability approach in tort is tempered, to an extent, by the defences available to a business. In particular, the producer can escape liability (under the so-called 'development risks' defence) by showing that when the product was supplied:

'the state of scientific and technical knowledge ... was not such that a producer of products of the same description as the product in question might be expected to have discovered the defect if it had existed in his products while they were under his control'.⁴²

³⁹ Product Liability Directive (85/374/EEC), Part 1 of the Consumer Protection Act 1987 (UK).

⁴⁰ Consumer Sales Directive (99/44/EC), Art 2; Consumer Rights Act 2015, ss. 9-18.

⁴¹ *Bolam v Friern Hospital Management Committee* [1957] 2 All ER 118, *Harrison v Shepherd Homes Ltd* [2011] EWHC 1811 (TCC)

⁴² Consumer Protection Act 1987, s 4 (2) (1) (e) and s. 4 (2) (based on EU Directive 85/374/EEC on product liability, article 7 (e)). For other defences: Consumer Protection Act 1987, s. 4/ EU Directive 85/374/EEC art 7.

However, this will only apply to so-called 'design' defects. The idea is that the supplier can escape legal responsibility by showing that although when the product was supplied this type of product was prone to flaws/risks by virtue of its basic makeup (its design); the state of scientific and technical knowledge was not advanced enough at that point for the producer to be aware of this tendency.⁴³ The defence does not apply to the much more routine problem of manufacturing defects-problems (such as foreign objects entering food, or toys or car parts with breaks or weaknesses) that are simply caused by breakdowns in quality control during the manufacturing process rather than having anything to do with limited scientific and technical knowledge as to inherently flawed designs.⁴⁴

In addition, even in the case of design defects, there is at least 'quasi' strict liability. After all, the producer is in principle liable simply on the basis of the consumer showing that there was a defect-without the consumer facing the above-mentioned problems of proving fault/negligence. The burden of proof in establishing the development risks (or any other) defence lies on the producer. This may not be such an easy burden to discharge, especially in an age where any information as to possible design risks (that producers could arguably have been aware of) is more readily accessible than ever before.

So not requiring consumers to establish negligence to make a claim against producers will very often make it much more likely that consumers will obtain redress. The problems of a negligence regime for consumers would be even greater in relation to front-line suppliers such as retailers who normally will have purchased the goods from a producer. Defects in goods usually originate in the production process, and if it is hard to show negligence by the producer, it is even harder with retailers. So, it would often be very difficult indeed for consumers to show that the retailer had not acted with reasonable care.

These quasi-strict and fully strict liability regimes indicate an underpinning need ethic that recognises the relative vulnerability of the consumer. It recognises that insofar as traders suffer economic losses through being required to provide remedies to consumers when goods are defective, they are often well placed to absorb this (e.g., through insurance), or to distribute this among all customers (e.g. through small price rises). However, consumers, as private citizens, often have limited capacity to absorb economic losses caused by defective goods.⁴⁵ Also, defective goods may have a significant effect on the private life of the consumer and create 'consumer surplus' effects,⁴⁶ such as the loss of time, distress, or inconvenience of taking action, affecting their personal lives.⁴⁷

⁴³ Hodges, "Development Risks: Unanswered Questions" (1998) 61 *M.L.R.* 560; Mildred and Howells, "Comment on 'Development Risks: Unanswered Questions'" (1998) 61 *M.L.R.* 570.

⁴⁴ For authoritative judicial consideration, see *A and others v National Blood Authority and another* [2001] EWHC QB 446 (Burton J).

⁴⁵ Willett, *Fairness in Consumer Contracts* (Ashgate, 2007).

⁴⁶ Seminally, see Harris/Ogus/Phillips, "Contract Remedies and the Consumer Surplus" (1979) 95 *Law Quarterly Review* 581.

⁴⁷ Willett, "General Clauses and the Competing Ethics of EU Consumer Law" (2012) *CLJ* 412, at p. 420, and for recent re-affirmation of this problem, Citizens Advice and Oxford Economics, *Consumer Detriment* (Oxford 2016).

The strict and quasi-strict liability standards are also based on a need ethic in that they recognise that consumers often struggle to protect themselves (from these negative economic and consumer surplus consequences) by the exercise of self-reliance. As consumers are not expert, 'repeat players' in the business in question, they generally have limited knowledge or understanding of the risks of goods being defective.⁴⁸ So if the law only imposed a fault-based standard, consumers would not think it necessary to seek to bargain for traders to provide express (strict liability) commitments as to quality/safety. Even if they did, the need-oriented view is that they would usually not be successful: individual consumers are usually neither sufficiently important to traders, nor able to match traders' bargaining sophistication and experience.⁴⁹ This would leave consumers having to prove negligence once safety or quality problems arise, which is often very difficult.

Overall then, private law strict and quasi-strict liability standards are grounded in a need ethic that recognises consumer vulnerabilities.⁵⁰ Fault based standards are based more on the alternative business self-interest/consumer self-reliance ethic: businesses escape responsibility for defective outcomes unless consumers have managed (through self-reliant action) to bargain for express guarantees of good quality and safe outcomes or to establish negligence by the business when a dispute arises.

2. Innovation and the continuing importance of the need ethic

It is conceivable that the risks to consumers may actually be exacerbated in circumstances of 3D-Printing innovation. New technical and business models bring new and less well known risks of failure (whether based on unknown design defects or simply inexperience in this form of manufacturing process): so that there may be greater risk of the resulting goods or digital content being of poor quality, or even unsafe. There is the general risk posed by making increasing numbers of consumer products using a relatively new form of technology. There may also be particularly risky aspects of production and supply in the 3D-printing market. 3D-printing may prompt a shift from the purchased of physical items to the purchase of a CAD-file which allows a physical item to be 3D-printed, either by a commercial printer or by a consumer with a home 3D-printer. There may be a high risk of defective products emerging if the platforms and shops using these commercial printers are not experienced producers, with special expertise in the code, printer, physical materials or the overall process; and these

⁴⁸ For recent support from behavioural economics, Esposito, "A Dismal Reality: Behavioural Analysis and Consumer Policy" (2017) 40 *Journal of Consumer Policy* 1.

⁴⁹ Brownsword, *Contract Law: Themes for the Twenty-First Century* (Oxford, 2006), 79-85 and Willett, *Fairness in Consumer Contracts* (Ashgate, 2007), 39-46.

⁵⁰ Some consumers may not have these vulnerabilities (e.g. being rich and able to absorb losses, exceptionally well informed and able at bargaining), but the strict and quasi strict standards are based on a (need-oriented) view that the majority are indeed vulnerable relative to traders. Some consumers will be even more vulnerable than average, which is not given recognition in these generally applicable standards but is in other parts of consumer law especially unfair commercial practices: on this and the complexities of consumer vulnerability generally Reich, "Vulnerable Consumers in EU Law" in: Leczykiewicz/Weatherill, *The Images of the Consumer in EU Law* (Hart, 2016)). Strict liability standards are also imposed in business to business sales (Sale of Goods Act 1979, ss. 12-15), but these can be excluded/limited subject to a test of reasonableness (UCTA, ss. 6-7), the non-excludability in business to consumer contracts (CRA, s.31) emphasising the underpinning need ethic

problems are perhaps even more likely in the case of home printer users. The risks may also be increased by the inexperience of hobbyist consumer producers, who write the occasional CAD file code and supply it to others to print at home or via a platform or shop. Such producers (not being traditional professionals) will often lack the skill and experience needed to identify potential quality or safety shortcomings in their designs.⁵¹

So, it appears that the risk of poor quality and unsafe goods will increase with 3D-printing. This reinforces the importance of the need ethic as an underpinning value. This ethic is based partly on the perception that consumers are vulnerable as loss bearers. There is no reason to suppose that they are any more able to absorb losses caused in the 3D-printing market than they are in markets generally: they are no better placed to insure against economic losses, no less likely to suffer consumer surplus losses (distress, inconvenience etc.) when they buy goods produced and supplied in innovative ways such as via 3D-printing.

The need ethic also takes consumers to be vulnerable⁵² when it comes to self-reliant protection of their interests: and this seems likely to be just as much of a problem, and quite possibly more of a problem, in the 3D-printing market and the digital environment more generally, as it is in traditional sectors. For a start, it seems likely that consumers are relatively uninformed about new risks of detriment posed by these innovative technologies. Consumers probably do not generally consider whether goods that they buy derive from innovative processes such as 3D-printing or more traditional production processes pose different risks. They may be aware that they are using a novel process, but are likely to assume the authorities have equal confidence in new and old processes. In addition, as with many things marketed via the internet, consumer choices may be strongly steered by highly sophisticated processes such as behavioural advertising, cyber-butlering etc., which are likely to further reduce consumer reflection on quality risks.⁵³ This may limit the competitive discipline imposed on suppliers, further increasing the risk of poor quality.⁵⁴ In addition, if consumers are even less well informed and reflective than in markets generally, they are also even less likely to seek to bargain for express commitments from traders as to the quality and safety of what they are buying: so legally imposed (strict and quasi strict liability) standards are especially important.

These points notwithstanding, it is important to ask whether innovation offers some technical or other solution to consumer vulnerability and/or increased risks, e.g. some way of improving consumer risk assessment capabilities.⁵⁵ It has been argued that the internet has facilitated

⁵¹ See *infra* on responding to these increased risks by clarifying who is a business supplier and by re-allocating responsibility within the production and supply network.

⁵² The notion of "vulnerability" is much-discussed in the consumer law literature. For a useful overview of different types of vulnerability, see e.g., Cartwright, "Understanding and Protecting Vulnerable Financial Consumers" (2015) 38 *Journal of Consumer Policy* 119.

⁵³ Brownsword, "The E-Commerce Directive, Consumer Transactions, and the Digital Single Market: Questions of Regulatory Fitness, Regulatory Disconnection and Rule Redirection" in: Grundmann (ed.), *European Contract Law in the Digital Age* (Intersentia, 2018).

⁵⁴ Also, on strict liability improving competition by providing a clearer standard: Grundman, "The Fault Principle as the chameleon of Contract Law: A Market Function Approach" (2009) *Michigan Law Review*, 1583-1599.

⁵⁵ For the potential of artificial intelligence in empowering consumers, see Contissa/Lagioia/Lippi/Micklitz/Palka/Sartor/Torroni, "Towards Consumer-Empowering Artificial Intelligence" in *Proceedings of the Twenty-Seventh*

entrance to the market of many more suppliers and that this generally improves competition and quality.⁵⁶ It is also claimed that the new sources of information and reputational feedback mechanisms in internet markets better inform consumers,⁵⁷ which improves informed choice (e.g. as to risks of poor quality and unsafe products) and in turn improves competition and quality.⁵⁸ The argument then might be that, as much of the digital content and goods in the digital world, including in the 3D-printing market, are probably bought on the internet, there is less need for an underpinning need ethic (for strict and quasi strict liability standards). Customer feedback sites provide a continuous stream of reviews and critique of goods and digital content by consumers, which helps to inform other consumers about the likely quality of products. This influences consumers to buy from those with the better reputations, which imposes competitive pressure on all producers and suppliers to improve their quality and safety and reduces the risk of poor quality and unsafe products. This could imply that there is less need for the law to incentivise high standards through strict and quasi strict liability: that a negligence standard would be sufficient.

However, behavioural science research has demonstrated time and again that consumers are very limited in their ability to access, read and understand information, and that their ability to process information is affected by, e.g., a status-quo bias, underestimating risks, being over optimistic and other factors.⁵⁹ There is no evidence to suggest that these problems can be eradicated by internet sources of information and reputational feedback.⁶⁰ Indeed, there are particular risks associated with reputational feedback: First, consumers may be even more trusting and over optimistic than normal as the reputational information comes from other consumers. Second, the reputational feedback information may be unreliable because these other consumers are not experts. They do not know what to look for in terms of latent defects etc., but can only speak from *ad hoc* experience (they may have been lucky/unlucky with the product, not known how to use it, not had it for long enough for defects to emerge when they do the review or be more influenced by aesthetic and functional factors than issues of safety which only arise when things go wrong). Third, there may be downright corruption, e.g. where feedback providers have been paid to give positive reviews.⁶¹

It appears then that in innovative markets such as 3D-printing there is just as much and probably more reason (than in markets generally) to adhere to the need ethic. Clearly, the case is even stronger where safety risks are concerned. However, there is a final question to

International Joint Conference on Artificial Intelligence 5150 [available at <https://www.ijcai.org/proceedings/2018/0714.pdf> (accessed 14 August 2018)].

⁵⁶ Koopman/Mitchell/Thierer, "The Sharing Economy and Consumer Protection Regulation – The Case for Policy Change?" (2014-15) 8 *Journal of Business Entrepreneurship and Law* 529.

⁵⁷ Cf. Busch, "Crowdsourcing Consumer Confidence: How to Regulate Online Rating and Review Systems in the Collaborative Economy" in: De Franceschi (ed), *European Contract Law and the Digital Single Market* (Intersentia, 2016).

⁵⁸ Although *fn* cautionary views: Malbon, "Taking Fake Online Consumer Reviews Seriously" (2013) 36 *Journal of Consumer Policy* 139; Competition and Markets Authority (UK), *Online reviews and endorsements – Report on the CMA's call for information*, CMA41 (June 2015).

⁵⁹ Esposito, "A Dismal Reality: Behavioural Analysis and Consumer Policy" *supra*, *fn* 00.

⁶⁰ Federal Trade Commission, *The Sharing Economy*, (2016), 5 on limits of reputational feedback.

⁶¹ Competition and Markets Authority, *Online reviews and endorsements – Report on the CMA's call for information*, CMA41 (June 2015).

be asked about the relationship between consumer law values and innovation: Does maintaining or extending protection risk obstructing an important innovation? If so, it might be necessary to consider a shift away from the need ethic-moving along the spectrum from strict and quasi strict liability to a greater role for negligence in order to facilitate technological developments. However, innovators have often called for deregulation e.g. it was argued that bio-technology industries deserved exemption from product liability laws imposing strict liability,⁶² yet these businesses have thrived without such exemptions and consumers continued to have the security of the protective regime.

There should be very strong evidence of a likely chilling effect before it is decided to lower standards to encourage innovation. This is especially so as the rate of innovation is more rapid than ever before in human history and this brings an increased risk of detriment. Given these factors, if the law were to lower standards in response to every innovation, not only would there be a very high risk of increased consumer detriment, but it would be very time and resource consuming for lawmakers. The law would be in a constant and confusing state of flux, undermining the values of clarity and certainty that are important in consumer law. There does not appear to be evidence as to the chilling effect of maintaining good standards of protection in relation to other recent digital innovations. For example, when the law responded to the growth of internet selling by providing consumers with information and cancellation rights there is no evidence that less internet selling took place.⁶³ In general terms, there appears no particular evidence that good standards of protection would have a chilling effect in relation to 3D-printing. However, we shall return and review the risks of this in relation to the specific legal issues that we identify as arising and the responses that we suggest as desirable (Part III below).

So, the broad conclusion for now is that notwithstanding technological innovations in the consumer market (such as 3D-printing), there remains a good case for adherence to the need ethic: risks are as high as before (or higher), consumer vulnerabilities are as significant (or more so) than before, and there is no obvious countervailing case based on the risk to innovation posed by traditional forms of consumer protection. The next part will consider how the law can adapt to the distinctive features of the 3D-printing market while staying true to the need ethic.

III. 3D Printing and the Law

In this part, we highlight the particular quality and safety issues that might arise in the context of 3D-printing, the legal questions that are raised,⁶⁴ and how the law can respond while continuing to reflect the need ethic. We will argue that for many aspects, this can be achieved

⁶² See e.g., Traynor/Cunningham "Emerging Product Liability Issues in Biotechnology" (1988) 3 *Berkeley Technology Law Journal* 149; Fox/Traynor, "Biotechnology for Human Life and Health – The Special Case for a negligence-only rule to promote critical innovation" (1991) 6 *High Tech L.J.* 1.

⁶³ Cf. Bowsher, "Online retail sales continue to soar", *Financial Times*, 18 January 2018.

⁶⁴ See also Osborn, "Regulating Three-Dimensional Printing: The Converging World of Bits and Atoms" (2014) 51 *San Diego Law Review* 553, 558-562; Twigg-Flesner, "Conformity of 3D prints – Can current Sales Law cope?" *supra*, fn 00.

by applying existing legal rules, albeit with - fairly moderate - clarifications and extensions for some of them. However, some aspects of 3D-printing would put existing laws under heavy strain, and a more radical step will be needed, e.g., by introducing a form of network liability (discussed below).

Several new business models have developed which utilise the specific features of the 3D-printing technique outlined earlier. There are two stages to the 3D-printing process: first, the item to be printed has to be designed using suitable software and a CAD-file will be created. Secondly, the CAD-file will be used to instruct a 3D-printer to convert the code contained in the CAD-file into the physical item. Where the overall manufacturing process is fully integrated, all the stages from conception to design to production will be under the control of one entity, but the distinct nature of the design stage and the production/printing stage makes it possible to separate these into discrete events. Thus, anybody who has suitable software can use this to design a new item by creating a CAD-file. This could be done a professional designer, by an individual doing this at home in their spare time (i.e., a “hobbyist”), or even in a shared manner via open-source platforms where multiple people (whether professionals or hobbyists) can contribute to creating and improving a design contained in a CAD-file. Such a CAD-file can then be made available for purchase (either in return for payment of money or some other consideration) or simply shared for free – the digital nature of the CAD-file, and the internet, make this an extremely easy process. A consumer can therefore acquire a CAD-file in multiple ways, and it will not always be obvious who the author(s) of the CAD-file is (are). The second stage is the conversion of the CAD-file into a physical item. A consumer who has a CAD-file could make the physical item on a personal desktop 3D-printer (whether belonging to that consumer or another private individual). Alternatively, the CAD-file could be taken to a professional 3D-printing service which will then use the CAD-file to make the physical item. There are already on-line platforms which allow consumers both to offer their designs for sale and to upload their own or another’s CAD-file and then to order the physical item.⁶⁵

So what quality and safety problems might arise in the 3D-printing market and how can these problems be addressed while adhering to underpinning values i.e. the need ethic, whether through modest clarifications or extensions, or more significant deviations from doctrinal tradition. There are five particular issues to consider: (i) the use of 3D printing in the commercial production of goods; (ii) the potential liability of commercial operators who produce a printed item based on a CAD-file; (iii) the basis for liability for problems with the CAD-file and the design it contains; (iv) the blurred boundary between commercial and non-commercial (“hobbyist”) operators; and (v) whether some of the potential liability gaps created by the very significant role played by hobbyists in this market merit the introduction of some form of network liability.

What will emerge in the analysis to follow is that adherence to the need ethic simply requires continuing with existing legal rules in cases (i) and (ii); and modest extensions/clarifications to existing rules in cases (iii) and (iv). In contrast, the suggestion that continuing to follow a need

⁶⁵ For a useful survey of the various types of platform, see Rayna/Striukova, “A Taxonomy of Online 3D Printing Platforms” in: van den Berg/van der Hof/Kosta, *3D Printing - Legal, Philosophical and Economic Dimensions* (Springer, 2016), ch.9.

ethic might require adopting a form network liability (case (v)) can be considered a more radical deviation from doctrinal tradition.

1. 3D printing used in commercial production of goods

Goods which a consumer obtains at the point of retail will increasingly be commercially manufactured using a 3D printer, either because this technology is integrated into the manufacturing process, or because 3D printing technology is utilised to decentralise production to regional or local 3D-printing facilities. A company might, for instance, prefer to print on demand at several locations rather than have a central production and distribution centre.⁶⁶ It will also allow for the personalisation for goods. As already argued above, a need based ethic currently underpins the law dealing with goods manufactured by traditional means, and the same rules apply to goods manufactured using 3D-printing technology.

The business that supplies the goods under a contract to the consumer will be liable for any non-conformity under current (strict liability) rules of sales law: these rules apply to goods no matter what forms of technology were used to produce them.⁶⁷ Also as with any sale of goods, these strict liability standards will apply regardless of whether the flaw originally results from the CAD design file, materials used or manner of printing: the focus of rules is on the final condition of the goods supplied to the consumer, it being no excuse that the source of the defect is something that the final supplier had no control over.⁶⁸

Traditional (need based) strict liability tort standards will also apply to producers who do not supply 3D-printed goods directly to the consumer under a supply contract.⁶⁹ This may be important where either the consumer who bought from the seller cannot make a claim based on the strict liability contractual standards against the seller because the seller is insolvent; or where the party affected by the defect cannot use the strict liability contractual standards because they did not actually buy the goods under a contract of sale with the seller (perhaps they acquired it as a gift or were simply affected by it e.g. family members injured by defective brakes-made by 3D-printing in car bought by father or mother).⁷⁰ The producer of a defective item made by a 3D-printer will be liable (to pay damages) in the normal way under the strict (tort) product liability regime where the product contains a 'defect' which causes injury or damage to property.⁷¹ Similarly to the strict liability standards in contract law, the producer does not escape liability just because the defect was caused by something supplied to the producer by another party such as a defective CAD design file or defective materials, which the producer had no reason to know were defective: the producer has nevertheless produced

⁶⁶ In the international commercial context, see Greenbaum/Gelbart/Sheinberg, "Digital Delivery of Physical Goods Shipping in the 3D Printing Era – Problems and Solutions" (2017) 41 *Tulane Maritime Law Journal* 39.

⁶⁷ I.e., Part 1 of the Consumer Rights Act 2015. There is a statutory remedy package involving a short term (usually 30 day) right to reject and obtain a refund; a choice of repair or replacement; and if (for various reasons set out in the provisions) repair or replacement do not work out, the possibility of price reduction or final rejection (Consumer Rights Act, ss.19-24). The common law right to claim damages is also preserved ((Consumer Rights Act, s.19(9)-(11)).

⁶⁸ Of course, the front line seller may have remedies (based on breach of the strict liability conformity standards from the Sale of Goods Act 1979, s. 14 against the party from whom he purchased a defective finished item.

⁶⁹ E.g., under Part I of the Consumer Protection Act 1987.

⁷⁰ Liability under the Consumer Rights Act 2015 only falls on the trader who supplied the goods to the consumer.

⁷¹ Consumer Protection Act 1987, s.2.

and distributed a defective product which has caused loss or injury.⁷² Of course in such circumstances the producer may have recourse against their supplier.⁷³

The strict product liability regime also already makes it clear that any component parts can give rise to liability in their own right and this would apply to 3D printed component products.⁷⁴ It is possible that 3D printers will be used to personalise products by modifying them or adding accessories. In this context, product liability law in both negligence and strict liability probably imposes a duty on the producer to check the accessory market and give advice as regards the compatibility and safety of known add-on or modifications.⁷⁵

Such strict liability standards in contract and tort reflect pre-existing values i.e. the need ethic, there being no case to adapt to a fault based standard simply because 3D-printing has been used in the production process: There is the same need based case for strict liability. Consumers have the same limited abilities to bear losses as with products generally, the same limited ability to exercise self-reliance to protect against such losses (e.g. by negotiating express guarantees pre-contractually); and the actual risks of defects are just as high as with any other product, indeed possibly higher given the new nature of the technology.⁷⁶ Indeed a consumer who buys a finished item in-store or on-line will often not even know how the item was produced, so they are unlikely to be aware of this increased risk.

However, there are two further points to consider here. First, are there special market conditions that render protection otiose? So, is there any particular evidence in the 3D-printing market that consumers can be alternatively protected, e.g. that there is particularly strong reputational signalling in relation to 3D-printed goods, which enables consumers to make more informed choices over the quality that can be expected from different businesses?⁷⁷ There does not appear to be any such evidence. Second, we must consider whether there is strong evidence that a strict liability approach would have a chilling effect on innovation. There does not appear to be any such evidence here. 3D-printing is being used increasingly widely in making consumer goods (62% of consumer goods, according to a recent survey),⁷⁸ with 22% of goods produced using that technology. Statistics suggest that the use of 3D-printing for consumer goods is rapidly increasing;⁷⁹ and this is despite the current strict liability standards.

⁷² Consumer Protection Act 1987, s.2(2).

⁷³ See *supra*, fn 00, on the criteria. Also although consumers may also have a remedy against such parties under negligence law, this might be complicated to establish and in practice the problems are circumvented by channelling strict liability to the producer or seller. See Freeman, "The liability of inventors and designers to consumers injured by defective product design" (1997) 5 *Consum. L.J.* 65.

⁷⁴ Cf. sections 1(2) and 1(3) of the Consumer Protection Act 1987. Such component producers have special defences if the defect in the final product resulted from their following instructions of the final producer, or from the way the final producer incorporated the components: e.g., section 4(1)(f) of the Consumer Protection Act 1987 (following Article 7(f) of the Product Liability Directive (85/374/EEC)

⁷⁵ Examples from the construction law field: *Independent Broadcasting Authority v EMI Electronics and BICC* (1980) 14 *Build LR* 1; *Investors in Industry Commercial Properties Ltd v South Bedfordshire District Council* [1986] 1 *All ER* 787; *Goldswain and another v Beltec Ltd (t/a BCS Consulting)* [2015] *EWHC* 556.

⁷⁶ *Supra*, Part II on the need ethic, consumer vulnerabilities and new technology risks.

⁷⁷ *Supra*, Part II.

⁷⁸ Sculpteo, *The State of 3D Printing* (2017), p.24.

⁷⁹ *Ibid.*

2. Liability of professionals converting a CAD-file into a finished product.

A new businesses model, which has emerged recently and is likely to grow considerably, is a professional 3D printing service, both on the High Street and online. Such services allow a consumer to have the physical item printed from CAD-file which they have created themselves or obtained from a third party.

What exactly is the legal position in such cases? In the past, the supply of goods in which there was a major service element gave rise to debates in the UK as to whether the contract was a contract for the supply of goods or work and materials.⁸⁰ However, since the 1980s even where the contract was one for work and materials, it has seemed fairly clear that goods which eventually emerged from the process had to satisfy the strict liability standards as to satisfactory quality and fitness for purpose.⁸¹ The Consumer Rights Act 2015 has clarified the law with regard to consumer transactions, and now provides that that a contract will be one of sale (in which these strict liability standards will apply⁸²) where “goods are to be manufactured or produced and the trader agrees to supply them to the consumer”.⁸³ It is arguable that this would cover the production of a product by a commercial 3D-printing service. This extended notion of “sale” is based on the Consumer Sales Directive (99/44/EC),⁸⁴ although this absolves a seller from liability for non-conformity where “the lack of conformity has its origin in materials supplied by the consumer”.⁸⁵ However, there is no such qualification in UK Law, and so the fact that the consumer supplied the CAD-file which the 3D-printing service has turned into the finished product would not affect its liability towards the consumer for the quality and fitness for purpose of those goods.

This (need based) strict liability solution appears entirely appropriate. From the consumer’s perspective, the situation does not differ a great deal from the purchase of an already manufactured item, and so the same need-ethic seems appropriate in the case of these 3D-printing services. Consumer vulnerabilities to defective outcomes remain the same for these as any other products and there appear to be no greater prospects for consumer self-reliant protection than in other contexts. So the case appears to present itself for a continuation of the need based (strict liability) approach. Further there is no evidence that the market solves problems via especially fierce competition between businesses offering this sort of service, backed by especially strong reputational signalling.

It might be argued that there is a risk of chilling innovation by maintaining strict liability in this context where these 3D printing service providers may not engage in mass production (as often is the case with goods generally), so that there is less scope to internalise costs. However, though each product is made individually to order, there can be many orders for some particular products and the 3D-printing process itself will be a regular activity for the business. Moreover, small scale production should not be a reason for accepting a lower level

⁸⁰ See *Lee v Griffin*, (1861) 1 B and S 272, *Robinson v Graves* [1935] 1 KB 579 and *Watson v Buckley Osborne & Co* [1940] 1 All ER 174.

⁸¹ Then under the Supply of Goods and Services Act 1982.

⁸² Consumer Rights Act 2015, ss. 9-15

⁸³ Section 5(2)(a) Consumer Rights Act 2015.

⁸⁴ Cf. Art. 1(4) Consumer Sales Directive (99/44/EC).

⁸⁵ Article 2(3) Consumer Sales Directive (99/44/EC).

of consumer protection. There is no evidence that liability is having a chilling effect on the development of the 3D printing industry and we should be slow to accede to such arguments as they are easily made, but hard to prove and run counter to the rationales for protection.

Another possible reason that strict liability here might be said to risk chilling innovation is that a large element of what is being provided is a service and traditionally legal policy has been reluctant to impose strict liability for services because the outcome often cannot be predicted with certainty.⁸⁶ However, while this is the case with services such as medical treatment, there would seem to be fewer reasons to object to strict liability where the only task is to properly follow the instructions on the CAD file and use correct materials and processing procedures. This may be particularly true when the final product can be checked. There might be a concern that a strict liability approach would overburden the printing service provider in that it means that the provider is liable not only for errors within the printing process but also becomes the guarantor of the design of the product as found in the CAD (in the sense that they are liable for the final printed product even if the cause of the defect was a faulty design code). It might be considered harsh (and potentially to chill innovation by discouraging businesses from offering this sort of service) to impose liability on a printing service for defects that have their origin in a CAD file acquired elsewhere by the consumer, or even written personally by them. Traditional producers can be expected to know the design standards for their products and to monitor their products and have quality control procedures in place. But in the present situation, the 3D-printing service simply prints according to instructions in a CAD file that the service provider has no past connection with. This may seem unfair, but of course is not dissimilar to the plight of sellers generally who may not have knowledge of the design and no ability to quality control products, but who are nevertheless strictly liable for their defects.⁸⁷

Indeed, the problem is probably manageable under the strict liability standards in such a way as to protect the trader through modification of consumer expectations. Although the consumer's rights cannot be excluded using standard terms,⁸⁸ if the final product has an obvious defect and the supplier draws this to the consumer's attention there will be no liability for such non-conformity.⁸⁹ Second, the core strict liability standard, the satisfactory quality term, turns on what a 'reasonable person would regard as satisfactory'.⁹⁰ So, if the 3D-printing service provider indicates to the consumer that final product to be expected is simply a product conforming to the CAD-file (which may not be a perfect design), this arguably modifies what the reasonable consumer can expect/what they would regard as satisfactory. The consumer wanted a product printed that conformed to the CAD-file and has been warned as to the possible restrictions inherent in this, and so as long as the final product does indeed conform

⁸⁶ Willett, "Re-Theorising Consumer Law", *supra*, fn 00, 198-99.

⁸⁷ Whether under the Consumer Rights Act 2015, the Consumer Sales Directive (99/44/EC) or other consumer sales regimes (see Howells/Twigg-Flesner/Micklitz/Lei, *Comparative Consumer Sales Law* (Routledge, 2017)).

⁸⁸ Consumer Rights Act 2015, s. 31.

⁸⁹ Cf. s.9(4)(a) Consumer Rights Act 2015; Art.2(3) Consumer Sales Directive (99/44/EC).

⁹⁰ Cf. s. 9(2) Consumer Rights Act 2015; Art.2(2)(d) Consumer Sales Directive (99/44/EC).

to the CAD-file, this is arguably all that a reasonable consumer could expect/regard as satisfactory.⁹¹

What of strict (tort) liability for a product that is defective in the sense of actually being unsafe? Where such a defect emerges from a 3D-printing service, and the party affected is the consumer that purchased the service/goods, then this consumer can also claim damages under the above (strict liability) contract law regime (unsafe goods will usually be in breach of the satisfactory quality standards⁹²). However, what if the defective product has harmed a third party, e.g. a family member or friend of the consumer who has no contractual claim against the service provider?

In such cases, the 3D-printing service would also be a producer for the purposes of the Consumer Protection Act 1987 (as someone who ‘makes’ goods using the code and the printer), and therefore liable under the strict tort product liability regime to the injured (non-contracting) consumer.⁹³ This would apply whether the fault derived from the printer, the materials used or the CAD-file. All that matters is that the final product is defective. Of course this also means that the liability would apply in cases where the defect derived from a defective CAD-file, whether or not the service supplier/producer provided or had prior knowledge of the CAD-file.⁹⁴ In cases where the service supplier/producer did not supply or have past knowledge of the CAD-file, what if the service supplier/producer has warned the consumer that all that can be expected in terms of safety is what is written in the CAD file-with whatever flaws this may contain? Although producers can modify consumer expectations of safety in the product liability context,⁹⁵ given that the right to physical safety deserves higher protection than the right to quality, it seems likely that the courts would insist upon a basic threshold of safety in such cases and hold the supplier/producer liable for failure to meet this notwithstanding any warnings given based on the CAD-file.

Above we set out the various reasons that a need-oriented ethic should continue to be followed to support a continued strict liability standard in relation to contract law standards. The same arguments apply here with adaptations to the safety context: consumer vulnerabilities to the losses caused by goods printed by platforms are no less than in relation to other goods; consumers have no greater capacity to self-protect than in other cases; the risks may be greater due to the new technology; we need to be particularly protective where safety interests are concerned; and there is no evidence that innovation makes the protection otiose or that innovation will be undermined by the protection.

⁹¹ It might be argued that the trader need not even state that the final product can only be guaranteed to conform to the CAD-file, as the reasonable person would regard this as obvious, but a cautious trader would make the point clear.

⁹² Safety is a factor to be taken into account in determining whether goods are of satisfactory quality: Consumer Rights Act, s. 9 (3) (d).

⁹³ It goes without saying that the regulatory consumer safety laws should apply to the final products produced, especially the powers to take remedial action.

⁹⁴ Where the problem derives from a CAD-file, see the recommendation *infra* to clarify that the CAD-file is a product, meaning that there would also be an action in strict tort liability against the designer of the file.

⁹⁵ Section 3(1), Consumer Protection Act 1987, requires a level of safety “as persons generally are entitled to expect”, and such expectations can be modified by appropriate warnings: see *Worsley v Tambrands Ltd* [2000] P.I.Q.R. P95; *A v National Blood Authority* [2001] 3 All ER 289; most recently: *Wilkes v Depuy International Ltd* [2016] EWHC 3096 (QB).

3. Liability for CAD file.

An integral element of the 3D-production process is the creation of a CAD file which contains the design of the physical item to be produced. In instances where a consumer simply buys a finished item, there is not going to be separate liability to the consumer on the designer who created the CAD file, because the design stage is part of the overall production process, just as it would be with goods produced using more traditional means. The situation starts to get more complicated once a consumer buys, or acquires, the CAD-file in a separate transaction, and then either creates the physical product on their own 3D printer, or has someone else, such as a professional 3D-printing service, print the product for him/her. There could be any of a number of problems which related to the CAD file. In particular, there could be (a) a flaw in the design recorded in the CAD file; or (b) a problem with the CAD file itself (e.g., because it has become corrupted).⁹⁶

As indicated above, where consumers contract to buy goods made by a 3D-printing process strict liability operates. Thus, if the defective code has caused an item printed by a professional 3D-printing service to be defective, then as we saw above, this printing service provider will be strictly liable (in contract law) for defects resulting in the final goods supplied.⁹⁷ However, as we also noted above, this provider may be able to use warnings to modify their obligation such that they are only responsible for the final product conforming to what is on the file. In such circumstances, if the file is badly designed or corrupted, and such problems are simply reflected in the final product, the consumer would then have no recourse against the printing service provider. But the consumer has now paid for defective code and also for this to be converted into a finished product, only to be left (because of the defective code) with a defective final product. So the question arises as to what recourse the consumer should have and does have against anyone when it comes to recovering these losses. Another possibility of course is that the consumer uses the defective code to print the finished item at home and because of the defective code, the finished item is defective. Once again, the question is whether the consumer should have and does indeed have recourse in contract or tort⁹⁸ for the losses suffered.

Arguably, it would properly reflect the need ethic for there to be strict liability in both contract and tort in such circumstances. When a defective file causes the printed product to be defective, consumers have the same limited abilities to bear losses as with any defective product, the same limited ability to protect against such losses through self-reliance (e.g. by negotiating express guarantees pre-contractually); and the risks of CAD files leading to

⁹⁶ It may be that these instances are the digital equivalent of the familiar distinction between design and manufacturing defects in the area of product liability: see *A v National Blood Authority (No. 1)* [2001] 3 All E.R. 289; *Wilkes v DePuy International Ltd* [2016] EWHC 3096 (QB). Also Borra, "Products Liability in the 21st century" [2013] *Juridical Review* 199-225; Nolan, "Strict product liability for design defects" (2018) 134 *L.Q.R.* 176-181.

⁹⁷ See *supra* at X.X.

⁹⁸ As discussed above, tort may be an important route where a contractual claim is unavailable e.g. because the consumer buyer suffering the losses finds that the party from who they purchased the code under a contract (and against whom the contractual claim would lie) is now insolvent; or where the consumer suffering the losses did not buy the code under a contract but received it perhaps from a family member, friend or colleague,

defective end products are just as high as with any technology, perhaps higher given the new nature of the technology.

One issue is whether a CAD-file should be treated as only providing information which is then translated into action by a 3D-printer: and therefore whether this situation should be treated in the same way as the provision of information which consumers (or others) act upon, i.e., subject to the law of negligence and not to strict liability.⁹⁹ However, this analogy does not seem sound here. Where Y has relied on incorrect information provided by X, making X's liability subject to proof of fault by X can be explained on the basis that Y has exercised a reasonably significant degree of autonomy or self-reliance: Y mentally processes the information, perhaps makes judgements based on at least some degree of experience or even intuition as to whether and to what extent to trust it, and then decides precisely how to use the information. This autonomous agency by Y might be said to explain why X should bear something less than strict responsibility for the consequences of Y's reliance on the information. In contrast, there is much more limited autonomous or self-reliant agency by the consumer in our current scenario. The CAD-file is simply fed into the 3D-printer by the consumer and from this point it is the file that exercises agency: directly causing an action to occur by instructing the printer how to construct the materials into an end (potentially defective) product. On this basis it seems reasonable for the file to be treated in the same way as the law would treat a tangible product that is defective and (due to this defectiveness) affects another product i.e. to subject the file to strict liability.¹⁰⁰

Are there special market conditions that might make such protection otiose? So, is there any particular evidence in the 3D-printing market that consumers can be alternatively protected, e.g. that competition over code writing is especially fierce, and this is enhanced by superb reputational signalling of some kind?¹⁰¹ There does not appear to be any such evidence. Second, we must consider whether there is strong evidence that such an approach would have a chilling effect on innovation. Again there does not appear to be any such evidence here. There would appear to be no reasons why commercial digital content writers could not make the same assessments of risk as producers of goods. It is likely that some industry interests will argue that strict liability for code may threaten the development of an innovative industry. However, history shows that even more high risk and valuable sectors, such as biotechnology, have called for such special treatment, and not been granted it with no undue effects on innovation.¹⁰²

So what is needed to ensure that (need based) strict liability standards apply in contract and tort? In short the answer is that a degree of clarification/extension is required: which in the UK case has already recently occurred in the case of contract law but not in the case of tort law.

In UK contract law, prior to the Consumer Rights Act 2015 (and still now for business to business transactions), the standard of quality expected from digital content was unclear.

⁹⁹ On liability for negligent misstatements see e.g. Peel, *Treitel on the Law of Contract*, 14th ed., (Sweet & Maxwell, 2015), ch.9(2)(ii).

¹⁰⁰ Cf. Howells/Twigg-Flesner/Willett, "Product Liability and Digital Products" in Synodinou/Jougoux/Markou/Prastitou (ed.) *EU Internet Law – Regulation and Enforcement* (Springer, 2017).

¹⁰¹ See *supra*, Part II.

¹⁰² Burk/Bozcar, "Biotechnology and tort liability: A strategic industry at risk" (1995) 55 *Uni Pitt L R* 791.

There had been case-law dealing with the status of “software”, but this had not reached a clear position. Where the digital content was supplied on a tangible medium, i.e., goods, the digital content was in some instances classified as being part of those goods and therefore covered by the strict liability terms applicable to goods.¹⁰³ However, where there was no tangible medium (as where a CAD file is provided electronically), it was unclear whether the contract was “sui generis”, containing a common law implied (strict liability) term of reasonable fitness for purpose,¹⁰⁴ or a contract for services,¹⁰⁵ in which case there would only be a statutory implied term of reasonable care and skill (a fault standard).¹⁰⁶ In the latter scenario it might be difficult for the consumer to establish negligence by the supplier of the CAD-file, especially if the supplier was not the actual creator of the CAD-file (i.e., the producer), but had bought it from the creator and so could not typically be said to be negligent for not checking the file before selling it on to the consumer. If the supplier was also the producer of the CAD-file, it might be easier to establish negligence at least where it could be shown that the design was not created with sufficient care as to whether the printed product would be dangerous and could cause injury. However, there would not have been liability for simple quality shortcomings in negligence.¹⁰⁷

In the UK, the legal regime applicable to the contractual supply of digital content to consumers has now been clarified, and the strict liability conformity standards applicable to goods have been extended to digital content. The Consumer Right Act 2015 has a specific chapter on the supply of digital content.¹⁰⁸ This imposes strict liability obligations analogous to those for goods, i.e. supplying digital content of satisfactory quality and fit for any particular purpose made known.¹⁰⁹ This means that the supplier of a defective CAD file will be liable to the consumer buying the file without the need for the consumer to prove any fault on the part of the supplier. This liability would cover defects deriving from design flaws or from technical flaws with the CAD file.¹¹⁰

These provisions only apply where the digital content was supplied in return for the payment of a price,¹¹¹ so they would not apply where the digital content was acquired for free, or in return for providing data to the supplier. Similar remedies apply to digital content under the new regime (as to goods)¹¹² (repair, replacement, price reduction and damages);¹¹³ there is

¹⁰³ *International Computers Ltd v St Albans District Council* [1996] 4 All ER 481 and *SAM Business Systems v Hedley* (unreported).

¹⁰⁴ *Beta Computers (Europe) Ltd v Adobe Systems Ltd* [1996] SLT 604. In *Software Incubator Ltd v Computer Associates* [2018] EWCA Civ 518, the Court of Appeal held that software did not fall under the definition of “goods” in Reg.2(1) of the Commercial Agents (Council Directive) Regulations 1993 (overturning the High Court on this point).

¹⁰⁵ *Salvage Association v CAP* [1995] FSR 654.

¹⁰⁶ SGSA, s. 13-for B2C contracts, now CRA, s. 49.

¹⁰⁷ *Murphy v Brentwood DC* [1990] 1 AC 398.

¹⁰⁸ See Part 1, ch.3 Consumer Rights Act 2015 (ss. 33-47).

¹⁰⁹ Sections 34 and 35 Consumer Rights Act 2015.

¹¹⁰ If the supplier obtained the defective CAD file from another party, there may be the possibility of channelling liability along the contractual chain, although the supplier will not be able to rely on the provisions of the Consumer Rights Act 2015 but would have to make out a case based on the common law position and the terms of its supply contract.

¹¹¹ Consumer Rights Act 2015, section 33(1).

¹¹² See *supra*, fn 00.

¹¹³ Consumer Rights Act 2015, ss. 42-44.

no right to reject as such, although a price reduction can where appropriate amount to a full refund.¹¹⁴

These developments in the law involve a relatively modest doctrinal extension: in that contractual suppliers are made strictly liable not only (as previously) for qualitatively defective goods, but also (by analogy) for qualitatively defective digital content. So, while the approach taken can be said to be a values-driven approach in that the changes manage to ensure that the law responds to innovation by retaining an underpinning ethic of need; this is achievable here without a radical deviation from doctrinal tradition.¹¹⁵

The practical result is that consumers have recourse where a CAD-file to be used for 3D printing has shortcomings with regard to the quality and fitness for purpose of the design or the integrity of the file itself. However, this leaves unresolved at least some instances where for example a CAD-file supplied to a consumer leads to the consumer producing (on a home printer) a product that causes injury. Of course, in many cases consumers will be able to claim for the injury based on there being a breach of the (above discussed) strict liability contractual conformity obligations owed by the supplier: if the condition of digital content is such that it makes the finally produced goods unsafe this will normally mean that this digital content (the CAD-file) is of unsatisfactory quality. However, this form of recourse will not be available to the consumer injured by the finally produced goods where the supplier of the CAD-file has since become insolvent; and it will not be available where the party injured by the defect did not actually buy the goods under a contract with the supplier, but for instance received it as a gift. Equally, bystanders injured by the goods will not have contractual rights. In such cases it will be important to know whether there is strict (tort based) product liability on the producer.

In this connection, in particular, there is the question of whether a CAD file (or indeed any form of digital content) is a 'product' for the purpose of strict (tort) product liability law.¹¹⁶ There is no clear answer to this.¹¹⁷ Indeed, product liability law has long remained unreformed, but the need to address issues relating to the digital age may be a spur for it to be seriously reviewed.¹¹⁸ It would therefore be desirable to clarify/extend the current product liability regime such that it clearly applies to digital content,¹¹⁹ which would mean that a CAD file would be treated in the same way as a product. So there would be strict tort product liability for instance in cases where a consumer acquires a CAD-file, this causes a home printed item to be defective and leads to injury (but where for the sorts of reasons set out above) the consumer has no redress in contract law. This is a position advocated by many scholars¹²⁰ and indeed

¹¹⁴ S. 44 (2).

¹¹⁵ See *supra*, Part I for the foundational analysis of these issues as to values and doctrinal tradition.

¹¹⁶ Section 1(2)(c) of the Consumer Protection Act 1987 defines products as "any goods...", which imports the same difficulties already mentioned with regard to the pre-Consumer Rights Act 2015 difficulty of interpreting "goods" to include "software".

¹¹⁷ See Whittaker, *Liability for Products* (Oxford University Press, 2005), p.477.

¹¹⁸ There is an indication that this issue will be addressed by the European Commission in due course: see European Commission, *Artificial Intelligence for Europe* COM (2018) 237 final, p.15.

¹¹⁹ Cf. European Parliament Resolution of 3 July 2018, *Three-dimensional printing: intellectual property rights and civil liability*, paras 11-12.

¹²⁰ For a discussion see *inert alia*, Whittaker "European Product Liability and Intellectual Products' (1989) 105 *LQR* 125; Alheit, "The Applicability of the EC Product Liability Directive to Software" (2001) 34 *Comparative and International Law Journal of Southern Africa* 188 and Howells/Twigg-Flesner/Willett, "Product Liability and Digital Products", *supra*, fn 00.

implemented by some states.¹²¹ However, this is not a radical change, but merely clarifies that that software falls under the same rules as product generally.

As with introducing strict contract liability, introduction of strict tort liability for digital content (including CAD-files) would be values-driven (responding to innovation by retaining an underpinning ethic of need). Yet, as with the case of contract law, this would be achievable without radically departing from doctrinal tradition: producers are already strictly liable in tort for tangible products and all that is proposed is to make them liable by analogical extension (or perhaps even clarification) for digital content.

4. The boundary between “hobbyists” and “professionals”

Thus far, it has been shown that the need ethic should and can be maintained for several key features of 3D-printing: in some cases, with no changes to existing laws, and in other cases by modest clarification/extension of laws. However, we now turn to a further difficult challenge. The need ethic is reflected in strict liability rules, but these are strict liability rules that a consumer benefits from only when dealing with a professional seller: as discussed in Part II, the whole point is that there is typically considerable imbalance of power and resources between consumer and professional, justifying a need-oriented consumer protection regime. In contrast individual private parties involved in making and selling things are only subject to the general rules of contract and tort law: this typically meaning in contract law there being liability only where express commitments have been made, and in tort there being liability where there is negligence (based on breach of an established duty of care).

The digital revolution and sharing economy are disruptive in this regard because they allow perhaps more scope than ever before for individuals to compete with traditional forms of commerce. This is seen most obviously with taxis (*Uber*) and hotels (*Airbnb*). 3D printing is not part of the sharing economy – individuals do not yet regularly lend out their 3D printers. Printing services are mainly commercial operations, with only a few basic desktop 3D-printers currently available on the consumer market. However, the 3D-printing economy does give individuals more options to become CAD-file designers, and eventually producers of finished items (especially once more sophisticated 3D home printers become available).¹²² Individuals can create designs for fun, work on each other’s designs, and even help businesses with design projects (whether gratuitously or in return for some remuneration).

The question then is what is to become of the need ethic in these circumstances. The risks of defects are possibly even higher with hobby designers, producers and sellers involved. The consumer customer is as vulnerable as ever in terms of having limited resources to absorb losses. On these grounds the need ethic should apply and this should be expressed in strict liability standards. However, as indicated above, also key to the justification for the need ethic is the power *imbalance*: The idea is that while consumers are vulnerable in having limited ability to bargain to protect their interests and limited capacity to absorb losses, professional producers and suppliers are stronger in these regards. They are experienced in quality control;

¹²¹Under the Australian Consumer Law goods includes software, Schedule 2 s.2.

¹²² Anderson, *Makers – The New Industrial Revolution* (Random House, 2013).

skilled and experienced in protecting their interests through bargaining and perhaps issuing warnings to consumers that may restrict their responsibilities; and they typically have the resources to absorb the losses they suffer when required to provide remedies to consumers. For sure, it would probably be inappropriate to impose need oriented strict liability standards on hobby suppliers who display none of these characteristics i.e. who are no different from the typical non-professional player that the law has never previously imposed such standards on. However, as indicated above in the 3D-printing economy there are more opportunities for individuals to design CAD-files and eventually to become producers of finished items; so there may be many more hobbyists who come closer (than hobbyists in the 'old' economy) to looking like professionals: e.g. in terms of level of profit, capacity to bear losses etc. This poses a challenge for the law. The difficulty is in determining when should such parties turn from being regarded as hobbyist "non-traders" to being considered professional traders with strict liability responsibilities that provide need-oriented protection to the consumers they deal with and affect.

Indeed, the EU has recently noted the increasing difficulty for consumers in being able to tell whether they are dealing with a trader or an individual.¹²³ It has proposed to require an online platform to inform a consumer whether they are dealing with a trader.¹²⁴ This might help when a trader is using a platform to disguise their commercial nature, but it is of little use in determining whether someone *is* a trader or not in the first place. Their own self-declaration cannot be definitive. Additionally, there is recent CJEU guidance for determining in the context of EU law whether activities are of a business nature. These do not mention explicitly the factors suggested here in the text but are certainly broad enough to encapsulate them: in particular, whether transactions are carried out in an organised manner; whether they are intended to generate profit; whether the seller has relevant expertise that the buyer lacks; the legal status of the seller; whether the seller received remuneration or another incentive for conducting transactions; whether the seller purchased new or second hand goods to re-sell them; and whether the goods were all of the same type.¹²⁵ It will still require a case-by-case analysis and a degree of uncertainty remains.

The Consumer Rights Act 2015 imposes strict contractual liability on a "trader", defined as "a person acting for purposes relating to that person's trade, business, craft or profession, whether acting personally or through another person acting in the trader's name or on the trader's behalf".¹²⁶ However, that definition leaves open how one determines which activities would constitute a person's trade, business, craft or profession. In the past, the courts in the UK have taken account of the regularity or volume of transactions entered into by an individual

¹²³ European Commission, *Proposal for a Directive as regards better enforcement and modernisation of EU consumer protection rules* (COM (2018) 185). See Loos, "The Modernisation of European Consumer Law: A Pig in a Poke" (2019) 27 *European Review of Private Law* (forthcoming); Twigg-Flesner, "Bad Hand? The 'New Deal' for EU Consumers" (2018) 15 *GPR* 166.

¹²⁴ See draft Art.2(4), which would insert a new Article 6a into the Consumer Rights Directive (2011/83/EU) and introduce a number of information obligations on "online marketplaces", including "whether the third party offering the goods, services or digital content is a trader or not, on the basis of the declaration of that third party to the online marketplace".

¹²⁵ C-105/17 *Komisia za zashtita na potrebitelite v Evelina Kamenova* ECLI:EU:C:2018:808 (judgment of 4 October 2018), paras [38]-[40].

¹²⁶ Section 2(2) Consumer Rights Act 2015.

with a view to profit-the greater the regularity and volume the more likely the activities are to be considered to be related to trade, business etc.¹²⁷ Yet, the effect of digital technology is such that an individual who has designed a CAD-file for an item and offers this for purchase via a website for a few pounds might suddenly “sell” that file many times over, as this example by Osborn shows:

“Suppose a college student designs a CAD file for a simple widget in her dorm room for fun. She uploads it to a website and puts a price of five dollars for the CAD file, thinking little of it. For the first three months, she sells only one – to her mother. Is she a merchant at this point? It would seem not. To her amazement, in the next three months – while she does nothing but study for classes – the widget goes viral and she sells 20,000. Is she now a merchant? In one sense, yes, because she has sold 20,000 of the same widget. In another sense, no, because she expended no more effort and became no more sophisticated than when her mother was her only customer.”¹²⁸

Therefore, an unqualified ‘frequency or regularity of transactions for profit’ test may not be appropriate on its own. As this example shows, it could mean that someone is converted into a trader (by events outside their control) after they had completed their act of supply. A more nuanced approach to regularity might be required, whereby the question would be how often the ‘hobbyist’ in question actually takes steps to supply designs (e.g. how regularly they post files). Account should arguably also be taken of such factors as whether they take action in the form of marketing or advertising to promote sales; and whether they post and promote *different* designs. These indicatively business patterns of behaviour justify imposition of strict liability not least because the regular engagement is likely to bring greater experience and therefore perhaps more awareness of the need to self-protect e.g. by insuring against liability to consumers. Also of course larger profits are likely to be generated enabling the suppliers to absorb the costs of providing remedies to consumers if things go wrong.

There is a case for providing some form of clarification that elaborates on the statutory test to include these sorts of criteria as to how regularly someone posts files, their marketing and advertising activities, and the range of designs they post and promote. Rather than amending the Consumer Rights Act 2015 directly (or, indeed, other relevant legislation), this could be done in the guidance accompanying the Act, which already include examples on a variety of issues relevant to particular sectors.¹²⁹ Achieving greater clarity on the dividing line between trader and hobbyist would help to ensure that need based strict liability would apply only where it is most appropriate: a values driven approach that imposes strict liability where the traditional rationales genuinely apply in the new digital context. It would not involve doctrinal disruption,

¹²⁷ *Davies v Sumner* [1984] 1 WLR 1301 (HL); *R & B Customs Brokers Co. Ltd v United Dominions Trust Ltd* [1988] 1 WLR 321 (CA).

¹²⁸ Osborn, “Regulating Three-Dimensional Printing: The Converging World of Bits and Atoms” (2014) 51 *San Diego Law Review* 553, 573.

¹²⁹ *Explanatory Notes to the Consumer Rights Act*, available at <http://www.legislation.gov.uk/ukpga/2015/15/fns/contents> [last accessed 27 October 2018],

rather a simple clarification to adapt the legal standard to the new conditions of this particular aspect of the digital economy.

What about strict liability in tort? As explained above, this provides recourse to the injured consumer where there is no recourse against the contractual supplier e.g. due to their insolvency, or because the injured party did not receive anything under a supply contract but rather as a gift or was simply injured as a bystander. Here a producer has a defence under the strict product liability regime only where they are not acting in the course of a business or with a view for profit.¹³⁰ So, the defence is unavailable where a product is distributed with a view to profit even if the producer does not act like a business in any of the other ways discussed above (e.g. no regularity of production and supply, no advertising and promotion etc.).

Now this is perhaps a rather harsh outcome for a hobbyist who designs a file or makes a product only once for profit and is unlucky enough for there to be a defect and for someone to be injured. However, this has always been the case for products in general under this regime. The only difference now would be that under the proposal made above at (iii) the liability would now cover defective CAD-files supplied for profit. Of course there remains a good case for this approach, based on the need ethic: the physical well-being of consumers is at stake, and the producer has sought and received a profit. Nevertheless, it is true that such liability may well come as a shock to an individual who would not anticipate being caught by product liability rules and therefore would be unlikely to be insured; and this may have a chilling effect on individuals utilising 3D-printing as a hobby and potentially enriching the market with worthwhile designs.

One possible solution might be to create a new, intermediate category of “micro-producer”, under which the profit-making hobbyist is liable but only up to a fixed amount of a few hundred or a few thousand pounds.¹³¹ However, this this might unduly complicate matters, as the law would then be required to tackled two different ‘grey areas’, i.e., that between micro producer and full producer, and that between micro producer and outright hobbyist. To take just one possible criterion, the basis of the amount of profit made: what level of profit would be used to mark out the distinctions between the different categories? And if this turned out not to be a good criterion, what alternatives would be preferable? The sensible conclusion then may be that to ensure need oriented strict liability protection for consumers it is sufficient to retain and manage the current approach whereby hobbyists are strictly liable in tort even on the basis of a single supply for profit: although perhaps there is a case for some form of education campaign to inform hobbyists of the risks involved.

5. Radical deviation from doctrinal tradition: Network Liability

Given the greater role in the 3D-printing economy for “hobbyists”, some of whom may not satisfy the criteria to be strictly liable for quality or safety defects, this discussion now turns to

¹³⁰ S. 4(1)(c) Consumer Protection Act 1987.

¹³¹ Cf. Berkowitz, “Strict Liability for Individuals? The impact of 3-D printing on Products Liability Law” (2014) 92 *Washington University Law Review* 1019, 1043-1052

the question whether preservation of the need ethic may require a new approach that extends liability beyond traditional doctrinal boundaries-some form of network liability or insurance fund system.

It was explained in Part II that 3D-printing is one instance where two risks to consumers arise simultaneously: the first is the spread of what is still a relatively new form of technology, and the second is the potential of this new technology to enable non-experts to both design and produce 3D-printed items. Then the section immediately preceding here (section (iv) above in this Part), highlighted the uncertainties often involved in distinguishing between those that do and do not cross the threshold to be strictly liable to consumers. Certain clarifications were then proposed in relation to contractual supply i.e. making it clear that business status (and the accompanying strict liability responsibility) should depend on regularity of supply, significant marketing and advertising, and there being a range of designs that are posted and promoted. Now it seems quite likely that there may be significant numbers of suppliers in the 3D sector who, based on such criteria, are not considered to be business suppliers. Equally, there may be significant numbers of hobby producers who do supply for profit at all and therefore do not cross the threshold to make them strictly liable in tort (above at section (iv) in this Part).

There may therefore be a greater risk that consumers will not have a remedy for quality defects or injuries caused by 3D-printed products. Now consumers might seek to exercise self-reliance to protect themselves against these risks: determining whether what they buy comes from non-professional suppliers or producers (who will not be strictly liable) and either negotiating express guarantees as to quality or safety or insuring against the risks. However, such self-reliant action is especially challenging for consumers in this context. In traditional sales it may sometimes be easy for a consumer to recognise that a seller is another private individual e.g., at a car-boot sale. However, this is much more difficult in an on-line environment; and it is especially difficult to determine the status of the producers who sit at least one further level beyond suppliers in the network and who consumers will rarely have any contact with.

So, what can be done to fill the potential strict liability gap and retain a strong need ethic? A solution to this would be a type of 'network' liability, fixing parties in the production and supply network with liabilities they would not traditionally have; to plug gaps caused by the presence of non-professional hobbyist sellers and producers. There will, for example, be instances when a hobbyist has utilised the services of a professional 3D-printing service to create an item, before the hobbyist then sells the finished item to a customer. As discussed (at section (ii) above in this Part) this professional printing service will under existing rules be a producer and therefore strictly liable in tort for injury. However this strict tort liability does not include liability for pure quality defects;¹³² and while a professional seller will be contractually responsible for such quality defects the hobbyist seller who does not cross the threshold of being a professional business seller will not be so responsible (see section (iv) above in this Part).

¹³² The regime only covers injury or damage to property, this not including damage to the defective product itself (Consumer Protection Act 1987, s. 5 (1)-(2)).

So one form of network liability could involve extending the liability of the printing service/producer: to include liability for pure quality defects. This would fill the gap left by the hobbyist seller in the scenario described. It would be a fairly radical departure from doctrinal tradition and policy: the UK government and the EU have previously rejected or ignored arguments for imposing strict liability for quality defects on producers;¹³³ and the English courts have even refused to countenance liability for quality defects caused by negligence.¹³⁴ Nevertheless, strict producer liability for quality defects (at least in this sector) may be necessary if the law is to continue to reflect the need ethic in this new technical environment: a case of adherence to the need ethic requiring radical deviation from doctrinal tradition.¹³⁵ It must also be remembered that by comparison with either the consumer affected by the loss or the hobbyist seller such producers/printing service providers are better placed to absorb losses: they will usually have greater resources and be well placed to insure against the losses. Another possible scenario is that a hobbyist may supply via an online platform. Here if the hobbyist does not cross the threshold to be a professional business supplier, the hobbyist will not be contractually liable for quality/safety defects. Indeed, let us also suppose that this hobbyist (or another hobbyist) is the producer of the defective goods (or of the CAD-file that is the source of the defect). If such a hobby producer did not act for profit, then they would not even be liable for injury under the strict liability tort regime (see (4) above). Generally speaking, the online platform through which the contractual supply to the customer was made is merely an intermediary, because the actual contract for the supply of the goods is between the hobby seller and the customer. Therefore, the platform itself is not contractually liable for the quality or safety of the goods. Moreover, as the platform is not a producer, it is also not liable in tort. However, if the case for network liability is accepted in principle, then the particular role of online platforms in facilitating transactions would make this a further key area for applying network liability.¹³⁶ This would mean making the platform strictly liable for the safety and/or quality of the goods supplied by hobbyist suppliers through that platform. Doing so would certainly be a more radical deviation from doctrinal tradition. Intermediaries do not usually bear any immediate responsibility for the quality or safety of goods (assuming they have made no representations that might e.g. engage liability via a collateral contract,¹³⁷ or, in even for fraud or negligent misstatement). Again, however, this may be a form of doctrinal innovation that is required in order to help to ensure that the law continues to reflect the need ethic, by filling the gap caused by the hobbyist sellers/producers in the scenario described. In particular, it would

¹³³ Seminally, Bradgate/Twigg-Flesner, "Expanding the boundaries of liability for quality defects" (2002) 25 *Journal of Consumer Policy* 342; see also Willett, "Direct Producer Liability" in: Howells/Schulze, *Modernising and Harmonising Consumer Contract Law* (Sellier European Law Publishers, 2009).

¹³⁴ *Murphy v Brentwood D.C.* [1991] 1 AC 398.

¹³⁵ It is beyond the scope of this paper to review the case for introducing such liability for sectors generally, but see Bradgate/Twigg-Flesner, "Expanding the boundaries of liability for quality defects" and Willett, "Direct Producer Liability" *supra*, fn 00.

¹³⁶ The literature on the potential liability of online intermediary platforms is growing, but it is beyond the scope of this paper to engage with this literature in detail. See e.g., Helberger/Pierson/Poell, "Governing Online Platforms: from contested to cooperative responsibility" (2018) 34 *The Information Society* 1; Rodriguez de las Heras Ballell, "The Legal Anatomy of Electronic Platforms: A prior study to assess the need of a Law of Platforms in the EU" (2017) 3 *Italian Law Journal* 149, or Busch/ Schulte-Nölke/Wiewiorowska-Domagalska/Zoll, "The Rise of the Platform Economy: A New Challenge for EU Consumer Law?" (2016) 5 *EuCML* 3

¹³⁷ *Shanklin Pier v Detel Products LD* [1951] 2 All ER 471.

also channel liability towards a party with better resources and the ability to obtain insurance cover in respect of such liability: and a party who may 'only' be an agent but who clearly benefits from their position in this network and the profits they make from the hobbyists involved in the network.

Network liability would not be a complete leap into the unknown, of course, but rather build on established extension of traditional contract liability. Perhaps the most notable model for such an approach is the connected lender liability provision in section 75 of the Consumer Credit Act 1974. This imposes liability on a credit card company for matters such as the supply of poor quality goods, which is concurrent to that of a seller of goods or supplier of services to consumers, and allows consumers to have recourse against the credit card company on the same terms as against the seller/supplier.¹³⁸

One difficulty with a network liability approach might be its complexity. Suppose a scenario that a hobbyist CAD-file designer has an item printed by a shop and then supplies it through a platform. This combines the two potential areas of application discussed above. In such a situation, clear choices would need to be made as whether the liability should only be extended to the printing shop *or* the platform, or whether the particular network in this instance encompasses both.

A further question arises once one party in the network has taken the position of the liable party towards the final consumer, which is how the network should allocate the costs of this amongst its members.¹³⁹ One solution some kind of collective fund which could be used to recompense the person who provided a remedy to the final consumer. Alternatively, it might be simpler to impose liability more 'collectively' on the network. There could be an insurance fund, which could be financed through a small surcharge on the sale of 3D-printers as well as every time a professional 3D-printing service produces a physical item. Consumers affected by poor quality and dangerous items would then claim from the insurance fund.

One way or another, if we are to take a values-driven approach then a degree of doctrinal disruption in the form of some form of network liability may be required: to deal with the democratisation of production and supply in the 3D-printing sector, which brings a significant hobbyist element into play. Indeed, while not calling for this specific solution the European Parliament has already recently recognised that there is a problem: highlighting the difficulty for consumers to identify the person responsible for a problem with a 3D-printed product, and calling for a better definition of the responsibilities of all the parties involved in a 3D-printing process.¹⁴⁰

¹³⁸ Here the need oriented rationale is not that there are hobbyists who cause gaps in the liability system, more that it may be at least easier for consumers to obtain redress from a credit card company than traders who may perhaps be small in size; and that credit card companies are well resourced to cover the losses and benefit from their part in the network.

¹³⁹ For a detailed analysis of network liability, see Bradgate/Twigg-Flesner, "Expanding the boundaries of liability for quality defects", *supra*, fn 00.

¹⁴⁰ European Parliament Resolution of 3 July 2018, *Three-dimensional printing: intellectual property rights and civil liability*, Recital AE and paragraph 14.

IV. Concluding Comments: consumer law values, 3D-printing and the wider digital revolution

Using 3D-printing as a case study, this paper has provided a new theoretical framework for dealing with the challenges of digital innovation for consumer law. This is a framework that stresses the importance of underpinning values in determining how consumer law doctrine should respond to technological innovations. This framework holds that in deciding if underpinning values should change, legal policy should not underestimate either perennial risks and consumer vulnerabilities; or the scope for these risks and vulnerabilities to be increased by technological innovations. Neither should legal policy overestimate the risk that adherence to protective underpinning values will hamper innovation.

It has been shown that a need ethic currently underpins consumer private law, reflected in particular through strict liability standards of quality and safety. The argument has been that this ethic should continue to underpin rules applicable to 3D-printing, not least because consumer vulnerabilities and the risks from which the law seeks to protect consumer are just as, if not more, prevalent in the 3D-printing market. Preserving these values will generally not be a real threat to innovation.

The paper has then used this approach to develop a set of original doctrinal solutions to the distinctive quality and safety issues arising in the 3D-printing market. Despite the innovations and risks brought by 3D-printing, existing laws can often continue to promote the need ethic: albeit with some important extensions and clarifications related to digital content and who should count as a professional business supplier. In some instances, however, there may need to be a more radical departure from doctrinal tradition: forms of 'network' liability, whereby responsibilities are re-allocated to businesses such as 3D-printing service providers and internet platforms that are not subject to liability under traditional legal rules and principles. The analysis provided here is based on UK law, but its significance extends far beyond the UK. 3D-printing technology is developing across the world.¹⁴¹ The same risks (of new technology and inexperienced producers and suppliers) will apply across national borders, as will similar perennial power imbalances between businesses and consumers. In addition, strict liability doctrine applicable to goods is the norm in very many jurisdictions: e.g. across the EU, in Australia, Canada and New Zealand;¹⁴² so the same questions will arise as to whether and how (doctrinally) to adhere to the underpinning need ethic.

Indeed legal orders beyond the UK have already begun to consider some of the questions that arise in relation to 3D-printing and the digital economy more generally—the so called digital fourth industrial revolution.¹⁴³ What have often emerged are arguments supporting what we have presented here. For instance EU legal policy continues to assert the need for strong consumer protection.¹⁴⁴ At the same time the recent European Commission REFIT study

¹⁴¹ United Nations Conference on Trade and Development (UNCTAD), *Information Economy Report 2017 – Digitalization, Trade and Development*, p. 7.

¹⁴² See *supra*, fn 00.

¹⁴³ Schwab, *The Fourth Industrial Revolution*, (Crown, 2017)

¹⁴⁴ See the discussion in Howells/Twigg-Flesner/Wilhelmsson, *Rethinking EU Consumer Law* (Routledge, 2017), ch.1.

found that by and large EU consumer laws remained fit for purpose even in the online world.¹⁴⁵ Of course, again in line with our arguments, it is also recognised that there is a need for some modification and the proposal for a directive on digital content¹⁴⁶ is one response, as is the impetus new technologies have given to the review of the product liability directive.¹⁴⁷ The question then is in what circumstances more radical doctrinal deviation may be required in order to hold on to protective values. Here we discussed network liability for printing service providers and platforms on the 3D-printing sector. However, there may be a case for some similar form of liability on platforms in the sharing economy sector (e.g. Uber, AirBnB). These platforms also bring together consumers and potentially inexperienced suppliers, play an active and profitable role in the transaction and there is arguably a case to shift them from their traditional agent status to bearing at least some direct responsibility to consumers who may otherwise struggle to obtain redress.¹⁴⁸

3D printing is part of a much larger digital revolution – big data, cloud computing, Artificial Intelligence, the Internet of Things and the sharing/platform economy are just a few well know examples of how the consumer society is being revolutionised. There are numerous highly technical public law regulations on safety and technical compliance that provide mechanisms for society to guide the development of this digital revolution;¹⁴⁹ and increasingly we will see calls to develop ethical guidelines. Our argument is that at least as far as private law doctrine is concerned the law is often fairly technology neutral and future proof. However, the framework developed here provides a methodology to stress test private law to ensure it is fit to meet the challenges of 3D printing and other innovations of the Fourth Industrial Age.

To sum up, our framework broadly involves: (i) identifying the underpinning values of an area of law; (ii) identifying how these values manifest in specific rules; (iii) asking whether there is a reason to see these values changed by considering whether risks are lesser or greater than before, whether parties are more or less able to look after themselves and whether innovation is seriously threatened by sticking to the traditional values; (iv) if there are good reasons to stick to the traditional values, considering whether the existing specific rules can apply to new circumstances created by the innovations, either with no change or with adaptation or development that does not fundamentally change the legal regime; and (v) if radical regime change is needed to reflect traditional values, finding solutions that are workable and proportionate.

¹⁴⁵ Executive summary of the Fitness Check SWD (2017) 208 final.

¹⁴⁶ European Commission, *Proposal for a directive on certain aspects concerning contracts for the supply of digital content* (COM (2015) 634 final).

¹⁴⁷ *Evaluation of Council Directive 85/373/EEC of 25 July on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products* SWD (2018) 157 final

¹⁴⁸ For a discussion of the issues, see Twigg-Flesner, “Disruptive Technology – Disrupted Law?” in: De Franceschi (ed.), *European Contract Law and the Digital Single Market* (Intersentia, 2016), 36-7

¹⁴⁹ E.g., General Product Safety Regulations 2005 (S.I. 2005/1803), implementing the General Product Safety Directive (2001/95/EC) or the Supply of Machinery (Safety) Regulations 2008 (S.I. 2008/1597) implementing the Machinery Directive (2006/42/EC).