

Repair or Protection? The Conflict between the Right to Repair and Software Copyright in EU Law

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Abstract

This thesis assesses the efficiency of the EU Law's balancing act between the software developers' copyright protection on their respective computer programs and the software users' right to repair their defected software based devices. This research necessitates an EU legal method, implying the comprehensive analysis of EU legislation and the case law of the Court of Justice of the European Union, as well as the interpretation of scholarly works and key EU doctrines, all through the lens of emerging sustainability considerations and policy objectives towards circular economy transformation.

In that regard, the thesis aims to answer the question whether EU's copyright protection for computer programs limit the right to repair software-dependent products, and in the affirmative, how EU law should be amended in order to adequately address any existing imbalance between conflicting interests.

As far as the results of our research are concerned, we conclude that despite the EU's balancing aspirations, the conflicting policy interests and the existing inconsistencies of EU legislation require a thorough revision and amendment of EU law. At the end of our research, we summarise our recommendations and possible solutions as well in this regard.

Keywords: software, copyright, R2R, EU, sustainability

Abbreviations

CEAP	Circular Economy Action Plan
CJEU	Court of Justice of the European Union
EU	European Union
IoT	Internet of Things
MIT	Massachusetts Institute of Technology
R2R	Right to Repair
TMP	Technological Protection Measure
WTO	World Trade Organisation

1 Introduction

1.1 Background

“When digital transformation is done right, it’s like a caterpillar turning into a butterfly, but when done wrong, all you have is a really fast caterpillar.”¹ This quote by MIT professor George Westerman encapsulates the central tension underlying in this thesis. As the digitisation of even the most rudimentary devices accelerates, concerns regarding its negative consequences are increasingly arising. Apart from issues concerning artificial intelligence, cybersecurity and interoperability, another significant yet less explored area concerns intellectual property protection in digital products.

Within the European Union, copyright protection for computer programs grants software developers extensive exclusive rights over their creations. Computer programs are generally understood and protected as literary works under EU copyright law. Through this legal framework, developers are therefore granted extensive rights over the use and modification of their software. However, questions concerning the limits of copyright protection inevitably arise, particularly when such protection conflicts with broader societal interests, including sustainability and repairability.

Parallel to the technological transformation, sustainability concerns have gained growing traction within the European Union. The environmental consequences of planned obsolescence, increasing electronic waste and shortened product lifecycles have intensified political and legal debates surrounding the so-called “right to repair” (R2R). Repair is increasingly recognised not merely as a consumer convenience, but also as an important mechanism for promoting sustainability, extending product lifespan, and facilitating the transition towards a circular economy. In line with these objectives, the European Union has adopted several legislative and policy initiatives aimed at strengthening repairability, reducing waste generation and promoting sustainable consumption.

Despite this emerging regulatory framework, the practical execution of repair in the digital environment remains difficult. The repair of software-dependent products frequently requires interaction with protected software systems. Repair activities may require diagnostics, firmware restoration, reverse engineering, decompilation or the circumvention of technological restrictions.

Consequently, a persistent conflict of interests emerges between users and independent repairers on one hand, and software developers on the other. Users seek access necessary to facilitate repair and extend product lifespan, whereas developers

¹ Wadhawani Foundation, ‘Digital Transformation: Don’t build a faster caterpillar!’ (2022).

aim to prevent unauthorised interference with protected software systems by leveraging on intellectual property rights.

This conflict reflects a broader tension between two competing policy objectives. On one hand, copyright law seeks to incentivise innovation and creativity by protecting the exclusive rights of software developers. From this perspective, restrictive copyright protection may be regarded as necessary to prevent piracy, protect commercial investments and preserve software integrity. On the other hand, excessively restrictive copyright rules risk undermining the European Union's sustainability ambitions and circular economy objectives.

1.2 Purpose and research questions

This thesis aims to contribute to the academic discussion surrounding the relationship between EU copyright protection for computer programs and the emerging right to repair movement within the European Union. The analysis is conducted in an integrated manner, as the issue exists at the intersection of intellectual property law, consumer protection law and sustainability-oriented EU policy.

On one hand, EU copyright law aims to safeguard innovation and protect the legitimate economic interests of software developers through exclusive rights and technological protection measures. On the other hand, the European Union increasingly promotes repairability, sustainable consumption and circular economy objectives through right to repair initiatives. Consequently, tensions arise where copyright protection limits the practical ability of lawful users and independent repairers to access, modify or restore software-dependent products.

The thesis further aims to evaluate whether the current EU legal framework successfully balances these competing interests. In doing so, the study seeks to contribute to a broader understanding of how intellectual property law interacts with sustainability objectives in the digital age. Against this background, and for the purpose of the research, this thesis sets out to answer the following:

Key research question:

- To what extent does the EU's copyright protection for computer programs limit the right to repair software-dependent products, and what legal changes could be adopted in order to balance the conflicting interests involved?

The key research question is further divided into four sub-questions. Each sub-question will be addressed in Chapters 2 to 5 respectively, while Chapter 6 will provide the overall conclusions and answer the key research question.

Sub-question 1 addressed in Chapter 2:

- To what extent does Directive (EU) 2024/1799 effectively reconcile the right to repair software-dependent products with EU copyright protection of embedded software?

Sub-question 2 addressed in Chapter 3:

- To what extent do the protections granted under Directive 2009/24/EC (hereinafter: Software Directive) permit repair-related activities involving software-dependent products?

Sub-question 3 addressed in Chapter 4:

- How do technological protection measures and anti-circumvention rules under Directive 2001/29/EC (hereinafter: InfoSoc Directive) restrict the practical exercise of repair rights for software-dependent products?

Sub-question 4 addressed in Chapter 5:

- To what extent are EU case decisions capable of reconciling the tension between copyright protection and repairability?

1.3 Delimitations

This thesis focuses exclusively on the EU legal framework governing copyright protection for computer programs and its interaction with repair-related activities. Although the right to repair debate exists globally, the research is limited to EU law due to the scope and objectives of the study. For the same reasons, the thesis does not conduct a full comparative analysis of national legislation among EU Member States.

Additionally, while the thesis critically examines the restrictive effects of copyright protection and technological control on repair-related activities, it acknowledges that software developers and manufacturers possess legitimate interests in protecting intellectual property, software integrity, cybersecurity and commercial investments. However, a comprehensive technical or economic assessment of these interests falls outside the scope of this research.

1.4 Method and materials

To answer the research questions, this thesis primarily adopts a legal doctrinal method. Through the analysis of EU legislation and the works of legal scholars, the research systematically identifies, interprets and evaluates the legal framework governing copyright protection for computer programs and repair-related activities.

The doctrinal analysis is supplemented by structured case law analysis to identify interpretative patterns concerning the research object and to clarify ambiguities and gaps within the existing legal framework.

The thesis also incorporates elements of law in context research. Since the legal issues examined cannot be fully understood in isolation from broader societal developments, the analysis considers the EU's sustainability objectives, circular economy policies and right to repair initiatives. However, the thesis does not adopt independent research methods from other disciplines but merely incorporates

contextual insights necessary for understanding the broader implications of the legal framework.

The material used throughout the thesis consists of primary and secondary legal sources. Primary sources include EU regulations, directives and case law of the Court of Justice of the European Union and of national courts. Secondary sources consist of academic books, journal articles, policy papers and expert commentary concerning copyright law, sustainability and repairability.

1.5 Outline

Following this introduction, Chapter 2 examines the emergence of the right to repair movement and its relationship with sustainability and circular economy policies within the European Union.

Chapter 3 analyses the protection of computer programs under EU copyright law, focusing on lawful user rights, reverse engineering and decompilation. The chapter further examines the extent to which these mechanisms facilitate repair-related activities.

Chapter 4 explores the legal framework governing technological protection measures and anti-circumvention rules, assessing how these mechanisms may restrict the practical exercise of repair rights for software-dependent products.

Chapter 5 analyses selected German and Dutch jurisprudence concerning software-dependent products, with particular focus on software modification disputes and the growing control exercised by manufacturers over repair-related activities.

Finally, Chapter 6 presents the conclusions of the thesis and answers the key research question.

2 The Right to Repair in EU policy

2.1 Circular economy considerations

In the era of the EU's transition towards a more sustainable and resource-efficient economy, the right to repair has emerged as a central component.² The most significant document underpinning this sustainability trend is the European Green Deal, which establishes a comprehensive framework of policy instruments aimed at achieving climate neutrality by 2050.³ Within this broader policy, a particularly relevant tool for implementing the Green Deal's objectives is the Circular Economy Action Plan (CEAP).⁴ Adopted in 2020, the CEAP aims to transform product lifecycles by promoting durability-oriented practices such as repair, reuse, and recycling, with the ultimate goal of reducing the loss of value in products and materials over time. The plan targets specific sectors, such as batteries and packaging, and supports the development of secondary raw material markets, with the overall aim of shifting the EU from a linear to a circular economic model. This strategy also introduces legislative measures to reduce waste and keep resources in use for longer. The most important instruments within the CEAP are the Ecodesign for Sustainable Products Regulation⁵ and the Directive (EU) 2024/1799. The latter will be analysed in depth in the following section of the chapter to assess its effectiveness in adapting the traditional legal principle of the right to repair to the needs of the circular economy.

For the purpose of this research, it is important to clarify that these initiatives aim to dismantle the “linear consumption model” - represented by the traditional take-make-waste paradigm - and replace it with a “repair economy” that preserves resource value and minimizes waste.⁶ Within this context, repair plays a crucial role in this policy shift, as it enables the continued use of products that would otherwise be prematurely discarded.⁷

While the legislator must integrate circular economy principles into traditional mechanical repair, this imperative is even greater for digital products due to the fundamental technological shift toward the Internet of Things (IoT).⁸ This transition

² Directive (EU) 2024/1799 of the European Parliament and of the Council of 13 June 2024 on common rules promoting the repair of goods [2024] OJ L 1799.

³ The European Green Deal, Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions ‘The European Green Deal’ COM(2019) 640 final.

⁴ European Commission, ‘A new Circular Economy Action Plan: For a cleaner and more competitive Europe’ COM (2020) 98 final.

⁵ Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products [2024] OJ L 1781.

⁶ A. Tischner and K. Stasiuk, “Spare Parts, Repairs, Trade Marks and Consumer Understanding” (2023) 54 *International Review of Intellectual Property and Competition Law (IIC)* 26–60, 27.

⁷ Gomulkiewicz, R W ‘Considering a Right to Repair Software’ (2022) 37(3) *Berkeley Technology Law Journal* 943–988, 950.

⁸ *Ibidem*.

has turned once-simple goods into hybrid systems - comprising hardware and code - that are central both to daily life, such as smartphones and cars, and to specialized sectors like software-dependent medical devices.⁹ While this connectivity enhances functionality, it also establishes manufacturers as digital gatekeepers who exert unprecedented control over access, updates, and repair, thereby fundamentally reshaping traditional concepts of ownership and use.¹⁰

Despite the emergence of recent rules such as Directive (EU) 2024/1799, scholarly analysis highlights a persistent regulatory gap, noting that the current legal framework remains a bottleneck because it does not yet fully address software-based restrictions or technological protection measures (TPMs).¹¹ While EU policy strongly promotes repair as a means of achieving environmental and economic objectives, the increasing role of software introduces new legal challenges. While traditional repair was mainly based on the physical and mechanical replacement of defective components, the ability to repair software-based products may depend on access to software itself, diagnostic tools, and firmware, which are frequently controlled by manufacturers.¹²

This shift is reflected in EU copyright law, where software embedded in products is protected under Directive 2009/24/EC, granting rightsholders exclusive control over reproduction, modification, and distribution. As noted by A. Guadamuz, the increasing “servitization” of products through software allows manufacturers to retain control over functionality even after sale, thereby limiting user autonomy.¹³ Similarly, some scholars have argued that the licensing of embedded software blurs the distinction between ownership and use, restricting users’ ability to repair or modify their devices.¹⁴ Moreover, the use of technological protection measures safeguarded under the InfoSoc Directive can further prevent access to essential repair interfaces, reinforcing what has been described as a form of “post-sale control” over products.¹⁵ As a result, the concept of repair is no longer purely technical but also legal, raising questions about the extent to which existing legal frameworks facilitate or hinder repair activities.

This transition also requires addressing the modern phenomenon of premature obsolescence. While traditional hardware failure remains a factor, contemporary data identifies “digital aging” in software-dependent IoT devices as a primary driver of premature disposal. To respond to this issue, the EU is introducing the Digital Product Passport, a transparency tool designed to provide data on sustainability,

⁹ Ibidem; Gawer, A ‘Digital Control and Market Power in the Automotive Sector: OEMs, Gatekeeping, and the Future of Aftermarket Regulation’ (2026) 26(1) *Journal of Industry, Competition and Trade* 8;

Mulligan, D K and Karp, S ‘The Right to Repair Software-Dependent Medical Devices’ (2022) 50(4) *Journal of Law, Medicine & Ethics* 857.

¹⁰ Gomulkiewicz, ‘Considering a Right to Repair Software’ (2022), 945.

¹¹ Rosborough, A D ‘Unscrewing the Future: The Right to Repair and the Circumvention of Software TPMs in the EU’ (2020) 11(1) *Journal of Intellectual Property, Information Technology and E-Commerce Law* 26, 26-48.

¹² Gomulkiewicz, ‘Considering a Right to Repair Software’ (2022), 964.

¹³ ‘Digital Control and Market Power in the Automotive Sector’ (2026)

¹⁴ Perzanowski, A and Schultz, J *The End of Ownership: Personal Property in the Digital Economy* (MIT Press 2016).

¹⁵ Rimmer, M ‘Tractor Rage: The John Deere Dispute and the Right to Repair’ (2017) 39(3) *European Intellectual Property Review* 136.

circularity, and reparability.¹⁶ This shift reflects the fact that the very nature of what is repaired has been fundamentally altered by the integration of code into the physical realm.

Finally, it can be argued that for the CEAP to be truly effective, the legislator must refine existing laws to ensure that manufacturer control over the digital layer does not undermine the transition to a sustainable and repair-oriented society. This section of the hereby contribution systematically evaluates whether Directive 2024/1799 can reconcile circular economy objectives with EU copyright law, and where legislative reform is still needed.

2.2 Assessment of Directive (EU) 2024/1799 on Common Rules Promoting the Repair of Goods in the context of software-dependent products

The European Union's commitment to strengthening the right to repair has been codified in Directive (EU) 2024/1799, which establishes common rules aimed at promoting sustainable consumption and facilitating the transition towards a circular economy. By reinforcing consumer entitlements and imposing obligations on producers, the Directive seeks to normalise repair as an economically viable alternative to replacement.¹⁷

The Directive is primarily focused on the post-sale phase of the product lifecycle. It introduces obligations for producers to provide repair services for certain categories of goods even beyond the statutory guarantee period. Examples of the targeted categories of goods listed in Annex II - for which reparability requirements are established - are household appliances such as washing machines and dishwashers, but also other equipment as batteries for light means of transport. The most relevant category for the purpose of this research is the electronics and Information and Communication Technology (ICT) equipment.¹⁸ This latter category includes widely used devices such as smartphones, tablets, servers, data storage products, which are increasingly characterised by a high degree of software integration. By imposing a duty to repair under reasonable conditions, the Directive addresses a long-standing market distortion in which replacement has traditionally been more economically convenient than repair. By requiring manufacturers to ensure repair under reasonable conditions, the Directive aims to recalibrate market incentives in favour of product longevity and resource conservation.

The main feature of the instrument is the enhancement of access to repair-related inputs. In light of this, the obligations posed on manufacturers by the Directive can be summed up as follows. First, manufacturers are required to repair covered goods upon consumer request, unless such repair is factually or legally impossible, and may not refuse service solely because a previous repair attempt has been made by a third

¹⁶ European Commission, 'Circular Economy Action Plan' (2020).; Regulation (EU) 2024/1781 of the European Parliament and of the Council of 13 June 2024 establishing a framework for the setting of ecodesign requirements for sustainable products (Ecodesign for Sustainable Products Regulation).

¹⁷ Directive (EU) 2024/1799 of the European Parliament and of the Council of 13 June 2024 on common rules promoting the repair of goods, arts 1–2.

¹⁸ Ibid, Annex II.

party or by the consumer. Secondly, repair must be offered at a reasonable price and within a reasonable timeframe so as not to discourage its uptake. Thirdly, where repair is chosen within the seller's liability period, the legal guarantee is extended by twelve months, thereby creating an additional incentive in favour of repair. Finally, manufacturers must ensure access to spare parts, repair information, and necessary tools, for independent repairers as well.¹⁹ These measures are intended to reduce dependence on manufacturer-controlled repair networks and to stimulate competition within the repair market.²⁰

Notwithstanding these advances, the Directive operates within a broader legal architecture that was not originally designed for software-dependent products. More specifically, the expansion of the IoT radically changed the market. Connected devices are subject to continuous software updates, remote diagnostics, and manufacturer-controlled access systems.²¹ Thus, ownership becomes functionally fragmented: consumers may possess the physical device but lack effective control over its digital components.²² EU copyright law, as set out in Directive 2009/24/EC, grants rightsholders extensive control over computer programs, including exclusive rights of reproduction, modification, and distribution. In parallel, Directive 2001/29/EC provides legal protection for technological protection measures (TPMs) that restrict unauthorised access to copyrighted works. In practice, these regimes may significantly constrain the ability of users and independent repairers to carry out interventions involving software components.

In light of this, the Directive reveals significant limitations when applied to software-dependent goods. Although it acknowledges the increasing digitalisation of products, The Directive does not comprehensively address access to firmware, diagnostic interfaces, or software updates, all of which are often essential for effective repair of modern devices, nor does it explicitly regulate the role of technological protection measures (TPMs). To sum up, the functionality of many devices is no longer determined solely by their physical components but depends on software that is frequently licensed by contractual terms rather than sold. This reinforces technical safeguards implemented by manufacturers. As a result, even where hardware repair is technically feasible, software-related restrictions may render the overall repair process incomplete or ineffective.

This gives rise to a structural tension between competing regulatory objectives. On the one hand, EU consumer and environmental policy promotes repair as a means of extending product lifespans and reducing waste. On the other hand, intellectual property law preserves strong proprietary control over software layers that are often essential to repairability. Repair activities increasingly require access to or modification of embedded software, thereby intersecting with copyright protection and, in some cases, necessitating the circumvention of TPMs.

¹⁹ *ibid* art 5(1)–(3) (producer obligation to offer repair under conditions set out in the Directive).

²⁰ *ibid* recitals 3–6 (objectives relating to circular economy, sustainability, and product longevity).

²¹ 'Digital Control and Market Power in the Automotive Sector' (2026), 6.

²² Gomulkiewicz, 'Considering a Right to Repair Software' (2022), 957.

The legal effectiveness of Directive (EU) 2024/1799 ultimately depends on its interaction with intellectual property law, which is governed by Article 5(6). That provision prohibits repair-impeding techniques but subordinates this prohibition to 'legitimate and objective factors, including the protection of intellectual property rights.'²³ In practice, this allows manufacturers to justify repair restrictions on the basis of intellectual property rights, including firmware locks or serialisation systems.

The CJEU's judgment in *Nederlands Uitgeversverbond v. Tom Kabinet* (C-263/18) offers guidance on how such a proportionality assessment might operate.²⁴ That case concerned the resale of second-hand e-books through an online platform. The Court held that the distribution right under Article 4(2) of Directive 2001/29/EC is not exhausted for digital copies because, unlike tangible books, e-books do not deteriorate with use and therefore a second-hand market would unreasonably prejudice the rightsholder's legitimate interests.²⁵ Crucially, the Court applied a balancing test: it weighed the potential harm to copyright holders against the competing interest in secondary markets, ultimately finding that the latter could not justify an exception to exclusive rights. By analogy, courts should require evidence of actual, not hypothetical, harm when IP is invoked to justify repair restrictions under Article 5(6). A mere assertion of IP protection should not suffice.²⁶

Although Article 5(6) prohibits the use of hardware or software measures that hinder repair, its important qualification – permitting such restrictions when justified by legitimate and objective considerations, including the protection of intellectual property – ultimately preserves the dominance of existing IP regimes. This 'without prejudice' clause limits the transformative potential of the Directive. However, following the logic of *Tom Kabinet*, the burden of proving that an IP-based restriction is objectively justified should fall on the manufacturer, and the justification must be proportionate to the actual harm asserted.

In addition, the optional nature of certain copyright exceptions under Directive 2001/29/EC contributes to fragmentation across Member States, thereby generating legal uncertainty and undermining the coherence of the internal market. Against this background, it is necessary to reconsider the interpretation of 'normal exploitation' – a core concept under the three-step test.²⁷ If a manufacturer's primary business model shifts from selling products to controlling repair through software locks and TPMs, it is arguable that this does not constitute 'normal exploitation' of the copyrighted software embedded in the device. Rather, it may represent an ancillary or abusive exercise of IP rights that conflicts with the sustainability objectives of the European

²³ Art. 5(6), Directive (EU) 2024/1799.

²⁴ *Nederlands Uitgeversverbond v Tom Kabinet Internet BV* (C-263/18) EU:C:2019:1111.

²⁵ Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society (Copyright Directive) art 4(2).

²⁶ Portolano Cavallo, 'With Tom Kabinet, the CJEU rules that the (re)sale of second-hand e-books must be authorized by right holders' (Inform@ Digital & IP, 14 February 2020) <https://portolano.it/newsletter/portolano-cavallo-inform-digital-ip/with-tom-kabinet-the-cjeu-rules-that-the-resale-of-second-hand-e-books-must-be-authorized-by-right-holders> accessed 19 April 2026.; Bird & Bird, 'EU top court rules out possibility to create second-hand marketplaces for digital content' (MediaWrites, 20 January 2020) <https://www.twobirds.com/en/insights/2020/global/eu-top-court-rules-out-possibility-to-create-second-hand-marketplaces-for-digital-content> accessed 19 April 2026.

²⁷ Directive 2001/29/EC of the European Parliament and of the Council of 22 May 2001 on the harmonisation of certain aspects of copyright and related rights in the information society (Copyright Directive) art 5(5).

Green Deal. The CJEU has not yet ruled on this question, but it remains a live doctrinal issue.

In conclusion, while Directive (EU) 2024/1799 represents a significant advancement in the promotion of repair within the EU legal order, it does not resolve the tension between copyright protection software-dependent goods and the right to repair them in compliance with a circular economy model. The resolution of that tension will depend on future CJEU engagement with the three-step test and the concept of 'normal exploitation'.

3 Copyright Protection on Software

As mentioned in the previous chapter, the repair of software-based products has become convoluted, as it often requires access to, and interaction with software components that are protected under intellectual property law. Although the current European Union legal framework - primarily governed by the Software Directive on the legal protection of computer programs - provides derogations for a limited number of lawful uses, including acts of reproduction, observation, and decompilation, repair activities remain a grey zone. This chapter thus examines the extent to which EU copyright law permits or restricts the repair of software-based goods, particularly analysing the distinction between protected expression and unprotected functionality, the scope of lawful user rights, and the conditions under which reverse engineering and decompilation may be justified. Through an assessment of relevant case law of the Court of Justice of the European Union, this chapter argues that although EU law provides a degree of flexibility for repair-related activities, not only do these rights remain constrained and often uncertain in practice but also require framework amendment in the lens of the accelerated (push for) transition to circular economy.

3.1 Legal framework: the Software Directive

Enacted in 2009, the Software Directive replaced the former Council Directive 91/250/EEC, thus becoming the governing EU legal framework for software protection. As underlined in its preamble, the accelerated widespread of computer technology, and the increased risks accompanying it,²⁸ necessitated the repeal of the previous legal framework, and the adoption of a new one. The directive aligns with international IP legislation: it grants computer programs (defined broadly, encompassing preparatory design material as well)²⁹ copyright protection as literary works envisaged by the 1886 Berne Convention,³⁰ while respecting the non-primary nature of copyright: the protection only extends to expressions, not underlying ideas, with the only criteria for the provision of protection being work originality (and not necessarily novelty).³¹ In this regard, a computer program's literary work consists of source codes – instructions provided for programs, written in a programming language -, object codes – executable transformations of source codes that can be reconverted into readable text formats -, programming language translations,

²⁸ Recitals 1-5 of the preamble of Directive 2009/24/EC of the European Parliament and of the Council of 23 April 2009 on the legal protection of computer programs (Codified version) [2009] OJ L 111.

²⁹ Ibid, art.1(1).

³⁰ Ibidem.

³¹ Ibid, art.1(2-3).

program modifications and reproduction, as well as design materials (e.g. flowcharts).³²

3.2 Scope of protection: blurred lines between expression and functionality

As mentioned above, copyright only protects expressions, and not ideas, “including those which underlie its interfaces”,³³ as in technical parts required for the functionality of a given device. As voiced in regard to the previous directive however, criticism still stands as – in the absence of a definitive and exhaustive enumeration – many aspects of software (e.g. logic, algorithms, programming languages) fall into the “idea-expression dichotomy”,³⁴ creating a grey area of uncertainty. This distinction was clarified in the landmark judgment in *SAS Institute Inc v World Programming Ltd* which aimed to define the contours of European copyright protection on software.

In said case, the dispute arose as SAS Institute, the developer of the statistical SAS system enabling users to perform their own analysis compatible with SAS’s own programming language, alleged copyright infringement against World Programming Ltd (WPL), which created a competing program (World Programming System) compatible with SAS language scripts. They achieved this by studying the SAS manual and reproducing its functionality but in a different programming language, without having access to the SAS’s source code.³⁵ The claimant argued that the defendant copied the SAS manual, reproduced it in the creation of the WPL manual and used it, together with the SAS Learning Edition to develop the competing WPL system.³⁶ The English High Court referred the case to the CJEU for preliminary ruling, asking – among others – whether copyright protection expands to the functionality of the computer program, the programming language used and the data file format replicated.³⁷ In its judgment, the CJEU made reference to a previous case, in which they concluded that some program elements merely enable users to exploit a software to its fullest capacity without enabling infringing reproduction,³⁸ ultimately ruling that - given WPL’s lack of access to the source code and the reproduction of the SAS program thus being the result of a sole observation and study process - the above mentioned components fulfil the same purpose, thus falling outside the scope of copyright protection.³⁹

³² the inclusion of the latter reflecting the intent for the entirety of the program structure to be protected under copyright, as highlighted by Bridget Czarnota & Robert J. Hart *Legal protection of computer programs in Europe: a guide to the EC Directive* (London: Butterworth, OUP 1991) pp.35-36, cited by Samuelson, Vinje & Cornish [2012] p.4; Pamela Samuelson, Thomas C. Vinje & William R. Cornish ‘Does Copyright Protection Under the EU Software Directive Extend to Computer Program Behaviour, Languages and Interfaces?’ [2012] *European Intellectual Property Review* pp. 3-4.

³³ Software Directive, art.1(2).

³⁴ Robert Shaposka ‘A Criticism of the E.U. Directive Protecting Computer Software’ [1997] *Buffalo Journal of International Law* 3(2) pp.524-525.

³⁵ Case C-406/10 *SAS Institute Inc v World Programming Ltd* [2012], para.23-26; David Cran ‘No copyright in software functionality – SAS v WPL, the final chapter’ [2013] *RPC Legal*.

³⁶ Case C-406/10 *SAS Institute Inc v World Programming Ltd* [2012], para.27.

³⁷ *Ibid.*, para.28(1-5).

³⁸ *Ibid.*, para. 38; Case C-393/09 *Bezpečnostní softwarová asociace* [2010] ECR I-13971, para. 40-42.

³⁹ Case C-406/10, para. 42-46.

This case thus has become the bedrock of the EU's copyright law limits, with significant implications for repair considerations as well: not only did it confirm EU law's alignment with international (U.S.) practices,⁴⁰ but it also shed light on the risk of copyright expansion: protecting functionality, programming languages and interfaces would impede competition (by limiting innovation, reducing open-source development, causing vendor lock-in for customers, etc.) and prevent interoperability by interdicting data format recreation for compatibility purposes.⁴¹ As far as the repair considerations are concerned, the ruling gives room for the exercise of the right to repair, if such activity takes the form of independent development (akin to the observe-study-replicate procedure), circumventing any potential copyright infringement. Although this loophole is exploitable, not only does it remain limited - insofar as many repair activities necessitate reverse engineering or code reproduction which have the potential to infringe copyright, thus sustaining legal uncertainty - but it could also incentivize developers to refuse providing manuals and guides "which could be used as an aid to replicate the functionality of that program using their own source code".⁴²

3.3 Rights of lawful users

In accordance with universal copyright legislation, EU law also grants exceptions to exclusive rights. Article 5 of the Software Directive provides an exhaustive list of derogations: in the absence of prohibiting contractual clauses, acts of reproduction, translation and adaptation necessary for the intended use of a program (including the correction of error), as well as indispensable backup copies and observation, studying and testing activities do not require authorisation on behalf of the right holder.⁴³ This provision is significant, because it recognises (although strictly on the condition of the lack of contractual restraints) repair activities, which oftentimes involve necessary modifications, error corrections and functionality restoration in order for the software to function properly.

Article 5(3) is especially lenient, as it allows users to examine the functioning of a program and extract the base ideas from it, which not only gives room for reverse engineering (and most importantly, black box testing with no contractual constraints allowed),⁴⁴ but – stemming from the judgment of the previous case study -, it also allows repairers to analyse software behaviour and independently develop their competing program, thus circumventing IP protection. The reverse engineering exception integrated by the provision above was envisioned as a legal safeguard and competition inciting mechanism in order to allow developers to study each other's programs while inventing competing products,⁴⁵ but has expanded onto independent repairers. The provision has also been reinforced by the CJEU's ruling in the *SAS Institute Inc v World Programming Ltd* case, as the plaintiff claimed that WPL's use

⁴⁰ Computer Associates Int'l, Inc. v. Altai, Inc and Lotus Development Corp. v. Borland Int'l, Inc., as summarized by Samuelson, Vinje & Cornish [2012] p.7.

⁴¹ Ibid., pp.7-16.

⁴² Cran [2013].

⁴³ Software Directive, art.5.

⁴⁴ Ibid., art.8.

⁴⁵ Samuelson, Vinje & Cornish [2012] p.6.

of the Learning Edition went beyond what the license agreement permitted.⁴⁶ The Court dismissed the claim however, ruling that no contractual terms could contradict lawful reverse engineering, as accorded by the Software Directive.⁴⁷ This judgment has thus limited the circle of appealable usages, but the question whether developers could contest the users themselves, remained.

In this regard, *UsedSoft GmbH v Oracle International Corp* was a landmark case. Oracle is a software developing company which distributed its databank software on the internet, through downloading and via license agreements with a right to use the copy for an unlimited time. UsedSoft purchased “used” licenses from Oracle licensees, and resold them, enabling new customers to download copies from Oracle’s website.⁴⁸ Oracle sued, with the acting court staying proceedings and referring the case to the CJEU for preliminary ruling on whether internet downloading exhausts the right of distribution, as envisaged by Art.4(2) of the Software Directive, and in that case whether the user qualifies as a “lawful acquirer” in accordance to Art.5(1).⁴⁹ In its judgment, the CJEU overrode the international standard set by WIPO’s Copyright Treaty,⁵⁰ essentially equalizing offline and online distribution and creating a secondary digital market.⁵¹ The Court ruled, that transferring a copy of a computer program in the form of a such a license agreement constituted a “first sale”, and as such, exhausted the rightsowner’s distribution rights, in accordance with Art.4(2).⁵² In that regard, the Court also established, that any subsequent acquirer is to be recognized as “lawful acquirer” and provided the exceptions under Art.5(1) notwithstanding the exclusivity of the license agreement.⁵³

The teleological interpretation of the Court aimed to withhold copyright owners’ intention to limit the circle of “lawful acquirers”, but it had great implications for repair as well: if a copy of a downloadable software is deemed as an exhaustive sale instead of a license, users may have stronger leverage to exercise the rights granted under Art.5 of Software Directive against developers that rely on restrictive licensing terms to limit user control over software. The case also opened the door for independent repairers to acquire defected copies of software and potentially resell modified and corrected ones. This, however, is subject to many potential obstacles: contractual clauses can still limit Art.5(1) activities (irrespective whether first or second-hand users are concerned) and – as criticized regarding the previous Directive as well – the term “necessary” is too vague, many practices deemed such risking being contestable.⁵⁴ On the other hand, however, disregarding Oracle’s concerns about copies being used even after resale,⁵⁵ and ignoring the increased

⁴⁶ Case C-406/10 *SAS Institute Inc v World Programming Ltd* [2012], para.48.

⁴⁷ *Ibid.*, para.59-62.

⁴⁸ Case C-128/11 *UsedSoft GmbH v Oracle International Corp* [2012], para. 20-26; Matthew Hattersley ‘Reselling used software licences – new ruling from the European Court’ [2012] *Clarion*.

⁴⁹ Case C-128/11, para.24.

⁵⁰ Insofar as it established a “distinct line between distribution (which applies to tangible objects) and communication (which applies to digital or digitised works)” (Hattersley, 2025).

⁵¹ Andrew Nicholson ‘Old Habits Die Hard: *UsedSoft v Oracle*’ [2013] *SCRIPTed* 10(13) p.393.

⁵² Case C-128/11, para. 48 and 72; Nicholson [2013] pp.395-396.

⁵³ Case C-128/11, para. 77-80.

⁵⁴ Shaposka [1997] p.526.

⁵⁵ Case C-128/11, para.79.

piracy risks (insofar as illegal copies being made),⁵⁶ has weakened developers' reliance on IP protection, which has the ability to incentivize software owners to adopt countermeasures (e.g. switching to cloud-based subscription models to counter secondary markets, adopting technical protection measures – as will be elaborated in the followings -, etc.⁵⁷) that could jeopardize repairers' position.

3.4 Decompilation: a narrow window for repair

Article 6 of the Software Directive expands the circle of derogations by allowing decompilation to be performed in order to achieve interoperability with other computer programs.⁵⁸ Decompilation is a form of reverse engineering seeking to convert a program's object code into human-readable source code in order to understand software structure and program logic.⁵⁹ In the context of repair, decompilation can be essential for accessing embedded software in order to identify errors and ensure the program's compatibility with independent programs.

The right to repair, however, was challenged by developers in front of the CJEU. In the *Top System SA v Belgian State* case, Top System – a software company developing IT applications for the Belgian state - challenged SELOR - a public body – for the alleged unauthorized decompilation of its software for error correction purposes.⁶⁰ The acting court referred the case to the CJEU, preliminary asking whether error correction qualifies as lawful decompilation.⁶¹ In its reasoning, the Court highlighted the EU legislation's intent to restrict repair for interoperability purposes only, but ruled nevertheless that error correction necessity prevails,⁶² thus expanding decompilation to fault correction aiming to disable “a function that is affecting the proper operation of the application of which that program forms a part”.⁶³

The judgment has particular significance for repair, as it interpreted restrictive EU legislation in a broad and progressive manner by recognizing error correction as a legitimate justification for decompilation, reinforcing the idea that copyright protection cannot prevent the proper functioning of computer programs. However, decompilation remains subject to strict conditions: only executable when intelligible source code is not available, only to the extent deemed necessary for error correction and its application staying subject to contractual provisions (e.g. repair facilitated solely by rightholder).⁶⁴ In practice, these legal constraints and technological protection measures might constitute a bottleneck for users and independent repairers to decompile their software. Moreover, academics also argue that the

⁵⁶ Nicholson [2013] p.399

⁵⁷ Ibid., pp.406-407; Case C-128/11, para.79

⁵⁸ Software Directive, art.6

⁵⁹ Ciprian Raul Romitan 'Legal Protection of Computer Programs. Exceptions to Documents Subject to Restrictions. Documents Required to Enable the Legal Acquirer to Correct Errors. Decompilation' [2025]. *Rom. J. Intell. Prop. L.* p.184.

⁶⁰ Case C-13/20 *Top System SA v Belgian State* [2021] EU:C:2021:811, para.13-21.

⁶¹ Ibidem.

⁶² Ibid., para.46-53

⁶³ Ibid., para. 53

⁶⁴ Ibid., para. 63-74

application of traditional IP law principles on non-literary copyrightable works leads to the misunderstanding of decompilation and the unjustified safeguardings of ideas - which contradicts the very core of IP law -, advocating thus on a comprehensive review of decomposition and broader exceptions in order for it to allow for a more in-depth understanding and learning of underlying ideas.⁶⁵

3.5 The push-pull effects of the Software Directive

As examined above, the EU's Software Directive provides several mechanisms that could facilitate repair from the alignment to common international practices, to numerous derogations and even object code reverse engineering. These "push factors" (amplified by the CJEU's jurisdiction), enable certain forms of software reproduction, modification and decompilation, this way incentivizing repair-related activities. The cases analyzed above underline how the Court adopts a progressive interpretive approach, oftentimes siding with software users, aiming to legitimize as many debated repair practices as the contours of the legislation allows.

The CJEU's forward thinking, reformist intents are counterbalanced, however, by the rigidity and vagueness of the Software Directive. Contractual limitations that constitute a bottleneck for repair activities, as well as the uncertainty around what acts are deemed necessary for the proper functioning of a program are "pull factors" that give leverage for developers to contest repair-related activities they deem as copyright infringement.

Moreover – as seen above – the extensive interpretation of the Software Directive also bears the risk of developers adopting countermeasures, such as hindering independent development by refusing the provision of aid materials/tutorials, switching to cloud-based licensing business models, or – as it will be discussed in the next chapter – technical protective measures (TPMs) in order to safeguard their copyright privileges, thus seriously undermining repair activities provided by the legal framework.

As we infer from this chapter, the Software Directive and the auxiliary case-law created a fragmented and uncertain legal environment. In order for the EU law to adapt to a changing IP environment, one in which sustainability perspectives play an increased role, standing criticism against the inflexible nature of the directive needs to be addressed. Possible and suggested solutions in this regard include the codification of the precedents concluded by the CJEU (especially regarding the expansion of decomposition to error correction, or the acknowledgment of secondary-market users as "lawful acquirers") and the addition of a comprehensive (and possibly exhaustive) list concerning what aspects of a computer program qualify as expressions or mere ideas. These amendments could minimize – even if not eliminate – some of the uncertainty around repair activities.

⁶⁵ Jacobus Petrus Jooste 'Decompilation and copyright in ideas-the protection of non-literal elements of computer software and the idea/expression dichotomy (Doctoral dissertation, Stellenbosch: Stellenbosch University)' [2020] pp.328-337

4 Anti-circumvention measures: the practical limits of repair

4.1 Legal framework: InfoSoc Directive

The cornerstone of European Copyright Law, InfoSoc Directive was enacted with the purpose of implementing newly adopted WIPO obligations, and harmonising diverging national laws that had market-disruptive effect.⁶⁶ As highlighted by Hugenholtz, the legislators aimed to go beyond WIPO standards, setting the stage for strict anti-circumvention rules under Article 6,⁶⁷ which introduced the legal governance for technological protection measures.

Article 6(3) of the InfoSoc Directive defines technological protection measures (hereinafter TPMs) as “any technology, device or component that [...] is designed to prevent or restrict acts [...] which are not authorised by the rightholder of any copyright”. These measures include encryption, access controls requiring authentication and user identification, digital rights management (DRM) systems or digital watermarks.⁶⁸ Article 6(2) determines the scope of protection broadly as it not only prohibits the use of means that have the ability to circumvent the aforementioned protections, but also the manufacturing, distribution or even possession thereof, if said means are to be deemed compatible to bypass TPMs. Therefore, this provision not only reflects the unprecedentedly restrictive, manufacturer-focused approach of the EU legislation, but it also gives rightholders a wide room for maneuver, as the possibility to allege anti-circumvention claims towards any device, process or tool has thus become endless. In this regard, European legislation goes beyond standard copyright protection - which focuses on protection against unauthorized uses – and restricts through TPMs even the access to protected works. In this regard, situations could hypothetically arise in which the unlawful circumvention of a technological measure prohibits the use of a protected work which would otherwise be permitted under copyright law, thus creating a point of contention between the lawful user rights of the previous chapter and developers’ right to integrate TPMs into their computer program.

At this point it must be noted, however, that recital 50 of the preamble of the InfoSoc Directive accords a *lex specialis* character to the Software Directive, explicitly stating that technological measures on computer programs are exclusively governed by the latter, which – as assessed in the previous chapter – permits decompilation

⁶⁶ InfoSoc Directive, recitals 1,4,7 and 15

⁶⁷ Bernt Hugenholtz, Why the Copyright Directive is Unimportant, and Possibly Invalid [2000] *EIPR* 11, p. 501

⁶⁸ Omar Al-Makhzoumi et al. ‘Technological Protection Measures and Their Role in Protecting Digital Works’, p.484. In: Musleh Al-Sartawi, A.M.A., Al-Qudah, A.A., Shihadeh, F. (eds) *Artificial Intelligence-Augmented Digital Twins. Studies in Systems, Decision and Control* (503) (OUP 2024). *Springer, Cham*.

and necessary modifications for functionality purposes. However, not only is the cited provision outdated,⁶⁹ but it also does not entirely dissolve legal concerns: how could a lawful repair activity be carried out if certain TPMs (e.g. user identification limited to primary users only) restrict access to the defect itself? Therefore, although showing clarifying intentions in theory, the cited recital continues to contribute to the legal uncertainty surrounding the relation between technological measures and the current software copyright regime, especially since – as will be assessed – TPMs continue to block users’ right to repair in practice. The interaction between the two legal frameworks thus risks creating a situation in which rights recognized in principle are rendered ineffective in practice. In this sense, TPMs can be seen as mechanisms that constitute a bottleneck for law application and enforcement.

The InfoSoc Directive is subject to vast criticism, especially in regard to its overly-restrictive nature, inflexibility and inability to adapt to the everchanging digital and technological environment⁷⁰, with Hugenholtz going as far as describing it as a “badly drafted, compromise-ridden, ambiguous piece of legislation”.⁷¹ He expressly criticized the convoluting and confusing phrasing of Article 6. For instance, despite aiming to counterbalance the developers’ rights for TPMs with user interests, Art.6(4) created even more confusion, raising the question on what “appropriate measures” national legislators shall take in order to safeguard users against the manufacturers’ overexploitative tendencies.⁷² These concerns have great implications on repair activities as well, especially in regard to the existence of TPMs on software: would an “appropriate measure” imply that Member State legislations should entirely prohibit TPMs on software which bare a high risk for potential decompilations and necessary modifications in order to function properly? Can such threshold even be established? Or would a universal ban of TPMs on computer programs give rise to unlawful software uses, ultimately undermining copyright protection? The cited provision leaves this question open, with only a few cases being brought to the CJEU for interpretation as well.

4.2 Opening Pandora’s Box - the *Nintendo v PC Box* case

One case in front of the CJEU, however, not only served as a key judgment in clarifying the contours of over-lapping, yet in many aspects contradictory statutory EU law (insofar as the distinction between the applicability of the Software and InfoSoc Directives), but it also shed light on the different impetuses and diverging interests influencing the Court’s judgments regarding R2R and copyright compatibility.

The case involved Nintendo, a videogame and console producer, which implemented a recognition system – as a technological protection measure – into its devices and games in order to prevent the use of unauthorized, pirated games. PC Box, an Italian

⁶⁹ Recital 50 of the InfoSoc Directive refers to Directive 91/250/EEC, which has since been repealed and replaced by Directive 2009/24/EC. Although the latter largely codifies the former (and thus analogously shall apply to it as well), the lack of explicit updating of the InfoSoc Directive creates a contestable interpretative ambiguity.

⁷⁰ Martin Senftleben, ‘EU copyright 20 years after the InfoSoc Directive—flexibility needed more than ever.’ [2022] pp. 1-3. In: *Reforming Intellectual Property*. Edward Elgar Publishing.

⁷¹ Bernt Hugenholtz. ‘Why the Copyright Directive is Unimportant, and Possibly Invalid’ [2000] *EIPR* 11, p. 501.

⁷² Ibid, p.502.

company marketed circumventing equipment, which once installed, enabled unauthorized copies and independently developed games (“homebrews”) to run on Nintendo consoles.⁷³ Nintendo claimed copyright infringement, with the proceeding Italian court referring the case to the CJEU, asking the Court whether video games should be considered merely computer programs, or - given the involvement of non-software protected elements, such as visuals and sounds – “complex multimedia works”.⁷⁴ Such distinction was pivotal, since in the case of a narrower interpretation, the Software Directive, otherwise the InfoSoc Directive applies; the former applying looser anti-circumvention rules (Art.7), while the latter prohibiting commercially non-feasible anti-circumvention devices as well.⁷⁵

The CJEU reaffirmed the proceeding court’s stance, ruling that videogames shall be considered a “complex matter”, with the copyright protection concerning not only the underlying software, but also expanding onto “portable equipment intended to ensure access to those games and their use”,⁷⁶ as in hardwares. In this regard, such combined devices would fall under the provision of the InfoSoc Directive, and therefore captured by the TPM rules of Article 6. This has significant implications, since the Court effectively opened Pandora’s Box: not only would TPMs incorporated into a hardware be permissible according to the Court’s ruling, but the judgment also provided developers with unprecedented leverage: since most software-based appliances involve a hardware component and not solely the computer program itself, and since such devices fall under the stricter anti-circumvention rules of the InfoSoc Directive, the possibility is granted for them to abuse their position against those pursuing repair activities.

Although the Court advised for “checks and balances” to be applied, essentially ruling that such TPMs must be proportionate and applied only to the extent they fulfil the desired objective of preventing copyright infringement,⁷⁷ it conferred the national court with the burden of conducting such proportionality test, with only a quantitative guideline being provided on “how often those [circumventing] devices [...] are in fact used in disregard of copyright”.⁷⁸ Therefore, not only did the CJEU refuse to provide further clarification, essentially neglecting any further legal problems and uncertainties that could arise from this judgment⁷⁹, but their proposed quantitative assessment can be seen as unsatisfactory. For instance, Robert Caso criticized such approach, highlighting how it could lead to a defective assessment,

⁷³ Case C-355/12 *Nintendo Co. Ltd and Others v PC Box Srl and 9Net Srl* [2014] EU:C:2014:25 [9-13] (hereinafter: *Nintendo v PC Box*)

⁷⁴ *Ibid* [18]; Bohdan Widła, ‘More than a game: Did Nintendo v. PC Box give manufacturers more control over the use of hardware?.’ (2017). *Computer Law & Security Review*, 33(2) pp. 4-5.

⁷⁵ Martina Battista, “*Into the Wired: Digital Freedom or Piracy? The ECJ’s “Nintendo v. PC Box” Case Law as an Emblematic Example of Copyright Contradictions in the Information Society.*” (2014) p.85.

⁷⁶ *Nintendo v PC Box*, para. 23, 37.

⁷⁷ *Ibid*, para. 31.

⁷⁸ *Ibid*, para.38.

⁷⁹ Especially since the lack of a common, EU level interpretation of proportionality gives room for diverging national interpretations, undermining the harmonization intent of the preliminary ruling.

while underlining how a more comprehensive evaluation – incorporating qualitative research – would be more favorable.⁸⁰

Moreover, the proceeding Italian court set a developer-favoring precedent as well: in its subsequent judgment the court placed the burden of proof on PC Box, who thus must have proven that their circumvention tools were to be used for legitimate purposes only.⁸¹ As a result, the burden of proof will most likely be placed on users in subsequent cases, many of them being independent repairers who may lack the technical expertise to justify their arguments, thus their claims becoming seriously undermined. All in all, although the CJEU's judgment in *Nintendo v PC Box* aimed to clarify and contour the limitations of TPM protection, it caused even more uncertainty, setting a worrying precedent in regard to lawful users' R2R.

4.3 Diverging interests – the dichotomy within CJEU jurisdiction

As the aforementioned case demonstrated, by classifying videogames as complex works, the Court effectively enabled right holders to rely on the stricter anti-circumvention rules of the InfoSoc Directive, thereby bypassing the more flexible user rights provided under the Software Directive. The ruling feels confusing and preposterous in light of the actions the CJEU took in the cases elaborated in the previous chapter. The dichotomy of the Court is palpable: on one hand, the Court progressively widens users' repair rights – either through the delimitation between expression and functionality⁸², the expansion of the notion of lawful users⁸³ or through the permission of decompilation for error correction purposes.⁸⁴ On the other hand, however, with the *Nintendo v PC Box* ruling the Court seemingly cut short any further progress in this regard, potentially even reversing it by essentially justifying the loophole provided for developers to stifle repair-related activities. Thus, regardless of how extensively the Court intends to interpret the Software Directive, its justification of TPMs constitutes a bottleneck for such aspirations.

Therefore, although the theoretical possibility for carrying out repair activities is given and reinforced by the Court, in practice, TPMs play a central role in restricting them by creating closed, impenetrable technological ecosystems, rendering repair technically challenging or/and legally contestable. In that regard, TPMs not only protect the manufacturers' intellectual property, but they also serve as control mechanisms for effectively determining a product's lifecycle, which raises serious concerns about the compatibility of such companies' business practices with the EU's broader policy objectives in terms of sustainability promotion and transition to a circular economy.

⁸⁰ Robert Caso, 'Misure Tecnologiche Di Protezione: Cinquanta (E Più) Sfumature Di Grigio Della Corte Di Giustizia Europea (Technological Protection Measures (Fifty and More) Shades of Grey of the European Court of Justice)' [2014]. *Trento Law Tech Research Paper*. (19).

⁸¹ Bohdan Widła, 'More than a game: Did Nintendo v. PC Box give manufacturers more control over the use of hardware?.' (2017). *Computer Law & Security Review*, 33(2) pp. 7-8.

⁸² *SAS Institute Inc v World Programming Ltd*.

⁸³ *UsedSoft GmbH v Oracle International Corp*.

⁸⁴ *Top System SA v Belgian State*.

4.4 Addressing the imbalance

As examined in this chapter, there is an interest imbalance within EU law: on one hand the Union is committed to circular economy transformation and e-waste reduction, as proven by the permissive nature of the Software Directive and the progressive interpretative approach of the Court, on the other hand, however, it remains shackled by the rigidity and strictness of copyright law, as demonstrated – among others - by the overreaching TPM rules of the InfoSoc Directive. The question thus arises in regard to how this imbalance can be addressed.

One solution would be for the CJEU to take a proactive role in clarifying the proportionality criteria, henceforth evading both distinct national interpretations compromising the integrity of European law. In particular, the CJEU could explicitly recognise repair as a legitimate use that must be considered when assessing the proportionality of TPMs. This would not only be in line with its expansive interpretive approach, but it could also provide a clearer basis for users to challenge overly restrictive technological measures.

Moreover, the comprehensive amendment of the InfoSoc Directive, insofar as explicitly allowing the circumvention of TPMs for repair purposes – defined narrowly, only in cases where circumvention is indispensable for functionality restoration - could significantly give more room for users to exercise their R2R. This would also imply the necessity for a greater alignment of the InfoSoc Directive with the Software Directive (e.g. amending outdated provisions, clarifying the contours of devices qualifying as computer programs, etc.) in order to ensure the coherence of the EU legal framework and to dissolve the uncertainty surrounding legal competence.

5 Software Modification Disputes: When Repair Becomes Circumvention

5.1 The German Framework: The Evolution of Software Repair Jurisprudence

The deepening integration of software into consumer products led to real-world disputes on the post-sale control manufacturers can exercise over products, which can provide guidance on finding a balance within the persistent tension between legitimate repair practices and the protection of intellectual property. As previously analysed, in the absence of a consistent, uniform, and mandatory EU framework governing software-related repair, national case law from Member States becomes indispensable. Among these, German jurisprudence not only exposes deep legal inconsistencies but also serves as a powerful catalyst for legislative reform at the EU level.

An important development in this evolution is the German Federal Court of Justice's (*Bundesgerichtshof*) 2015 decision in the so-called *Cheat Software* case⁸⁵, concerning the modification of the runtime behaviour of video games without alteration of the underlying source or object code. By manipulating variables in the system's working memory (RAM), the cheat software enabled users to bypass built-in limitations, such as obtaining unlimited health or unlocking premium features without payment. The case raised the broader question of whether interventions affecting the functioning of a program, without reproducing its code, may fall within the scope of software copyright protection. The Court hereby reaffirmed that copyright protects the expression of software rather than its functionality and it held that manipulating only runtime data in volatile memory does not amount to an infringement of the program's protected code.⁸⁶ From a right-to-repair perspective, the decision is significant because many repair-related interventions similarly require interaction with software behaviour rather than direct copying of code. Activities such as bypassing software-induced performance restrictions or restoring disabled functionalities may involve altering the operation of a program at runtime without reproducing the protected source code itself.⁸⁷ The reasoning adopted in *Cheat Software* therefore illustrates the risk that legitimate repair activities may be characterised as infringing modifications, thereby narrowing the practical scope of

⁸⁵ *Cheat Software* (I ZR 88/13) [2015] GRUR 672 (BGH).

⁸⁶ Trebble, A, Aronsson-Storrier, A and Costin, J 'I can see clearly now the walls have gone: IP law vs mods, cheats and hacks in video games' (2025) *Interactive Entertainment Law Review* 1(aop) 3-4.

⁸⁷ Rosborough AD, 'Unscrewing the Future: The Right to Repair and the Circumvention of Software TPMs in the EU',

lawful repair and reinforcing manufacturers' control over software-dependent products after sale.⁸⁸

By contrast, a fundamental shift arrived with the German Federal Court of Justice's landmark 2025 ruling in *Action Replay II*.⁸⁹ That decision returns the focus to the strict boundaries of the Software Directive. Distancing itself from the *Cheat Software* doctrine, the Court distinguished between protected "expression" (source and object code) and unprotected "functionality" or runtime behaviour. It ruled that software modifying RAM variables during execution does not infringe copyright because it leaves the literal code untouched, finding that such runtime modification did not constitute a "targeted obstruction of competitors" under unfair competition law. *Action Replay II* legalised the runtime modification of a product's behaviour, provided the core code remains intact. From a repair perspective, this opens a crucial pathway: diagnostic tools, recalibration software, and performance-restoring interventions that operate exclusively at the RAM level can no longer be automatically classified as illegal circumvention or unfair interference.

Although *Action Replay II* liberalised certain forms of "runtime" modification, it did not establish a corresponding right to circumvent technological protection measures that restrict access to the software itself. Earlier influential decisions, such as those involving *Half-Life 2*⁹⁰ and other products that combine functional software with physical components, created what may be described as a "physical trap" in digital ownership.⁹¹ Under the Software Directive, users are granted limited rights to alter software where such modification is necessary for intended use or error correction. However, German and EU courts have limited the practical effect of these rights by categorising modern digital products as "hybrid" or "complex" goods, combining utilitarian software functions with protected audiovisual or artistic content. This hybrid-product approach has significant implications for ownership and repair rights. Under Article 4 of the InfoSoc Directive, the principle of exhaustion has been interpreted as applying primarily to tangible objects. The German Federal Court of Justice's decision in *Half-Life 2* exemplifies this reasoning, as the court accepted that ownership of a physical game copy did not prevent the publisher from tying the software to a non-transferable online account. In practice, this allows manufacturers to impose software locks⁹² that continue to govern the use of products long after sale.⁹³ The hybrid classification also strengthens the enforceability of End-User License Agreements (EULAs), enabling manufacturers to redefine ownership as a

⁸⁸ A useful contrast can be drawn with US case law such as *Blizzard Entertainment Inc v Bossland GmbH*, where liability for cheat software was grounded in DMCA anti-circumvention provisions and contractual enforcement rather than a strict distinction between protected code and unprotected runtime data, as adopted by the German Federal Court of Justice in *Cheat Software*. *Blizzard Entertainment Inc v Bossland GmbH* (CD Cal, 8:16-cv-01236-DOC-KES, 31 March 2017); Mirr, N 'Defending the Right to Repair: An Argument for Federal Legislation Guaranteeing the Right to Repair' (2023) 108(3) *Iowa Law Review*, 2411-2413; Trebble, A, Aronsson-Storrier, A and Costin, J 'I can see clearly now the walls have gone: IP law vs mods, cheats and hacks in video games' (2025) *Interactive Entertainment Law Review* 1(aop) 3-4.

⁸⁹ *Action Replay II* (I ZR 157/21) [2025] GRUR 1388 (BGH).

⁹⁰ *Half-Life 2* (I ZR 178/08) [2010] GRUR 822 (BGH).

⁹¹ Savič, M 'The Legality of Resale of Digital Content after UsedSoft in Subsequent German and CJEU Case Law' (2015) 37(7) *European Intellectual Property Review* 428.

⁹² e.g., non-transferable accounts, mandatory online activation, or region-locked licences

⁹³ Savič M, 'The Legality of Resale of Digital Content after UsedSoft in Subsequent German and CJEU Case Law', 426-429.

limited licence rather than a transfer of property rights.⁹⁴ Manufacturers therefore retain the ability to maintain post-sale control through digital locks and contractual restrictions.

5.2 The Dutch Framework: Post-Sale Control and the Paradox of Ownership

The Dutch legal framework offers a distinct and complementary set of reflections for understanding how copyright law interacts with repair and post-sale control of software-dependent products. Typically, the Netherlands has become a battleground for the interpretation of the exhaustion principle⁹⁵ in the context of digital ownership.⁹⁶ Even if this is more about the right of sale, it is still worth examining to what extent Dutch courts find a balance between manufacturer interests (copyright law) and end-user interests (consumer rights, circular economy) in the post-sale phase. The central unresolved question across Dutch cases aims to determine whether a consumer can be considered the true "owner" of the software embedded in their product or whether the software is merely licensed and never sold. On this basis depends the lawfulness of independent repair, modification, and resale.

The first Dutch case on the software resale debate is the so-called *Tom Kabinet* case. The dispute centred on an internet portal established to allow users to "resell" e-books they had lawfully purchased. Dutch publishers sued for copyright infringement, arguing that digital files, unlike physical books, are not subject to exhaustion because no tangible object changes hands. Although, in the first instance ruling the Amsterdam District Court Early Dutch litigation did not definitively resolve the issue, it highlighted the absence of clear legislative guidance on digital exhaustion.⁹⁷ This uncertainty was later resolved by the Court of Justice of the European Union in *Tom Kabinet*, which held that the exhaustion doctrine does not apply to digital copies of literary works distributed online under the InfoSoc Directive 2001/29/EC. The Court reasoned that e-books are supplied as non-rival digital services under the InfoSoc Directive rather than "sale of a copy" under the Software Directive, so the act of online transmission does not trigger exhaustion because no tangible copy is placed on the market and the author retains control over subsequent distributions.⁹⁸

On the same lines, in *VOB v Stichting Leenrecht*⁹⁹ – which also eventually reached the Court of Justice of the European Union (CJEU) – the dispute asked whether the lending right under EU copyright law applies to digital downloads. The Dutch Association of Public Libraries (VOB) argued that libraries should be permitted to

⁹⁴ ⁹⁴European Commission Joint Research Centre, *Towards an Effective Right to Repair for Electronics: Overcoming Legal, Political and Supply Barriers to Contribute to Circular Electronics in the EU* (Publications Office 2022), 26–44.

⁹⁵ the doctrine that a copyright holder's distribution right is exhausted upon the first sale of a lawful copy, thereby permitting resale without further permission. See Savič M, 'The Legality of Resale of Digital Content after UsedSoft in Subsequent German and CJEU Case Law', 414 – 429.

⁹⁶ *Ibidem*.

⁹⁷ *Stichting Brein v Tom Kabinet Internet BV* (Rechtbank Amsterdam, C/13/591073 / HA ZA 14-1217, 21 July 2014).

⁹⁸ *Tom Kabinet* (C-263/18, ECLI:EU:C:2019:1111).

⁹⁹ C-174/15 *Vereniging Openbare Bibliotheken v Stichting Leenrecht* EU:C:2016:856.

"lend" e-books under a "one-copy, one-user" model, exactly mirroring the physical lending of paper books. The core legal question was whether a digital download made available for an indefinite period – purchased rather than temporarily accessed – constitutes a sale that exhausts the distribution right. The CJEU held that digital lending can, in principle, fall within the scope of the public lending right, provided that the lending system ensures a strict “one-copy, one-user” limitation and that the copy becomes unusable by others during the lending period. However, the Court did not treat this mechanism as a form of digital sale, exhaustion, or transfer of ownership, but rather as a narrowly regulated exception within copyright law.¹⁰⁰ From the perspective of a circular economy and right-to-repair framework, the case is significant because it reflects an attempt to approximate digital access to the scarcity-based logic of physical goods, where possession is temporarily exclusive but not permanently transferred. At the same time, it also exposes the technical and legal limits of this analogy, since digital copies do not behave like physical objects and remain subject to continued control and enforcement mechanisms even when “lent” under licence. In the circular economy lens, the "one-copy, one-user" model, meaning treating a digital license as a discrete, transferable piece of property, would benefit independent repairers and spare-parts resellers.

Turning from doctrinal disputes to real-world enforcement, the Dutch "slowdown" litigation provides a critical illustration of software-mediated post-sale control. The ongoing collective action *ConsumentenClaim & Stichting Aequitas Belangenbehartiging v Apple Inc* (2024) alleges that Apple used software updates to intentionally reduce the performance of iPhone 6, 7, and SE models.¹⁰¹ Consumers claim that these updates concealed battery-related defects and forced premature device replacement. Although the case is framed under consumer law (typically, misleading practices) and competition law, it demonstrates that software is now the primary mechanism for controlling a product's functional lifespan.¹⁰² This controversy is a tangible effect of the exploitation of copyright law in a way that goes far beyond the protection of expression, as it is being weaponised to control entire product ecosystems. Manufacturers possess a de facto "remote kill switch" for their products via software updates, while current intellectual property law denies consumers a countermeasure to reverse those changes, as the tools required to bypass TPMs are restricted under the Software Directive.

This power asymmetry is the lived reality of the exhaustion paradox, as exhaustion is tied to physical objects and software-dependent products are left unprotected from manufacturer interference such as throttling or bricking. While the German Federal Court of Justice in *Action Replay II* suggests that runtime functional modifications are legal, market practices and TPMs effectively neutralise repair rights in practice. Manufacturers act as rule-makers for property they have already sold, using

¹⁰⁰ Savič M, ‘The Legality of Resale of Digital Content after UsedSoft in Subsequent German and CJEU Case Law’, 424 – 425.

¹⁰¹ *Stichting Aequitas Belangenbehartiging v Apple Inc and others* (Rechtbank Amsterdam, dagvaarding, 2025).

¹⁰² This litigation follows a longer history of software-based control. In 2016, Apple's "Error 53" update bricked iPhones that had undergone third-party repairs, particularly screen or home-button replacements; Australian courts later found that this ostensible "security measure" violated consumer law, leading to a significant fine in 2018. The 2017 "throttling" controversy, in which Apple reduced processor performance to compensate for ageing batteries, similarly revealed how software updates can degrade functionality under the guise of maintenance.

copyright as a shield against secondary markets and independent repair. Therefore, these two jurisprudential experiences underscore that, without legislative intervention, the circular economy's promise of extending product lifespans through repair and resale will remain subordinate to a copyright regime designed for a pre-digital era.

6 Balancing Repair Rights and Intellectual Property

6.1 Rethinking "Normal Exploitation" and the Function of Copyright

The German and Dutch jurisprudence described above reveals the limitations of treating software as a literary work, particularly where repair, interoperability, and runtime modification are concerned. These conceptual and practical tensions have led Toeniskoetter S. B. to argue against the classification of software within the category of literary works.¹⁰³ The author contends that copyright law is ill-suited to software because it protects expression rather than functionality, despite software deriving its economic value primarily from utilitarian and technical performance. Combined with expansive protection terms and anti-circumvention mechanisms, this framework enables manufacturers to maintain disproportionate post-sale control over products, thereby undermining the objectives of the right to repair and the circular economy. Toeniskoetter therefore concludes that software requires a distinct *sui generis* regime based on short-term functional protection and mandatory interoperability licensing, capable of balancing innovation incentives with sustainable repair and reuse. While this thesis does not align with the author's more radical proposal for a new category of intellectual property rights, it shares the view that a profound rethinking of the current framework is necessary. This position will be further developed in the following paragraphs through an analysis of the three-step test and the conclusions reached in the previous chapter, particularly on the basis that, although certain flexibilities exist within the Software Directive 2009/24/EC, they remain too narrow, fragmented, and uncertain to support a meaningful right to repair in the context of software-dependent products. Accordingly, this thesis seeks to advance normative interpretative reforms by analysing these competing interests through the lens of the three-step test and the principle of abuse of rights.

However, it is necessary to highlight the foundational constitutional status of sustainability – rooted in Article 3 TEU and Article 11 TFEU – beforehand.¹⁰⁴ This framework establishes that sustainability is not a secondary concern, but a binding legal and moral imperative that must be treated as a core objective of the European Union. Accordingly, environmental protection requirements “must” be integrated into the definition and implementation of all Union policies and activities, including intellectual property law. The following analysis should be understood in this light.

¹⁰³ Steven B. Toeniskoetter, 'Protection of Software Intellectual Property in Europe: An Alternative Sui Generis Approach' (2005) 10 *Intell Prop L Bull* 65.

¹⁰⁴ Holmes, S 'Climate change, sustainability, and competition law' (2020) 8(2) *Journal of Antitrust Enforcement* 359–360.

A central issue in reconciling repair rights with intellectual property lies in the interpretation of the three-step test, codified in Article 5(5) of the InfoSoc Directive¹⁰⁵ and embedded in the entire EU copyright framework. The three-step test provides that exceptions or limitations to copyright are permitted only if they: (1) apply in certain special cases; (2) do not conflict with the normal exploitation of the work; and (3) do not unreasonably prejudice the legitimate interests of the rightholder. Traditionally, this test has been interpreted to safeguard the economic interests of rightholders by preventing uses that would compete with or undermine established revenue streams.

Arguably, in light of the three-steps test, the concept of "normal exploitation" should not extend to the use of copyright as a tool for post-sale control over physical products. When a manufacturer sells a software-dependent product like a smartphone, a tractor or a medical device, the primary economic return on the software's creative expression is realised at the point of sale. Since repair activities are aimed to restore functionality to an already-sold product - and not to substitute the primary software market - one could argue that preventing repair through copyright or TPMs does not protect the market for the software itself but rather creates or protects a separate aftermarket for authorised repair services. This aftermarket, while profitable, should not be regarded as part of the "normal exploitation" of the copyrighted work. To hold otherwise would allow copyright to extend far beyond its traditional purpose of incentivising creativity and into the realm of competition law and consumer protection.¹⁰⁶

The third step of the three-step test also requires that an exception not "unreasonably prejudice the legitimate interests of the rightholder."¹⁰⁷ This introduces a proportionality inquiry on whether lawful repair actually harm the rightholder in a relevant way. Lawful repair typically does not redistribute software, pirate code, or compete with the primary software market. Moreover, where no demonstrable harm to the rightholder's legitimate interests can be established - beyond the loss of aftermarket service revenue - the exercise of exclusive rights to block repair may be considered disproportionate and excessive compared to the scope of copyright protection.¹⁰⁸ This argument is further supported by the principle of proportionality, which plays a central role in EU law. Restrictions on repair should be justified by concrete and demonstrable harm, not hypothetical or speculative risks.

Going one step further, it can be argued that manufacturers increasingly invoke copyright not to protect creative expression but to preserve ecosystem control and aftermarket dominance. Where intellectual property rights are used to prevent repair, restrict interoperability, enforce technological lock-in, or accelerate planned obsolescence, they may fall outside the scope of "legitimate interests" altogether. Such practices raise concerns not only from a sustainability perspective but also in

¹⁰⁵ Directive 2001/29/EC of the European Parliament and of the Council on the harmonisation of certain aspects of copyright and related rights in the information society [2001] OJ L 167/10, art 5(5).

¹⁰⁶ Rosborough AD, 'Unscrewing the Future: The Right to Repair and the Circumvention of Software TPMs in the EU', 43 – 45.

¹⁰⁷ Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) art 13.

¹⁰⁸ Mirr N, 'Defending the Right to Repair: An Argument for Federal Legislation Guaranteeing the Right to Repair' IOWA LAWREVIEW (2020) 105 *Iowa Law Review* 2393.

terms of competition and consumer protection.¹⁰⁹ By limiting access to repair and maintenance, manufacturers can effectively foreclose secondary markets, increase consumer dependency, and accelerate product obsolescence. This, in turn, undermines the objectives of the European Green Deal and the CEAP. Considering the CJEU's reasoning in *Nintendo Co Ltd v PC Box Srl* (Case C-355/12), TPMs must not block legitimate uses. By analogy, in a case such as the Dutch collective action against Apple for alleged planned obsolescence through software updates, if the claim of artificial performance degradation is substantiated, the use of TPMs to prevent users from reversing such changes would likely exceed what is permissible under EU law.

6.2 The Digital Product Passport as an Emerging Solution

In this context it is important to examine a recent legislative innovation that seeks to address software-mediated obsolescence through transparency rather than direct override of IP rights. The Ecodesign for Sustainable Products Regulation (ESPR) introduces the Digital Product Passport (DPP)¹¹⁰ as a mandatory information framework accompanying products throughout their lifecycle. The DPP addresses software-mediated obsolescence by requiring manufacturers to disclose detailed information on software update availability, the duration of software support, and update consequences for device performance. This transparency targets precisely the kind of hidden degradation alleged in cases like the Dutch Apple throttling litigation.

Crucially, the DPP architecture incorporates an attempt to balance transparency with intellectual property protection. Rather than a standardized and universal disclosure-rule, the DPP utilises role-based access control: consumers access simplified data for purchasing decisions; independent repairers access technical specifications and diagnostic parameters; regulatory authorities access full data for compliance verification; and proprietary trade secrets remain protected behind secure, role-based filters using decentralised identifiers and verifiable credentials. While the DPP does not itself provide the "keys" to circumvent TPMs it reduces the information asymmetry that manufacturers currently exploit to exclude independent repairers.¹¹¹ The DPP thus represents a complementary, non-legislative pathway toward enabling repair, but it cannot substitute for direct amendments to copyright law.

The future implementation of the ESP Regulation will determine the future development of R2R. Most likely, while it will succeed in preventing digital products from being "black boxes", its practical impact will depend on whether its transparency mandates are strong enough to overcome the "feudal" control manufacturers currently exercise through EULAs and trade secret protections.¹¹² While the DPP architecture is designed to bridge the information gaps that hinder

¹⁰⁹ See *Blizzard Entertainment Inc v Bossland GmbH, Half-life2*, and, most importantly, *ConsumentenClaim & Stichting Aequitas Belangenbehartiging v Apple Inc* (2024).

¹¹⁰ Regulation (EU) 2024/1781 of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for sustainable products [2024] OJ L 2024/1781, arts 9–12.

¹¹¹ Wicaksono H and others, 'Digital Product Passport (DPP) Technological Advancement and Adoption Framework: A Systematic Literature Review' (2025) 253 *Procedia Computer Science* 2980.

¹¹² Rosborough AD, 'Unscrewing the Future: The Right to Repair and the Circumvention of Software TPMs in the EU', 47.

circular practices, it remains a tool of disclosure rather than a tool of access. Therefore, even if the passport makes the consequences of software updates visible, the legal right for a consumer or independent repairer to actually bypass a software lock to reverse those consequences will still require the EU to move beyond transparency and implement direct, mandatory exceptions to the Software and InfoSoc Directives.

7 Conclusion

In conclusion, the current EU legal framework does not strike an appropriate balance between the protection of intellectual property and the promotion of repair. While recent policy developments signal a shift towards sustainability, this shift has not yet been fully reflected in copyright law. The exceptions in the Software Directive are too narrow; the anti-circumvention regime under the InfoSoc Directive is too rigid; and the deference to IP rights in new repair legislation preserves the status quo. As products become increasingly software-dependent, this imbalance is likely to intensify. Without targeted reform, intellectual property law risks undermining the very objectives that EU policy seeks in the transition to a circular economy. A recalibration of copyright law is therefore necessary. In light of the limitations listed above, through this thesis we identified several possible reforms that should be considered to better align EU copyright law with the right to repair and the circular economy. These reforms range from targeted legislative amendments to interpretative guidance for courts, as summarised below.

The introduction of a **mandatory and explicit repair** exception within the Software Directive would provide much-needed legal certainty. Such an exception should explicitly state that acts of reproduction, modification, and decompilation do not constitute infringement where they are necessary to restore the functionality of a software-dependent product or to maintain its usability. The exception should apply regardless of any contractual provisions to the contrary (such as EULA clauses prohibiting repair), thereby overriding private ordering that would otherwise undermine the right to repair. By clearly defining the scope of permissible repair activities, this measure would reduce legal ambiguity and support the development of independent repair markets. Moreover, the concept of "**lawful acquirer**" under **Article 5(1)** of the Software Directive should be clarified and, where appropriate, expanded. Secondary owners should have the same legal standing as original purchasers, and independent repairers should be recognised as lawful acquirers for the purpose of performing repairs on behalf of owners. In that regard, a comprehensive directive amendment entailing the codification of CJEU case law as well as a list clarifying the distinction between software aspects that qualify as ideas and expressions, would be the most adequate solution.

Without the ability to bypass technological protection measures, any repair exception risks being ineffective in practice. **Article 6 of the InfoSoc Directive** should be amended to introduce a mandatory exception allowing the circumvention

of TPMs where the sole purpose is lawful repair or maintenance of a software-dependent product. This exception should be subject to proportionate safeguards against abuse, such as limiting it to lawful acquirers and professional repairers, but should not require prior authorisation from the rightholder. Such an exception would align the anti-circumvention regime with the principle established in *Nintendo v PC Box*, namely that TPMs must not block legitimate uses.

Following the reasoning of the German Federal Court of Justice in *UsedSoft* and *Action Replay II*, the burden of **proof should be rebalanced**. Currently, the burden often falls unfairly on the repairer to prove that a copy is "lawful" or that an act is "necessary." Instead, manufacturers should be required to prove that a third-party repair tool or circumvention reproduces the protected expression of the code, rather than merely interacting with functional variables as permitted by the distinction between copyright-protected expression and unprotected functionality. This shift would align EU law with the functional/expression distinction already recognised in the *Action Replay II* ruling.

Finally, **greater coherence is needed between intellectual property law and other areas of EU regulation, particularly those relating to sustainability**, consumer protection, and competition. The objectives of the European Green Deal and the Circular Economy Action Plan should inform the interpretation and application of copyright rules. This could be achieved through legislative amendments explicitly linking IP exceptions to sustainability goals, as well as through a more purposive approach by the Court of Justice of the European Union, which could interpret existing exceptions considering overarching EU policy objectives.

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